Cultural Factors and the HPA Axis Stress Response

Among Latino Students Transitioning to College

by

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ABSTRACT

A record number of Latino students are enrolling in higher education in the U.S., but as a group Latinos are the least likely to complete a bachelor's degree. Cultural factors theoretically contribute to Latino students' success, including orientation toward ethnic heritage and mainstream cultures (i.e., dual cultural adaptation), feeling comfortable navigating two cultural contexts (i.e., biculturalism), and the degree of fit between students' cultural backgrounds and the cultural landscapes of educational institutions (i.e., cultural congruity). In a two-part study, these cultural factors were examined in relation to the hypothalamic-pituitary-adrenal (HPA) axis stress response (indexed by salivary cortisol), a physiological mechanism that may underlie how psychosocial stress influences academic achievement and health. First, Latino students' cortisol responses to stress were estimated in their daily lives prior to college using ecological momentary assessment (N = 206; 64.6% female; Mage = 18.10). Results from three-level growth models indicated that cortisol levels were lower following greater perceived stress than usual for students endorsing greater Latino cultural values (e.g., familism), compared to students endorsing average or below-average levels of these values. Second, cortisol and subjective responses to a standard public speaking stress task were examined in a subsample of these same students in their first semester of college (N = 84; 63.1% female). In an experimental design, viewing a brief video prior to the stress task conveying the university's commitment to cultural diversity and inclusion (compared to a generic campus tour) reduced cortisol reactivity and negative affect for students with greater Latino cultural values, and also reduced post-task cortisol levels for students with greater mainstream U.S. cultural values (e.g., competition). These findings join the

growing science of culture and biology interplay, while also informing initiatives to support first-year Latino students and the universities that serve them.

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INTRODUCTION

Latino[1] and non-Latino White high school graduates now enroll in college at comparable rates (Fry, 2013), and the number of post-secondary certificates awarded to Latinos almost doubled from 2003 to 2013 (National Center for Education Statistics [NCES], 2016). However, Latinos are still less likely to enroll in 4-year institutions and complete bachelor's degrees (NCES, 2015). Among 25-29 year olds, approximately 15% of Latinos have completed a bachelor's degree or higher vs. 41% of non-Latino Whites, a gap that has widened from 18 to 26 percentage points in the last 25 years (NCES, 2015). The disparities only become more deeply concerning at higher levels of education; Latinos comprise 17% of the nation but hold only 9% of all master's and 7% of doctoral degrees (NCES, 2016). Beyond what is at stake for Latinos' own career prospects and well-being, this inequality has implications for the nation's economy. Recent projections estimate that Latinos will comprise almost 30% of the national population by 2060 (U.S. Census Bureau, 2015).

Efforts in psychology and related disciplines to better understand these disparities have mostly focused on documenting differences between Latinos (or other racial/ethnic minorities) and their majority (White[2]) peers. Despite the best of intentions, these ethnic comparative studies tend to reinforce a "deficit" view of ethnic minority development and

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[1] There are complex historical origins of the pan-ethnic labels "Latino(a)" and "Hispanic," as well as regional preferences. For consistency and simplicity, "Latino" is used here to refer to a female or male residing in the U.S. with family ancestry in a Spanish-speaking country in Latin America, including the Caribbean and parts of the U.S. that were formerly territories of Spain or México (Umaña-Taylor & Updegraff, 2013).

[2] "Non-Latino White" hereafter referred to as "White."

generally do not offer potential explanations for observed ethnic differences (Betancourt & Fuentes, 2001; García Coll, Akerman, & Cicchetti, 2000; García Coll et al., 1996). As an alternative, examining differences *among* Latino students may help to better identify strengths within this diverse group, including how some effectively respond to demands as they prepare for and adjust to college despite barriers to their success (Davis-Kean, Mendoza, & Susperreguy, 2012). This focus on within-ethnic group variation is critical to avoid misguided comparisons that recognize one group's achievement and typical development as the standard (i.e., White, middle class), while labeling other groups deviant from these norms (García Coll et al., 1996).

Physiological reactivity and recovery processes are considered key mechanisms that may underlie how psychosocial stress leads to mental and physical health problems (Compas & Reeslund, 2009). Alterations in stress physiology also help to identify individuals' capacity to respond and adapt accordingly when faced with challenge (Compas, 2006; Myers, 2009). The stress response of the hypothalamic-pituitary-adrenal (HPA) axis is one mechanism through which psychosocial stress can impact adjustment and health across development (Adam, Klimes-Dougan, & Gunnar, 2007; Chrousos & Gold, 1992). The HPA axis, and its hormonal end product cortisol, supports physiological function, regulates other biological systems, and mobilizes the body's resources (de Kloet, 2004; Sapolsky, Romero, & Munck, 2000), particularly in response to uncontrollable stressful situations involving social evaluation (Dickerson & Kemeny, 2004). Cortisol activation in the short-term fulfills vital physiological and psychological functions, but prolonged cortisol activation resulting from frequent exposure to such stressors (and/or failure to shut down this response following a stressor) contributes to health problems over time (McEwen, 2004; Shirtcliff, Peres, Dismukes, Lee, & Phan, 2014). Changes in HPA axis function can also impair cognitive capacities like working memory (Shields, Bonner, & Moons, 2015), which has implications for students learning new material and taking exams (Heissel, Levy, & Adam, 2017).

Examining the dynamic and adaptive role of the cortisol stress response *in context* is central for understanding how students transitioning to college regulate stress responses and ultimately adapt to the demands of novel social situations and academic expectations. This may be particularly important among Latino students, many of whom routinely face uncontrollable, socially evaluative stressors as underrepresented students on predominantly White university campuses, including discrimination, everyday microaggressions, and feelings of not belonging (Hurtado, Carter, & Spuler, 1996; Hurtado & Ruiz Alvarado, 2015; Smedley, Myers, & Harrell, 1993; Wei, Ku, & Liao, 2011; Yosso, Smith, Ceja, & Solórzano, 2009). Altered HPA reactivity has been identified as one likely mechanism through which these stressors negatively impact the health and educational outcomes of racial/ethnic minorities (Heissel et al., 2017; Levy, Heissel, Richeson, & Adam, 2016; Myers, 2009) and Latinos specifically (Cervantes & Castro, 1985; Gallo, Penedo, Espinosa de los Monteros, & Arguelles, 2009). Aside from a few recent exceptions (e.g., Luecken et al., 2013; Luecken, Mackinnon, Jewell, Crnic, & Gonzales, 2015), research that links psychological stress with health-relevant biological mechanisms has mostly been conducted with mostly White (European, or European American) samples or ethnic-comparative designs (for review, see Doane, Sladek, & Adam, 2018). More within-group studies are needed to appropriately examine the diversity of cultural practices and values among Latino students and how these cultural factors contribute to their development (Baca Zinn & Wells, 2000; Gonzales, Germán, & Fabrett, 2012; Umaña-Taylor & Updegraff, 2013).

The present two-part study focused on cortisol responses to stress as one dynamic biological mechanism that is particularly salient for the health, well-being, and success of students as they prepare for and adjust to new contexts in college. This study joins efforts to explore culture and biology interplay (Causadias, Telzer, & Lee, 2017) as part of a new frontier termed *cultural neurobiology* (Doane et al., 2018) by examining cultural factors in relation to cortisol stress responses in two methodologically distinct ways among Latino students before and after their entrance to college. First, Latino students' situational cortisol responses to naturally occurring stress were estimated in their daily lives during their final months of high school. Following a modified ecological momentary assessment (EMA), Latino high school seniors admitted to a 4-year university provided saliva samples and completed corresponding diary reports of daily experiences as they went about an otherwise typical weekly routine. Second, cortisol and subjective responses to a standard laboratory psychosocial stress task (modified Trier Social Stress Test) were assessed in a subsample of the same students once they began college. Prior to the individual achievement-focused public speaking stress task, participants were randomly assigned to view either a brief video clip conveying a reminder of the university's support for cultural diversity and inclusion *or* a generic video tour of campus (control group). In both parts of this study, theoretically-motivated cultural factors were explored as potential moderators of Latino students' stress responses: *cultural orientation* (practices and values along two dimensions), *biculturalism*, and *cultural congruity* in school. This two-part study drew upon the strengths of both EMA and experimental designs, research in and outside the lab, and cultural and biological inquiry to uncover how culturally salient processes may contribute to Latino students' physiological and emotional reactions to stress. By investigating a stress-sensitive and health-relevant biological mechanism, the study also aimed to inform applied initiatives to enhance Latino students' capacities for college persistence, health, and success.

Stress and Cultural Adaptation of Latino Students Transitioning to College

Although they are often treated as one homogenous group, Latinos in the U.S. are diverse with respect to national origin, nativity and generational status, immigration history, and socioeconomic status (SES; Baca Zinn & Wells, 2000; Gonzales et al., 2012; Umaña-Taylor & Updegraff, 2013). Latinos trace their ancestry to over 20 different Spanish-speaking countries with their own socio-political histories, contributing to great diversity among Latinos' demographic characteristics, immigration experiences, maintenance of ethnic heritage practices, opportunities upon arrival in the U.S., and rate of integration with mainstream U.S. society (Baca Zinn & Wells, 2000; Gonzales et al., 2012). The majority (64%) of Latinos in the U.S. are of Mexican descent, followed by Puerto Ricans (9%), Cubans (3.5%), and other Central and South American and Caribbean groups (U.S. Census Bureau, 2011). Although they are routinely grouped together under a pan-ethnic label, Latinos' experiences of preparing for and pursuing higher education in the U.S. vary along these demographic and cultural dimensions, creating diverse pathways to and through 4-year degree programs (Crisp, Taggart, & Nora, 2015; Davis-Kean et al., 2012; Hill & Torres, 2010; Ong, Phinney, & Dennis, 2006).

Latinos transitioning to college face generic demands experienced by all students, but also more unique challenges as students from immigrant families and students of color. These stressors include heightened feelings of not belonging, pressure to prove negative ethnic stereotypes wrong by succeeding in school, subtle but harmful daily microaggressions, competing work-school demands, and language brokering (i.e., translating, interpreting) for parents and family members (Hurtado et al., 1996; Nora, 2004; Smedley et al., 1993; Sy, 2006; Wei et al., 2011). Stress stemming from Latino students' minority status, such as experiencing discrimination, has been associated with lower college persistence attitudes, lower life satisfaction, lower self-esteem, and greater depressive and anxious symptoms (Arbona & Jimenez, 2014; Corona et al., 2016; Ojeda, Navarro, Meza, & Arbona, 2012; Wei et al., 2011; Witkow, Huynh, & Fuligni, 2015). College can be one of the first times that many Latino students are treated as minorities and develop a greater awareness of societal prejudice (e.g., Ethier & Deaux, 1994; Huynh & Fuligni, 2012). Latino students have also reported a sense of alienation or *cultural incongruity* in the predominantly White, middle-class college setting that values individualism and competition over interdependence and collaboration (Castillo et al., 2006; Gloria & Pope-Davis, 1997; Rodriguez, Guido-DiBrito, Torres, & Talbot, 2000).

Culturally-informed developmental theory. Definitions vary, but most researchers acknowledge that *culture* comprises values, traditions, and beliefs that influence the behaviors of a particular social group (American Psychological Association, 2003; Kitayama, 2002; Rogoff, 2003). Culture can be considered a context in which development unfolds (e.g., Latino ethnic heritage, "college culture"), but also a developmental process (e.g., adaptation to new contexts). In reciprocal fashion, individuals are active agents in the process of constructing culture and contributing to cultural diversity through their own beliefs and actions (Vélez-Agosto, Soto-Crespo, Vizcarrondo-Oppenheimer, Vega-Molina, & García Coll, 2017). Even guiding theories of human development that emphasize interactions between individuals and their context (e.g., Bronfenbrenner, 1989; Eccles et al., 1993; Gottlieb, Wahlsten, & Lickliter, 2006; Lerner & Castellino, 2002; Sameroff, 1995) have received critique for not adequately considering multi-layered cultural influences in development, particularly when studying racial/ethnic minority youth (Causadias, 2013; García Coll et al., 1996; Gonzales & Kim, 1997). Many have argued that culture must be conceptualized as a major source of influence on developmental processes, rather than a cursory background context variable (García Coll et al., 1996; García Coll & Magnuson, 1999; Raffaelli, Carlo, Carranza, & Gonzalez-Kruger, 2005). For example, "culture" was originally situated in the distant macrosystem of Bronfenbrenner's (1989) bioecological model, but culture also exerts more direct influences on human development through proximal processes in the microsystem, such as the language(s) youth prefer to use and the ways in which families socialize ethnic practices (Vélez-Agosto et al., 2017).

García Coll and colleagues (1996) proposed an integrative model to consider the unique ecological circumstances of youth of color growing up in the U.S. The integrative model highlights the importance of examining variation within rather than between racial/ethnic groups to emphasize the diversity and strengths of minority youth and their families. Based in social stratification theory, the model suggests that observed ethnic differences likely represent legitimate adaptations to contextual demands embedded within historical and current systems of oppression (e.g., racism, segregation). García

Coll and colleagues (1996) proposed that the experiences of youth and their families within inhibiting and promoting environments result in *adaptive cultures*, or social systems defined by sets of goals, values, and attitudes that differ from the dominant culture and influence developmental competencies.

Guided by this model, there may not be reason to expect that Latino students pursuing college differ from majority culture (White) peers in normative developmental processes, but it is important to acknowledge that Latino students are exposed and must respond to daily challenges generated by a racially stratified society (e.g., segregated high schools; discrimination on campus). Such inhibiting environments may contribute to poor health, adjustment, and educational outcomes via disruptions to physiological activation and regulation processes over time (Gallo et al., 2009; Heissel et al., 2017; Levy et al., 2016; Myers, 2009; Pascoe & Smart Richman, 2009). These alterations in stress physiology may help to explain how discrimination and other sources of psychosocial stress negatively affect the health, well-being, and success of Latinos and other underrepresented minority students.

Despite disproportionate exposure to inhibiting environments, Latino students also draw upon and generate adaptive cultures as they navigate the novel social milieu of the college transition. According to culturally-informed resilience frameworks, protective cultural resources enable some ethnic minority youth to achieve positive (or better than expected) outcomes despite facing marginalization, discrimination, and socioeconomic inequalities (Neblett, Rivas-Drake, & Umaña-Taylor, 2012; Raffaelli et al., 2005). Various cultural processes directly promote the achievement and well-being of Latino youth and/or buffer them from the adverse effects of stress that many experience as youth of color and immigrants or children of immigrants (Gonzales et al., 2012; Gonzales, Jensen, Montaño, & Wynne, 2015; Neblett et al., 2012). The present study focused on three related but distinct cultural factors theorized to serve protective functions for Latino students: cultural orientation (practices and values), biculturalism, and cultural congruity in school. Aside from the latter, very little research has focused on these factors during the college transition specifically.

Cultural orientation. The dual process of cultural adaptation includes *acculturation*, the process by which individuals acquire knowledge, behavioral expectations, attitudes, and values associated with the dominant mainstream culture, and *enculturation*, the process by which individuals acquire this same set of features associated with their ethnic culture of origin (Gonzales, Knight, Birman, & Sirolli, 2004). Greater orientation toward ethnic heritage culture and endorsement of Latino cultural values (e.g., centrality of the family, respect for parents and elders, religiosity) have been linked with Latino youth's academic engagement, social coping efforts, and lower levels of depressive symptoms, risky behaviors, and substance use (Brittian, Toomey, Gonzales, & Dumka, 2013; Delgado, Updegraff, Roosa, & Umaña-Taylor, 2011; Gonzales et al., 2008; Unger, Ritt-Olson, Soto, & Baezconde-Garbanati, 2009). Latino youth who maintain a strong connection to their ethnic culture may be protected from negative aspects of the acculturation process because they are less likely to experience family conflict by remaining more similar to their parents and/or because they are more likely to benefit from strong family support (Gonzales, Deardorff, Formoso, Barr, & Barrera, 2006).

One defining Latino cultural value is *familismo* (familism), which involves strong identification with and attachment to immediate and extended family and includes feelings of loyalty, reciprocation, and solidarity among family members (Sabogal, Marín, Otero-Sabogal, Marín, & Perez-Stable, 1987). Among Latino youth, higher levels of familism have been associated with academic motivation (Fuligni & Pedersen, 2002), lower levels of internalizing problems (Ayón, Marsiglia, & Bermudez-Parsai, 2010; Delgado et al., 2011; Smokowski, Chapman, & Bacallao, 2007), fewer behavior problems (Delgado et al., 2011; Germán, Gonzales, & Dumka, 2009; Marsiglia, Parsai, & Kulis, 2009), and less substance use (Gil, Wagner, & Vega, 2000; Telzer, Gonzales, & Fuligni, 2014). There are specific components of familism, including the desire to maintain close family relationships (*emotional support*), the belief that individuals have a responsibility to support their family members (*family obligations*), and that the behavior of an individual reflects on the whole family (*family as referent*; Knight et al., 2010; Sabogal et al., 1987). Familism may positively impact youth development in a variety of ways, such as by increasing the amount of social support available from family members, deterring deviant behaviors that could bring shame to the family, and promoting healthy family interactions (Gonzales et al., 2015). Further, immigrant parents tend to place a high value on education and set high academic expectations for their children (Suárez-Orozco & Suárez-Orozco, 1995; Suizzo, 2015). For example, Mexican immigrant parents emphasize the value of *educación* (becoming well-educated, well-mannered, and socially responsible) and share *consejos* (stories of the struggle they have gone through to help children succeed; Suizzo, 2015).

Internalizing family messages regarding the importance of education, striving to make one's family proud, and a strong desire to repay immigrant parents all play central roles in motivating Latino students to pursue college in the first place (Davis-Kean et al., 2012; Deil-Amen & Lopez Turley, 2007; Suárez-Orozco & Suárez-Orozco, 1995). Despite these rich familial sources of motivation, many Latino students become caught in conflict between aiding the family directly in the short-term and aiding in the long-term by pursuing higher education in culturally incongruent settings (Fuligni, 2007; Sánchez, Esparza, Colón, & Davis, 2010; Vasquez-Salgado, Greenfield, & Burgos-Cienfuegos, 2015). The very definition of "success" in college may be fundamentally different for many Latino students, who place a greater emphasis on giving back to their community and repaying family sacrifices compared to individual achievement (Burgos-Cienfuegos, Vasquez-Salgado, Ruedas-Gracia, & Greenfield, 2015; Garrod, Kilkenny, & Gómez, 2007; Torres, 2009; Tseng, 2004). Similarly, Arnett's (2000) description of a protracted, self-focused developmental period known as "emerging adulthood" may poorly characterize the transition to adulthood for many racial/ethnic minority youth and those from immigrant families who have strong obligations to family during this time (Fuligni, 2007; McLoyd, Purtell, & Hardaway, 2015). Indeed, a recent longitudinal study found that Latino high school seniors planned to contribute financially to their families in the future at higher rates than their European American peers and *actually* contributed more to their families 2 years after high school; in part, this difference in family contributions mediated the observed ethnic disparity in college persistence (Witkow et al., 2015).

These family obligations and connections to heritage cultural values have important but complex implications for Latino students' success as they pursue higher education at mainstream U.S. institutions (Castillo, Conoley, & Brossart, 2004; Corona et al., 2017; Fuligni, 2007; Sy, 2006). From a developmental perspective, older adolescents take a more active role in their own cultural development as they mature cognitively and socially (Bernal, Knight, Garza, Ocampo, & Cota, 1990), which can result in more complex processes of cultural adaptation as they gain autonomy and choose how to spend their time (Knight, Jacobson, Gonzales, Roosa, & Saenz, 2009). Evidence suggests that familism values, time spent with family, and involvement in traditional Mexican culture decline on average from early to late adolescence (Updegraff, Umaña-Taylor, McHale, Wheeler, & Perez-Brena, 2012) followed by increases in familism values into young adulthood (Fuligni & Pedersen, 2002; Padilla, McHale, Rovine, Updegraff, & Umaña-Taylor, 2016). In cross-sectional studies of Latino students' college experiences, those who endorsed the support component of familism reported lower levels of mental health symptoms (Corona et al., 2017), and parents' efforts to instill ethnic pride and the value of ethnic heritage were associated with students' greater self-esteem and lower levels of depressive and physical health symptoms (Rivas-Drake, 2011). In another study, Latina students from immigrant families who spent more time with family reported lower school stress and higher academic achievement, but those who more frequently engaged in language brokering for family members reported higher school stress (Sy, 2006), a direct example of the opposing influences that family support and demands for assistance may have on Latinos' adjustment to college.

Among the few longitudinal studies to focus on Latino college students specifically, Ong, Phinney, and Dennis (2006) found that students' reports of strong family interdependence at the beginning of their first year predicted greater academic achievement across the early college years, regardless of SES. However, another longitudinal study of Latino, Asian, and European American high school seniors found that the value placed on supporting family in the future was associated with a lower likelihood of being enrolled or completing a college degree 4 years later (Witkow et al., 2015). An important aim of future research is to reconcile the presumed benefits and observed challenges of maintaining heritage culture connections and family obligations for Latino students as they transition to the mainstream context of college.

Biculturalism. Students who are able to interact effectively within both ethnic and mainstream contexts are likely to have a distinct advantage (e.g., Félix-Ortiz & Newcomb, 1995; Rumberger & Larson, 1998), perhaps especially when transitioning to college in the U.S. Indeed, García Coll and colleagues (1996) considered biculturalism a normative developmental competency for immigrant youth. Theoretically, youth with greater bicultural competence are able to rely on support within the mainstream culture but also retain protective resources of their heritage culture that enable them to cope with culturally relevant stressors (Gonzales et al., 2015). Among Latino adolescents, biculturalism has been associated with higher self-esteem, academic and peer competence, academic ambitions, psychological well-being, and less internalizing problems (Bauman & Summers, 2009; Carvajal, Hanson, Romero, & Coyle, 2002; Love & Buriel, 2007; Parke & Buriel, 1998; Portes & Rumbaut, 2001; Smokowski & Bacallao, 2007; Szapocznik, Kurtines, & Fernandez, 1980). A meta-analysis of mostly adult studies demonstrated a strong association between biculturalism and positive adjustment across a range of psychosocial indicators (e.g., life satisfaction, low levels of depression), over and above the influence of orientation toward one culture or the other (Nguyen & Benet-

Martínez, 2012). Yet, perhaps due to measurement challenges, it remains unclear whether being bicultural leads to better adjustment, whether better adjustment contributes to developing a greater degree of biculturalism, or how biculturalism and adjustment inform each other reciprocally over time (LaFromboise, Coleman, & Gerton, 1993).

As Latino students transition to college they must adapt to institutions that overwhelmingly value mainstream cultural norms, such as the importance of independence, competition, and self-reliance (Burgos-Cienfuegos et al., 2015; Castillo et al., 2004; Gloria, Castellanos, & Orozco, 2005; Stephens, Fryberg, Markus, Johnson, & Covarrubias, 2012a). Strong ethnic loyalty in these contexts may actually become a barrier to success, particularly for low-income Latino students who might come to view the college environment as "elitist" with few opportunities for further connections with other Latinos (Niemann, Romero, & Arbona, 2000). Many Latino students must adapt to incongruent cultural expectations in college, particularly if their family has a more recent immigration history or if they are the first in their family to attend college (Castillo et al., 2004; Gloria & Castellanos, 2012). For example, some students have reported they must adopt values that differ from their families' in order to succeed in a higher education system that emphasizes individual academic success (Vasquez-Salgado et al., 2015). Educational anthropologists have described the "multiple worlds" (e.g., high school, college, family) that Latino and other minority students must navigate; theoretically, the most successful students are able to more easily integrate values and expectations across these multiple worlds (Cooper, Jackson, Azmitia, & Lopez, 1998). Thus, Latino students who are able to benefit from maintaining heritage cultural practices and values while also adapting to mainstream culture, or students with greater *bicultural competence*, would be expected to be most successful in college.

The empirical base of formally testing this prediction is small but growing. Latino students classified as bicultural have demonstrated greater ambition to pursue college after high school compared to their less bicultural peers (Zarate, Bhimji, & Reese, 2005). One cross-sectional study of Mexican-origin college students found that higher acculturation *and* higher enculturation were both uniquely associated with greater college self-efficacy (i.e., perceived ability to perform college-related tasks), which predicted greater academic and life satisfaction (Ojeda, Flores, & Navarro, 2011). However, other studies measuring both dimensions have shown the relatively greater importance of acculturation on its own; more acculturated Latinos have reported less stress, greater well-being, and a greater willingness to seek help once in college (Castillo et al., 2004; Miville & Constantine, 2006; Quintana, Vogel, & Ybarra, 1991; Schwartz et al., 2013). Indeed, a study of immigrant students from 30 U.S. colleges and universities revealed that acculturation indices were more strongly related to well-being than heritage cultural practices and values, which held by gender, ethnicity, and immigrant generation (Schwartz et al., 2013).

In a longitudinal study using a person-centered design, Rivas-Drake and Mooney (2009) found that Latino students who endorsed mainstream attitudes and behaviors but also reported awareness of discrimination ("accomodators") experienced more dramatic improvements in GPA from the first to third year of college, compared to students who exclusively favored mainstream attitudes and behaviors ("assimilators"). However, students who reported the most ethnic distinctiveness and the greatest social distance from Whites ("resisters") became increasingly involved in campus activities after their first year compared to other groups (Rivas-Drake & Mooney, 2009), suggesting that both bicultural students and those who maintain strong ties to their ethnic culture without fully accepting mainstream college ideology have opportunities to succeed. This possibility, of course, may only be available on campuses that deliberately construct promoting environments and value cultural diversity and inclusion. Overall, this small but growing literature points to the acculturative pressures facing Latino students transitioning to college, and illustrates the benefits granted to those who are able to confidently navigate within the mainstream norms so strongly reinforced by the U.S. higher education system.

Cultural congruity. Scholars from various disciplines have proposed that students' capacity to succeed is, in part, due to the degree of fit between the student and her/his environment. According to *person-environment fit theory* from the developmental literature, disruptions to normative developmental processes can occur as a result of a mismatch between students and the opportunities of their social environments (e.g., school classrooms; Eccles et al., 1993). Similarly, *cultural dissonance theory* from the education literature suggests that cultural discontinuities between students' home and school experiences contribute to the academic and social challenges facing many ethnic minority students (Tyler et al., 2008). Applied to the college experience, theory also highlights the importance of *cultural congruity* or *cultural match* – students' overall fit within the larger university environment given their personal cultural orientation and the university's culture (Gloria & Robinson Kurpius, 1996; Stephens et al., 2012a).

From this perspective, it is not only students who must culturally adapt (or assimilate), but universities too that must shoulder some of the responsibility for creating culturally congruent, promoting environments that welcome Latino students and their families (Aguinaga & Gloria, 2015; Castillo et al., 2006). Notably, SAT scores fail to predict the college persistence of Latino students (Fuertes & Sedlacek, 1994), and experiences during college have a greater impact on the educational outcomes of first-generation students compared to their peers whose parents attended college (Hahs-Vaughn, 2004), suggesting that universities have an even greater responsibility for cultivating promoting environments for first-generation Latino college students. As a prime example of how this may be achieved, simply representing university culture in terms of interdependence (i.e., being part of community) improved first-generation students' performance on academic tasks and reduced perceived difficulty of the tasks, compared to the typical representation of university culture in terms of independence (i.e., paving your own path; Stephens et al., 2012a).

Nora and Cabrera (1996) have proposed that collective experiences involving faculty, students, and other academic staff enhance students' academic engagement and encourage stronger commitment to obtaining degrees. These experiences and perceptions of campus climate may be particularly critical for the success of Latino students (Crisp et al., 2015). Feeling valued as part of the university environment helped to explain, in part, why Latino students at a large public university in the Midwest (4% Latino enrollment) decided to persist in college, although this association was most pronounced for more highly acculturated students (Aguinaga & Gloria, 2015). Similarly, perceived cultural congruity was positively associated with Latina students' psychological well-being at a large public university in the Southwest (18% Latino enrollment; Gloria et al., 2005). On the other hand, Latino students with greater commitments to their ethnic identity tended to perceive a more negative environment at a large western university (18% Latino enrollment), which in turn was associated with feeling less committed to degree completion (Castillo et al., 2006). This suggests that universities still have ground to cover in order to foster welcoming, promoting environments for diverse groups of Latino students. Each of these studies recruited a sample of Latino students from a particular university setting (e.g., Midwest vs. Southwest), so additional research is warranted to continue exploring whether student-environment fit processes unfold in similar fashion across contexts.

HPA Axis Stress Response

The HPA axis is one of the body's major stress response systems, recruiting the body's resources to react to stressors and stimulating release of the steroid hormone cortisol (Chrousos & Gold, 1992; de Kloet, 2004). In coordination with other biological systems, including the autonomic nervous system, the HPA axis production of cortisol represents a series of events that allow for adaptive behavioral responses during stressful situations (Chrousos & Gold, 1992). Cortisol is produced in the body through a series of steps: corticotropin-releasing hormone and vasopressin released by the paraventricular nucleus of the hypothalamus travel through the blood to the anterior pituitary, where they stimulate production of adrenocorticotropic hormone, which in turn binds to receptors on the adrenal cortex to stimulate the production and release of cortisol (Herman & Cullinan, 1997; Johnson, Karmilaris, Chrousos, & Gold, 1992). In addition to serving as a marker of the HPA stress response, cortisol is involved in a feedback loop to regulate the more immediate but energy-consuming sympathetic nervous system response, effectively helping to restore homeostasis following stress exposure (Sapolsky et al., 2000). Reliable and valid estimates of serum or plasma cortisol concentration can be obtained in saliva

(Kirschbaum & Hellhammer, 1989). Cortisol levels reach their peak in saliva approximately 20-25 minutes following a stressor but take up to an hour to return to baseline levels (Adam et al., 2007; Nicolson, 2008).

More than simply a "stress hormone," cortisol must be considered across contexts, between individuals, and relative to the timing of activation and recovery in order to fully examine its role in adaptation (Adam, 2012; Miller, Chen, & Zhou, 2007; Shirtcliff et al., 2014). Cortisol reactivity is necessary in order to cope with acute life stressors. For example, cortisol levels increase when individuals are open to experience, socially engaged, and facing difficult but manageable challenges (Del Giudice, Ellis, & Shirtcliff, 2011; Fries, Shirtcliff, & Pollak, 2008). Acute cortisol increases in daily life are also followed by rises in activeness, alertness, and relaxation (Hoyt, Zeiders, Ehrlich, & Adam, 2016). However, repeated wear and tear on the HPA axis through chronic activation can lead to allostatic load, a costly physiological burden resulting from prolonged exposure to stress hormones that overtax response systems and reduce individuals' adaptive capacity (McEwen, 2004; Myers, 2009). HPA axis dysregulation resulting from chronic activation suppresses the immune system, damages hippocampal neurons responsible for memory consolidation, and has been implicated in the development of diabetes, hypertension, cardiovascular disease, chronic fatigue syndrome, depression, and impaired cognitive abilities (Kumari et al., 2011; Lupien et al., 1997; Maheu, Joober, Beaulieu, & Lupien, 2004; McEwen, 1998; Nater et al., 2008; Pariante, 2003). Recent theoretical models have identified alterations in HPA stress responses resulting from racial/ethnic-based stressors as a potential contributor to racial/ethnic disparities in health and educational outcomes (Heissel et al., 2017; Levy et al., 2016;

Myers, 2009). These recent theory-building efforts haved focused attention on how adverse experiences disrupt typical HPA functioning, but little to no work has yet considered how cultural strengths may promote regulation of cortisol responses to stress among Latinos pursuing college.

Cortisol responses to stress in daily life. In addition to its role in stress reactivity, cortisol is released throughout the day in a typical pattern characterized by relatively high levels at waking, a dramatic increase ranging from 50% to over 150% approximately 30 minutes later known as the cortisol awakening response (CAR), and then a general decrease across the rest of the waking day (e.g., Adam & Kumari, 2009; Pruessner et al., 1997; Stalder et al., 2016). By gathering repeated saliva samples and corresponding brief survey reports of daily experiences,[3] researchers can estimate cortisol responses to real-world emotional reactions or perceptions of stress as situation-specific, within-person deviations from an individual's average daily cortisol pattern (Adam, 2006; Doane & Zeiders, 2014; Sladek, Doane, Luecken, & Eisenberg, 2016). "Reactivity" using this method refers to acute elevations in cortisol level (relative to an individual's typical diurnal cortisol pattern) following or coinciding with situational reports of greater stress than usual (relative to an individual's typical level of stress), rather than the more detailed reactivity and recovery patterns observed in controlled lab studies. This approach aims to approximate physiological reactivity to stress that actually occurs in participants' daily lives without needing to create an artificially stressful challenge in a lab.

[3] Part of a class of data collection methods known as ecological momentary assessment (Stone & Shiffman, 1994) or the experiencing sampling method (Larson & Csikszentmihalyi, 1983).

The first studies using this “naturalistic” approach found that cortisol reactivity to a stressful lab task did not significantly correspond with reactivity to stressful events in the daily lives of European men (van Eck, Nicolson, Berkhof, & Sulon, 1996a), but stressful daily events were associated with increased cortisol levels (van Eck, Berkhof, Nicolson, & Sulon, 1996b). Since then, more researchers have collected salivary diurnal cortisol to better estimate real-world reactions to stress (Adam, 2012; Granger et al., 2012; Kudielka, Gierens, Hellhammer, Wüst, & Schlotz, 2012). Such studies have found that daily stressors and negative affect were associated with increased cortisol levels among healthy European adults (Jacobs et al., 2007; Smyth et al., 1998). In relatively diverse (i.e., ethnically heterogeneous) samples of U.S. adolescents, situational elevations in cortisol from typical diurnal rhythms have been found in relation to more worry/stress (Adam, 2006), more loneliness (Doane & Adam, 2010), and more negative affect (Doane & Zeiders, 2014) than usual. In samples of European and U.S. college students, cortisol levels increased in anticipation of a real-life multiple-choice exam (Nicolson, 1992), were higher on exam day compared to a control day (Verschoor & Markus, 2011), were higher when students were alone during the day compared to when they were not (Matias, Nicolson, & Freire, 2011), and were higher when perceiving greater stress was combined with coping more actively than usual (Sladek et al., 2016). Thus, diary-reported stressors have been linked with estimates of naturalistic cortisol “reactivity” in predominantly White or ethnically heterogeneous study samples from Europe and the U.S. However, each of these studies operationalized “stress” differently (e.g., perceived stress, negative affect, feeling lonely) and almost all found evidence for moderators of cortisol reactivity (i.e., estimates only significant for some individuals, and not others; Adam, 2006; Doane & Adam, 2010; Doane & Zeiders, 2014; Matias et al., 2011; Sladek et al., 2016).

As of yet, researchers have not applied such an approach to understand variation in cortisol reactivity in the daily lives of Latino students, specifically. Revisiting García Coll and colleagues' (1996) integrative model, there is no reason to believe that Latino students' typical cortisol reactivity differs from that of their majority peers. However, the model also proposes that social stratification of the U.S. constructs prohibiting environments in which racial/ethnic minority youth become disproportionately exposed to stress and its adverse effects. In a related line of work, studies have established one disturbing but important pathway linking discrimination and other forms of psychosocial stress with less rapid rates of decline in cortisol throughout the day (i.e., flatter diurnal slopes) among racial/ethnic minority youth (Huynh, Guan, Almeida, McCreath, & Fuligni, 2016; Martin, Bruce, & Fisher, 2012) and both racial/ethnic minority (Adam et al., 2015; DeSantis et al., 2014; Zeiders, Hoyt, & Adam, 2014) and White adults (Fuller-Rowell, Doan, & Eccles, 2012). Together these findings suggest that discrimination and other psychosocial risk factors heighten daily HPA axis responsivity as early as adolescence, which can negatively impact long-term health through allostatic load or disruptions to circadian cycles (Adam et al., 2015, 2017). In studies of Mexican-origin adolescents and young adults, more frequent discrimination was associated with greater total diurnal cortisol output (Zeiders, Doane, & Roosa, 2012), whereas greater chronic family stress (e.g., difficulty paying bills) and greater acculturation were associated with reduced CARs characteristic of chronic fatigue or "burnout" (Kwak et al., 2017; Mangold, Mintz, Javors, & Marino, 2012; Mangold, Wand, Javors, & Mintz, 2010).

Few studies have extended this line of inquiry to acute cortisol reactivity in daily life or to culturally-informed protective factors that might promote optimal physiological responses to naturally occurring everyday stress and negative emotions. As an exception, Doane and Zeiders (2014) found that cortisol levels among racially/ethnically diverse adolescents were higher during negatively-valenced situations specifically for those who reported greater discrimination but not for those with greater social support from friends. When these same youth began college, the degree to which cortisol levels were related to situational perceptions of stress was also attenuated for those who generally coped more actively with social stress and who reported greater confidence in their ability to cope with stress (Sladek et al., 2016). These preliminary findings in a diverse, ethnically heterogeneous sample suggest that contextual factors and psychological resources moderate cortisol responses to stress in daily life.

To extend this available research, how might theoretically protective cultural factors help to explain how cortisol responses to stress in daily life differ between Latino students as they prepare to begin college? Consistent with theory and prior findings in the psychological literature (Brittian et al., 2013; Delgado et al., 2011; Gonzales et al., 2015), does maintaining connections to heritage Latino culture offer protection by attenuating cortisol levels during (or following) stressful situations? How might orientation toward mainstream culture (i.e., acculturation) play a role? Does the comfort and ease of navigating two cultures (biculturalism) provide Latino students added regulatory benefits when responding to stress in their daily lives? Taking the fit between students and their context(s) into account, does greater cultural congruity in high school attenuate Latino students' cortisol levels during (or following) daily stressful situations?

Cortisol responses to stress in laboratory settings. Estimating cortisol reactivity in daily life affords unique opportunities to consider HPA stress responses in real-world everyday contexts. Despite this innovation, however, the approach remains correlational in nature and subject to various threats to internal validity. Only the standardization and control of lab settings allow researchers to model more detailed rates of change in cortisol reactivity and recovery, while also offering the opportunity to readily manipulate variables of interest and randomly assign participants to conditions in an experimental design. Thus, far more routinely than the field studies described above, researchers have used laboratory tasks designed to examine the degree of cortisol elevations in anticipation of and in response to a stressor (i.e., reactivity), as well as the rate of change in returning to pretest levels thereafter (i.e., recovery; Adam et al., 2007; Dickerson & Kemeny, 2004; Foley & Kirschbaum, 2010). In one of the most widely-replicated lab stress paradigms, the Trier Social Stress Test (TSST), participants give a speech and perform challenging mental arithmetic in front of two confederate "judges" while being video recorded (Kirschbaum, Pirke, & Hellhammer, 1993). The TSST produces a stressful psychosocial challenge that is uncontrollable and socially evaluative, conditions thought to most consistently activate the cortisol response (Dickerson & Kemeny, 2004).

To be clear, cortisol increases in response to a stressful experience reflect a normative and adaptive pattern (Dickerson & Kemeny, 2004; Kirschbaum & Hellhammer, 1994; McEwen, 2004; Shirtcliff et al., 2014). However, exaggerated cortisol levels in anticipation of, in response to, or while recovering from psychosocial stress have all been considered disruptions to the expected HPA axis stress response (Adam et al., 2007; Burke, Davis, Otte, & Mohr, 2005). The negative health correlates of routinely exaggerated (i.e., higher than normal) cortisol levels in response to stress include suppressed immune function and the development of chronic diseases, such as hypertension (McEwen, 1998) and major depression (Parker, Schatzberg, & Lyons, 2003). On the other hand, failure to exhibit an HPA response to relevant stressors can also be considered maladaptive. Blunted cortisol reactivity (i.e., absence of a response, or less of a response than anticipated) has also been linked with adverse health outcomes, including externalizing symptoms and depression (Hagan, Roubinov, Mistler, & Luecken, 2014; Phillips, Ginty, & Hughes, 2013).

Among many factors that may alter cortisol responses to psychosocial stress, researchers have focused on measuring how individuals typically respond psychologically to stress (i.e., coping styles), introducing social support before or during the stressful challenge, and training participants in stress management to meet demands of the task (Foley & Kirschbaum, 2010). For example, coping styles characterized by actively focusing on problems, relying on and seeking social support, and avoidance have all been associated with less of a cortisol response (i.e., lower compared to others without these characteristics, but not necessarily blunted or absent; Hori et al., 2010; Matheson & Anisman, 2009; Matheson & Cole, 2004; Rohrmann, Hennig, & Netter, 2002; Sladek, Doane, Jewell, & Luecken, 2017). Individuals who used a greater range of observed coping strategies during a stressful task exhibited less of a cortisol response compared to those using less strategies, suggesting that a more flexible coping profile might contribute to lower reactivity rather than any one style (Roubinov, Hagan, & Luecken, 2012). Cortisol levels have also been lower for men in the presence of a supportive partner (Kirschbaum, Klauer, Filipp, & Hellhammer, 1995; Heinrichs, Baumgartner, Kirschbaum, & Ehlert, 2003), for women who received physical contact from partners (Ditzen et al., 2007), and for participants trained in behavioral stress management (Gaab et al., 2003).

Altering the social evaluation component of the TSST itself has produced mixed results. Replacing the typically neutral audience with "friendly" judges who were instructed to respond warmly to participants did not produce significant cortisol reactivity in one study (Wiemers, Schoofs, & Wolf, 2013). However, participants were informed of their assignment to the control group prior to the task, friendly judges did not wear lab coats, and participants were not video recorded, suggesting that other methodological features may account for this finding. In another study holding more constant across conditions, supportive judges produced cortisol reactivity comparable to the standard judges (Taylor et al., 2010). Thus, any degree of social evaluation, even when offered with the best of intentions in a supportive manner, appears to prompt HPA reactivity.

Based on findings from a meta-analysis, Dickerson and Kemeny (2004) have argued that, more than other factors, the magnitude of the HPA stress response is influenced by the extent to which individuals' sense of "social self" (their social value and status based on other's perceptions of their worth) is threatened. Given that most lab reactivity study samples to date comprise predominantly White college students, culturally-relevant factors that might influence Latino students' cortisol responses by boosting perceptions of their social value remain virtually unexplored. The potential cultural contributions to the variability in Latino students' responses to psychosocial stress have been theorized for some time (Cervantes & Castro, 1985; Gallo et al., 2009), but as of yet, remain untested with the strengths of a culturally-informed experimental design to systematically manipulate the conditions of a psychosocial stress task.

In one line of research, Cohen and Sherman (2014) have detailed the wide array of health and education benefits that can result from prompting individuals to reflect on what they value the most. This process of self-affirmation, however fleeting, is thought to enable individuals to appraise specific stressors in reference to a larger context after remembering what matters most to them, thereby protecting against threats to one's identity and sense of self (Sherman & Cohen, 2006). Latino middle school students who completed self-affirmation writing exercises showed an improved academic trajectory that remarkably persisted for 3 years into high school (Sherman et al., 2013). Recently, researchers used this affirmation idea to prompt a culturally-relevant sense of interdependence focused on the family (i.e., selecting values to write about that are important to "you and your family"), which improved Latino college students' performance on a verbal reasoning task compared to their peers who completed the standard self-affirmation exercise (writing about values "important to you"; Covarrubias, Herrmann, & Fryberg, 2016). Others have developed full-fledged programs in partnership with universities specifically tailored to affirming minority students' cultural identities. Results from some of these bridge programs show that participants become two to three times more likely to enroll in college than demographically matched students not enrolled in such programs (Gándara & Contreras, 2009; Tierney, 1999).

Researchers have not directly tested the effects of cultural affirmation on Latino college students' cortisol responses to psychosocial stress. In one study, racially/ethnically diverse college students (56% Asian, 21% White) who affirmed their personal values via a writing exercise prior to the TSST exhibited lower average cortisol responses (Creswell et al., 2005), but how culture fits into the affirmation process was not an explicit focus of the study. In another study, framing university culture prior to a speech task in terms of interdependent norms (i.e., "learning by being part of a community") instead of independent norms (i.e., "paving your own path") resulted in lower average cortisol responses specifically for first-generation college students, theoretically by fostering a cultural match between framing of the stress task and first-generation students' motivations for performing well (Stephens, Townsend, Markus, & Phillips, 2012b). Among the rapidly growing number of Latino students pursuing college, how might culturally-affirming university messages of diversity and inclusion foster a cultural match, boost students' perceptions of their social/cultural value as part of the campus community, and thereby reduce cortisol and subjective responses to stress? Since not all Latino students would be expected to respond to such messages in the same way, how might students' cultural orientations, degree of biculturalism, or perceived cultural congruity in college moderate their responses to receiving the university's message?

The Current Study

The literatures on cultural adaptation of Latino students and stress physiology are rich, but as of yet, separate. The current two-part study exemplifies an expanding area of research focused on culture and biology interplay (Causadias et al., 2017), specifically a new frontier termed *cultural neurobiology* (Doane et al., 2018), which seeks to appropriately measure culturally salient adaptation processes in relation to the function of physiological stress systems. This project combined the strengths of a within-group, ethnically-homogenous EMA with an experimental follow-up study in order to (1) estimate Latino students' cortisol responses to stress in their daily lives before they began college, and (2) examine cortisol and subjective responses to a standard public speaking stress task after a subsample of these same students began college. Due to constraints of the respective methods, a benefit of this multi-method approach is the pairing of a correlational study relying on naturally occurring cultural differences between students with an experiment to test the effects of manipulating cultural messaging prior to a standardized stressful challenge. Focusing on variation among a group of Latino students transitioning to college advances prior work by allowing for greater sensitivity in the measurement of relevant cultural factors.

The current study was designed to answer the following research questions and test the following specific hypotheses:

Research question 1a. As a replication of previous research with either predominantly White or relatively diverse (i.e., ethnically heterogeneous) study samples, do greater perceptions of stress and/or negative affect than usual in everyday life correspond with situational increases in salivary cortisol among Latino high school seniors preparing to begin college?

Hypothesis 1a. Within a model for the diurnal rhythm of cortisol, within-person increases in situational diary-reported perceived stress level and/or negative affect (i.e., higher levels than each individual's average) were expected to be associated with corresponding situational elevations in cortisol. Perceived stress level and an average of negative affect items from diary reports were examined as two separate indicators, given the complexity of capturing naturally occurring stressful situations in daily life. Prior empirical work has used these or similar measures to demonstrate associations with cortisol in predominantly White (Adam, 2006; Smyth et al., 1998) and ethnically heterogeneous samples of adolescents and young adults (Doane & Zeiders, 2014; Sladek et al., 2016), and there was no reason to expect that Latino students' typical cortisol responses would differ, on average.

Research question 1b. As a novel research contribution, do these "naturalistic" cortisol responses to everyday stress differ between Latino students? If so, how might cultural factors partially account for these differences? Specifically, does cultural orientation (practices or values, along dual dimensions), biculturalism, or cultural congruity in school predict individual differences in cortisol responses to everyday stress?

Hypothesis 1b. Expectations were tentative and this research question was mostly exploratory given the novel nature of the study design. This estimated cortisol response was expected to be attenuated for Latino students with a greater connection to ethnic heritage culture (e.g., higher endorsement of Latino cultural practices and values) and mainstream U.S. culture (e.g., higher endorsement of mainstream cultural practices and values), for students who more comfortably and easily navigate two cultural contexts (e.g., more bicultural), and for students who perceive a greater sense of cultural congruity with their high school. These expectations were supported by prior work showing that heritage cultural orientation, biculturalism, and cultural congruity promotive positive adjustment and/or protective Latino youth from adverse effects of stress regarding behavioral outcomes (Corona et al., 2017; Gloria et al., 2005; Nguyen & Benet-Martínez, 2012; Ong et al., 2006; Rivas-Drake & Mooney, 2009). Though these cultural factors have never been tested with respect to cortisol, protective contextual and psychological factors have predicted attenuations in this estimated cortisol response in daily life for diverse adolescents (Doane & Zeiders, 2014; Sladek et al., 2016).

Bicultural students were expected to benefit from enhanced regulation when under stress because they are theoretically more prepared to cope with culturally relevant stressors (Gonzales et al., 2015) or more simply have greater practice adapting to demands across multiple settings (Nguyen & Benet-Martínez, 2012). On the other hand, bicultural students also contend with a greater variety of daily stressors spanning two cultural contexts (e.g., family obligations, school demands; Sy, 2006), and uniquely bicultural stressors (e.g., expectations to communicate in two languages; Love & Buriel, 2007), which could prompt more exaggerated (but potentially still adaptive) cortisol responses. Students with a greater sense of cultural congruity in high school were expected to benefit from available supports in their school setting when responding to stressors throughout the day (Gloria & Robinson Kurpius, 1996), thereby exhibiting lower cortisol levels during or following typical everyday stress. On the other hand, these students who feel more supported as members of their ethnic group in school may be particularly vulnerable to out-of-the-ordinary stressors that occur in other contexts outside school (Tyler et al., 2008), which could prompt more exaggerated cortisol responses.

Research question 2a. Does priming first-year Latino college students with messages of a welcoming, culturally diverse, and inclusive college environment in anticipation of an otherwise culturally incongruent, individual achievement-focused stress task (Trier Social Stress Test; TSST) reduce their cortisol and negative affective responses to the task, compared to Latino students in a control group?

Hypothesis 2a. Students randomly assigned to watch a brief video clip emphasizing culture, diversity, and inclusion on campus (i.e., the importance of learning from others, being a part of and contributing to a diverse and inclusive university community) before preparing for the TSST were expected to exhibit reduced, but likely still significant, cortisol and affective responses to the task (i.e., lower rate of increase, increase to a lower peak value), compared to students in the control group randomly assigned to watch a neutral video clip of the same length without such supportive messages (video tour of campus). Specifically, reminding Latino students of their social and cultural value as part of a diverse and inclusive university community was expected to provide a sense of cultural belonging and promote the belief that students of all cultural backgrounds are accepted and can be successful in college. This feeling of cultural belonging was expected to buffer Latino students from threats to their sense of self prompted by the socially-evaluative challenge, and thus reduce mobilization of the HPA axis stress response and corresponding emotional distress (Covarrubias et al., 2016; Dickerson & Kemeny, 2004; Stephens et al., 2012b).

Research question 2b. Do differences between Latino students on cultural orientations, biculturalism, or cultural congruity in college moderate the effects of experimental condition?

Hypothesis 2b. The effects of condition on reducing stress responses to the task were expected to be most pronounced for students with a greater orientation toward Latino culture, for more comfortably bicultural students, and for students who feel more culturally congruent with their college environment (compared to students scoring lower on those respective dimensions), due to a greater degree of person-context fit with the culturally-inclusive message prior to the task (Gloria & Robinson Kurpius, 1996; Stephens et al., 2012a).

CHAPTER 2

METHOD

Latino high school seniors who planned to enroll as first-year students at Arizona State University (ASU; 21.7% Latino undergraduate enrollment; ASU Facts at a Glance, 2017) in the fall of 2017 were recruited for *Transiciones*, a multi-method longitudinal study (N = 209; T1; Doane et al., under revision). The current study used survey, daily diary, and salivary diurnal cortisol data from T1 prior to students' college enrollment (*research questions 1a and 1b*) and survey and salivary cortisol reactivity data in the lab (*research questions 2a and 2b)* once a subsample of these students began college (N = 85; T2). This second part of the project was an independently coordinated extension of the larger longitudinal study.

Participants

High school seniors living in the Phoenix metropolitan area who identify as Latina(o)/Hispanic, who gained admission to ASU, and who paid financial deposits or selected to defer payment to enroll in fall 2017 were recruited using institutional admissions data from December 2016 to July 2017. Students were also recruited through community partnerships (e.g., ASU's Hispanic Mother-Daughter program), orientation sessions on the ASU Tempe campus, and word of mouth. In total, 209 participants attended 91 different high schools. Two participants did not provide saliva samples and one used corticosteroid medication during sampling that led to extreme outlier cortisol values, leaving 206 participants in the analytic sample (M_{age} = 18.10; SD = 0.41). In addition to identifying as Latino/Hispanic (85.0% Mexican descent), 32 participants

(15.5%) also identified as White/Caucasian-American, 3 (1.5%) as Native American, and 2 (1.0%) as Asian/Asian-American. See Table 1 for a descriptive summary of the sample.

Beginning in August 2017, T1 participants who were at least 18 years of age and enrolled at ASU were eligible to participate in a 2-hour follow-up study of college experiences and health. These eligible students received e-mails and text messages inviting their voluntary participation, resulting in a subsample that closely resembled the demographic composition of T1. One participant chose to opt out of the stress task beforehand, leaving 84 participants in the analytic sample ($M_{\text{age}} = 18.56$; $SD = 0.35$). In addition to identifying as Latino/Hispanic (85.7% Mexican descent), 14 participants (16.7%) also identified as White/Caucasian-American, 1 (1.2%) as Native American, and 1 (1.2%) as Asian/Asian-American. See Table 1. Those who participated in the T2 follow-up study did not differ significantly on any demographic characteristics compared to those who did not participate, ps > .23.

Procedure

T1 EMA. All procedures were approved by the university Institutional Review Board. Depending on participants' preference, study personnel visited participants' homes or hosted participants in a lab on ASU's campus to deliver study materials, gather survey responses, and provide instructions for saliva sampling and diary reporting procedures. Participants and parents (for participants under the age of 18) provided written consent at the beginning of these visits. For 3 typical weekdays (generally Monday – Wednesday), participants provided five saliva samples each day via passive drool (i.e., expelled saliva through a straw into a small plastic vial): immediately upon waking (M_{time} = 7:17 AM; SD = 1.70 hours), 30 minutes after waking (M_{time} = 7:50 AM;

SD = 1.70 hours), 2 other times during the day when they received automated text message reminders (approximately 3 and 8 hours later, designed to avoid mealtimes; M_{time} = 12:21 PM; *SD* = 1.85 hours; and 5:00 PM; *SD* = 1.68 hours), and at bedtime (M_{time} = 11:26 PM; *SD* = 1.45 hours). Participants were instructed not to eat, drink, or brush their teeth 30 minutes prior to providing a saliva sample. In addition to recording the date and time of each saliva sample, participants retrieved the necessary straws from a MEMS 6™ (Aardex) track cap compliance device, which objectively records adherence to sample timing. Participants also wore an actigraph wrist-based accelerometer to objectively assess waking and bed times.

Following each saliva sample, participants completed brief diary entries using web-enabled smartphones (or paper-and-pencil if Internet access was not available) to report what they were doing and feeling, as well as the presence, nature, and perceived severity of stress within the last hour ("situation"). Participants also reported recent eating, exercise, and caffeine, nicotine, and medication use. In total, 15 saliva samples (*M* = 14.56, *SD* = 1.61) and 15 corresponding diary reports (*M* = 13.97, *SD* = 2.24) were expected from each participant across the 3-day protocol, resulting in 3003 total samples and 2877 total diaries. Participants also completed a one-time questionnaire online, including measures of cultural factors, emotional health, and questions about school, family, and friends. Participants received text message reminders to improve adherence to the study protocol and were encouraged to contact study personnel with any questions throughout the week. Study personnel returned to participants' homes or met in a lab on ASU's campus upon completion of the study to collect completed materials and pay each participant up to $110 for all study components.

With necessary precautions taken, these data collection techniques have been used successfully to maintain a high level of fidelity to the intensive nature of these procedures across several diverse samples of adolescents and young adults (Adam, 2006; Doane & Adam, 2010; Sladek et al., 2016, 2017). Problems adhering to saliva sample timing can systematically bias cortisol estimates, particularly waking values and the CAR (Kudielka, Broderick, & Kirschbaum, 2003; Stalder et al., 2016); thus, track cap, actigraph, and self-report data were carefully inspected to determine "compliant" vs. "non-compliant" saliva samples (DeSantis, Adam, Mendelsohn, & Doane, 2010; Doane & Zeiders, 2014). Waking samples were considered compliant if track cap-detected times were within 15 minutes of participants' actigraph-detected wake times (79.5% of waking samples). Second samples were considered compliant if track cap-detected times were within 23 and 37 minutes after track cap-detected times for waking samples (67.4% of second samples). These compliance rates include the more stringent criteria that actigraph or track cap data was available for samples to be considered compliant (i.e., non-compliance assumed if missing compliance information). Rather than allowing problems adhering to the protocol to bias estimates of morning cortisol (and models of the diurnal rhythm; see Stalder et al., 2016, for recent expert consensus), cortisol values from non-compliant samples were treated as missing data in analyses (10.9% of all samples). Alternative models were also fit with values from all non-compliant samples included.

T2 lab task. All procedures were pilot tested with Latino student volunteers and modified based on their feedback. The university Institutional Review Board approved all procedures. Students who agreed to participate were invited to an on-campus testing room in the afternoon (generally 1:30pm or 4pm), a standard practice to control for diurnal cortisol patterning that naturally changes more substantially in the morning. Participants were instructed to avoid exercising, eating, or drinking anything besides water in the hour prior to the study. An experimenter greeted participants, obtained their written consent, screened if any of the behaviors listed above occurred in the past hour, and allowed them to adjust to the testing room for at least 15 minutes while listening to quiet music and reading magazines before recording baseline measures. Prior to baseline, participants were only aware they would be asked to "talk about themselves in front of others," and that bonus incentives were available for performing well.

After baseline measures, the experimenter instructed participants to complete a modified version of the Trier Social Stress Test (TSST; Kirschbaum et al., 1993). Participants were asked to prepare a 5-minute speech, the topic of which was "randomly decided" (but actually the same for all participants). After selecting from one of three possible topics, all participants read instructions for delivering a speech about why they are uniquely qualified for a "university student award" in front of student experts who would video record the speech (see Appendix). Participants were also told they would be able to see themselves during the speech on a small screen, there was another challenge component to the task after the speech that the experts would explain, and they could receive a $10 bonus for their performance if positively evaluated by the experts. After participants read these instructions, the experimenter added that "your speech should align with the goals of ASU" and explained there was a quick video to watch to help them prepare. Prior to their arrival, participants were randomly assigned to one of two conditions. Students randomly assigned to the *cultural inclusion* condition (n = 45) viewed a brief video clip (2 minutes, 19 seconds) produced by the university that emphasizes culture, diversity, and inclusion on campus (i.e., the importance of learning from others, being a part of and contributing to a diverse and inclusive university community).[4] Students randomly assigned to the *control* condition (n = 39) instead watched a brief video clip of the same length that covered a neutral college topic (e.g., a narrated video tour of campus; see Appendix for video scripts). After viewing the video and before preparing their speech, participants responded to brief manipulation check questions (see Appendix).

After 5 minutes of preparation, the experimenter left the room and the "expert judges" (one female and one male undergraduate or graduate research assistant) entered to observe, time, and video record the 5-minute speech. These judges were trained to maintain neutral dispositions, avoid providing any affirmative feedback, and prompt participants to continue when pausing for long lengths of time or failing to speak for the full 5 minutes. Before data collection began, a team of 13 judges completed at least 8 hours of training each, performed as a judge at least once during pilot testing while being observed by the doctoral candidate, and met behavioral expectations for consistent and ethical conduct of the task. Following the speech, the original TSST includes performing mental arithmetic in front of the experts, which was not used due to concerns about confounding with academic ability for first-year college students. As a replacement, participants were instructed to complete a 5-minute sustained attention allocation task (i.e., continuous performance task) on the computer while the experts pretended to evaluate their task performance on a handheld tablet. This combination of a psychosocial and cognitive stressor involving social evaluation and uncontrollable conditions has most

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[4] Available to view at https://yourfuture.asu.edu/culture

consistently activated the HPA response in lab settings (Dickerson & Kemeny, 2004). Judges were blind to condition. All other aspects of the task were consistent across conditions.

Participants provided saliva samples via passive drool on five occasions to assess cortisol reactivity and recovery: baseline (after 15-minute acclimation period, prior to receiving details about the task), immediately after completing the TSST (25-30 minutes after baseline), and 15, 30, and 45 minutes after the TSST. Participants also completed a brief self-report measure immediately following each saliva sample to assess negative and positive affect, as well as perceived stress level (e.g., "*How stressed do you feel right now?*" from 0 to 10). After the TSST, participants completed questionnaires and thereafter listened to quiet music and read magazines. After all measures were complete, participants were offered water and a snack and thoroughly debriefed regarding the deception of the study design (e.g., shown judge scripts, given the option to watch the other video). Thirteen participants in the control group accepted the offer to watch the cultural inclusion video, and three participants in the cultural inclusion group watched the control video. All participants were paid $25, given the $10 "bonus," and asked to avoid discussing their experience with peers who may also be participating in the study.

Measures

Salivary cortisol. At T1, participants were instructed to store completed saliva samples in their refrigerator until materials were returned to the lab (typically 4 days later), where they were stored at -80C. Saliva collected at T2 was immediately stored at -80C. Samples were then 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, Kirschbaum, Rohde, Stahl, & Strasburger, 1992). The inter-assay (7.1% to 9.0%) and intra-assay (4.0% to 6.7%) coefficients of variation were acceptable. Only a single assay was possible for nine samples from T1 and two samples from T2; otherwise, the average concentration from both assays was used (nmol/L). Seven T1 outlier values were windsorized to 50 nmol/L, following standard practice (Nicolson, 2008). No T2 values were windsorized. Cortisol values were then transformed using the natural log function due to positive skew (T1 skew = 2.08 before transforming, -0.70 after transforming; T2 skew = 2.71 before transforming, 0.05 after transforming).

Situational diary-reported stress and negative affect (T1). Two indicators from diary reports that have previously demonstrated associations with cortisol among adolescents were used to assess psychosocial stress in daily life: perceived stress level (Sladek et al., 2016) and negative affect (Doane & Zeiders, 2014). In each diary report, participants were asked to describe the most stressful event they encountered in the last hour and rate how stressful that event was (0 = *no stress at all* to 10 = *extreme stress*). Participants also indicated how much they felt seven negative mood states (*distressed*, *upset*, *guilty*, *afraid, ashamed*, *nervous, scared*) within the last hour from a validated short form of the Positive and Negative Affective Schedule (PANAS; Mackinnon et al., 1999; Watson, Clark, & Tellegen, 1988) on a scale from 0 (*very slightly or not at all*) to 4 (*extremely*). Average scores were computed from the seven negative items from each diary report (αs ranged from .81 to .84).

Affective responses to lab stress (T2). Participants responded to all 20 PANAS items (Watson et al., 1988) after each saliva sample at T2 as additional outcome measures (10 negative affect items, αs ranged from .76 to .93; 10 positive affect items, αs ranged from .88 to .93). A square root transformation was applied to T2 NA scores (skew = 3.00 before transforming, 0.91 after transforming). See Appendix.

Cultural adaptation. Joining recent efforts to gain a broader understanding of complex dual cultural adaptation processes among Latino youth (Gonzales et al., 2004; Knight et al., 2010; Updegraff et al., 2012), four survey measures were used to assess individual differences in related but distinct aspects of cultural adaptation at T1 and T2: behavioral cultural practices (e.g. language use), cultural values (e.g., familism), biculturalism (e.g., perceived comfort and ease of navigating both Latino and mainstream cultures), and cultural congruity in school (e.g., perceived fit between school and ethnic background). See Table 2 for descriptive statistics, correlations among cultural measures, and alphas. See Appendix for full measures.

Behavioral cultural practices. Participants responded to 29 items from the Acculturation Rating Scale for Mexican Americans – II (ARSMA-II; Cuellar, Arnold, & Maldonado, 1995) modified to be inclusive of all Latinos/Hispanics (e.g., "I associate with Mexicans and/or Mexican Americans" becomes "I associate with Latinos/Hispanics").[5] Participants reported how frequently they engage in each behavior or cultural practice using a fully-anchored scale from 1 (*Not at all*) to 5 (*Extremely often or almost always*). The ARSMA-II produces two subscales that have previously

[5] One item of the original 30-item Mexican American measure no longer carries the same meaning when adapted for Latinos/Hispanics: "I like to identify myself as a Latino American/Hispanic American."

demonstrated adequate internal consistency across various study samples: Latino Orientation (e.g., "My friends, while I was growing up, were Latino or Hispanic") and Anglo Orientation ("My friends, while I was growing up, were of Anglo/European American origin"). Higher scores on the Latino Orientation subscale reflect a greater degree of enculturation, whereas higher scores on the Anglo Orientation subscale reflect a greater degree of acculturation. Item responses from each subscale were averaged to form composite scores at T1 and T2.

Cultural values. The 50-item Mexican American Cultural Values Scale (Knight et al., 2010) assessed the extent to which participants endorse traditional Mexican cultural values (familism, respect, religiosity, traditional gender roles; e.g., "Parents should teach their children that the family always comes first") and mainstream U.S. values (material success, independence and self-reliance, and competition and personal achievement; e.g., "Parents should encourage children to do everything better than others"). Participants reported how much they believe in each statement using a fully-anchored scale from 1 (*not at all*) to 5 (*completely*). The measure was originally developed for Mexican Americans, but it has since been used with other Latino groups who share a cultural heritage (Corona et al., 2017). Previous research has indicated the respective subscales load on two correlated higher-order latent factors reflecting endorsement of Mexican cultural values (36 items) and mainstream U.S. values (14 items), respectively (Knight et al., 2010). The same higher-order correlated two-factor model was fit to T1 data to confirm this factor structure in the present sample. Model fit was acceptable [$\chi^2(1165) = 1964.82$, $p < .001$; CFI = .85, RMSEA = .06, SRMR = .08] and similar to model fit in the original measurement development sample of Mexican American middle school students and their parents (Knight et al., 2010). Thus, item responses were averaged to create separate composite scores for endorsement of Latino and mainstream cultural values at T1 and T2.

Biculturalism. Participants also completed the Bicultural Comfort and Bicultural Ease subscales of the Mexican American Biculturalism Scale (Basilio et al., 2014). Similar to the ARSMA-II, original item wording was modified to be inclusive of all Latinos/Hispanics. The 9-item Bicultural Comfort subscale assessed how comfortable individuals feel when interacting with both Latinos/Hispanics and Whites/European Americans. Participants respond to each question (e.g., "Sometimes you may need to speak Spanish, and other times you may need to speak English. Which of the following best describes you?") using one of six response options that change slightly for each item ranging from 1 (*only comfortable when needing to speak Spanish* or *only comfortable when needing to speak English*) to 5 (*always comfortable in both situations*). The 9-item Bicultural Ease subscale assesses how difficult individuals perceive the process of navigating two cultures simultaneously. Participants respond to each of the scenarios (e.g., "Needing to speak Spanish sometimes, and English other times is_________) from 1 (*very easy*) to 5 (*very difficult*). Following the original authors, higher scores were coded to reflect greater perceived comfort and ease navigating two cultures. Subscale scores were highly correlated (Table 2), so a mean composite of all 18 items was formed for T1 (α = .88) and T2 (α = .90).

Cultural congruity. The 13-item Cultural Congruity Scale (Gloria & Robinson-Kurpius, 1996) assessed the extent to which participants feel their ethnic/cultural background fits with the norms and expectations of their school setting. Participants indicate how much they experience each feeling or situation (e.g., “My ethnic values are in conflict with what is expected at school,” “My family and school values often conflict,”) using a 7-point scale from 1 (*not at all*) to 7 (*a great deal*). Only one slight wording change from T1 to T2 was necessary for one item to make the scale applicable to both high school and college students. After reverse scoring appropriate items so higher scores reflected greater cultural congruity (i.e., “fit”), the mean of 13 item responses was used as a composite measure at T1 and T2.

Lab task manipulation check (T2). After viewing the video and prior to the task, participants responded to two statements as a manipulation check: “ASU is a diverse and inclusive place” and “ASU 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 one manipulation check.

Participants then responded to eight items from the Primary Appraisal and Secondary Appraisal Scale (PASA; Gaab, Rohleder, Nater, & Ehlert, 2005), designed to measure anticipatory cognitive stress appraisals. Given its original development with male German university students, exploratory factor analysis (EFA) was conducted to explore underlying dimensions relevant for the present sample. Using principal axis factoring with direct oblimin (oblique) rotation (Gorsuch, 1997), observed eigenvalues over 1.00 (3.44 and 1.56) were compared with those from parallel analysis using Watkins’ (2006) MonteCarlo program, which suggested a two-factor structure. Together the two factors accounted for 62.6% of item variance. Two items loaded highly (.79 and .80) on the first factor, “Investment in Task” (e.g., “The situation is important to me,” “I do not care about this situation,” reverse scored), which aligns with one component of primary appraisal stress processing (Lazarus & Folkman, 1984). The remaining six items loaded highly (.41 - .75) on the second factor, "Anticipated Coping with Task" (e.g., "In this situation I know what I can do," "I can think of lots of solutions for solving this task"), which aligns with secondary appraisal processes (all item cross-loadings < .30). Items from each factor were reverse-scored as appropriate and then averaged to form two measures that assess differences in appraisal of the task after the experimental manipulation but before completing the task (Investment in Task: $r = .63$, $p < .001$; Anticipated Coping with Task: $\alpha = .83$). See Appendix for all items.

Covariates. Analytic models were fit first without covariates (see below), followed by models with covariates added. Several factors known to influence cortisol activity (Foley & Kirschbaum, 2010) and/or overlap with cultural dimensions (Gonzales et al., 2012) were evaluated as potential covariates. Only variables significantly associated with outcomes in preliminary analyses or contributing significantly in analytic models were included as covariates: participant's sex (1 = *male*, 0 = *female*), immigrant generation score (from 0 = *participant, both parents, and both sets of grandparents born outside U.S.* to 7 = *participant, parents, and both sets of grandparents born in U.S.*; Umaña-Taylor, Alfaro, Bámaca, Guimond, & Buehler, 2009), average of mothers' and fathers' educational attainment (1 = *less than high school* to 10 = *doctorate or other advanced degree*), depressive symptoms (CES-D; Radloff, 1977), sleep duration (hours slept) assessed by actigraph watches at T1, time of lab session since self-reported wake time at T2, oral contraceptive use (T1: $n = 15$; T2: $n = 6$), general corticosteroid medication use (T1: $n = 36$, T2: $n = 10$), whether stress from the last hour at T1 was ongoing (37.9% of situations) or completed at the time of diary report, recent exercise and caffeine use at T1, whether participants completed the T1 protocol during summer instead of during school (n = 74), and whether participants lived at home at T2 (n = 21). Body mass index (using objectively measured height and weight) and high school grade point average (GPA) from official transcripts were not significantly associated with outcomes and thus not included in models.

Analytic Plan

Data processing. Descriptive statistics were reviewed for all study variables, including means, ranges, standard deviations, and skewness/kurtosis, to determine whether data transformations were warranted. Together, descriptive statistics and visual inspection of the data aided in the identification of outliers. Repeated measures data were plotted visually for each person to screen for outliers and aggregated to aid in the selection of appropriate models of change (plots in SAS version 9.3). Extreme cortisol values (and extreme sampling times at T1) were investigated further by using all available information (self-report, track cap, actigraphy) to determine if outliers could be explained. Next, bivariate correlations were used to explore relations among variables of interest and potential covariates.

Power analysis. Estimating statistical power for multilevel models is a complex endeavor (Scherbaum & Ferreter, 2009). Simulation multilevel modeling studies have indicated

that only sample sizes of 50 or less at the highest (cluster) level typically lead to biased estimates of standard errors; sample sizes > 50 (as in both parts of the present study) typically result in unbiased and accurate estimates of the regression coefficients (fixed effects), variance components (random effects), and standard errors (Maas & Hox, 2005).

For the experimental design in the lab setting, GPOWER (v. 3.1) was used to examine required sample size a priori using ANCOVA comparing two conditions as an example, although growth modeling techniques were the focus of the analytic plan. For illustration purposes, setting power at .80, α at .05, and an expected medium effect size of condition (f = .25), 128 participants were required. Setting power at .70, α at .05, and an expected medium effect, 101 participants were required.

Modeling cortisol stress responses in daily life (T1). Up to 15 pairs of diary reports and cortisol values from each participant across 3 days were used to estimate relations between situational (within-person) changes in diary-reported stress and deviations in cortisol from individuals' typical diurnal profiles. Three-level growth models were used to address situational (Level 1), daily (Level 2), and individual (Level 3) variation in cortisol (e.g., Adam, 2006). This approach adds statistical power by using a within-person, repeated measures design, accounts for within-person and within-day associations among cortisol levels, has a relatively high tolerance for missing data, allows for the modeling of multiple cortisol indices simultaneously (reactivity to daily experiences, waking levels, CAR, diurnal slope), and has the ability to explore both time-varying state (e.g., situational changes in stress) and non-time-varying trait influences (e.g., sex) on the cortisol response (Adam, 2006; Hruschka, Kohrt, & Worthman, 2005; Raudenbush & Liu, 2001). These multilevel growth models were fit in Mplus 7 (Muthén and Muthén, 1998-2012) using maximum likelihood estimation with robust standard errors to account for the nested structure and handle missing data.

First, unconditional (i.e., empty) three-level models with no predictors were fit to identify sources of variance in cortisol levels. Unconditional models were also fit for diary-reported predictors of interest (perceived stress level and negative affect) to better understand sources of variance in these repeated psychological measures. Intraclass correlations (ICCs)[6] were used to quantify the proportion of person-level variance for nested data that was stable within individuals over 3 days and the degree to which these variables violated the independence assumption (1.00 = 100% of variance accounted for by between-person differences). The residual variances (1 – ICC) then indicated how much cortisol and diary-reported variables fluctuated across days and situations.

Two growth model frameworks were used to explore the best modeling approach for these diurnal cortisol data. First, diurnal cortisol patterns were modeled at Level 1 by including a sample-, day-, and person-specific growth parameter indicating how long after waking each saliva sample was provided (0 = *wake time*), this parameter squared to capture a small but often significant curvilinear trend (*time since waking*^{2}), and a dummy variable for the second saliva sample of the day representing the size of the CAR (1 = *second sample*, 0 = *not second sample*; Adam, 2006). This model is motivated by evidence that the CAR represents a deviation from the diurnal rhythm that may be mediated by a fundamentally different biological system, and that the size of the CAR tends to be unrelated to other aspects of the diurnal pattern (Schmidt-Reinwald et al., 1999). As a second approach, three-level bilinear spline growth models were used to separate time of day into discrete phases in order to account for observed changes in cortisol before and after the morning peak (Grimm, Ram, & Estabrook, 2017). Such models account for the expected increase in cortisol after waking and the expected

[6] ICC = Cluster-level variance/(Cluster-level variance + Residual variance)

decrease throughout the rest of the day, with a knot or transition point in between the two change processes. Using this approach, diurnal cortisol was modeled at Level 1 by including a pre-knot linear growth term to represent the expected increase from waking to 30 minutes later, a post-knot linear growth term to represent the expected linear decrease from the second sample until the end of the day, and a post-knot quadratic growth term to represent any curvilinear change.

For both of these approaches, diary measures of situation-specific stress were then included to predict situational deviations in cortisol from each individual's average pattern. Next, likelihood ratio chi-square difference tests (nested model tests) were used to evaluate whether stress-cortisol associations significantly varied across persons. Following these tests, corresponding random slope terms were included to allow for individual variation in within-person relations (Snijders & Bosker, 2012). At Level 2, day- and person-specific covariates (such as sleep duration) were included. At Level 3, person-specific covariates were included to adjust for between-person differences in the various components of diurnal cortisol change. Aside from the coding for time already described, continuous Level 1 and Level 2 predictors were centered within-person (i.e., an individual's average of available scores subtracted from each situational or daily score) and Level 3 predictors were grand-mean centered (i.e., the average for the entire sample subtracted from each individual's score; Enders & Tofighi, 2007; Kreft, De Leeuw, & Aiken, 1995). By centering in this way, the Level 1 coefficient of primary interest can be interpreted as the estimated difference in cortisol associated with a 1-unit increase in diary-reported stress relative to an individual's average or typical stress score (i.e., when perceiving *more stress than usual*).

Below are equations for each of the study hypotheses without covariates using perceived stress level as an example Level 1 predictor (in bold) for situation *s*, day *d*, and individual *i* with Level 1 residual variance (u_{sdi}), Level 2 intercept variance (u_{0di}), and Level 3 intercept variance (u_{00i}), including random slope terms (u_{10i} - u_{40i}) assuming significant variance between individuals in associations of Level 1 predictors with the outcome.

Hypothesis 1a. *Within a model for the diurnal rhythm of cortisol, within-person increases in situational diary-reported perceived stress level and/or negative affect (i.e., when students report higher levels than their own individual average) were expected to be associated with corresponding situational elevations in cortisol.*

Level 1 (situation):

$cortisol_{sdi} = b_{0di} + b_{1di}(CAR_{sdi}) + b_{2di}(time\ since\ waking_{sdi}) + b_{3di}(time\ since\ waking^{2}{}_{sdi}) + b_{4di}(\boldsymbol{stress\ level}_{sdi})$
$+ u_{sdi}$

Level 2 (day):

$b_{0di} = \beta_{00i} + u_{0di}$

$b_{1di} = \beta_{10i}$

$b_{2di} = \beta_{20i}$

$b_{3di} = \beta_{30i}$

$b_{4di} = \beta_{40i}$

Level 3 (person):

$\beta_{00i} = \gamma_{000} + u_{00i}$

$\beta_{10i} = \gamma_{100} + u_{10i}$

$\beta_{20i} = \gamma_{200} + u_{20i}$

$\beta_{30i} = \gamma_{300} + u_{30i}$

$\beta_{40i} = \gamma_{400} + u_{40i}$

Below is an example Level 1 equation for a bilinear spline growth model, with a knot point fixed at the second sample of the day (Level 2 and Level 3 similar to above):

$cortisol_{sdi} = b_{0di} + b_{1di}(time\ until\ 2^{nd}\ sample_{sdi}) + b_{2di}(time\ since\ 2^{nd}\ sample_{sdi}) + b_{3di}(time\ since\ 2^{nd}$

$sample^2_{sdi}) \qquad + b_{4di}(\textbf{\textit{stress level}}_{sdi}) + u_{sdi}$

Hypothesis 1b. *This estimated cortisol response was expected to be attenuated for Latino students with a greater connection to ethnic heritage culture and mainstream U.S. culture, for students who more confidently and easily navigate two cultural contexts (e.g., more bicultural), and for students who perceive a greater sense of cultural congruity with their high school.*

Using the same Level 1 and Level 2 equations as above, below are example Level 3 equations using Latino orientation ARMSA-II scores (in bold) as an example person-level predictor of slope variance (i.e., cross-level interaction).

Level 3 (person):

$\beta_{00i} = \gamma_{000} + \gamma_{001}(\textbf{\textit{Latino orientation}}_i) + u_{00i}$

$\beta_{10i} = \gamma_{100} + u_{10i}$

$\beta_{20i} = \gamma_{200} + u_{20i}$

$\beta_{30i} = \gamma_{300} + u_{30i}$

$\beta_{40i} = \gamma_{400} + \gamma_{401}(\textbf{\textit{Latino orientation}}_i) + u_{40i}$

Significant cross-level interactions were investigated using simple slopes techniques for multilevel modeling (Preacher, Curran, & Bauer, 2006). Simple slopes were estimated for associations between stress and cortisol at the grand mean and 1 *SD* above and below the mean of the cultural measure (Aiken & West, 1991).

Modeling cortisol responses to a lab task (T2). Cortisol responses to the laboratory stress task were first explored using the standardized mean-change statistic (Cohen's *d*) and area under the curve with respect to ground (AUC_g), followed by more detailed analysis of change using multilevel bilinear spline growth models (i.e., multiphase growth curve models; Ram & Grimm, 2007).

Hypothesis 2a. *Students randomly assigned to watch a brief video clip emphasizing culture, diversity, and inclusion on campus before preparing for the TSST were expected to exhibit reduced, but likely still significant, cortisol and negative affective responses to the task, compared to students in the control group randomly assigned to watch a neutral video clip of the same length without such supportive messages.*

First, the average magnitude of change in cortisol between the first and third saliva samples, reflecting the average cortisol increase from baseline to 15 minutes after completion of the task, and between the third and fifth samples, reflecting the average cortisol decrease until 45 minutes after task completion, were calculated using the standardized mean-change statistic (Becker, 1988; Dickerson & Kemeny, 2004).[7] These standardized effect sizes (i.e., *z*-scores) for each participant were then averaged within each condition and the means were compared descriptively across conditions. Second, overall cortisol output across the task was calculated using a trapezoid formula (AUC_g; Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). Effect of assigned condition on cortisol AUC_g was tested using a one-way analysis of covariance (ANCOVA), adjusting for covariates.

Finally, two-level bilinear spline growth models were used to estimate the slopes of cortisol reactivity and recovery, which can vary across individuals (i.e., random effects; Hostinar, McQuillan, Mirous, Grant, & Adam, 2014; Ram & Grimm, 2007). Using this approach, cortisol reactivity and recovery were modeled using exact time of

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[7] $d = (M_3 - M_1)/SD_1$ and $d = (M_5 - M_3)/SD_3$

each sample while also examining experimental condition as a person-level predictor of differences in the peak level (intercept) and stress response growth patterns (in bold below). Growth parameters were selected based on the task timeline and visual inspection of the data. Variables that vary with cortisol (time) were Level 1 predictors, and variables that vary with individuals (condition) were Level 2 predictors. Condition and other dichotomous variables (e.g., sex) were dummy coded. Continuous Level 2 predictors were grand-mean centered. Example equations presented for bilinear spline growth model of cortisol at time *t* for individual *i* with Level 1 residual variance (u_{ti}) and Level 2 intercept variance (u_{0i}) without covariates.

Level 1 (saliva sample):

$$cortisol_{ti} = b_{0i} + b_{1i}(time\ until\ 3^{rd}\ sample_{ti}) + b_{2i}(time\ since\ 3^{rd}\ sample_{ti}) + u_{ti}$$

Level 2 (person):

$$b_{0i} = \beta_{00} + \beta_{01}(\boldsymbol{condition}_i) + u_{0i}$$
$$b_{1i} = \beta_{10} + \beta_{11}(\boldsymbol{condition}_i) + u_{1i}$$
$$b_{2i} = \beta_{20} + \beta_{21}(\boldsymbol{condition}_i) + u_{2i}$$

Hypothesis 2b. *The effects of condition on reducing responses to the task were expected to be most pronounced for students more oriented toward Latino culture, for more comfortably bicultural students, and for students who feel more culturally congruent with their college environment (compared to students scoring lower on those respective dimensions).*

Between-person predictors were added at Level 2 to test whether individual differences in cultural factors accounted for significant individual variation in peak cortisol (intercept) and cortisol response patterns. Interactions were tested by forming the product of condition and centered cultural scores (in bold). Example Level 2 equations presented using Latino orientation ARMSA-II scores as an example.

Level 2 (person):

$b_{0i} = \beta_{00} + \beta_{01}(condition_i) + \beta_{02}(Latino\ orientation_i) + \beta_{03}(\boldsymbol{condition_i * Latino\ orientation_i}) + u_{0i}$

$b_{1i} = \beta_{10} + \beta_{11}(condition_i) + \beta_{12}(Latino\ orientation_i) + \beta_{13}(\boldsymbol{condition_i * Latino\ orientation_i}) + u_{1i}$

$b_{2i} = \beta_{20} + \beta_{21}(condition_i) + \beta_{22}(Latino\ orientation_i) + \beta_{23}(\boldsymbol{condition_i * Latino\ orientation_i}) + u_{2i}$

Significant interactions were investigated using simple slopes techniques for multilevel modeling (Preacher et al., 2006). Simple slopes were estimated for the effect of condition on cortisol at the grand mean and 1 *SD* above and below the mean of the cultural measure (Aiken & West, 1991).

CHAPTER 3

RESULTS

Descriptive Statistics and Bivariate Correlations (T1)

Figure 1 includes a scatterplot and loess curve of diurnal cortisol data prior to addressing sampling compliance and log transformation. Descriptive statistics are presented in Table 3. In addition to these person-level averages, within-person variation in stress level and negative affect (NA) were also explored descriptively at each measurement occasion of the day. For stress level, average within-person *SD*s and the ranges of these *SD*s were generally stable but increasing across the day: waking *SD* = 1.67, range = 0 – 5.77; 30 minutes post-waking *SD* = 1.73, range = 0 – 5.51; 3 hours post-waking *SD* = 1.96, range = 0 – 5.77; 8 hours post-waking *SD* = 1.99, range = 0 – 7.07; bedtime *SD* = 2.07, range = 0 – 7.07. Within-person variation in NA also showed a relatively stable but increasing pattern across the day: waking *SD* = 0.26, range = 0 – 1.86; 30 minutes post-waking *SD* = 0.27, range = 0 – 2.02; 3 hours post-waking *SD* = 0.35, range = 0 – 1.89; 8 hours post-waking *SD* = 0.35, range = 0 – 1.86; bedtime *SD* = 0.34, range = 0 – 1.69.

Bivariate correlations for T1 are presented in Table 4. Only one significant association emerged between cultural measures and average cortisol levels across the day. On average, behavioral Latino orientation (ARSMA-II subscale) was slightly associated with higher waking cortisol. All other correlations of cultural measures with average cortisol values were not significant, *p*s > .07. Biculturalism and cultural congruity were slightly associated with lower average diary-reported stress and NA.

Given significant associations with one or more average cortisol values (Table 4), the following covariates were included as Level 3 (between-person) predictors in adjusted growth models after testing hypotheses as outlined in the Analytic Plan: participant's sex, immigrant generation score, parent education, depressive symptoms, oral contraceptive use, and general corticosteroid medication use. BMI was not significantly associated with any average cortisol values, *p*s > .19. Summer participation was also not significantly associated with average cortisol values, *p*s > .11, but it was associated with lower average diary-reported stress, and thus included as a covariate. Finally, sleep duration (measured objectively via actigraphy) was included as a Level 2 (day-specific) covariate, and whether recent stress was ongoing at the time of the diary report (1 = *ongoing*, 0 = *completed*) and self-reported caffeine use and exercise in the hour prior to saliva sampling were included as Level 1 (situation-specific) covariates, given significant within-person associations with cortisol (Doane et al., under revision).

Modeling the Diurnal Cortisol Pattern (T1)

An unconditional model indicated that approximately 87.4% of the variance in cortisol was attributable to within-person (i.e., sample-to-sample and day-to-day) differences, ICC = .126. Although not outcomes of interest, unconditional models revealed that approximately 75.1% of the variance in stress, ICC = .249, and 58.7% of the variance in NA, ICC = .413, were attributable to within-person differences. Using nested model tests to evaluate relative improvement in model fit, a linear growth model with a dummy code to represent the cortisol awakening response (CAR) fit the data significantly better than the unconditional model, $\chi^2(9) = 2428.77$, $p < .001$. Adding a quadratic term fit the data significantly better than the linear model, $\chi^2(6) = 86.12$, $p < .001$. Interpreting estimates from this model revealed the expected average diurnal cortisol pattern with relatively high cortisol levels at waking (5.59 nmol/L; intercept), an approximate 100% increase 30 minutes after waking (CAR),[8] and an approximate 7% linear decline in cortisol per hour estimated at waking, the rate of which significantly changed across the day (Table 5, Model 1).

Fitting a bilinear spline growth model revealed similar results. A model with pre- and post-knot linear growth terms fit the data significantly better than the unconditional model, $\chi^2(9) = 2266.26$, $p < .001$, and adding a post-knot quadratic term fit significantly better than the bilinear model, $\chi^2(6) = 87.54$, $p < .001$. Interpreting estimates from this model revealed the expected average diurnal cortisol pattern with an approximate 125% linear increase in cortisol per hour from waking to 30 minutes post-waking (or 62.5% increase per 30 minutes), relatively high cortisol levels 30 minutes post-waking (9.63 nmol/L; intercept), and an approximate 17% linear decline in cortisol per hour thereafter estimated at 30 minutes post-waking, the rate of which significantly changed across the day (Table 6, Model 1).

Cortisol Response to Stress in Daily Life (T1)

Next, diary-reported perceived stress level and NA (centered within-person) were added separately as predictors of situational deviations in cortisol from the typical pattern, modeled using the two approaches detailed above (*Hypothesis 1a*). On average, neither stress, $b_4 = -0.01$, $p = .17$, nor NA, $b_4 = -0.04$, $p = .31$, significantly predicted situational deviations in cortisol. Nested model tests indicated there was significant

[8] Because cortisol values were log transformed, the effect sizes can be interpreted as a percent change per 1 unit change in the predictor after using the formula: β% change = [(e^β) – 1].

individual variance in the within-person association of stress with cortisol, $\chi^2(6) = 21.39$, $p < .01$, but not for the within-person association of NA with cortisol, $\chi^2(6) = 9.09$, $p = .17$. These results were consistent in the bilinear spline model. Neither stress, $b_4 = -0.01$, $p = .08$, nor NA, $b_4 = -0.04$, $p = .31$, significantly predicted situational deviations in cortisol, on average. Similarly, the within-person association of stress with cortisol significantly varied across individuals, $\chi^2(6) = 15.20$, $p = .02$, and the within-person association of NA with cortisol did not, $\chi^2(6) = 9.71$, $p = .14$.[9] Thus, perceived stress level was used as the focal predictor in subsequent models to investigate individual differences in the cortisol stress response in daily life.

Cultural Moderators of the Cortisol Stress Response (T1)

Given significant individual variance in the extent to which diary-reported stress predicted situational deviations in cortisol, cultural measures were tested separately as between-person predictors of this variance (i.e., cross-level interactions; *Hypothesis 1b*). There was a significant cross-level interaction for Latino cultural values (MACVS subscale), $\gamma_{401} = -0.02$, $p < .01$ (Table 5, Model 2). Including this predictor in the model reduced the between-person slope variance of stress with cortisol by 11.8% (pseudo $R^2 = .118$; small effect by traditional R^2 standards for variance accounted for; Cohen, 1988). The interaction remained significant when adjusting for between-person covariates that were significantly correlated with average cortisol values and daily and situational factors significantly associated with cortisol in preliminary analyses (Table 5, Model 3).

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[9] Due to a slight positive skew (1.92) and kurtosis (3.82) in the NA distribution, models were also fit with the NA predictor transformed using the natural log function. Results were similar for both growth model approaches – the transformed variable did not significantly predict cortisol, *p*s > .13, and the within-person associations of log transformed NA with cortisol did not vary significantly across individuals, *p*s > .10.

Plotting simple slopes indicated that within-person increases in stress were significantly associated with *lower* cortisol for participants scoring 1 *SD* above the mean of Latino cultural values, $b = -0.02$, $p < .01$, but not at the mean, $b = -0.01$, $p = .32$, or 1 *SD* below the mean, $b = 0.01$, $p = .75$ (Figure 2). Based on the size of the significant slope coefficient, a one-unit within-person increase in stress was associated with approximately 2.2% lower cortisol, for participants scoring 1 *SD* above the mean of Latino cultural values. The more detailed region of significance indicated that greater stress than usual was associated with lower cortisol specifically for participants scoring at least 0.11 points above the mean of Latino cultural values (44.6% of the sample). These significant individual differences in cortisol were estimated to emerge specifically when stress was greater than 2.68 points above an individual's average stress level (15.0% of situations). Cortisol was estimated to be approximately 9.4% lower during or following these situations of greater stress than usual for participants scoring above average on Latino cultural values, compared to those scoring below average. Cross-level interactions were not significant for behavioral Anglo or Latino orientation, mainstream cultural values, biculturalism, or cultural congruity with, *p*s > .36, or without adjusting for covariates, *p*s > .20.

Latino cultural values also significantly moderated the stress-cortisol association in the bilinear spline model, $\gamma_{401} = -0.02$, $p = .03$ (Table 6, Model 2). Including this predictor in the model reduced the between-person slope variance of stress with cortisol by 10.1% (pseudo $R^2 = .101$; small effect). The interaction remained significant when adjusting for covariates (Table 6, Model 3). Plotting simple slopes using estimates from this spline model indicated that within-person increases in stress were significantly associated with *lower* cortisol for participants scoring 1 *SD* above the mean of Latino cultural values, $b = -0.02$, $p < .05$, but not at the mean, $b = -0.01$, $p = .22$, or 1 *SD* below the mean, $b = 0.002$, $p = .94$ (highly similar to Figure 2). Based on the size of the significant slope coefficient, a one-unit within-person increase in stress was associated with approximately 2.3% lower cortisol, for participants scoring 1 *SD* above the mean of Latino cultural values. Using estimates from this spline model, greater stress than usual was associated with lower cortisol specifically for participants scoring at least 0.07 points above the mean of Latino cultural values (48.0% of the sample). These significant individual differences in cortisol were estimated to emerge only when stress was greater than 1.93 points above an individual's average stress level (22.1% of situations). Cortisol was estimated to be approximately 8.7% lower during or following these situations of greater stress than usual for participants scoring above average on Latino cultural values, compared to those scoring below average. Similar to the other growth model, cross-level interactions in the spline model were not significant for behavioral Anglo or Latino orientation, mainstream cultural values, biculturalism, or cultural congruity with, *p*s > .47, or without adjusting for covariates, *p*s > .14.

Sensitivity Analyses (T1)

A series of additional models were fit to explore whether the significant cross-level interaction was sensitive to covariate selection, survey measurement, protocol compliance, centering time, person-specific daily stress trends, or multivariate outliers. Using both growth modeling approaches, the interaction remained significant when adjusting for all between-person covariates on all aspects of the diurnal cortisol pattern (i.e., all covariates added as predictors of all between-person slope variances), *p*s < .04.

The interaction also remained significant when using only the mean of familism items as the cultural moderator (i.e., without items for respect, religiosity, and traditional gender roles), *p*s $< .01$. The interaction was also significant in both models when cortisol values from non-compliant samples were returned to the dataset (rather than treated as missing), *p*s $< .02$, suggesting the result is robust to participants' degree of adherence to the sampling protocol. Further, participants' degree of sampling non-compliance was not associated with Latino cultural values, $r = .03$, $p = .69$, indicating there was not differential adherence to procedures. The interaction was also significant in an alternative growth model in which time was centered at the third sample of the day (specific to each person and day), $p = .02$. Thus, the result holds when the model intercept is centered at waking, 30 minutes after waking, or approximately 3 hours after waking.

On average, there was a slight, positive trend in perceived stress across the day, $b_1 = 0.11$, $p < .01$, which varied significantly across individuals, $p < .01$. Alternative models were fit using the situational residuals from day- and person-specific stress trends as the focal predictor (i.e., situational deviations in stress from an individual's daily stress trend, rather than situational deviations from an individual's average 3-day stress level); the interaction remained significant in both alternative models, *p*s $< .05$. Finally, a jackknife procedure (Efron & Stein, 1981) was used to explore whether data from any particular individual(s) unduly influenced model parameters. After systematically removing data from each individual and re-fitting the model for each exclusion, the distribution of coefficient estimates for the interaction ranged from -0.023 to -0.019, all of which were significant, *p*s $< .02$. Thus, the significance of the interaction was generally consistent across the sample and not driven by multivariate outliers.

Descriptive Statistics and Bivariate Correlations (T2)

Figure 3 includes a scatterplot and loess curve for lab cortisol data from participants' first semester of college. See Table 7 for descriptive statistics of T2 study variables. Cortisol values from one participant and affect scores from two participants were statistical outliers (> 3 *SD*s above sample-specific mean). Growth models were fit with and without including data from these participants. On average, participants rated the speech task between *moderately* and *very* challenging ($M = 4.69$; $SD = 1.20$) and the attention task between *not at all* and *slightly* challenging ($M = 1.86$; $SD = 1.11$). Perceived stress level significantly increased from baseline ($M = 2.24$; $SD = 1.08$) to immediately after the task ($M = 3.27$; $SD = 1.42$), $t(83) = 7.50$, $p < .01$, $d = 0.84$ (large effect). On average, cortisol levels increased 88.3% ($SD = 1.34$) from the first sample at baseline to the third sample provided approximately 15 minutes after completion of the stress task, and then decreased 69.2% ($SD = 0.60$) by the fifth sample provided 30 minutes later. Overall, 68.7% of participants showed a cortisol increase from baseline to 15 minutes after the task, and 95.2% showed a decrease thereafter. Regarding affect scores, 89.3% of participants showed increases in NA and 69.0% showed decreases in PA from baseline to immediately after the task. Thereafter, 90.4% of participants showed decreases in NA and 61.4% showed continued decreases in PA.

Bivariate correlations among T2 variables are presented in Table 8. On average, mainstream cultural values (MACVS subscale) were slightly associated with higher cortisol immediately after the task and 15 minutes after the task, and moderately associated with higher cortisol 30 minutes and 45 minutes after the task. Latino cultural values (MACVS subscale) were also slightly associated with higher cortisol 45 minutes after the task. All other correlations of cultural measures with average cortisol values were not significant, *p*s > .09. Biculturalism was moderately associated with lower NA 15 minutes after the task, and cultural congruity was moderately associated with lower NA at each measurement occasion. Behavioral Anglo and Latino orientation (ARSMA-II subscales) were both slightly associated with higher baseline PA, and cultural congruity was slightly associated with lower PA 15 and 45 minutes after the task. All other correlations of cultural measures with affect scores were not significant, *p*s > .06.

Given significant associations with one or more average cortisol values (Table 8), the following covariates were included as Level 2 (between-person) predictors in adjusted growth models after testing hypotheses for cortisol as outlined in the Analytic Plan: participants' sex, baseline time since waking (hours), oral contraceptive use, and whether participants lived at home. Immigrant generation and depressive symptoms were also considered as additional covariates in follow-up sensitivity analyses given significant associations with one or more cultural measures. BMI and high school GPA were not significantly associated with cortisol, *p*s > .11. Given significant associations with one or more affect scores, participants' sex, immigrant generation, and depressive symptoms were included as covariates in growth models for NA and PA. GPA was not significantly associated with affect scores, *p*s > .07.

Manipulation Check (T2)

Participants randomly assigned to view the cultural inclusion video did not differ significantly from those assigned to view the control video on any demographic characteristics, *p*s > .33, or scores on cultural measures, *p*s > .26. The average response to the manipulation check questions (e.g., "ASU is a diverse and inclusive place") was between *agree* and *strongly agree* (M = 5.36 out of 6.00; SD = 0.67), suggesting a ceiling effect. Indeed, all participants selected at least *somewhat agree*, except for two participants who selected *somewhat disagree*. Agreement with these questions was not significantly correlated with time of participation across the semester, $r(82) = -.05$, p = .54. Watching the cultural inclusion 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), $t(82) = 0.63$, $p = .53$. However, the cultural inclusion group (M = 4.99; SD = 0.67) did score significantly higher than the control group (M = 4.39; SD = 0.97) on "Investment in Task," $t(64.20) = 3.20$, $p < .01$, $d = 0.72$ (medium effect). "Anticipated Coping with Task" did not differ significantly between the cultural inclusion (M = 3.81; SD = 0.85) and control groups (M = 3.68; SD = 0.83), $t(82) = 0.67$, $p = .50$. Participants' perceptions of how stressful the task was after its completion also did not differ significantly by condition, $t(82) = 0.50$, $p = .62$.

Modeling Average Stress Response Patterns (T2)

Based on the standardized mean-change statistic (i.e., magnitude of difference in repeated measures in SD units), the average increase in cortisol was relatively smaller for the cultural inclusion group, $d = 0.83$, than the control group, $d = 1.43$, with both considered large effects. The average decrease in cortisol after the task was relatively larger for the cultural inclusion group, $d = -0.71$, than the control group, $d = -0.52$, with both considered medium effects. In terms of overall cortisol output throughout the lab session (AUCg)[10], the cultural inclusion group (M = 1.71; SD = 0.49) did not differ

[10] Transformed using the natural log function due to positive skew. Similar result when excluding statistical outlier without covariates, $p = .63$, and with covariates, $p = .93$.

significantly from the control group (*M* = 1.70; *SD* = 0.60), $t(82) = 0.12$, $p = .91$. Results from ANCOVA adjusting for covariates were similar, $F(1, 77) = 0.03$, $p = .86$. See Figures 4 – 6 for outcome means plotted by condition.

Unconditional two-level models indicated that approximately 35.8% of the variance in cortisol was attributable to within-person (i.e., sample-to-sample) differences, ICC = .642. Using nested model tests to evaluate relative improvement in model fit, a bilinear spline model for cortisol with a knot point fixed at the person-specific time of the third sample (generally 15 minutes after the task) fit the data significantly better than the unconditional model, $\chi^2(2) = 101.38$, p < .001. Adding quadratic terms before and after the knot point did not fit the data significantly better than the bilinear model, $\chi^2(2) = 2.72$, $p = .26$, and were thus not retained in subsequent analyses. Interpreting estimates from the bilinear model indicated that, on average, cortisol increased from baseline by approximately 0.9% per minute until reaching approximately 5.355 nmol/L 15 minutes after the task, and then cortisol decreased by approximately 1.5% per minute thereafter (Table 9, Model 1). Nested model tests indicated there was significant individual variance in the pre-knot rate of change (reactivity), $\chi^2(2) = 150.90$, $p < .001$, but not in the post-knot rate of change (recovery), $\chi^2(2) = 0.59$, $p = .75$. Thus, subsequent models focused on predicting the significant individual differences in the intercept (peak cortisol level 15 minutes after the task) and cortisol reactivity, but not recovery (see Table 9).

Unconditional two-level models indicated that approximately 58.0% of the variance in NA, ICC = .420, and 31.7% of the variance in PA, ICC = .683, was attributable to within-person differences. A bilinear spline model for NA with a knot point fixed at the person-specific time of the second report (immediately after the task) fit the data significantly better than the unconditional model, $\chi^2(2) = 229.64$, p < .001, and adding a post-knot quadratic term fit the data significantly better than the bilinear model, $\chi^2(1) = 56.47$, *p* < .001. There was significant individual variance in the post-knot linear rate of change (recovery), $\chi^2(2) = 10.26$, *p* < .01, but not significant individual variance in the pre-knot linear rate of change (reactivity) or the post-knot quadratic term, *p*s > .11. Thus, subsequent models focused on predicting significant individual differences in the intercept (NA immediately after the task) and NA recovery, but not reactivity (see Table 10). A bilinear spline model for PA similarly fit the data significantly better than the unconditional model, $\chi^2(2) = 66.66$, p < .001, but adding a post-knot quadratic term did not fit significantly better, *p* = .45. There was significant individual variance in the PA rate of change after the task, $\chi^2(2) = 15.28$, *p* < .001, but not significant individual variance in the pre-knot linear rate of change, *p* = .28. Thus, subsequent models focused on predicting significant individual differences in the intercept (PA immediately after the task) and the rate of change thereafter, but not reactivity.

Cultural Moderators of Cortisol Responses to the Lab Task (T2)

Next, experimental condition (1 = *cultural inclusion*, 0 = *control)* was included as a predictor of model intercepts and trajectories with significant individual variance (*Hypothesis 2a*). On average, condition did not account for significant individual variance in cortisol reactivity, $\beta_{11} = -0.005$, *p* = .10, or the cortisol intercept, $\beta_{01} = -0.045$, *p* = .73 (Table 9, Model 1). Next, cultural measures were included separately as predictors (i.e., main effects) and moderators of the effects of condition (i.e., interactions; *Hypothesis 2b*). Greater Latino cultural values were significantly associated with higher cortisol 15 minutes after the task (intercept), $\beta_{02} = 0.230$, *p* = .03, and significantly moderated the effect of condition on the cortisol reactivity slope, $\beta_{13} = -0.010$, $p = .03$ (Table 9, Model 2a). These effects remained significant when adjusting for covariates that were significantly correlated with average cortisol values (Table 9, Model 3a). Including Latino cultural values and the interaction in the model reduced the between-person variance in the cortisol intercept by 5.3% (pseudo $R^2 = .053$; small effect) and the between-person variance in the reactivity slope by 9.7% (pseudo $R^2 = .097$; small effect).

Plotting simple slopes for the significant three-way interaction (time x group x Latino values) indicated that cortisol reactivity was less positive (i.e., not as steep of an increase) for participants in the cultural inclusion condition who scored 1 *SD* above the mean of Latino cultural values, $b = 0.002$, $p < .10$ ($n = 4$ individuals; 8.9% of group), compared to participants in the control condition who also scored above average on Latino cultural values, $b = 0.014$, $p < .05$ ($n = 8$ individuals; 20.5% of group).[11] Based on size of the difference in slope estimates, being in the cultural inclusion group (compared to control group) reduced the rate of cortisol increase by 1.2% per minute for participants scoring above average on Latino cultural values. By comparison, cortisol reactivity slopes were more similar for participants in the cultural inclusion condition who scored 1 *SD* below the mean of Latino cultural values, $b = 0.008$, $p < .05$ ($n = 5$ individuals; 11.1% of group), compared to participants in the control condition who also scored below average on Latino cultural values, $b = 0.006$, $p = .056$ ($n = 9$ individuals; 23.1% of group). Based on size of the difference in slope estimates, group rates of cortisol increase differed by only 0.2% per minute for participants scoring below average on Latino

[11] These significance tests evaluate whether simple slope estimates differed from zero, not whether they differed from each other.

cultural values. See Figure 7a for all four simple slopes plotted by time, and see Figure 7b for a more direct comparison of the effect of condition separately for low and high Latino cultural values.

In a separate model, greater mainstream cultural values were significantly associated with a higher intercept (i.e., peak cortisol 15 minutes after the task), β_{02} = 0.368, $p < .01$, and greater cortisol reactivity (i.e., steeper rate of increase), β_{12} = 0.008, p = .01 (Table 9, Model 2b). An interaction between condition and mainstream cultural values in predicting the cortisol intercept was initially not significant, β_{03} = -0.239, p = .10 (Table 9, Model 2b), but this interaction was significant when adjusting for covariates significantly correlated with average cortisol values, β_{03} = -0.337, p = .03 (Table 9, Model 3b). Including mainstream cultural values and the interaction in the model reduced the between-person variance in the cortisol intercept by 12.2% (pseudo R^2 = .122; small effect).

Plotting simple slopes indicated that the cultural inclusion condition significantly reduced peak post-task cortisol levels for participants scoring 1 *SD* above the mean of mainstream cultural values, b = -0.41, p = .01, but not for participants at the mean, b = -0.15, p = .17, or 1 *SD* below the mean, b = 0.10, p = .54 (Figure 8). The more detailed region of significance indicated that condition had a significant effect specifically for participants scoring at least 0.23 points above the mean of mainstream cultural values (36.9% of the sample). Based on size of the slope coefficient, cortisol 15 minutes after the task was estimated to be approximately 33.6% lower for participants scoring above average on mainstream cultural values in the cultural inclusion group compared to the control group. This same interaction did not predict significant variance in cortisol reactivity (pre-knot linear increase), with or without adjusting for covariates (Table 9, Models 2b and 3b). Behavioral Anglo and Latino orientation, biculturalism, and cultural congruity were not significantly associated with cortisol and did not significantly moderate effect of condition in similar models with, *p*s > .11, or without adjusting for covariates, *p*s > .16.

Cultural Moderators of Affective Responses to the Lab Task (T2)

On average, condition did not account for significant individual variance in the NA intercept or post-knot rate of change, *p*s > .16, or in the PA intercept or post-knot rate of change, *p*s > .26. However, a significant interaction emerged between condition and Latino cultural values in predicting NA immediately after the task (intercept), β_{03} = -0.212, $p = .045$ (Table 10, Model 2). Including Latino cultural values and the interaction in the model reduced the between-person variance in the NA intercept by 5.9% (pseudo $R^2 = .059$; small effect). The interaction remained significant when adjusting for covariates that were significantly correlated with average NA scores (Table 10, Model 3). Plotting simple slopes indicated that the cultural inclusion condition reduced peak post-task NA for participants scoring 1 *SD* above the mean of Latino cultural values, b = -0.16, $p = .06$, at the mean, $b = -0.03$, $p = .59$, or 1 *SD* below the mean, $b = 0.10$, $p = .27$ (Figure 9). The more detailed region of significance indicated that condition had a significant effect ($p < .05$) specifically for participants scoring at least 0.87 points above the mean of Latino cultural values (11.9% of the sample). This same interaction did not predict significant variance in the post-knot trajectory, with or without adjusting for covariates (Table 10, Models 2 and 3).

Regarding other cultural measures, greater cultural congruity was significantly associated with lower NA immediately after the task, $\beta_{02} = -0.134$, $p = .02$, but this main effect was no longer significant when adjusting for covariates, $\beta_{02} = -0.029$, $p = .63$. Behavioral Anglo and Latino orientation, mainstream cultural values, and biculturalism were not significantly associated with NA and did not significantly moderate effect of condition with, *p*s > .32, or without adjusting for covariates, *p*s > .25.

In terms of PA, greater behavioral Latino orientation was significantly associated with higher PA immediately after the task, $\beta_{02} = 0.315$, $p < .01$, but this main effect was no longer significant when adjusting for covariates, $\beta_{02} = 0.181$, $p = .08$. Greater cultural congruity was significantly associated with a more negative rate of post-task decline in PA, $\beta_{22} = -0.004$, $p = .01$, and significantly moderated the effect of condition on this rate of change, $\beta_{23} = 0.006$, $p = .02$. However, these findings were no longer significant when excluding two outliers, and thus not investigated further (discussed below). Behavioral Anglo and Latino orientation, Latino cultural values, mainstream cultural values, and biculturalism were not significantly associated with PA and did not significantly moderate effect of condition with, *p*s > .17, or without adjusting for covariates, *p*s > .09.

Sensitivity Analyses (T2)

A series of additional models were fit to explore whether significant interactions were sensitive to additional covariates, survey measurement, centering time, or statistical outliers. Latino values and mainstream values remained significant moderators of the effects of condition on the cortisol reactivity slope, $p = .02$, and cortisol intercept, $p = .02$, respectively, when including all covariates as predictors of the intercept and slope, and when adding immigrant generation and depressive symptoms as covariates. Unlike the mean of all items for Latino cultural values, the mean of familism items (without respect, religiosity, traditional gender roles) did not significantly moderate the effects of condition on the cortisol reactivity slope, $p = .07$, or NA intercept, $p = .07$. Mainstream values did not significantly moderate the effect of condition on cortisol levels when time was centered at baseline, $p = .71$, or the 2nd sample immediately after the task, $p = .08$, indicating the result is specific to peak cortisol levels 15 minutes after the task. However, Latino values did significantly moderate the effect of condition on NA when time was centered at baseline, $p = .03$, and the 3rd report 15 minutes after the task, $p = .05$, indicating the result is not specific to task reactivity per se. Regarding outliers, Latino values and mainstream values remained significant moderators of the effects of condition on the cortisol reactivity slope, $p = .02$, and cortisol intercept, $p = .03$, respectively, when excluding one participant with outlier cortisol values ($N = 83$). Additionally, Latino values remained a significant moderator of the effect of condition on the NA intercept when excluding two participants with outlier affect scores, $p = .03$. Significant findings that emerged initially for cultural congruity as a predictor and moderator of the effect of condition on post-task change in PA were not significant when excluding these two outliers, $p = .18$ and .28, respectively.

Based on standard practice (Aiken & West, 1991), simple slopes from the significant three-way interaction (time x group x Latino values) predicting cortisol reactivity were plotted 1 *SD* above and below the mean of Latino values (26 total individuals; 31.0% of the sample; Figures 7a and 7b). To include more of the sample in these estimations (48 individuals; 57.1% of sample), simple slopes were also plotted at 0.5 *SD* above and below the mean of Latino values. These plots revealed very similar information. Cortisol reactivity was less positive (i.e., not as steep of an increase) for participants in the cultural inclusion condition who scored 0.5 *SD* above the mean of Latino values, $b = 0.004$, $p < .10$ ($n = 12$ individuals; 26.7% of group), compared to participants in the control condition who also scored above average on Latino values, $b = 0.012$, $p < .05$ ($n = 13$ individuals; 33.3% of group). By comparison, cortisol reactivity slopes were more similar for participants in the cultural inclusion condition who scored 0.5 *SD* below the mean of Latino values, $b = 0.007$, $p < .05$ ($n = 10$ individuals; 22.2% of group), compared to participants in the control condition who also scored below average on Latino values, $b = 0.008$, $p < .05$ ($n = 13$ individuals; 33.3% of group).

CHAPTER 4

DISCUSSION

Despite encouraging gains in postsecondary education, Latino young adults remain less than half as likely as non-Latino White young adults to hold a bachelor's degree in the U.S. (NCES, 2016), and Arizona specifically (Milem, Salazar, & Bryan, 2016). This disparity has critical implications for the financial security and health of Latinos, who comprise the nation's fastest growing ethnic group (U.S. Census Bureau, 2015). Young adults with a bachelor's degree earn approximately 62% more than those without (NCES, 2015), and a college education reduces risk for health problems and mortality in middle age (Schafer, Wilkinson, & Ferraro, 2013). Although myriad social and economic factors predict Latinos' college persistence (Crisp et al., 2015; Davis-Kean et al., 2012; Hill & Torres, 2010), examining detailed stress response processes may help to further articulate how Latino students successfully manage the challenges of transitioning to college. Specifically, hypothalamic-pituitary-adrenal (HPA) axis activity has been identified as a mechanism through which life stress can disrupt educational pursuits (Heissel et al., 2017) and lead to health problems (Gallo et al., 2009; Garcia, Wilborn, & Mangold, 2017; Levy et al., 2016; Myers, 2009). Culture and its multi-layered influences are considered organizing forces in development (Vélez-Agosto et al., 2017), coping (Gonzales & Kim, 1997), and health (Campos & Kim, 2017), yet the ways in which cultural factors may relate to HPA stress responses have received very little empirical attention. More often, stress reactivity studies have compared ethnic groups as a proxy to measure cultural variation, which tends to reify deficit models without accounting for within-group diversity of cultural practices and values (Causadias et al., 2017; Doane et al., 2018; Gonzales et al., 2012).

The goals of the present two-part study were to examine Latino students' cortisol responses (1) to stress in their daily lives prior to enrolling at a local 4-year university and (2) to a standard psychosocial stress task during their first college semester. Several cultural moderators of Latino students' stress responses were examined based on theory and empirical evidence for their protective functions regarding behavioral outcomes: *cultural orientation* in terms of practices (e.g., language use, ethnic interactions) and values (e.g., familism, material success; Gonzales et al., 2004; Knight et al., 2010), degree of comfort and ease navigating dual cultural contexts (i.e., *biculturalism*; Basilio et al., 2014; LaFromboise et al., 1993), and sense of fit between students' cultural backgrounds and school (i.e., *cultural congruity*; Gloria & Robinson Kurpius, 1996). In the first part of the study (T1), ecological momentary assessment (EMA) and three-level growth modeling were used to estimate situational deviations in cortisol from Latino high school students' typical diurnal cortisol patterns before they began college. Results indicated that cortisol levels were lower during or following greater perceptions of stress than usual specifically for students endorsing greater Latino cultural values (e.g., familism, respect, religiosity), compared to students endorsing average or below-average levels of these values. In the second part of the study (T2), an experimental design was used to induce cortisol reactivity during these same students' first semester of college, as well as to test the stress buffering effects of a brief video message designed to promote person-context fit. Results from bilinear spline growth models indicated that a video showcasing the university's commitment to cultural diversity and inclusion (compared to a generic campus tour) reduced cortisol reactivity to the task and negative affect for students endorsing greater Latino cultural values, and also reduced peak cortisol levels after the task for students endorsing greater mainstream U.S. cultural values (e.g., material success, self-reliance, competition). Other hypothesized cultural factors (behavioral cultural orientations, biculturalism, cultural congruity) did not significantly moderate cortisol responses to stress during either occasion of this multi-method study.

Cortisol Responses to Stress in Latino High School Students' Daily Lives

This study was the first to use EMA to estimate situational cortisol responses to everyday stress in an ethnic-homogenous sample of Latino high school students as they prepared to enroll at a 4-year university. Prior studies in this small but growing literature have comprised predominantly White (e.g., Smyth et al., 1998; van Eck et al., 1996a, 1996b) or relatively diverse (i.e., ethnically heterogeneous) samples (e.g., Doane & Adam, 2010; Doane & Zeiders, 2014). These sample characteristics have limited the extent to which researchers can appropriately measure and test the role of salient group-specific cultural factors in relation to acute changes in stress hormones, which has received growing interest from those interested in the basic science of culture-biology interplay (Causadias et al., 2017; Doane et al., 2018) and identifying pathways to reduce health and education disparities (Heissel et al., 2017; Levy et al., 2016). Studies that have started this process have tended to focus on how adverse culture-linked experiences (e.g., ethnic/racial discrimination) disrupt typical functioning of physiological stress systems, rather than how cultural strengths may positively influence adaptation to stress (Causadias et al., 2017; Myers, 2009). Thus, the composition of the present sample and the measurement of protective cultural factors among Latinos – a diverse group connected by a shared ethnic heritage – provide unique contributions to the study of stress reactivity in daily life.

Based on studies using comparable methods (Adam, 2006; Doane & Zeiders, 2014; Sladek et al., 2016), acute elevations in cortisol were expected to correspond with situations in daily life when Latino high school students perceived greater stress or negative affect than usual (i.e., positive within-person association). Importantly, "situations" in the context of this study may include stressors from the external environment, internal experiences of stress, or some combination of the two, since participants rated whatever they felt was most stressful to them in the last hour. Further, it was expected that the degree of these cortisol responses to everyday stress would differ between students, and protective cultural factors would help to explain this variation. Specific expectations regarding these individual differences were tentative and mostly exploratory, given the novelty of the present sample and design. In general, protective cultural factors were hypothesized to attenuate the expected positive within-person association of everyday stress with cortisol. The primary finding that emerged was unexpected and held through a robust series of sensitivity analyses: cortisol levels were *lower* (by 8-9%) during or following greater perceptions of stress than usual that were considered completed for students with above-average levels of Latino cultural values (almost half the sample), whereas greater perceptions of stress than usual did not significantly predict situational deviations in cortisol for students reporting relatively lower levels of these same values.

Although this finding did not support tentative hypotheses, it is consistent with previous research that has found individual differences in the extent to which everyday stress is related to acute changes in cortisol (Adam, 2006; Doane & Zeiders, 2014; Sladek et al., 2016; Smyth et al., 1998), and is the first to illustrate how cultural values help to account for these differences in the daily lives of Latino students preparing for college. It is not entirely surprising that perceived stress was not, on average, associated with higher cortisol, because most available EMA studies have found that various measures of situational stress only relate to cortisol in daily life for particular individuals, such as males (Smyth et al., 1998), older compared to younger adolescents (Adam, 2006), and adolescents reporting greater chronic interpersonal stress (Doane & Adam, 2010), greater discrimination and lower social support from friends (Doane & Zeiders, 2014), and less confidence in abilities to cope with stress (Sladek et al., 2016). The present study adds to this literature by highlighting that not all Latino students react to daily stress in the same manner as they prepare for college, while also identifying cultural values as a moderator of the extent to which Latino students' perceptions of stress relate to cortisol production in daily life. There are several possible explanations to consider for why cortisol levels were lower during or following greater perceived stress than usual specifically for students with greater Latino cultural values.

First, relatively lower cortisol levels after already-completed stressful situations may reflect a process of healthy physiological regulation as levels continue to fall after returning to baseline (generally within an hour) and thereafter resuming the natural diurnal decline (Adam et al., 2007; Nicolson, 2008). Consistent with some previous findings (Jacobs et al., 2007; Smyth et al., 1998; van Eck et al., 1996b), stress deemed ongoing by participants as they completed diary reports (vs. completed stress) was associated with higher cortisol, and an adjusted model showed the primary interactive effect remained significant when partialing out the contribution of ongoing or anticipated future stress (almost 40% of all reports). As such, cortisol may have returned to the natural daily pattern (lower levels expected as time progresses) following completed stress that could have occurred up to an hour (or more) before saliva sampling, for students with greater Latino cultural values. Conversely, regulation of cortisol responses following completed stress may have been more variable by remaining heightened over time or taking longer to return to baseline, for students with comparatively lower levels of the putative protective factor. The ability to recover from physiological activation after perceived threats have ended is an important component of regulation and is thought to protect against the damaging effects of cumulative wear and tear on stress systems (i.e., allostatic load; McEwen, 1998). This time-sensitive interpretation is consistent with the theoretical rationale for ethnic heritage values as a protective resource for Latino youth, and with a dynamic and adaptive view of the cortisol stress response in context. However, this possible interpretation of the finding requires additional research to clarify specific timing of the physiological reactivity and recovery process in daily life, which may benefit from assessing the psychological experience of stress at various intervals in relation to collecting saliva samples (e.g., asking for samples 20-30 minutes after diary reports; Adam, 2006).

According to the integrative model (García Coll et al., 1996), the daily lived experiences of youth of color within inhibiting and promoting environments result in *adaptive cultures*, including the maintenance or reinforcement of values that may differ from the dominant/mainstream culture. In theory, these cultural values are transmitted through the practices and relationships of daily life, resulting in pervasive effects on health and development (Markus & Kitayama, 2010; Vélez-Agosto et al., 2017; Weisner, García Coll, & Chatman-Nelson, 2010). Gonzales and Kim (1997) also theorized that the cultural meanings attached to challenging circumstances figure prominently throughout the stress and coping process for ethnic/racial minority youth, including protective cultural influences like traditional ethnic heritage values that maintain even as minority youth acculturate to the dominant culture. For Latino youth, endorsing ethnic heritage values to a greater extent has been linked with various indicators of positive adjustment (e.g., Berkel et al., 2010; Fuligni & Pedersen, 2002; Gonzales et al., 2008). Latino youth who maintain a strong connection to their ethnic culture may be less likely to experience family conflict by remaining more similar to their generally less acculturated parents and/or more likely to benefit from strong family support (Gonzales et al., 2006; Gonzales et al., 2015; Lui, 2015; Unger et al., 2009), which is perhaps especially important for this group of students still living at home in the final months before starting college.

These Latino cultural values have not yet been linked with cortisol stress responses, but they have been associated with greater parental acceptance and perceived availability of social support (Knight et al., 2010). In turn, social support has been linked with more adaptive HPA regulation in studies across various ethnic groups and ages (e.g., Doane et al., under revision; Doane & Zeiders, 2014; Hostinar, Sullivan, & Gunnar, 2014; Shirtcliff, Skinner, Obasi, & Haggerty, 2017). In terms of stress physiology, emerging evidence suggests that adolescence and the transition to adulthood may be a particularly critical developmental window for the positive effects of feeling connected with and supported by family members. For example, more frequent father engagement during adolescence has been associated with lower cortisol responses to stress among

Mexican American and European American young adults (Ibrahim, Somers, Luecken, Fabricius, & Cookston, 2017), and perceived emotional support from family has buffered African American adolescents from the harmful effects of cumulative racial discrimination on physiological function in young adulthood (Brody et al., 2014). In the present study, holding similar values that help maintain connections with immigrant parents or grandparents (e.g., centrality of the family, respect for elders, religious faith) likely offered these mostly 2^{nd} generation Latino students enhanced family support as they navigated the daily demands of preparing for college, which could have contributed to more effective HPA regulation when moving on from completed stressful situations. Given that a greater degree of enculturation has also been associated with greater support-seeking coping (Brittian et al., 2013; Cervantes & Castro, 1985), and a social support coping style has been associated with lower HPA stress responses for some adults (e.g., O'Donnell, Badrick, Kumari, & Steptoe, 2008; Sladek et al., 2017), social-specific coping strategies (e.g., asking friends for help, receiving assistance from family) may have also helped students with greater Latino cultural values respond effectively when encountering greater stress than usual in daily life.

On the other hand, an alternative explanation for this unexpected finding warrants consideration. Depending on the context, acute cortisol increases in response to typical stress may be functionally adaptive (Del Giudice et al., 2011; Shirtcliff et al., 2014) and help boost energy and promote relaxation (Adam et al., 2006; Hoyt et al., 2016). Thus, it is possible that lower estimated cortisol in response to stress for students with greater Latino cultural values could reflect HPA axis dysregulation (i.e., absence of an adaptive response; Phillips et al., 2013). In a racially/ethnically diverse sample of young adults using similar methods, Doane and Adam (2010) found that everyday feelings of sadness and loneliness corresponded with lower cortisol levels only for those who scored higher on a trait measure of loneliness. In the cultural adaptation literature, recent findings have shown that some Latino youth, such as those with stronger ethnic identity living in areas of relatively high Latino concentration, may actually be more vulnerable to the negative effects of discrimination and other bicultural stress (e.g., Piña-Watson, Ojeda, Castellon, & Dornhecker, 2013; Romero, Piña-Watson, & Toomey, 2018). Loneliness differs from general perceptions of stress and ethnic identity differs from cultural values measured in the present study, but this emerging evidence does present the possibility that Latino students who remain more connected to ethnic heritage culture may also face certain disadvantages as they finish high school (e.g., discrimination, cultural differences and marginalization from peers; Romero et al., 2018). In turn, the stress of experiencing discrimination may disrupt typical HPA stress responses in daily life (Doane & Zeiders, 2014).

While certainly possible, this alternative interpretation deviates from the theoretical rationale for the study and is limited for three primary reasons. First, discrimination has most often been linked with *hyperactivation*, such as increased reactivity (Doane & Zeiders, 2014; Pascoe & Smart Richman, 2009), elevated flatter diurnal slopes reflecting hypercortisolism (Huynh et al., 2016), and greater daily hormonal output (AUCg; Huynh et al., 2016; Zeiders et al., 2012), rather than the lower situational cortisol levels found here for students with greater Latino cultural values. Indeed, stronger connections to one's culture of origin are thought to protect against the negative effects of discrimination (Brittian et al., 2013; Gonzales et al., 2008; Umaña-

Taylor & Updegraff, 2007), and a recent study found that Mexican-origin adolescents who felt more positively about their ethnic background exhibited more adaptive, steeper diurnal cortisol slopes (Zeiders, Causadias, & White, 2018). Second, an important line of research has shown that greater acculturation (and not enculturation) has been linked with blunted morning cortisol output characteristic of chronic fatigue or "burnout" (Doane et al., under revision; Kwak et al., 2017; Mangold et al., 2010, 2012; Mendoza, Dmitrieva, Perreira, Hurwich-Reiss, & Watamura, 2017), which contradicts the possibility that values indicative of the enculturation process would be disruptive on a physiological level. Finally, EMA studies have reported lower cortisol levels in relation to situational reports of positive affect (Matias et al., 2011; Nater, Hoppmann, & Klumb, 2010; Smyth et al., 1998) and use of active coping strategies (Sladek et al., 2016), all of which reported similar effect sizes (5-10% lower) as the present study.

Viewed within the context of this previous research, it is relatively unlikely that the present finding of lower cortisol levels following everyday stress reflects dysregulated or somehow damaging physiological responses for students with greater Latino cultural values. Still, it is widely acknowledged that there is not necessarily a "good" or "bad" cortisol profile (Del Giudice et al., 2011; McEwen, 1998; Miller et al., 2007; Shirtcliff et al., 2014), so further research is needed to continue exploring the timing and contexts of physiological adaptation. The finding requires replication especially because this was one of the first studies to examine Latino youth's reports of naturally occurring real-world stress in relation to their stress physiology.

Beyond the primary significant finding that emerged, several hypothesized cultural moderators did not help to account for individual differences in the stress-cortisol association, including behavioral cultural orientations, mainstream cultural values, a separate measure of biculturalism, and an index of cultural congruity in school. For Latino students who have been accepted to a 4-year university, more external cultural practices (e.g., language use, traditions, ethnic contact) may not differentiate stress response processes to the same extent as the more internal experience of valuing heritage cultural norms. The separate dimension of mainstream values may not have accounted for cortisol differences for developmental or contextual reasons; these students still lived at home and many routinely interacted with less acculturated immigrant family members as they reacted to stressors during their preparation for college, so adopting mainstream U.S. values (e.g., independence, self-reliance) discrepant from generally more traditional family values may not have afforded the same degree of benefits (Gonzales et al., 2006; Lui, 2015).

Compared to individuals with an orientation toward exclusively one culture, those with greater bicultural competence report better adjustment and stronger ethnic identity, but also perceive more discrimination and report more stressors unique to the bicultural experience (e.g., translating; Basilio et al., 2014; Love & Buriel, 2007). This duality may situate biculturalism as a protective factor in some contexts and vulnerability factor in others (Yoon, Langrehr, & Ong, 2011). Associations between biculturalism and adjustment vary by individual characteristics (e.g., stronger for those born in U.S., for males) and outcome domains (e.g., stronger for psychological adjustment than physical health; Love & Buriel, 2007; Nguyen & Benet-Martínez, 2012). These or other moderators may have potentially masked an association with typical stress reactivity in the present study. Also, some have theorized that connection with at least one culture may be the most important source of protection during cultural adaptation, rather than the more demanding requirement of competence in two cultures simultaneously (LaFromboise et al., 1993). Differences in cortisol stress responses may not have emerged by biculturalism in this sample of Latino students admitted to college, who by mainstream definitions are academically successful and likely hold strong connection to at least one culture.

Measurement of these hypothesized moderators may also have contributed to the lack of significant findings. The acculturation rating scales (Cuellar et al., 1995) and cultural congruity measure (Gloria & Robinson Kurpius, 1996) were developed over 20 years ago with samples of Mexican-origin university students. As the process of cultural exchange and the nature of diversity shifts over time, particularly for the rapidly growing U.S. Latino population, these widely-used measures originally developed in earlier generations for specific contexts warrant continued psychometric evaluation. For example, behavioral acculturation and cultural congruity scores were relatively high on average, indicating the present sample of mostly U.S.-born students was generally accustomed to practices and interactions within their native mainstream U.S. culture (e.g., English language use, interacting with European American peers) and generally felt their ethnic background was appreciated and respected in their high schools. Moving forward, person-centered approaches that identify various profiles or classes of cultural adaptation may provide needed clarification and avoid variable-focused separation of overlapping cultural dimensions (e.g., Coatsworth, Maldonado-Molina, Pantin, & Szapocznik, 2005; Knight et al., 2014). However, such approaches will present unique challenges when incorporated into modeling daily cortisol responses to stress as done in the present study.

Further, the extent to which these cultural dimensions remain consistent or change over time as Latino students transition to the college context may provide better insight into the role of cultural adaptation in the stress response process, compared to the present approach that considered the moderators solely as markers of individual differences at one point in time.

Results from the present analyses also did not support the expectation that negative affect would be associated with situational differences in cortisol, or help identify how Latino students differed from each other in this association. Negative affect may partially mediate the association of stress appraisals with acute alterations in cortisol (Jacobs et al., 2007; Smyth et al., 1998; van Eck et al., 1996b), but the present EMA design did not lend itself to rigorously testing mediational pathways of acute stress. It was not an aim of the present study to test such mediation, but it is possible that the overlapping reports of perceived stress and negative affect masked more complex associations than tested separately here. It is revealing that relatively more of the overall variance in perceived stress (75%) than negative affect (59%) was attributable to situational fluctuations within individuals. As previous research has shown (Hauner et al., 2008; Nater et al., 2010), individual differences in negative affect (e.g., neuroticism) not measured in this study may account for more trait-like differences in cortisol (e.g., diurnal pattern, latent indicators) that were not the focus of these more dynamic situation-to-situation analyses. Finally, the possibility remains that PANAS items (Watson et al., 1988) did not adequately assess the construct of negative affect in this ethnic-homogenous EMA study of Latino high school students. This is relatively unlikely, given that negative affect was positively correlated with perceived stress and depressive symptoms (as expected), the PANAS has been validated extensively in over 50 countries (Thompson, 2007), and was recently used in a daily diary study of low-income Latino middle school students (Santiago et al., 2017). Still, future research should continue to carefully evaluate the cultural sensitivity of mood measures and other daily diary reports.

Lab Stress Responses Among First-Year Latino College Students

The second component of this study was the first of its kind to examine whether cultural factors might account for how first-year Latino college students respond physiologically and subjectively to a standard psychosocial stress task that mimics a college-relevant situation. This component of the study provided a needed contribution to evaluate the utility of a standard reactivity paradigm for Latino students, who are underrepresented in universities (NCES, 2016), and thereby also in study samples most common in stress reactivity research. Slight modifications to the original Trier Social Stress Test (TSST; Kirschbaum et al., 1993) for this sample of first-year Latino students produced an average large effect size of cortisol increase (comparable to standard effects reported in meta-analysis; Dickerson & Kemeny, 2004), cortisol increases in 69% of participants (comparable to 63% - 85% of other study samples; Foley & Kirschbaum, 2010; Hostinar et al., 2014), and substantial variability in rates of reactivity. Further, this experimental study was among the first to test the potential salutary effects of brief video programming that conveys a university's guiding mission of inclusion and celebrating students' diverse cultural backgrounds. Nested within the design of a larger longitudinal project, this study was also one of very few to collect stress reactivity data and diurnal cortisol data from the same individuals (for exceptions see Kidd, Carvalho, & Steptoe, 2014; Sladek et al., 2017; Trawalter, Adam, Chase-Lansdale, & Richeson, 2012). By modeling individual-specific rates of reactivity using bilinear spline growth models (Ram & Grimm, 2007), the present study also improved upon methodological limitations of prior reactivity studies that have ignored complexity in change processes.

Following theories of person-context fit (e.g., Eccles et al., 1993; Gloria & Robinson Kurpius, 1996; Stephens et al., 2012a; Tyler et al., 2008), it was expected that students with greater Latino cultural values, those with greater bicultural competence, and those who perceived greater cultural congruity with the university environment would benefit the most from viewing a brief cultural diversity and inclusion video prior to completing the stress task (compared to those in the control group who viewed a narrated campus tour). Consistent with expectations, cortisol reactivity (i.e., linear rate of increase from baseline to post-task) was reduced (i.e., less positive or steep) and negative affect was generally lower for students randomly assigned to the cultural inclusion group with greater Latino cultural values, compared to students in the control group with similarly high values. Cortisol levels were also reduced specifically 15 minutes after the task (i.e., lower peak levels) for students in the cultural inclusion group with greater mainstream cultural values, compared to students in the control group with similarly high values. Importantly, the only significant main effect produced by the manipulation was greater investment in the task (i.e., caring about the situation, thinking that it mattered) for the cultural inclusion compared to control group; on average, the groups did not significantly differ on demographic characteristics, cultural measures, or perceived stressfulness of the task.

In general, the relatively reduced rate of cortisol increase for students in the cultural inclusion group with greater Latino cultural values (0.2% increase per minute) can be interpreted as adaptive when compared to the more exaggerated reactivity for students in the control group with similarly high values (1.4% increase per minute). From this perspective, those expected to benefit most from the pre-task message of inclusion were buffered from higher cortisol levels in response to stress (approximately 1.2% lower rate of increase per minute), which may contribute to suppressed immune function, risk for hypertension, major depression, and even accelerated cellular aging over time (Foley & Kirschbaum, 2010; McEwen, 1998; Parker et al., 2003; Tomiyama et al., 2012). An alternative interpretation – that reduced reactivity could reflect a potentially maladaptive, blunted response pattern (Phillips et al., 2013; Shirtcliff et al., 2014) – is relatively unlikely in this case. Responses were attenuated, but cortisol still generally increased for students in the cultural inclusion group with greater Latino cultural values (i.e., estimated positive simple slope). These students also reported lower negative affect compared to students with similar values in the control group. 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; Stephens et al., 2012a), as well as the few studies showing that such micro-interventions can reduce cortisol reactivity in lab settings (Creswell et al., 2005; Stephens et al., 2012b). The present study is the first among this important work to specifically test the application of a video message conveying reminders of a university's actual mission to appreciate cultural diversity and affirm inclusion as a guiding principal of the institution.

The design of this experimental manipulation was based on the theory of *cultural congruity* or *cultural match*, which proposes that students' opportunities for success in college are determined, in part, by degree of fit between personal cultural orientation(s) and the cultural context of the university environment (Gloria & Robinson Kurpius, 1996; Stephens et al., 2012a). As Latino students begin their first semester of college, they undergo a normative developmental transition but also begin a cultural transition to a higher education context that generally reinforces mainstream cultural norms of independence, competition, and self-reliance (Burgos-Cienfuegos et al., 2015; Castillo et al., 2004; Gloria et al., 2005; Vasquez-Salgado et al., 2015). Not unlike the situations in which many Latino college students find themselves on a daily basis (Garrod et al., 2007; Syed, 2010; Tseng, 2004; Yosso et al., 2009), these mainstream norms are explicitly clear in the Trier Social Stress Test (Kirschbaum et al., 1993). Slightly modified for the present study, this protocol required participants to speak about why they were *uniquely* qualified to *win* a university student award in front of expert and older peer evaluators. Some Latino students, such as those with stronger connections to their family's ethnic heritage culture, were expected to sense a greater degree of cultural mismatch with the task expectations than others (Castillo et al., 2006; Gloria & Castellanos, 2012). Indeed, greater Latino cultural values were correlated with lower cultural congruity in college in this part of the study (but not in the larger sample during high school). For these students who retain values central to their Latino heritage as they begin college (e.g., familism, respect), even a relatively brief reminder of the university's commitment to appreciate and celebrate cultural diversity reduced their cortisol reactivity to the otherwise culturally incongruent, individual achievement-focused stress task that replicated standard challenges of the mainstream college environment. This finding complements studies that have illustrated the academic and psychological benefits of familism and interdependence during Latino students' first few years of college (Aguinaga & Gloria, 2015; Corona et al., 2017; Ong et al., 2006; Rivas-Drake, 2011).

Students with greater Latino cultural values in particular may have felt bolstered by the inclusive message as they were evaluated during the task either by feeling more respected, more accepted, or perceiving less of a threat to their sense of social self. Socially-evaluative threat, which occurs when an important aspect of social identity is (or could be) negatively judged by others, plays a key role in mobilization of the HPA axis stress response (Dickerson & Kemeny, 2004; Gruenewald, Kemeny, Aziz, & Fahey, 2004). Students who viewed the cultural inclusion video also reported a greater sense of investment in the task (i.e., thinking that the situation mattered) than those in the control group. Thus, it is also possible the university reminder about diversity and inclusion reduced cortisol responses by providing more ideas about culturally meaningful content that could be covered in the speech (Stephens et al., 2015), such as the reasons students with greater Latino cultural values may be pursuing college in the first place (e.g., to make family proud, to give back to community; Tseng, 2004). This affirmation of personal goals is thought to enable individuals to appraise stressors in reference to a larger context by remembering what really matters to them, thereby also protecting against social threats to identity (Cohen & Sherman, 2014; Sherman & Cohen, 2006). This finding complements prior work showing that recalling values important to one's family (rather than important to one's self) improved Latino students' performance on academic tasks (Covarrubias et al., 2016), and that remembering the influence of one's social-class background in college improved first-generation students' physiological "thriving" (ratio of DHEA to cortisol) in response to stress (Stephens et al., 2015). There was also evidence in the present study that students in the cultural inclusion group with greater Latino cultural values experienced less emotional distress compared to those in the control group with similar values. However, sensitivity analyses revealed this finding was not necessarily specific to task reactivity, and thus should be interpreted with caution.

In a separate test of another dimension of dual cultural adaptation, being in the cultural inclusion group also reduced cortisol levels specifically at their peak after the task (model intercept) for Latino students with greater mainstream cultural values, compared to students in the control group with similar values (approximately 33.6% lower). This finding was not necessarily expected, but highlights the importance of assessing the related but distinct dual dimensions of cultural values for Latino students as they adjust to college. As prior work has shown in younger adolescents and adults (Knight et al., 2010), the two dimensions were slightly correlated in this sample. Students who endorsed the importance of material success, self-reliance, and competition may have been particularly sensitive to the demands of a task that reinforces these very ideals. In prior research, Mexican-origin adults with fewer role models in their extended family and who lacked money for necessities endorsed greater materialistic, personal achievement, and competitive values (Knight et al., 2010). First-year Latino college students who endorse these same values may have had a heightened desire to compete for a positive evaluation and achieve success when introduced to the upperclassmen or college graduates who served as the "expert" judges. Particularly in the higher education system where this independent, competitive spirit is deeply valued (Stephens et al., 2012a), heightened physiological responses to speaking in front of potential role models may be adaptive to prepare for approaching the task at hand. Indeed, mainstream values were generally associated with higher cortisol levels across the task, potentially a physiological sign of anticipating and preparing for a difficult but manageable challenge (Del Giudice et al., 2011; Shirtcliff et al., 2014). Yet it is striking that students in the control group with greater mainstream cultural values exhibited the highest peak cortisol levels after the task, which could be potentially damaging over time if chronic evaluation exhausts the response system. Fortunately, the culturally inclusive message reduced these relatively high post-task cortisol levels for students with greater mainstream values, suggesting they (like those with greater Latino values) may have also been aided by ideas about content to include in the speech or specifically equipped to cope with social evaluation once reminded of the university's respect for all cultures.

Beyond the significant findings that emerged, several hypothesized cultural factors did not moderate the effects of condition on cortisol or subjective responses to stress, including behavioral cultural orientations, a separate measure of biculturalism, and cultural congruity in college. Although the acculturation rating scales improve upon proxy measures of the cultural change process (e.g., nativity, language use; Cuellar et al., 1995), researchers have suggested the scales leave out essential attitudinal and belief dimensions of dual cultural adaptation (Cabassa, 2003; Knight et al., 2010; Updegraff et al., 2012). Similar to the first part of this study, the value differences that emerged might suggest that internal experiences of culture play a greater role in differentiating stress response processes than cultural behaviors (e.g., language use, social interactions). For this particular sample in which all students were proficient in English and attended the same relatively diverse 4-year university, the degree to which students varied regarding observable cultural practices may have also been limited.

As discussed in the previous section, higher scores on the separate measure of biculturalism may have identified students with both better adjustment *and* greater awareness of societal prejudice (Basilio et al., 2014). This has complex implications for how students with greater bicultural competence reacted to the present task and the university's message of inclusion. For example, the appreciation of cultural diversity may have fostered a sense of fit for bicultural students as intended (thereby reducing cortisol reactivity to the task), but the reminder of cultural differences may have also created pressure for these students to acknowledge the challenges of being bicultural in today's society in front of an unresponsive evaluative panel (thereby increasing reactivity). Latino students with a similar bicultural profile (termed "accommodation") have shown improved academic performance across the college years compared to more exclusively acculturated students (Rivas-Drake & Mooney, 2009), so future research should continue to test the potential benefits of biculturalism over time, as well as subgroup differences that may emerge by nativity, gender, or college context (Love & Buriel, 2007; Nguyen & Benet-Martínez, 2012; Yoon et al., 2011). Of the cultural measures in the present study, biculturalism was the most strongly correlated with gender (males scored higher), which may be another avenue to more closely consider in future work.

Consistent with the literature on Latino college students' psychological adjustment (Aguinaga & Gloria, 2015; Gloria et al., 2005; Gloria & Robinson Kurpius, 1996), greater perceived cultural congruity with the university environment was correlated with generally lower negative affect and lower depressive symptoms.

However, this promotive factor did not predict stress response differences or differential responses to the university's inclusion message. Before completing the stress task, almost all students in this sample agreed their university is a diverse and inclusive place that cares about students of all cultural backgrounds, suggesting a rather strong degree of cultural fit with the university environment regardless of which video they had just viewed. Cultural congruity scores were also relatively high on average, suggesting Latino students may already see commitments to an inclusive mission in their first semester at a university where at least 1 in 5 students is Latino. Similar manipulations should be explored in other university contexts that vary with respect to their progress on diversity and inclusion efforts, geography, institution size, and actual degree of racial/ethnic diversity. Given that students in this sample reported on relatively immediate adjustment to their new university environment, it is also important to continue assessing cultural congruity beyond the first semester. Indeed, college can be one of the first times that many Latino students are treated as minorities and develop a greater awareness of societal prejudice (Ethier & Deaux, 1994; Huynh & Fuligni, 2012). Latino students' physiological and emotional reactions to the university's inclusion efforts may begin to vary as they continue to evaluate over time whether their cultural values and traditions align with their college context.

Integration of Findings from Multiple Methods across Time

This study in two distinct but related parts drew upon the strengths of both an EMA approach outside the lab and an experimental approach in the lab to examine Latino students' stress reactivity across the developmental and cultural transition period of beginning college. The EMA approach allowed for the approximation of physiological reactivity to stress that actually occurred in Latino students' daily lives prior to college, affording the unique opportunity to consider HPA stress responses in real-world contexts. On the other hand, the experimental approach allowed for greater control over stress exposure as a smaller group of the same Latino students started college, while also offering the opportunity to manipulate pre-task messages and capitalize on the design strengths of an experiment. The EMA approach was correlational in nature and open to questions regarding the timeline of the stress response process, whereas the experimental approach was subject to external validity threats and questions regarding the real-world applicability of a manufactured stressor. If the logistical obstacles of time and funding can be overcome, the present multi-method approach exemplifies the benefits of integrating multiple study designs and research perspectives.

Together, findings from both methods converged to identify Latino cultural values as a predictor that meaningfully differentiates Latino students' cortisol reactivity, both before and after the college transition. Despite this convergence, it is important to highlight the different study designs that revealed this pattern of findings. Before college, greater Latino cultural values predicted lower cortisol levels (relative to the typical diurnal pattern) following naturally occurring perceptions of stress that were greater than students' typical reports of stress in daily life. Once college began, viewing a university message of diversity and inclusion reduced cortisol reactivity to a standard psychosocial stress task for students with greater Latino cultural values, compared to those in the control group with similar values. The culturally inclusive message also reduced peak cortisol levels in response to the task for students with greater mainstream cultural values, compared to those in the control group with similar values. This set of values, such as self-reliance and importance of material success, may carry particular salience for Latino students as they begin to acculturate to the mainstream culture of universities, especially when facing stressful tasks that accentuate competitive individualism. The two separate parts of this study were not specifically designed to test longitudinal changes, but the initial pattern of findings does present intriguing questions surrounding the development of cultural values as they relate to stress responsivity and college adjustment for further research.

Limitations and Future Research Directions

Study participants were all self-identified Latina(o)/Hispanic students admitted and planning to attend one large, public 4-year university in the southwestern U.S. relatively close to their family's home following their final year of high school. Future research should consider whether these results generalize to other types of institutions (e.g., community colleges, small private colleges), geographic regions, or student characteristics (e.g., out-of-state, transfer). Participants attended 91 different high schools in various neighborhoods of the largest metropolitan area in a state where 40% of all public school students are Latino (Milem et al., 2016). Future research might also consider school or neighborhood-of-origin characteristics (e.g., college prep curriculum, ethnic composition) identified in sociological models of college success (e.g., Ayala, 2012; Deil-Amen & Lopez Turley, 2007). In addition, this within-ethnic group study of Latinos, of mostly but not exclusively Mexican descent, was built on the assumption that there are common characteristics among members of the broadly defined Latino(a)/Hispanic pan-ethnic label. Sample size limitations prevented more specific ethnic heritage (e.g., Mexican, Cuban, etc.) or biracial/multiracial status (e.g., Mexican and European American, etc.) comparisons, but future work should continue to account for these and other variations in the experiences of Latino students (Baca Zinn & Wells, 2000; Doane et al., 2018; Umaña-Taylor & Updegraff, 2013). At ASU, 54% of Latino first-year students were female in 2016 (ASU Office of Institutional Analysis, 2017), but the proportion of women in this study (65%) better approximated the national proportion of women awarded bachelor's degrees among Latinos/Hispanics (61%; NCES, 2016). Future work should consider more closely how stress responses and college pathways may differ by gender and its intersections with ethnicity and culture (e.g., Ovink, 2014).

While innovative, the EMA component of this study in daily life was limited by its correlational nature, number of measurement occasions, brief assessment of everyday stressors, and data collection timeline that included summer months after students' high school graduation. First, the association between perceived stress in the past hour and salivary cortisol levels was likely an underestimate of true cortisol "reactivity," given that cortisol levels reach their peak in saliva approximately 20-25 minutes following a stressor and take up to an hour to return to baseline (Nicolson, 2008). Despite clear instruction to participants, frequent contact via text messaging during data collection, and statistically adjusting for "ongoing" perceptions of stress at the time of diary completion, there was still considerable room for error in the degree to which participants matched timing of saliva samples with diary reports designed to capture experiences of the last hour. However, participants' degree of adherence to procedures based on objective indicators was not associated with their cultural values, suggesting there were no systematic procedural differences that could confound the primary results.

Second, participants only completed two situational assessments during midday (i.e., during school or work), when the potential for variability in stressful experiences is arguably greatest. On average, there was a small increasing daily stress trend accounted for in follow-up analyses, and the variability in reports of stress was relatively consistent across the day. It is possible additional measurement occasions or days could improve assessment of acute physiological responses to stress, but such design decisions must be weighed against participant burden and available funding.

Third, diary reports of perceived stress level and negative affect were inherently brief and based on prior research (Adam, 2006; Doane & Zeiders, 2014; Sladek et al., 2016) to enhance applicability to a diverse group of Latino adolescents. There was substantial within-person variability in these measures in the current study, but future research should continue to critically evaluate the psychometric validity of diary measures. Qualitative research should continue to prove useful as a first step to check assumptions and review whether available measures are appropriate for specific participant populations (e.g., Gonzales, Doane, Sladek, Jenchura, & Kennedy, 2017; Knight et al., 2010). Future cortisol research may also consider the effects of daily stress unique to Latino students' minority status or immigration histories, such as discrimination, acculturative stress, or in-group conformity pressures (Rodriguez et al., 2000; Smedley et al., 1993), and whether these add to or interact with general life stress to influence daily stress physiology and health (Myers, 2009).

Finally, due to the intensive nature of the study procedures and project timeline, some participants (36%) completed assessments after high school graduation during the summer months preceding college. This difference in protocol was not directly associated with cortisol and did not account for variance in the stress-cortisol association. Future work might consider more closely the impact of daily schedules (e.g., school vs. work, school vs. vacation) on cortisol responses to stress.

As an extension of a larger longitudinal project, the second component of this study in the lab was limited by the size of the subsample, number of measurement occasions, potential potency of the manipulation, and diverse racial/ethnic composition of the task judges. First, the recruited subsample was relatively small and potentially underpowered to detect hypothesized between-person interactive effects. For the significant three-way interaction that did emerge, subgroup sizes for each estimated slope were small and thus should be interpreted with caution pending replication. However, the subsample closely approximated the demographic composition of the study from which it was drawn, multilevel growth models improve statistical power compared to more traditional repeated measures approaches (Maas & Hox, 2005; Raudenbush & Liu, 2001), and other cortisol reactivity studies have reported similar or smaller sample sizes (e.g., Ram & Grimm, 2007; Roubinov et al., 2012; Stephens et al., 2012b).

Second, the modeling of curvilinear cortisol reactivity and recovery patterns (and inter-individual variability in those patterns) was limited in this study with five measurement occasions. Some studies have modeled response trajectories using a greater numbers of samples from each participant (e.g., Bendezú & Wadsworth, 2018; Hostinar et al., 2014; Ram & Grimm, 2007), but such design decisions must be weighed against participant burden and requisite funding. Indeed, many cortisol reactivity studies obtain five or fewer samples (e.g., Matheson & Anisman, 2009; Roubinov et al., 2012; Sladek et al., 2017; Wiemers et al., 2012).

Third, there was a notable ceiling effect regarding the intended priming of the experimental manipulation. Almost all participants (in both conditions) rated the university as a diverse and inclusive place that values students of all cultural backgrounds, so the effect of the video clip to prime the relevance of cultural diversity and inclusion was likely smaller than anticipated. Different “dosage” levels of the manipulation could be explored in future research, especially in university contexts that may be less overtly welcoming of students from underrepresented cultural backgrounds. For example, other studies have incorporated brief reading and writing exercises, or even hour-long educational interventions, to reinforce the potency of experimental effects on cortisol responses (e.g., Creswell et al., 2005; Stephens et al., 2012b, 2015).

Finally, the team of “expert judges” who observed the stress task resembled the racial/ethnic composition of the university they attended (i.e., majority White, about 20% Latino), but because of this team-level diversity it was not possible to test whether stress responses varied as a function of judge ethnicity. Based on recent pilot testing, researchers have recommended same-ethnic peers as stress task judges in a sample of particularly vulnerable Mexican American middle school students (Johnson et al., 2017). In the present study of Latino university students, pilot testing with Latino undergraduate and graduate students prompted a few protocol modifications (e.g., wording of task instructions, removal of some pre-task questionnaire items). Following these changes, only one participant elected to skip the task before it started for fear of public speaking, and none visibly exhibited severe or concerning distress. Still, future studies should continue to carefully examine previously accepted protocols and adapt as necessary for groups of interest in order to reliably examine typical stress responses in a safe manner.

Several avenues also remain for future research. Future plans with data collected in the lab will focus on video-recorded speech content, observable behavioral responses during the speech, potential time-lagged associations of negative affect with cortisol, post-speech attention task performance, and post-task observational ratings completed by the judges. Also, potential gender differences in speech preparation and content, as well as physiological and emotional responses, may be explored further, given mixed results in prior research (e.g., Kirschbaum et al., 1995; Kudielka, Buske-Kirschbaum, Hellhammer, & Kirschbaum, 2004). Gender may also moderate the ways in which stress responses predict subsequent outcomes. Finally, future research will continue to consider how Latino students adjust to college as they transition through the first year and beyond. The first semester provided a unique window of opportunity to examine Latino students' stress responses during their relatively immediate adjustment to college. Stress reactivity during this first semester may serve as an important mediator that helps to explain how pre-college characteristics influence later college success. Future research should consider Latino students' shared and differential pathways through the college experience, including developmental, cultural, and physiological changes as they relate to persistence.

Implications for Policy and Practice

The scope of this two-part study focused rather narrowly on the single outcome of HPA axis reactivity, which has been identified as a physiological mechanism contributing to stress-related changes in physical and mental health (Adam, 2012; Gallo et al., 2009; Levy et al., 2016; Myers, 2009) and cognitive performance relevant for academic achievement (Heissel et al., 2017; Joëls, Pu, Wiegart, Oitzl, & Krugers, 2006). Although the present study did not examine more direct indices of health (e.g., psychopathology, immune function) or college success (e.g., academic performance, degree persistence), accumulating evidence indicates that alterations in HPA reactivity identify risk for later problems across these domains. For example, chronic activation of the HPA axis stress response suppresses the immune system and serves as a risk marker for diabetes, hypertension, and depression in adulthood (Boomershine, Wang, & Zwilling, 2001; McEwen, 1998; Parker et al., 2003), potentially via the costly physiological burden of allostatic load (McEwen, 2004). Heightened cortisol reactivity can also harm memory recall (Smeets, Jelicic, & Merckelbach, 2006), inhibit working memory (Shields et al., 2015), and damage memory consolidation over time (Lupien et al., 1997; Maheu et al., 2004), all problems for college students as they learn new material and take exams (Heissel et al., 2017). The physiological toll of chronic stress can also disrupt functioning of prefrontal brain regions involved in coping and self-regulation (Compas, 2006), further amplifying risks to health and well-being. Thus, cultural variation in cortisol stress responses identified in the present study (in daily life and the lab), particularly the protective role of cultural values, has important implications for the health and academic success of Latino students as they transition to college.

First, pre-college findings demonstrated that cultural aspects of Latino students' lives are related to their everyday physiological stress responses during the sensitive time of anticipating and preparing for college. These results support what many have argued for some time – that Latinos' cultural assets (e.g., *familismo*, desire to be *bien educado*, or well-mannered and socially responsible) have gone unrecognized or underappreciated for too long in the U.S. school system (Ayala, 2012; Fuller & García Coll, 2010;

Gonzales et al., 2004, 2017; Hill & Torres, 2010). Students who have internalized values of their Latino heritage to a greater extent exhibited lower cortisol levels after perceiving greater stress than usual as they finished high school and prepared for college, providing stakeholders across various contexts (e.g., families, high schools) further evidence for the importance of appreciating the cultural elements of Latino students' lives. This study is among the first to demonstrate how culture truly "gets under the skin" to influence health-relevant physiological stress responses for Latino students transitioning out of the K-12 system.

In addition to individual- or family-level preventative interventions that build upon existing cultural strengths of Latino students and their families (Gonzales et al., 2004), institutions of higher education should also be held accountable for recognizing and supporting the cultural aspects of Latino students' lives before and after this transition. Even before college classes begin, most universities already have extensive infrastructure in place capable of constructing culturally congruent, promoting environments that welcome Latino students and their families. For example, bilingual college representatives should be invited to speak with parents in Spanish about financial aid and curriculum during orientation sessions, and interested or admitted students should be introduced to available campus clubs and college-graduate mentors (Aguinaga & Gloria, 2015; Gándara & Contreras, 2009). Many universities already have such efforts in place (e.g., Access ASU, ASU Future Sun Devil Families; Crow, 2015), but they require further evaluation with respect to cultural sensitivity and likely additional funding (Gloria & Pope-Davis, 1997). The supportive elements of these programs likely help Latino students feel that the values of their heritage culture will not only be appreciated, but also meaningfully represented in their future environment as they manage stressful demands of the college transition (e.g., worrying about financial aid, not feeling academically prepared, leaving home). Based on the current results, respecting and representing these values may help promote more adaptive stress response regulation during this critical time.

Many universities and colleges across the country have publicly voiced their commitments to enhance racial/ethnic and socioeconomic diversity on their campuses (e.g., Crow, 2015; Housel & Harvey, 2009; Stephens et al., 2012a). According to the present study, such efforts seem to be reaching the intended audience, at least among Latino students attending a large public university in the Southwest. Almost all students in this sample agreed their university is a diverse and inclusive place, which values students of all cultural backgrounds. However, particular students (those with especially strong cultural values across two dimensions) benefited more than others from a brief reminder of this inclusive message as they prepared for and completed a challenging college-related task. The results highlight the diversity in value preferences *among* Latino students, which university officials should recognize when selecting priorities to emphasize. For example, universities should avoid "one-size-fits-all" approaches and instead focus on understanding what students value and how these values may differ (or not) from institutionalized norms of competition and independence. Faculty, university staff, and students should also be empowered to create campus communities that respect and celebrate Latino culture. Building on prior research indicating the importance of the university climate for Latino students' success and well-being (Bordes-Edgar, Arredondo, Kurpius, & Rund, 2011; Castillo et al., 2006; Gloria et al., 2005), the present study found that a greater sense of cultural congruity predicted lower depressive symptoms and lower emotional distress in the lab during the first semester. This growing body of evidence should be used to support existing policies and/or inform policy changes that prepare universities for reorganizing from exclusive to inclusive places, such as creating multicultural campus centers or enriching opportunities for existing multicultural or Latino student groups.

At ASU, the present findings provide evidence for online delivery of a message that is already built to scale, viewed by all incoming students at orientation sessions and available on university websites and social network platforms. If even this very brief, easily deliverable micro-intervention helped reduce some Latino students' acute physiological reactivity to stress, this presents exciting opportunities to test more pervasive effects across other domains relevant to students' success (e.g., academic, social). Importantly, the university's message did not appear to cause detrimental physiological or psychological effects for any group of Latino students in the present study, but continued research should remain sensitive to how diversity messages may be perceived differently by students of different cultural backgrounds.

The message presented in this study clearly matched the reality that most Latino students perceived at an institution that prides itself on not merely preaching, but actually fulfilling, an inclusive mission. Transferring a similar manipulation to other institutions with different histories of commitment to diversity and inclusion will require attention to the authenticity of the message. Racial/ethnic disparities still persist despite the recent move to focus on diversity initiatives, both in Arizona and the nation. For example, Latinos comprise 22% of ASU undergraduate enrollment (ASU Facts at a Glance, 2017) but over 40% of Arizona public K-12 schools (Milem et al., 2016), and nationally Latinos comprise 16% of undergraduate enrollment at 4-year public institutions but 25% of public K-12 schools (NCES, 2016). Without broader systemic changes to reduce higher education inequality, brief psychological interventions that tout a university's commitment to cultural diversity and inclusion may be inconsistent with underrepresented students' lived experiences, and thus rendered ineffective.

CHAPTER 5

CONCLUSION

The U.S. Latino population has grown by more than 50% since 2000, and projections indicate Latinos will account for almost 30% of the national population by 2060 (U.S. Census Bureau, 2015). Despite recent gains in college enrollment, the gap between Latinos and non-Latino Whites in bachelor's degree completion rates has only widened in the last 25 years (NCES, 2015). This two-part study focused on the stress-sensitive biological mechanism of HPA axis reactivity, which may be one piece of the much larger puzzle of racial/ethnic disparities in education and health. The study provided an important contribution to available stress reactivity literature as the first to focus on the diversity of cultural assets among Latino students transitioning to college, including cultural orientations, biculturalism, and degree of fit between students' cultural backgrounds and school settings. These cultural factors were examined as moderators of salivary cortisol stress responses in two methodologically distinct ways before and after Latino students' entrance to a 4-year university. Before college began, cortisol levels were lower following greater perceptions of stress in daily life for students with greater Latino cultural values (e.g., familism, respect, religiosity), compared to their peers with lower levels of these same values. Once college began, cortisol reactivity to a psychosocial stress task was reduced for students with greater Latino cultural values randomly assigned to view a university-sponsored message of cultural diversity and inclusion, compared to those with similar values in the control group without the message. Additionally, post-task cortisol levels were also lower for students in the cultural inclusion group with greater mainstream U.S. cultural values (e.g., independence, self-reliance), compared to those in the control group with similar values. Other hypothesized cultural factors did not significantly moderate cortisol responses across both parts of this study.

Findings from the present study highlight the existing strengths of Latino students, which have often been overlooked in stress reactivity and college adjustment research. These results join a growing initiative to explore the science of culture and biology interplay (Causadias et al., 2017; Doane et al., 2018), and provide empirical support for cultural values as a protective factor that plays a role in physiological stress system function. Colleges and universities should be empowered to appreciate cultural differences among Latino students as they respond to stress during the transition to college, while also respecting and celebrating Latinos' ethnic heritage in culturally-sensitive ways. Results also lend support to diversity and inclusion efforts already in place at institutions across the country, but further research is needed to test contextual differences in messages about these efforts. Future research should continue the important work of appropriately measuring culturally relevant adaptation across the college years and how such processes relate to the success and well-being of historically underrepresented students.

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Table 1

Summary of Demographic Information

	T1		T2	
	n	%	*n*	%
Sex				
Female	133	64.6%	53	63.1%
Male	73	35.4%	31	36.9%
[a]Family heritage				
Mexican	175	85.0%	72	85.7%
South or Central American	18	8.7%	9	10.7%
Cuban	11	5.3%	3	3.6%
Other	10	4.8%	3	3.6%
Immigrant generation				
1st generation	22	10.7%	10	11.9%
2nd generation	128	62.1%	54	64.3%
3rd generation or above	56	27.2%	20	23.8%
Most commonly speak Spanish or Spanish/English				
With family	102	49.5%	42	50.0%
With friends	7	3.4%	4	4.8%
[b]Subjective family income				
Upper/Upper-middle class	22	10.7%	10	11.9%
Middle class	98	47.6%	31	36.9%
Lower-middle/Working class	85	41.2%	42	50.0%
First-generation post-secondary education	102	49.5%	38	45.2%
First-generation 4-year college/university	141	68.4%	55	65.5%
	M	*SD*	*M*	*SD*
Parent education level				
Mother	3.82	2.45	4.04	2.63
Father	3.63	2.72	3.91	2.96

Note. T1 $N = 206$. T2 $N = 84$. 1st generation = born outside the U.S. 2nd generation = born in U.S., at least one parent born outside U.S. 3rd generation = both parents born in U.S. First-generation post-secondary education = neither parent completed education after high school. First-generation 4-year college/university = neither parent completed bachelor's degree.

[a]Could select more than one.

[b]One participant did not respond to this question.

Table 2

Descriptive Statistics and Bivariate Correlations among Cultural Measures

	1	2	3	4	5	6	7	8
1. ARSMA-II Anglo Orientation[a]	---	-.25*	.01	.03	.15	.18	.21†	.34*
2. ARSMA-II Latino Orientation	-.27*	---	.13	.40*	.23*	.27*	-.25*	-.54*
3. Mainstream Cultural Values	.03	.02	---	.26*	.02	.15	-.17	-.07
4. Latino Cultural Values	-.08	.33*	.19*	---	.13	.19†	-.27*	-.03
5. Bicultural Comfort	.09	.21*	.10	.24*	---	.56*	.32*	.02
6. Bicultural Ease	.06	.07	.09	.13†	.58*	---	.16	-.12
7. Cultural Congruity	.12†	-.18*	-.16*	-.05	.23*	.29*	---	.33*
8. Immigrant Generation Score	.32*	-.62*	.01	-.07	-.13†	-.14*	.18*	---
# of items	13	16	14	36	9	9	13	---
T1 α	.69	.91	.81	.95	.83	.82	.84	---
T1 *M*	3.94	3.42	2.88	3.27	3.41	3.77	5.66	2.62
T1 *SD*	0.46	0.82	0.58	0.70	0.90	0.70	0.98	2.32
T1 Minimum	2.23	1.44	1.50	1.28	1.22	1.44	2.38	0
T1 Maximum	5.00	5.00	4.71	4.94	5.00	5.00	7.00	7
T2 α	.74	.92	.90	.96	.88	.85	.84	---
T2 *M*	3.96	3.46	2.95	3.27	3.28	3.77	5.62	2.56
T2 *SD*	0.47	0.87	0.75	0.74	1.03	0.70	0.98	2.26
T2 Minimum	2.85	1.50	1.29	1.06	1.00	2.33	1.92	1
T2 Maximum	4.85	4.94	4.86	5.00	5.00	5.00	7.00	7

Note. T1 N = 206. T2 N = 84. T1 and T2 bivariate correlations presented below and above the diagonal, respectively. Immigrant generation score: 0 = participant, both parents, and both sets of grandparents born outside U.S. to 7 = participant, parents, and both sets of grandparents born in U.S.

[a]Removing any item from the subscale resulted in lower internal consistency; thus, all items were included in the average score. †p < .10. *p < .05.

Table 3

Descriptive Statistics for T1 Diurnal Cortisol, Diary Measures, and Continuous Covariates

Cortisol	*M*	*SD*	Min	Max	Skew	Kurtosis
Waking cortisol level	8.01	3.97	0.04	25.41	1.44	3.68
30 min post-waking cortisol level	13.28	6.05	0.08	47.05	1.76	6.89
3 hours post-waking cortisol level	4.89	2.85	0.17	21.56	2.36	8.39
8 hours post-waking cortisol level	3.41	2.06	0.05	15.72	2.12	7.49
Bedtime cortisol level	1.75	1.54	0.03	12.88	3.14	15.96
Diary Reports	***M***	***SD***	**Min**	**Max**	**Skew**	**Kurtosis**
Waking stress level	2.47	2.14	0.00	8.67	0.56	-0.66
30 min post-waking stress level	3.34	2.46	0.00	10.00	0.44	-0.35
3 hours post-waking stress level	4.36	2.15	0.00	10.00	-0.12	-0.60
8 hours post-waking stress level	4.34	2.28	0.00	10.00	0.13	-0.31
Bedtime stress level	4.60	2.57	0.00	10.00	0.17	-0.79
Waking negative affect	0.33	0.44	0.00	2.19	2.10	4.53
30 min post-waking negative affect	0.41	0.49	0.00	2.43	1.98	4.17
3 hours post-waking negative affect	0.56	0.54	0.00	2.71	1.48	2.03
8 hours post-waking negative affect	0.52	0.51	0.00	2.57	1.56	2.50
Bedtime negative affect	0.61	0.59	0.00	2.95	1.40	1.84
Covariates	***M***	***SD***	**Min**	**Max**	**Skew**	**Kurtosis**
Body mass index	25.10	5.60	14.46	45.27	1.05	1.22
Average parent education level	3.72	2.36	1.00	10.00	0.76	-0.48
Depressive symptoms	16.39	10.29	0.00	50.00	0.90	0.49
Sleep duration (hours)	6.43	1.23	3.10	9.92	0.05	0.18

Note. T1 $N = 206$. Averages of raw cortisol values in nmol/L presented for descriptive purposes (log transformation used in analyses). Stress level: 0 (*no stress at all*) to 10 (*extreme stress*). Negative affect: 0 (*very slightly or not at all*) to 4 (*extremely*). Body mass index = weight (lbs) / height $(\text{in})^2$ x 703. Parent education level: 1 = *less than high school* to 10 = *doctorate or advanced degree* (3.72 between *high school graduate/GED* and *some college, vocational, or technical school*). Depressive symptoms possible range: 0 to 60 (Radloff, 1977). Frequencies for dichotomous covariates presented in the measures section.

Table 4

T1 Bivariate Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Waking cortisol	--															
2. +30 min cortisol	.66*	--														
3. +3 hours cortisol	.32*	.30*	--													
4. +8 hours cortisol	.40*	.34*	.55*	--												
5. Bedtime cortisol	.32*	.24*	.42*	.46*	--											
6. Average diary stress	.02	-.07	-.17*	-.04	-.05	--										
7. Average diary NA	-.08	-.11	-.06	-.10	-.04	.51*	--									
8. Anglo Orientation	.01	.05	.05	.09	.03	.06	-.08	--								
9. Latino Orientation	.17*	.08	-.07	-.01	-.01	.14†	.12†	-.27*	--							
10. Mainstream Values	.05	.05	.09	.05	-.05	-.02	.05	.03	.02	--						
11. Latino Values	.05	-.01	-.11	.01	-.02	.10	.12†	-.08	.33*	.19*	--					
12. Biculturalism	.07	.08	.13†	.002	.07	-.17*	-.22*	.09	.17*	.11	.21*	--				
13. Cultural Congruity	-.12†	-.13†	-.07	-.06	.01	-.22*	-.26*	.12†	-.18*	-.16*	-.05	.29*	--			
14. Sex (1 = male)	.01	-.06	.19*	.10	-.09	-.19*	-.06	.15*	-.18*	.20*	-.03	.28*	.09	--		
15. Immigrant generation	-.17*	-.08	-.04	.03	-.003	-.01	-.08	.32*	-.62*	.01	-.07	-.15*	.18*	.05	--	
16. Parent education	-.02	.01	.15*	.10	.06	-.08	-.09	.23*	-.46*	.12†	-.21*	-.09	.03	.10	.44*	--
17. Depressive symptoms	-.15*	-.16*	-.07	-.09	-.07	.25*	.44*	-.10	.01	.03	-.07	-.37*	-.45*	-.21*	-.04	-.09

Note. $N = 206$. †$p < .10$. *$p < .05$.

Table 5

Fixed Effects Estimates from 3-Level Growth Models of Diurnal Cortisol (Dummy Code for CAR)

	Model 1		Model 2		Model 3	
	Est.	*SE*	Est.	*SE*	Est.	*SE*
Intercept (waking cortisol level), b_0	1.79*	0.05	1.76*	0.05	1.80*	0.06
Latino cultural values, γ_{001}			-0.04	0.04	-0.04	0.04
Male, γ_{002}					-0.07	0.09
Immigrant generation, γ_{003}					-0.03	0.02
Parent education, γ_{004}					0.03	0.02
Depressive symptoms, γ_{005}					-0.01	0.01
Oral contraceptive use, γ_{006}					-0.39	0.29
General corticosteroid use, γ_{007}					-0.01	0.09
Summer participation, γ_{008}					-0.01	0.07
Night-before sleep duration, β_{01}					0.06*	0.03
Cortisol awakening response, b_1	0.69*	0.03	0.72*	0.04	0.80*	0.05
Male, γ_{101}					-0.13	0.10
Immigrant generation, γ_{102}					0.01	0.01
Parent education, γ_{103}					-0.004	0.02
Depressive symptoms, γ_{104}					-0.01	0.004
Oral contraceptive use, γ_{105}					-0.15	0.12
General corticosteroid use, γ_{106}					-0.18	0.15
Night-before sleep duration, β_{11}					0.01	0.03
Diurnal cortisol slope, b_2	-0.07*	0.01	-0.06*	0.01	-0.08*	0.01
Male, γ_{201}					0.06*	0.02
Parent education, γ_{202}					-0.001	0.002
Depressive symptoms, γ_{203}					-0.001	0.001
Oral contraceptive use, γ_{204}					0.02	0.01
Night-before sleep duration, β_{21}					-0.03*	0.01
Quadratic function, b_3	-0.002*	0.001	-0.003*	0.001	-0.001*	0.001
Male, γ_{301}					-0.40*	0.10
Night-before sleep duration, β_{31}					0.14*	0.03
Perceived stress level in last hour, b_4			-0.01	0.01	-0.01	0.01
Latino cultural values, γ_{401}			-0.02*	0.01	-0.02*	0.01
Male, γ_{402}					-0.002	0.02
Depressive symptoms, γ_{403}					0.001*	0.001
Summer participation, γ_{404}					-0.01	0.01
Ongoing stress, b_5					0.03*	0.01
Exercise in last hour, b_6					0.16*	0.08
Caffeine in last hour, b_7					0.16*	0.06

Note. N = 2638 samples nested within 206 individuals. Cortisol values (nmol/L) transformed using the natural log function. Est. = regression coefficient estimate. *SE* = robust standard error. †p < .10. *p < .05.

Table 6

Fixed Effects Estimates from 3-Level Bilinear Spline Growth Models of Diurnal Cortisol

	Model 1		Model 2		Model 3	
	Est.	*SE*	Est.	*SE*	Est.	*SE*
Intercept (30-min post-waking), b_0	2.27*	0.05	2.24*	0.05	2.32*	0.06
Latino cultural values, γ_{001}			-0.04	0.04	-0.04	0.04
Male, γ_{002}					-0.16†	0.09
Immigrant generation, γ_{003}					-0.02	0.02
Parent education, γ_{004}					0.02	0.02
Depressive symptoms, γ_{005}					-0.01	0.01
Oral contraceptive use, γ_{006}					-0.37	0.30
General corticosteroid use, γ_{007}					-0.05	0.09
Summer participation, γ_{008}					-0.03	0.08
Night-before sleep duration, β_{01}					0.004	0.03
Pre-knot linear change, b_1	0.81*	0.08	0.83*	0.09	0.86*	0.10
Male, γ_{101}					-0.13	0.19
Immigrant generation, γ_{102}					0.07*	0.03
Parent education, γ_{103}					-0.01	0.04
Depressive symptoms, γ_{104}					-0.002	0.01
Oral contraceptive use, γ_{105}					0.20	0.35
General corticosteroid use, γ_{106}					-0.10	0.23
Night-before sleep duration, β_{11}					-0.12*	0.06
Post-knot linear change, b_2	-0.18*	0.01	-0.17**	0.01	-0.20*	0.01
Male, γ_{201}					0.09*	0.02
Parent education, γ_{202}					-0.001	0.002
Depressive symptoms, γ_{203}					0.001	0.001
Oral contraceptive use, γ_{204}					0.02	0.01
Night-before sleep duration, β_{21}					-0.02*	0.01
Post-knot quadratic change, b_3	0.003*	0.001	0.003*	0.001	0.004*	0.001
Male, γ_{301}					-0.53*	0.12
Night-before sleep duration, β_{31}					0.13*	0.03
Perceived stress level in last hour, b_4			-0.01†	0.01	-0.01	0.01
Latino cultural values, γ_{401}			-0.02*	0.01	-0.02*	0.01
Male, γ_{402}					-0.001	0.02
Depressive symptoms, γ_{403}					0.001*	0.001
Summer participation, γ_{404}					-0.004	0.01
Ongoing stress, b_5					0.04*	0.01
Exercise in last hour, b_6					0.14†	0.08
Caffeine in last hour, b_7					0.12*	0.06

Note. N = 2626 samples nested within 206 individuals. Cortisol values (nmol/L) transformed using the natural log function. Est. = regression coefficient estimate. *SE* = robust standard error. †$p < .10$. *$p < .05$.

Table 7

Descriptive Statistics for T2 Cortisol, Affect, and Continuous Covariates

Cortisol	*M*	*SD*	Min	Max	Skew	Kurtosis
Baseline cortisol level	4.14	2.39	1.20	13.15	1.63	2.98
Post-task cortisol level	5.40	3.83	1.27	28.98	3.18	16.49
15 min post-task cortisol level	6.80	4.77	1.13	32.32	2.25	8.80
30 min post-task cortisol level	4.99	3.00	1.13	15.02	1.34	1.97
45 min post-task cortisol level	3.98	2.09	0.88	10.14	0.89	0.69
AUCg	6.37	3.71	1.48	25.72	2.11	7.95
Affect	***M***	***SD***	**Min**	**Max**	**Skew**	**Kurtosis**
Baseline NA	0.34	0.48	0.00	3.00	3.75	17.02
Post-task NA	0.82	0.70	0.00	3.70	1.60	3.27
15 min post-task NA	0.30	0.45	0.00	2.80	3.47	14.02
30 min post-task NA	0.21	0.50	0.00	3.70	5.28	32.22
45 min post-task NA	0.19	0.42	0.00	3.20	5.23	33.05
Baseline PA	1.35	0.74	0.00	3.00	0.47	0.47
Post-task PA	1.12	0.81	0.00	3.50	0.79	0.79
15 min post-task PA	1.07	0.84	0.00	3.20	0.86	0.86
30 min post-task PA	0.86	0.74	0.00	3.00	0.96	0.96
45 min post-task PA	0.90	0.78	0.00	3.20	1.03	1.03
Covariates	***M***	***SD***	**Min**	**Max**	**Skew**	**Kurtosis**
Body mass index	27.01	6.49	14.49	47.84	1.00	1.02
Average parent education level	3.97	2.61	1.00	9.00	0.61	-0.99
Depressive symptoms	17.13	8.90	0.00	51.00	1.01	1.81
Time since wake time	7.08	2.09	1.70	13.03	-0.40	0.56
High school GPA	3.50	0.42	2.37	4.00	-0.53	-0.38

Note. T2 $N = 84$. Averages of cortisol levels and AUCg (area under the curve with respect to ground) in nmol/L and averages of negative affect (NA) presented for descriptive purposes (log and square root transformation, respectively, used in analyses). NA and positive affect (PA): 0 (*very slightly or not at all*) to 4 (*extremely*). Body mass index = weight (lbs) / height (in)^2 x 703. Parent education level: 1 = *less than high school* to 10 = *doctorate or advanced degree* (3.97 between *high school graduate/GED* and *some college, vocational, or technical school*). Depressive symptoms possible range: 0 to 60 (Radloff, 1977). High school GPA unweighted, from official transcripts. Frequencies for dichotomous covariates presented in the measures section.

Table 8

T2 Bivariate Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Baseline cortisol	--															
2. Post-task cortisol	.68*	--														
3. Task +15 min cortisol	.41*	.85*	--													
4. Task +30 min cortisol	.40*	.79*	.94*	--												
5. Task +45 min cortisol	.45*	.77*	.87*	.94*	--											
6. Condition (1 = culture)	.17	.03	-.04	-.02	-.07	--										
7. Anglo Orientation	-.07	-.08	-.01	-.01	-.03	.14	--									
8. Latino Orientation	-.01	.08	.10	.12	.11	.03	-.25*	--								
9. Mainstream Values	.03	.26*	.25*	.32*	.31*	.12	.01	.13	--							
10. Latino Values	.12	.15	.12	.18†	.25*	.03	.03	.40*	.26*	--						
11. Biculturalism	-.001	.12	.12	.13	.08	.10	.18	.28*	.08	.18	--					
12. Cultural Congruity	-.15	-.08	-.03	-.05	-.03	.09	.21†	-.25*	-.17	-.27*	.29*	--				
13. Sex (1 = male)	.08	.26*	.26*	.22*	.17	.07	.07	-.11	.11	-.12	.24*	.06	--			
14. Immigrant generation	-.01	-.05	-.03	-.004	.03	.03	.34*	-.54*	-.07	-.03	-.04	.33*	-.04	--		
15. Parent education	.01	-.04	-.10	-.01	.06	.04	.20†	-.50*	.17	-.14	-.16	.23*	.01	.52*	--	
16. Depressive symptoms	.08	-.08	-.05	-.004	.02	-.10	.03	.13	.11	.18†	-.22*	-.56*	-.20†	-.14	-.16	--
17. Time since waking	-.23*	-.17	-.07	-.13	-.17	-.16	-.07	.10	-.24*	-.09	-.07	-.09	.03	-.21†	-.21†	-.11

Note. N = 84. †$p < .10$. *$p < .05$.

Table 9

Fixed Effects Estimates from 2-Level Bilinear Spline Growth Models of Cortisol

Moderator: **Latino Values**	Model 1		Model 2a		Model 3a	
	Est.	*SE*	Est.	*SE*	Est.	*SE*
Intercept (15 min after task), b_0	1.703*	0.109	1.709*	0.105	1.634*	0.103
Condition, β_{01}	-0.045	0.132	-0.051	0.127	-0.128	0.119
Latino values, β_{02}			0.230*	0.103	0.254*	0.095
Condition * Latino values, β_{03}			-0.214	0.166	-0.263	0.167
Male, β_{04}					0.266*	0.116
Time since waking, β_{05}					-0.040†	0.022
Oral contraceptive use, β_{06}					-0.412*	0.209
Living at home, β_{07}					0.192	0.119
Time until 3rd sample (reactivity), b_1	0.012*	0.002	0.012*	0.002	0.010*	0.002
Condition, β_{11}	-0.005	0.003	-0.005†	0.003	-0.005†	0.003
Latino values, β_{12}			0.006†	0.003	0.006*	0.003
Condition * Latino values, β_{13}			-0.010*	0.005	-0.010*	0.005
Male, β_{14}					0.005†	0.003
Time since 3rd sample (recovery), b_2	-0.015*	0.001	-0.015*	0.001	-0.015*	0.001

Moderator: **Mainstream Values**	Model 2b		Model 3b	
	Est.	*SE*	Est.	*SE*
Intercept (15 min after task), b_0	1.741*	0.098	1.653*	0.089
Condition, β_{01}	-0.093	0.121	-0.154	0.112
Mainstream values, β_{02}	0.368*	0.108	0.359*	0.094
Condition * Mainstream values, β_{03}	-0.239†	0.145	-0.337*	0.157
Male, β_{04}			0.274*	0.128
Time since waking, β_{05}			-0.035	0.022
Oral contraceptive use, β_{06}			-0.392†	0.219
Living at home, β_{07}			0.205	0.125
Time until 3rd sample (reactivity), b_1	0.013*	0.002	0.011*	0.002
Condition, β_{11}	-0.006*	0.003	-0.006*	0.003
Mainstream values, β_{12}	0.008*	0.003	0.008*	0.003
Condition * Mainstream values, β_{13}	-0.005	0.004	-0.006†	0.004
Male, β_{14}			0.005†	0.003
Time since 3rd sample (recovery), b_2	-0.015*	0.001	-0.015*	0.001

Note. N = 420 samples nested within 84 individuals. Cortisol values (nmol/L) transformed using the natural log function. Condition (1 = cultural inclusion). Time scaled in minutes. Continuous level 2 predictors grand-mean centered. Est. = regression coefficient estimate. *SE* = robust standard error. †p < .10. *p < .05.

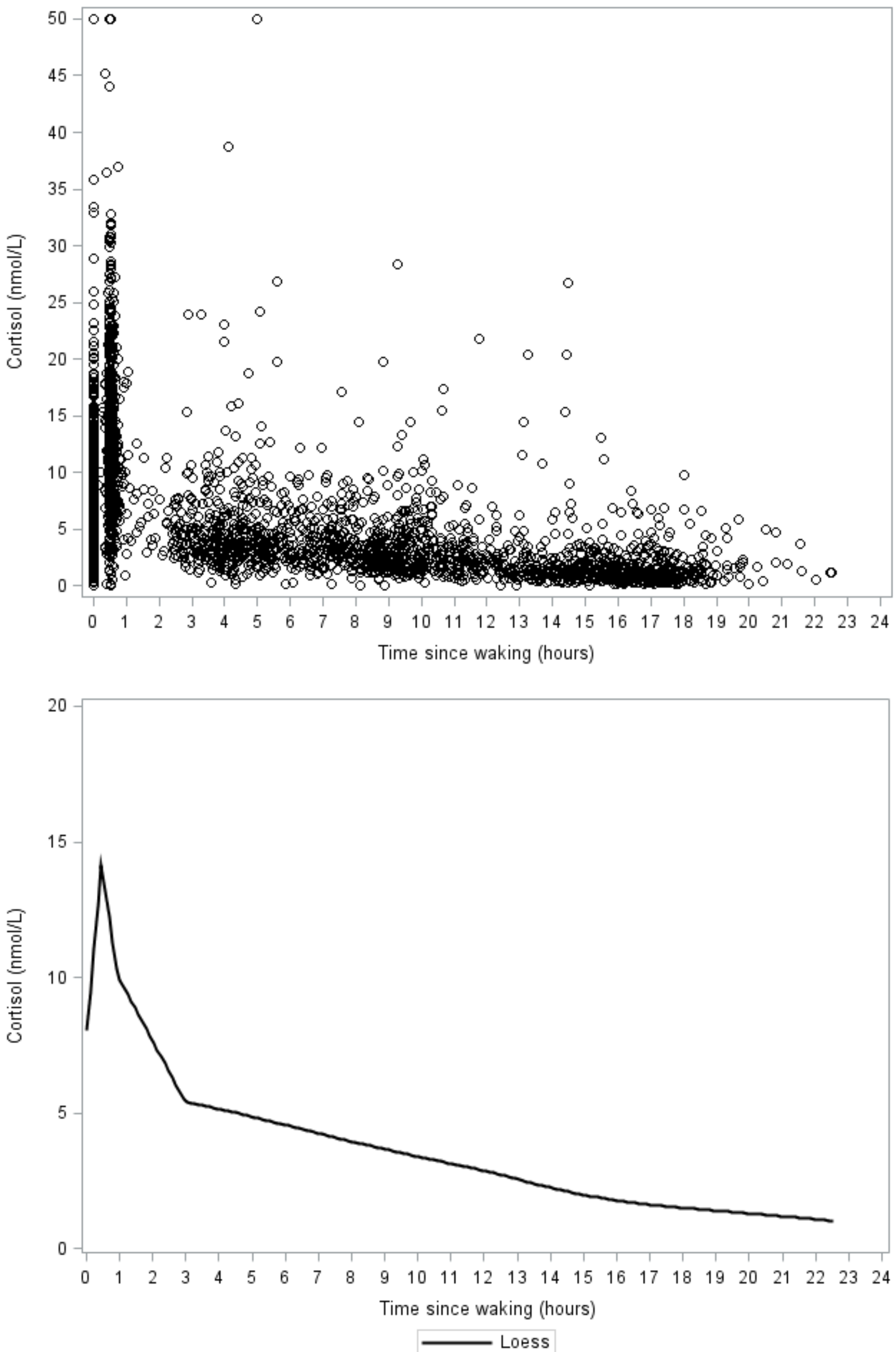
Table 10

Fixed Effects Estimates from 2-Level Bilinear Spline Growth Models of Negative Affect

	Model 1		Model 2		Model 3	
	Est.	*SE*	Est.	*SE*	Est.	*SE*
Intercept (after task), b_0	0.808*	0.042	0.847*	0.061	0.832*	0.061
Condition, β_{01}			-0.070	0.070	-0.033	0.061
Latino values, β_{02}			0.092	0.074	0.034	0.070
Condition * Latino values, β_{03}			-0.212*	0.105	-0.173*	0.082
Male, β_{04}					-0.014	0.061
Immigrant generation score, β_{05}					-0.018	0.010
Depressive symptoms, β_{06}					0.018*	0.004
Time until 2nd report, b_1	0.012*	0.001	0.012*	0.001	0.012*	0.001
Time since 2nd report, b_2	-0.030*	0.002	-0.031*	0.003	-0.032*	0.003
Condition, β_{21}			0.002	0.001	0.002	0.001
Latino values, β_{22}			-0.001	0.001	-0.001	0.001
Condition * Latino values, β_{23}			0.001	0.002	0.001	0.002
Male, β_{24}					0.003*	0.001
Time since 2nd report^2, b_3	0.0004*	0.0001	0.0004*	0.005	0.0004*	0.005

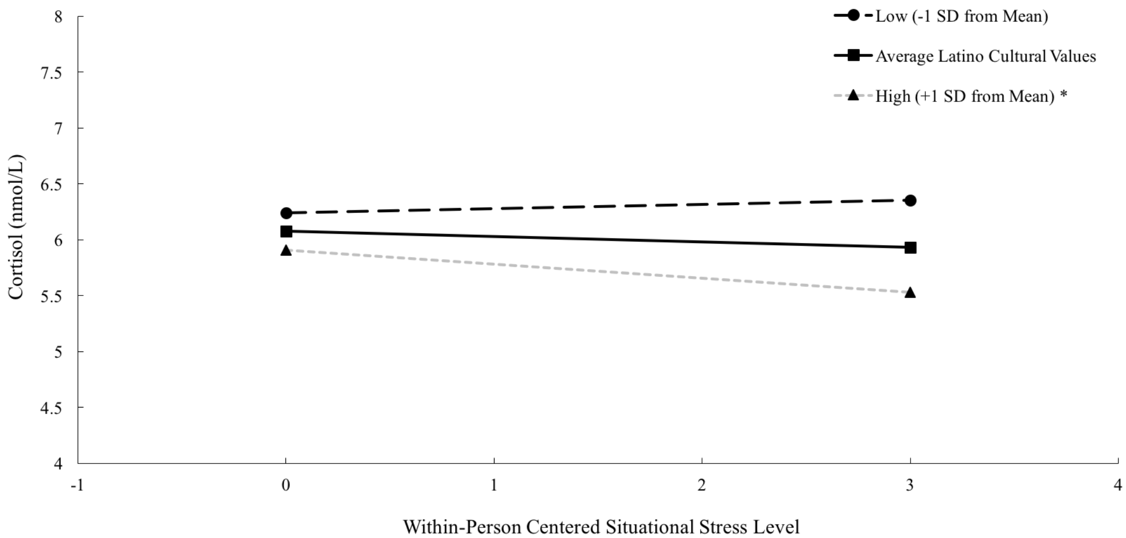
Note. N = 420 reports nested within 84 individuals. Negative affect (NA) transformed using square root. Condition (1 = cultural inclusion). Time scaled in minutes. Continuous level 2 predictors grand-mean centered. Est. = regression coefficient estimate. *SE* = robust standard error. †$p < .10$. *$p < .05$.

Figure 1



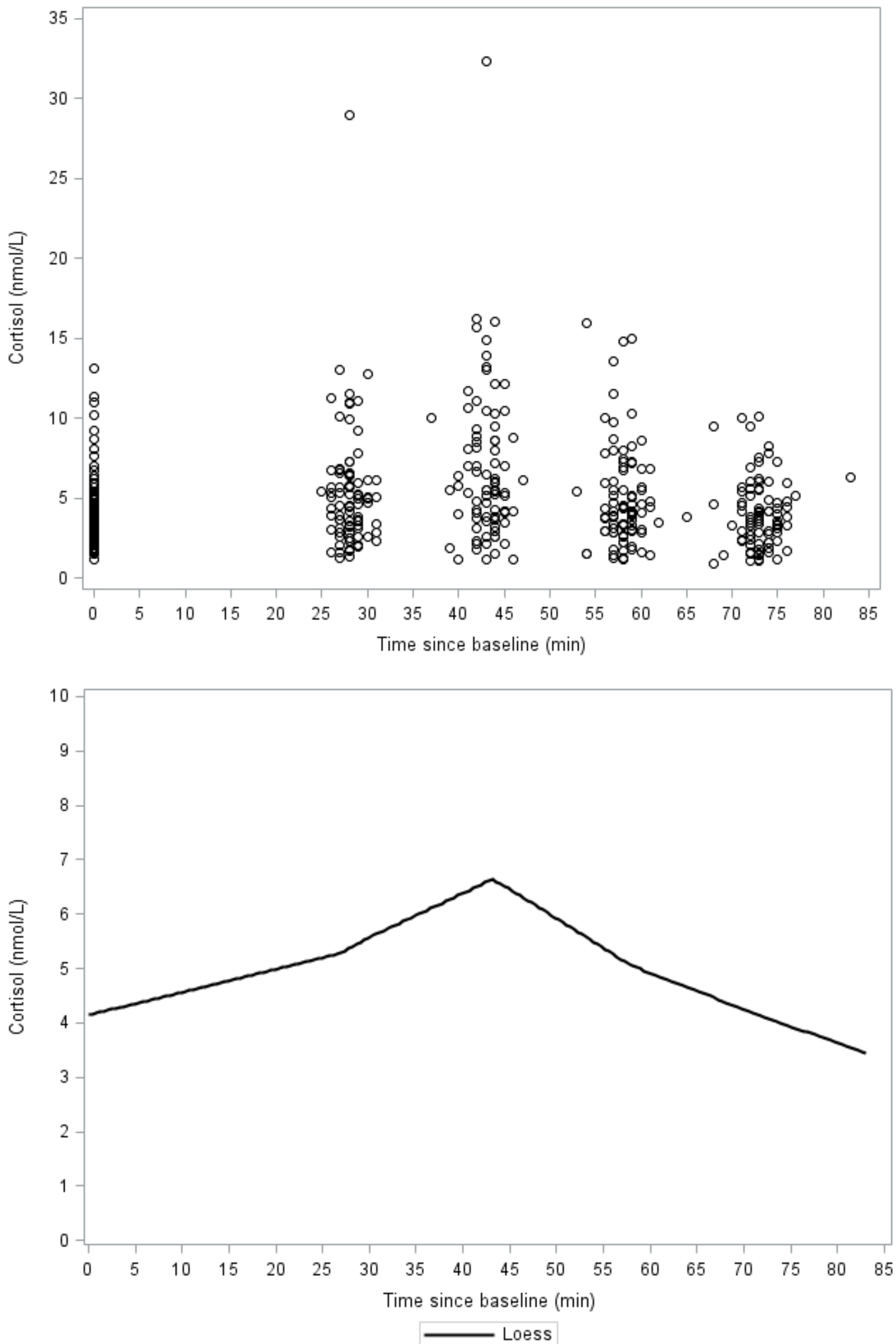
Note. Scatterplot and loess curve following average trend of T1 diurnal cortisol data.

Figure 2



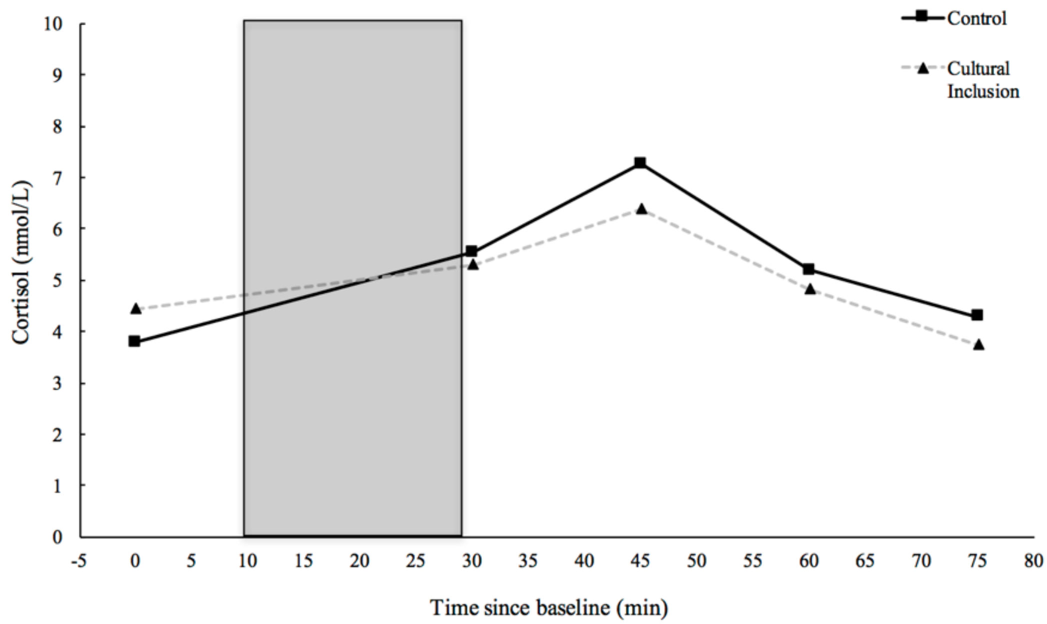
Note. Simple slopes of situational stress level (0 = within-person mean; 3 = three units above within-person mean) by cortisol level (nmol/L) plotted at the grand mean and +/-1 *SD* from mean of Latino cultural values. *$p < .01$.

Figure 3



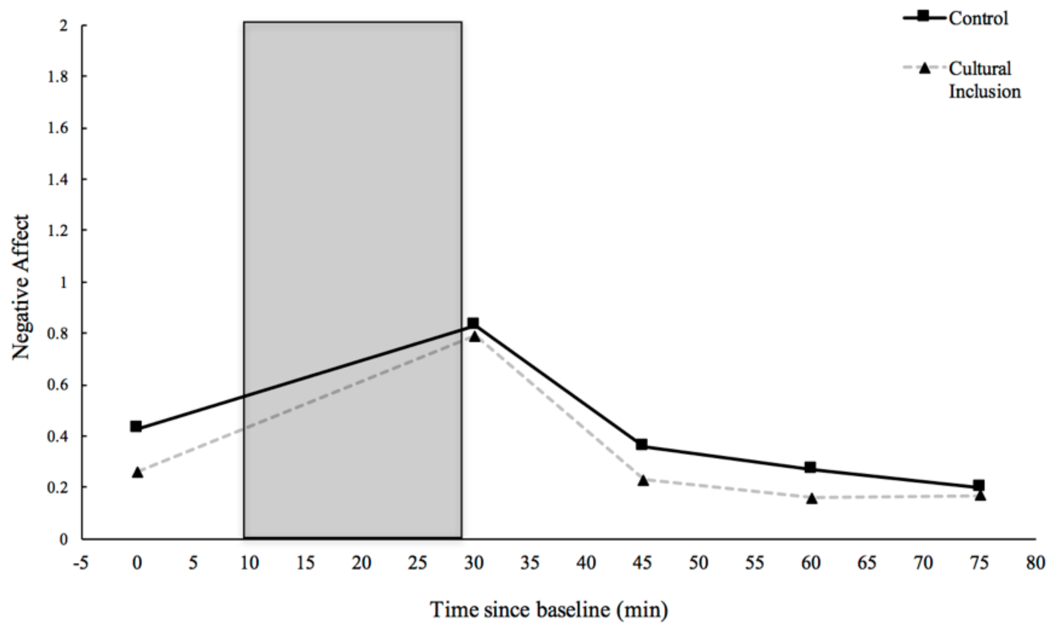
Note. Scatterplot and loess curve following average trend of T2 lab cortisol data.

Figure 4



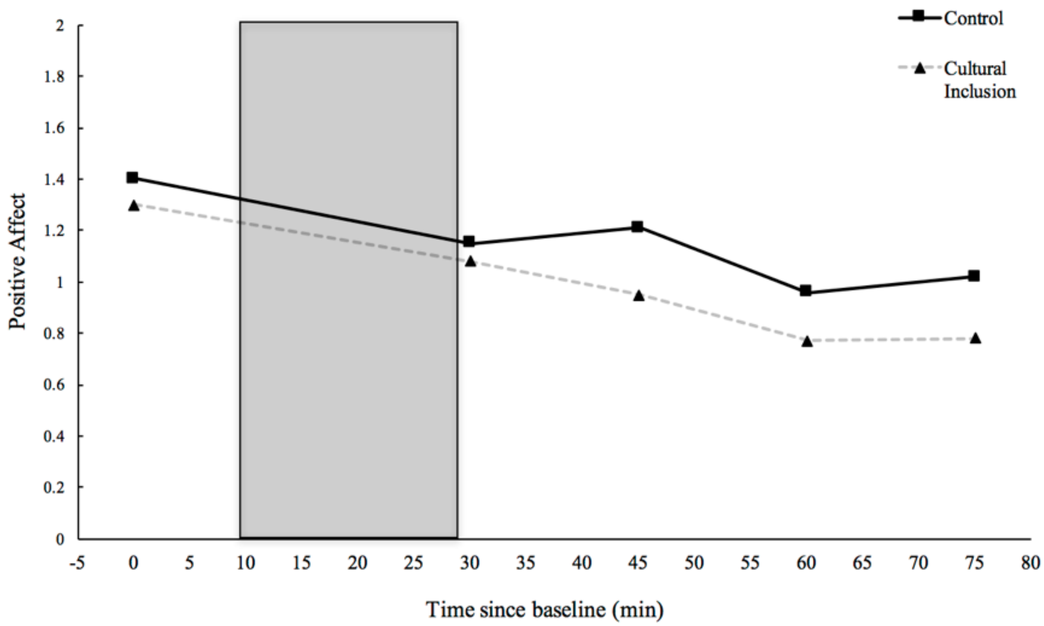
Note. Shaded region indicates duration of the stress task. On average, no significant differences between control (n = 39) and cultural inclusion (n = 45) conditions, pairwise ps > .11.

Figure 5



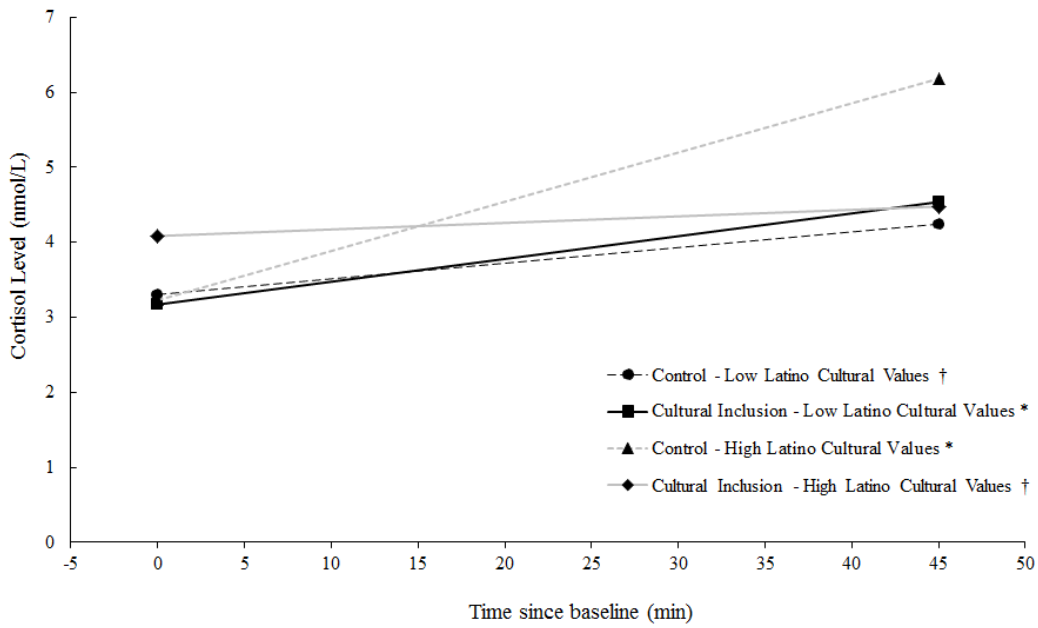
Note. Shaded region indicates duration of the stress task. On average, no significant differences between control (n = 39) and cultural inclusion (n = 45) conditions, pairwise ps > .15.

Figure 6



Note. Shaded region indicates duration of the stress task. On average, no significant differences between control (n = 39) and cultural inclusion (n = 45) conditions, pairwise ps > .16.

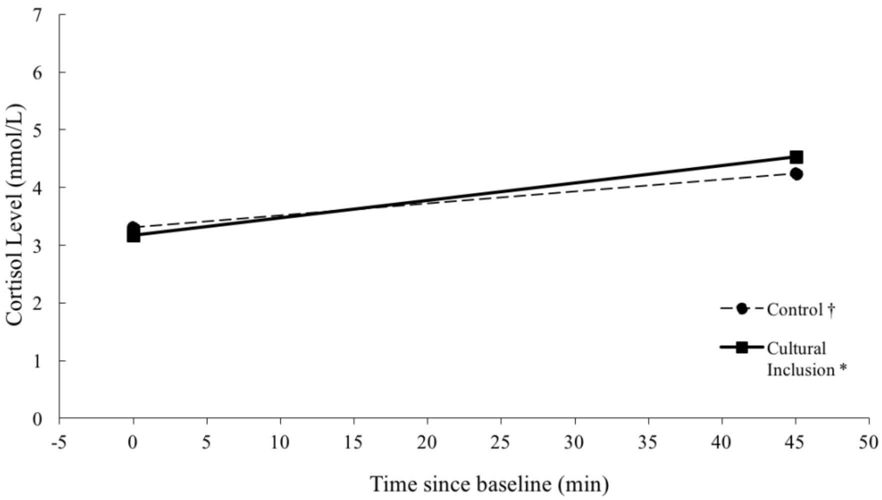
Figure 7a



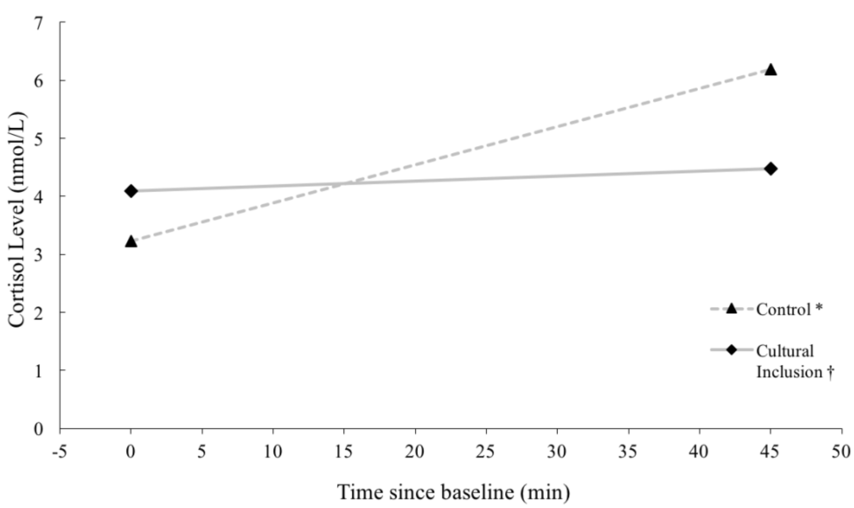
Note. Simple slopes of effect of experimental condition (0 = *control*, 1 = *cultural inclusion*) on cortisol reactivity (rate of increase from baseline to 15 min post-task) plotted at -1 (low) and +1 (high) *SD* from mean of Latino cultural values. †$p < .10$. *$p < .05$.

Figure 7b

Low Latino Cultural Values (-1 *SD* from Mean)

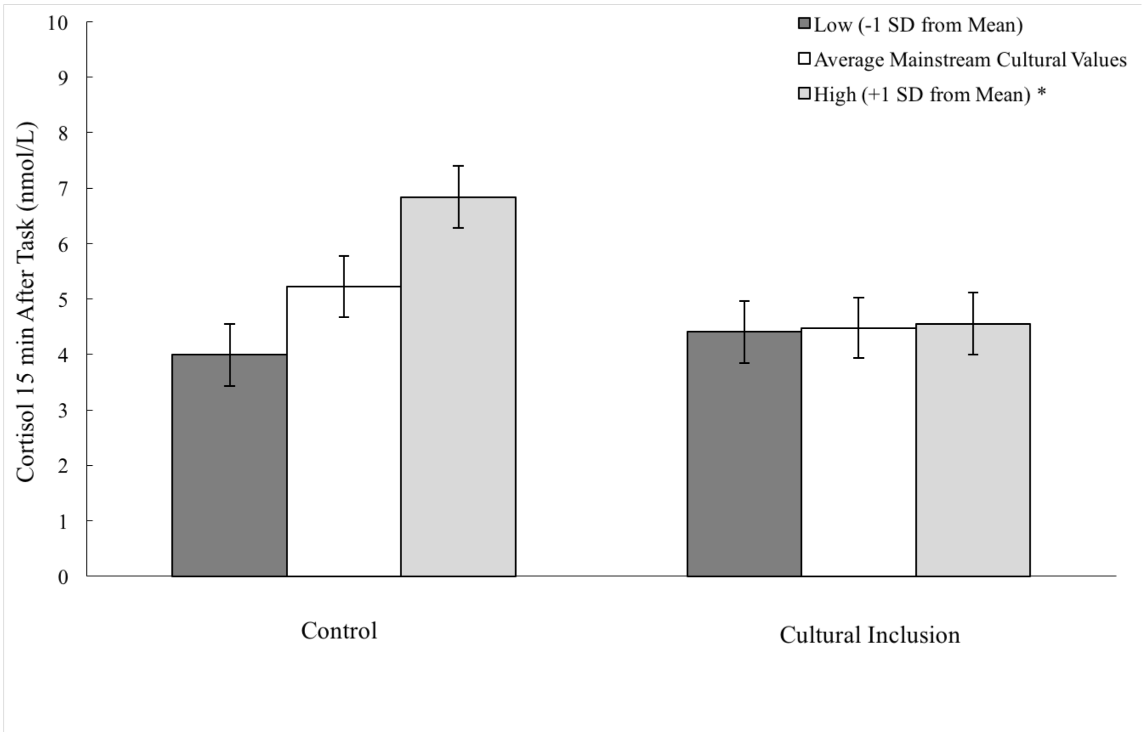


High Latino Cultural Values (+1 *SD* from Mean)



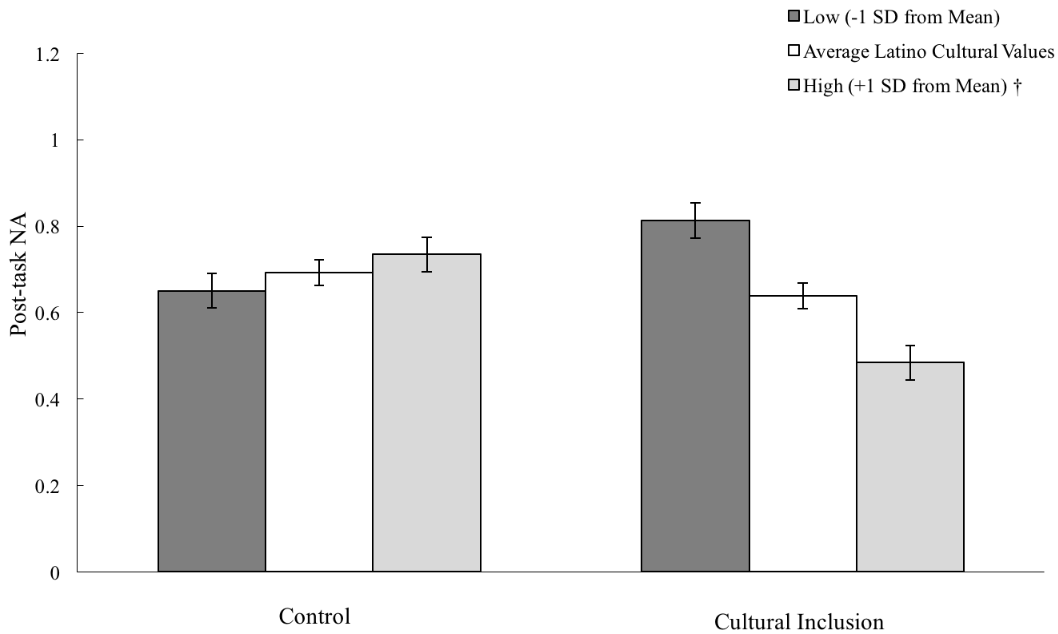
Note. Simple slopes of effect of experimental condition (0 = *control*, 1 = *cultural inclusion*) on cortisol reactivity (rate of increase from baseline to 15 min post-task) plotted at -1 (low) and +1 (high) *SD* from mean of Latino cultural values. For low Latino cultural values, cortisol levels did not differ by group at baseline or 15 min post-task, *p*s > .69. For high Latino cultural values, cortisol levels did not differ by group at baseline, $p = .75$, but there was a marginally significant group difference 15 min post-task, $b = -.32$, $p = .06$. †$p < .10$. *$p < .05$.

Figure 8



Note. Simple slopes of effect of experimental condition (0 = *control*, 1 = *cultural inclusion*) on cortisol level 15 minutes after the task (model intercept) plotted at the grand mean and +/-1 *SD* from mean of mainstream cultural values. *$p < .05$.

Figure 9



Note. Simple slopes of effect of experimental condition (0 = *control*, 1 = *cultural inclusion*) on negative affect (NA) immediately after the task (model intercept) plotted at the grand mean and +/-1 *SD* from mean of Latino cultural values. †p = .06.

APPENDIX A

MEASURES

Situational Diary-Reported Stress

Describe the most stressful situation or event you encountered in the past hour.

How stressful was this event? (0 = *no stress at all*, 10 = *extreme stress*)

Was the situation or event still ongoing when you started this diary entry?

____ongoing ____completed

PANAS short form (Mackinnon et al., 1999; Watson et al., 1988)

Indicate to what extent you felt each of the following emotions within the last hour:

0 = *very slightly or not at all*, 1= *a little*, 2 = *moderately*, 3 = *quite a bit*, 4 = *extremely*

Interested	Alert
Distressed	Ashamed
Excited	Inspired
Upset	Nervous
Strong	Determined
Guilty	Enthusiastic
Afraid	Scared

Full PANAS for T2 lab study (Watson et al., 1988)

Right NOW, how much do you feel…

0 = *very slightly or not at all*, 1= *a little*, 2 = *moderately*, 3 = *quite a bit*, 4 = *extremely*

Interested	Irritable
Distressed	Alert
Excited	Ashamed
Upset	Inspired
Strong	Nervous
Guilty	Determined
Scared	Attentive
Hostile	Jittery
Enthusiastic	Active
Proud	Afraid

Acculturation Rating Scale for Mexican Americans II (Cuellar et al., 1995)

The next questions are about your sense of identification and familiarity with **Latino/Hispanic** people and culture, and with **European American/Anglo** people and culture. **White** is another term often used to describe European Americans/Anglos. Latino/Hispanic culture includes many different groups, such as **Mexicans or Mexican Americans, Puerto Ricans, and others**. If you belong to a specific Latino/Hispanic group, please think of that group when you answer these questions.

1 = Not at all, 2 = Very little or not very often, 3 = Moderately, 4 = Much or very often, 5 = Extremely often or almost always

1. I speak Spanish.
2. I speak English.
3. I enjoy speaking Spanish.
4. I associate with Anglos/European Americans.
5. I associate with Latino or Hispanic people.
6. I enjoy listening to Spanish language music.
7. I enjoy listening to English language music.
8. I enjoy Spanish language TV.
9. I enjoy English language TV.
10. I enjoy English language movies.
11. I enjoy Spanish language movies.
12. I enjoy reading (e.g., books) in Spanish.
13. I enjoy reading (e.g., books) in English.
14. I write (e.g., letters) in Spanish.
15. I write (e.g., letters) in English.
16. My thinking is done in the English language.
17. My thinking is done in the Spanish language.
18. My contact with my family's country of origin (if different than the USA) has been…
19. My contact with the USA has been…
20. My father identifies or identified himself with a Latino/Hispanic group.
21. My mother identifies or identified herself with a Latino/Hispanic group.
22. My friends, while I was growing up, were Latino or Hispanic.
23. My friends while I was growing up, were of Anglo/European American origin.
24. My family cooks foods from a Latino/Hispanic country (e.g., Mexican food, Cuban food).
25. My friends now are of Anglo/European American origin.
26. My friends now are Latino or Hispanic.
27. I like to identify myself as an Anglo/European American.
28. I like to identify myself with a Latino/Hispanic group.
29. I like to identify myself as an American.

Mexican American Cultural Values Scale (Knight et al., 2010)

The next statements are about what people may think or believe. Remember, there are no right or wrong answers. Tell us how much you believe that...

1 = Not at all, 2 = A little, 3 = Somewhat, 4 = Very much, 5 = Completely

1. One's belief in God gives inner strength and meaning to life.
2. Parents should teach their children that the family always comes first.
3. Children should be taught that it is their duty to care for their parents when their parents get old.
4. Children should always do things to make their parents happy.
5. No matter what, children should always treat their parents with respect.
6. Children should be taught that it is important to have a lot of money.
7. People should learn how to take care of themselves and not depend on others.
8. God is first; family is second.
9. Family provides a sense of security because they will always be there for you.
10. Children should respect adult relatives as if they were parents.
11. If a relative is having a hard time financially, one should help them out if possible.
12. When it comes to important decisions, the family should ask for advice from close relatives.
13. Men should earn most of the money for the family so women can stay home and take care of the children and the home.
14. One must be ready to compete with others to get ahead.
15. Children should never question their parents' decisions.
16. Money is the key to happiness.
17. The most important thing parents can teach their children is to be independent from others.
18. Parents should teach their children to pray.
19. Families need to watch over and protect teenage girls more than teenage boys.
20. It is always important to be united as a family.
21. A person should share their home with relatives if they need a place to stay.
22. Children should be on their best behavior when visiting the homes of friends or relatives.
23. Parents should encourage children to do everything better than others.
24. Owning a lot of nice things makes one very happy.
25. Children should always honor their parents and never say bad things about them.
26. As children get older their parents should allow them to make their own decisions.
27. If everything is taken away, one still has their faith in God.
28. It is important to have close relationships with aunts/uncles, grandparents and cousins.
29. Older kids should take care of and be role models for their younger brothers and sisters.

30. Children should be taught to always be good because they represent the family.
31. Children should follow their parents' rules, even if they think the rules are unfair.
32. It is important for the man to have more power in the family than the woman.
33. Personal achievements are the most important things in life.
34. The more money one has, the more respect they should get from others.
35. When there are problems in life, a person can only count on him/herself.
36. It is important to thank God every day for all one has.
37. Holidays and celebrations are important because the whole family comes together.
38. Parents should be willing to make great sacrifices to make sure their children have a better life.
39. A person should always think about their family when making important decisions.
40. It is important for children to understand that their parents should have the final say when decisions are made in the family.
41. Parents should teach their children to compete to win.
42. Mothers are the main people responsible for raising children.
43. The best way for a person to feel good about himself/herself is to have a lot of money.
44. Parents should encourage children to solve their own problems.
45. It is important to follow the Word of God.
46. It is important for family members to show their love and affection to one another.
47. It is important to work hard and do one's best because this work reflects on the family.
48. Religion should be an important part of one's life.
49. Children should always be polite when speaking to any adult.
50. A wife should always support her husband's decisions, even if she does not agree with him.

Mexican American Biculturalism Scale (Basilio et al., 2014)

Latinos may act differently when they are with other Latinos than when they are with Whites (Gringos; individuals of European American backgrounds). In the following items we will be asking you how comfortable you are in these different situations.
Example Response Options
1 = I am only comfortable when (I need to speak in Spanish).
2 = I am only comfortable when (I need to speak in English).
3 = I am sometimes comfortable in both of these situations.
4 = I am often comfortable in both of these situations.
5= I am most of the time comfortable in both of these situations.
6 = I am always comfortable in both of these situations.

1. Sometimes you may need to speak Spanish, and other times you may need to speak English. Which of the following best describes you?

2. Sometimes you may feel a part of the Latino/Hispanic community, and other times, you may feel a part of the White (Gringo) community. Which of the following best describes you?

3. Sometimes you may need to work with a group for the group to be successful, and other times you may need to compete with others for you to be successful. Which of the following best describes you?

4. Sometimes you may need to solve a problem in a Latino/Hispanic way, and other times you may need to solve a problem in a White (Gringo) way. Which of the following best describes you?

5. Sometimes you may need to interact with other Latinos/Hispanics, and other times you may need to interact with Whites (Gringos). Which of the following best describes you?

6. Sometimes you may need to make an important decision on your own, and other times you may need to ask your family for advice. Which of the following best describes you?

7. Sometimes you may need to participate in Latino/Hispanic traditions, and other times you may need to participate in White (Gringo) traditions. Which of the following best describes you?

8. Sometimes you may feel proud to be part of the Latino/Hispanic community, and other times you may feel proud to be part of the US community. Which of the following best describes you?

9. Sometimes you may be obligated to satisfy your family's needs, and other times you may satisfy your own needs. Which of the following best describes you?

Now we would like you tell us how easy or difficult you find the kind of situations we have been asking you about.
Response Options
1 = very easy
2 = easy
3 = neither easy or difficult
4 = difficult
5 = very difficult

1. Needing to speak Spanish sometimes, and English other times is ____________.

2. Being considered a part of the Latino/Hispanic community sometimes, and a part of the White (Gringo) community other times is _______________.

3. Needing to work with a group for the group to be successful sometimes, and needing to compete with others for me to be successful other times is ___________.

4. Needing to solve a problem in a Latino/Hispanic way sometimes, and in a White (Gringo) way other times is _________.

5. Needing to interact with other Latinos/Hispanics sometimes, and with Whites (Gringos) other times is ____________.

6. Needing to make important decisions on my own sometimes, and asking my family for advice other times is ______________.

7. Needing to participate in Latino/Hispanic traditions sometimes, and White (Gringo) traditions other times is ____________.

8. Being proud to be part of the Latino/Hispanic community sometimes, and being proud to be part of the US community other times is _____________.

9. Being obligated to satisfy my family's needs sometimes, and satisfying my own needs other times is _____________.

Cultural Congruity Scale (Gloria & Robinson Kurpius, 1996)

For each of the following items, indicate the extent to which you have experienced the feeling or situation at school.

1 = *not at all* to 7 = *a great deal*

1. I feel that I have to change myself to fit in at school.
2. I try not to show the parts of me that are “ethnically” based.
3. I often feel like a chameleon, having to change myself depending on the ethnicity of the person I am with at school.
4. I feel that my ethnicity is incompatible with other students.
5. I can talk to my friends at school about my family and culture.
6. I feel I am leaving my family values behind by going to college.
7. My ethnic values are in conflict with what is expected at school.
8. I can talk to my family about my friends from school.
9. I feel that my language and/or appearance make it hard for me to fit in with other students.
10. My family and school values often conflict.
11. I feel accepted at school as an ethnic minority.
12. As an ethnic minority, I feel as if I [will] belong on a college campus.
13. I can talk to my family about my struggles and concerns at school.