Title
Hugs: Associations with Next-day Cortisol Awakening Response and Changes with Acculturation Over the First Year of College

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Publication Date
2021

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

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Hugs: Associations with Next-day Cortisol Awakening Response and Changes with Acculturation Over the First Year of College

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Psychology

by

Chelsea Elizabeth Romney

2021

ABSTRACT OF THE DISSERTATION

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Study 1. Previous research suggests that affectionate touch might downregulate stress systems like the hypothalamic pituitary adrenal (HPA) axis. However, the current literature lacks in generalizability beyond the laboratory setting and outside the context of romantic relationships. The cortisol awakening responses (CAR) is a measure of HPA axis that is responsive to daily fluctuations in stress and social information. However, associations between affectionate touch and CAR have never been assessed. I used ecological momentary assessment (EMA) methods to measure daily hugging behavior in 104 first year college students and salivary cortisol to assess the cortisol awakening response (CAR). I found that participants who reported more daily hugs also had smaller CARs the next morning. This study contributes to the literature on social interactions and stress responsive systems and emphasizes the importance of assessing affectionate touch behaviors that can be exchanged outside the context of romantic relationships.

Study 2. Compared to European Americans, Latinx Americans may engage in more affectionate touch behavior across a variety of social environments. However, previous studies fail to assess how changes in identification with Latinx or Anglo culture, or acculturation, influences affectionate touch behavior. Since acculturation changes as the cultural context changes, I tested if hugging behavior changed with acculturation for Latinx students over the first year of college. Three days of ecological momentary assessment (EMA) and self-reported acculturation were measured at the beginning and the end of the year. Individual preference for touch, identification with the Latinx cultural value, simpatía, and the demographics of students' home communities were also considered. In our sample of 81 students, we did not find evidence of these relationships. However, this study emphasizes the importance of considering the personal, social, and cultural factors that influence affectionate touch behavior.

The dissertation of Chelsea Elizabeth Romney is approved.

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2021

This is dedicated to everyone who, after this long year of social distancing, just needs a hug.

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Hugs: Associations with Next-day Cortisol Awakening Response and Changes with Acculturation Over the First Year of College

Two people greet each other at the airport with an enthusiastic hug. A crying baby presses their face against their mother's chest. Friends high-five and embrace as they watch their team score a goal. Touch is a ubiquitous part of the human experience and plays a role in a variety of social interactions.

Major functional roles for social touch include affiliative behavior, communication, and emotional expression (Morrison et al., 2010). [1] Certain physical touch expressions may have emotional and social connotations that are less effectively expressed in language (Burgoon, 1991; Burgoon et al., 1992). Touch can express a variety of emotions. In Hertenstein, Verkamp, Kerestes, and Holmes (2006) participants expressing emotions with arm touches from behind a curtain, showed that interpersonal touch could be used to signal at least six different types of emotion, including happiness, fear, disgust, anger, and sadness. Studies on visual (i.e. facial) displays of emotion yield similar results for emotion identification (Elfenbein & Ambady, 2002).

Social touch can be categorized into simple, protracted, and dynamic touch. Simple touch involves brief, intentional contact to a relatively restricted location on the body surface of the receiver during a social interaction, such as the brief placement of a hand on the shoulder or a handshake. Protracted touch involves longer, and often mutual skin-to-skin contact between

[1] While touch can communicate positivity and affiliation, it does not always carry a positive emotional valence. Social touch can also be a vehicle for abuse and harassment (Flannery et al., 2007). When provoked, humans can do emotional and physical damage on each other using a range of social touch interactions. Furthermore, consent is an extremely important part of any social touch interaction. Regardless of intention, consent is absolutely key in order for a social touch interaction to be positive in nature. Lee and Guerrero (2001) found that participants' interpretation of the valence of touch on the hand, waist, face, and shoulder (viewed as video scenarios) were dependent on the specific characteristics of the person (such as his/her gender, age, and relationship with the touched person) and who was being touched. While the issues of appropriateness and consent within social touch are important issues, for the purpose of this paper, we will lead with the assumption that both participants of the social touch interaction interpret it as positive and wanted.

individuals, and usually includes a component of pressure like hugging, holding hands and cuddling. Dynamic touch involves continuous movement over the skin from one point to another, and can often be repetitious, as in stroking, rubbing, and caressing (Field, 2001). Different types of touch may be exchanged depending on the relationship context. For example, greetings with strangers may include simple or protracted touch whereas, dynamic touch and sexual touch may be reserved for romantic partners.

Social touch has been referred to in the literature using a range of terminology. Terms like affection, affectionate behavior, affectionate touch, physical intimacy, physical affection, and romantic behavior encompass social touch used to communicate positive and intimate feelings. Affectionate touch has been defined as physical touch interactions that are intended to demonstrate positivity toward another person (e.g., love, care, fondness, and appreciation) (Floyd, 2006). Affectionate touch can also be referred to by specifically identifying the action, such as kissing, hugging, caressing, holding hands, or patting on the back.

The current literature on social touch has limited generalizability since it has primarily been conducted in romantic partners. The behaviors in the majority of these studies are more relevant to the romantic relationship context, like hand-holding, backrubs, kissing, and sexual intimacy (Gallace & Spence, 2010). To address this issue, the current study focuses on hugs. Hugs are a relatively common affectionate touch behavior that can be engaged in by romantic or non-romantic social partners. A growing area of research suggests that hugs may related to both emotional (Murphy et al., 2018) and physiological benefits (Cohen et al., 2016).

Jakubiak and Feeney (2016) posit a model in which affectionate touch is processed through relational-cognitive and neurobiological pathways to impact relational, psychological, and physical well-being. They assert that stress responses are influenced by affectionate touch receipt.

Study 1 of this dissertation focuses on the stress responsive hormone, cortisol. Specifically, I assessed how daily affectionate touch is related to the cortisol awakening response the next day. Cortisol and the neurobiological pathways that influence the hypothalamic-pituitary-adrenal (HPA) axis will be discussed in more detail in Study 1.

Along the relational-cognitive pathway of Jakubiak and Feeney's (2016) model, the type of affectionate touch and personal, situational, relational, and cultural factors influence the effect that affectionate touch has on the interpretation of touch, relational-cognitive changes, and well-being outcomes. Study 2 of this dissertation focuses on personal and cultural factors in a sample of Latinx young adults. In Study 2, I assess if the amount of hugs changes as a function of shifts in cultural orientation, or acculturation, and how that may interact with individual preference for affectionate touch, specific cultural norms, and context.

Study 1: Daily Fluctuations in Affectionate Touch Behavior and Cortisol Awakening Response (CAR) the Next Day

The first study in this dissertation project examines the association between hugs and the cortisol awakening response (CAR), a measure of hypothalamic-pituitary adrenal (HPA) axis functioning. According to Jakubiak & Feeney's (2016) model of affectionate touch, the authors posit that through neurobiological and relational-cognitive effects, affectionate touch can result in reduced stress and stress reactivity. Specifically, they propose that affectionate touch acts as a stress buffer, though much of the evidence for this association is based on acute laboratory stress paradigms.

To understand how affectionate touch may decrease the activity of stress responsive systems in the body outside the context of acute stress, we can use the theoretical model of Generalized Unsafety Theory of Stress (GUTS) (Brosschot et al., 2018). In traditional stress theory, stressors are viewed as threats in the environment that lead to activation in stress-related physiological systems. The GUTS theory conceives stress as a constant default response that is turned off by safety cues, as opposed to being turned on by threats in the environment. From this point of view, the environment is viewed as generally unsafe and physiological stress responses are continuously activated. Affectionate touch may act as an environmental safety cue that would deactivate or decrease the perpetual physiological stress response.

Affectionate touch may act as a particularly effective safety cue due to early-life programming. Research in animals, for example, suggests that affectionate touch in primates, such as allo-grooming (grooming another animal), serves important survival purposes in early life including thermoregulation and protection from predators or threats. Maintaining an ideal warm temperature or "thermoregulation" is necessary for mammalian babies and is accomplished with snuggling and cuddling for primates and “huddling” in a pile in species born in litters. Sharing heat with other warm bodies decreases the body’s energetic burden thus allowing energy allocation for other important processes, such as growth, healing, and cell repair (Morrison et al., 2010). The close physical proximity with others who can provide defense against a threat also may provide further signals of a safe environment. These early safety signals may explain neural circuitry that is strengthened in infancy and continues to predict physically affectionate (or grooming) behaviors throughout the lifespan.

While the evolutionary importance of warmth and protection decreases in primates as age and body size increase, grooming and cuddling behaviors continue throughout adulthood. Some species of primates devote as much as 20% of their day to grooming behaviors, much of which is spent grooming others, rather than themselves (Dunbar, 1991; Lehmann et al., 2007). While these behaviors may serve the purpose of hygiene maintenance (i.e. removal of parasites, fur cleanliness, etc.), evidence suggests that grooming behaviors perform a unique social function that may also facilitate bonding (Dunbar, 2010). Social grooming in primates can be exchanged between companions, called grooming partnerships or “friendships” that can last on the timescale of years (Silk, 2019). Since early life affectionate touch indexes an unexposed, warm, secure environment and may signal benefits of social proximity like decreased energy expenditure through thermoregulation and increased protection from threat, affectionate touch may signal to the central nervous system that metabolically expensive stress responses or vigilance is unwarranted (i.e. Porges, 2008) and may explain why close proximity to others dampens HPA and sympathetic-adrenal-medullary (SAM) activation (Morrison, 2016). From the GUTS perspective, these grooming behaviors may explain why “lonely” primates are at higher risk for chronic stress related diseases (Dunbar, 2010).

Like grooming, daily affectionate touch in humans may provide cues of safety that reduce activation of stress responsive systems. One study found that married women who reported higher levels of affectionate touch in their nighttime daily diaries also had lower overall levels of salivary cortisol (Ditzen et al., 2008). In another study of married couples, daily diary reports of affectionate touch predicted lower cortisol output the next day. Most interestingly, affectionate touch predicted cortisol output above and beyond other positive relationship factors like perceived partner responsiveness, self-disclosure, and overall marital quality for the wives in the sample (Romney, Robles, Repetti, in prep). Both studies indicate that daily reports of affectionate touch can affect the stress responsive system of the HPA axis. However, these studies were limited in a few ways. They both assessed affectionate touch only between romantic partners. They had relatively small sample sizes (both just under 50 subjects). Finally, the reports of affectionate touch behavior were self-reported at the end of the day. Daily diaries rely on participants' recall of affectionate touch throughout the entire day, thus the responses may have been influenced by retrospection and recall bias. Measurement details for cortisol will be detailed after the neurobiological pathways of touch are discussed below.

Neurobiological pathway

When affectionate touch is received, functionally specialized nerve fibers in the skin called cutaneous C afferents receive the signals. Specifically, the C tactile (CT) afferents, a type of slow-conducting, unmyelinated peripheral nerve fiber has been shown to be sensitive to innocuous tactile stimulation (Olausson et al., 2010). The "social touch hypothesis" centers around these CT afferents and postulates that social touch is a distinct domain of touch, with specific afferents which can distinguish tactile stimuli that are most likely to occur during close social interactions and the ''noise'' (i.e. outside the range of likely velocities) of tactile stimulation not likely to carry affective meaning (Morrison et al., 2010). Indeed, humans are able to discriminate between interpersonal touch, intrapersonal touch, and the passive touch of an object or surface on the skin (Bolanowski et al., 1999).

Touch information received through CT afferents is relayed to the somatosensory areas S1 and S2 and to affect-related regions such as the insula and orbitofrontal cortex (Wessberg et al., 2006). The insular cortex and the orbitofrontal cortex work together to process affectionate touch as emotional information. The insula receives signals from sensory inputs and transmits information to the orbitofrontal cortex. The orbitofrontal processes complex emotional evaluations (Rolls, 2010). This underlying neurocircuitry can regulate proximity and continued affectionate touch with a loved one.

The opioid system plays a key role in motivation to engage in affectionate touch. The μ-opioid receptor is implicated in contact-seeking behavior. Beta-endorphins increase during social contact; the μ- opioid (MOR) receptor binds to beta-endorphins (Panksepp et al., 1978), which are associated with the experience of pleasure. This is supported by a human study that found that a slight difference in a gene (OPRM1), which increases the MOR receptor's binding affinity to endogenous opioids, was correlated with more pleasure experienced in social situations and increased engagement in affiliative behaviors (Troisi et al., 2012). In connection with affectionate touch and the downregulation of the stress response, the opioid system also has an influence on the HPA axis evidenced by the release of adrenocorticotropic hormone (ACTH) from the pituitary and GCs from the adrenals in response to administration of opiates like morphine (Pechnick, 1993).

The neuropeptide oxytocin has been associated with a range of social touch interactions, such as romantic touch and mother-infant contact (Feldman, 2012). Oxytocin is synthesized in the supraoptic and paraventricular nuclei of the hypothalamus and is widely released throughout the body (Gordon et al., 2011). Interestingly, although oxytocin and cortisol are not commonly assessed in the same studies, evidence suggests that the HPA axis and oxytocin systems are mutually regulated (Dabrowska et al., 2011). For example, in several studies higher peripheral blood levels of oxytocin are moderately associated with lower levels of peripheral cortisol (Gamer & Büchel, 2012; Rehn et al., 2014).

HPA axis, cortisol, and the cortisol awakening response

The HPA axis system includes neurons in the medial parvocellular region of the PVN that secrete corticotrophin-releasing hormone and arginine vasopressin, which travel to the anterior pituitary and cause the release of ACTH into general circulation (Gunnar & Vazquez, 2006). ACTH subsequently binds to its receptors in the adrenal cortex, leading to the release of cortisol. Circulating cortisol binds to receptors distributed throughout the brain and the body (Cone et al., 2003). The HPA axis system makes energy available to the body's cells by helping to mobilize glucose (McEwen, 1998). According to the GUTS theory, generalized unsafety is related to HPA axis activation for the purpose of mobilizing energy to protect against constant threat. Thus, safety cues like hugging may signal to reduce HPA activation, as less energy is warranted when safety is increased.

Cortisol, the peripheral product of the HPA axis, follows a diurnal pattern of secretion, meaning it is secreted in a similar pattern each day. Cortisol levels increase toward the end of sleep and continue to increase until about 30-45 minutes post-waking and then gradually decrease throughout the day. This process repeats again each day. The cortisol awakening response (CAR) represents the largest increase (50-60%) in cortisol concentration during the day. The CAR is measured as the increase between concentrations at awakening and the concentrations at 30-45 minutes after awakening. The CAR is a marker of both cortisol reactivity (to awakening) and an important piece of the diurnal rhythm. The CAR may be related to clinical outcomes. For example, in a longitudinal study, adolescents that had larger CARs were at higher risk for major depressive disorder at a one-year follow-up (Adam et al., 2010).

Currently, the speculated function of the CAR is that it represents the attempt to mobilize energy stores in the body that the brain anticipates needing to combat the challenges of the coming day (Fries et al., 2009). Indeed, evidence suggests that larger CARs are related to more upcoming demands. In one study, individuals who experienced more work-related stressors showed larger CARs the next day (Sin, Ong, Stawski, & Almeida, 2017). Another study found that CARs were larger on workdays than work-free weekend days (Schlotz et al., 2004). Finally, in a study of ballroom dancers, the competitors demonstrated larger CARs on the day of competition. Whereas on non-competition days, dancers had normal CARs (Rohleder et al., 2007).

Social cues may be particularly influential on the CAR. One study found that increased feelings of loneliness predicted a larger CAR the next day (Doane & Adam, 2010). Another study found that the CAR was higher the day after participants reported having a lack of social recognition (Wüst et al., 2000). The CAR is theorized to be a measure of anticipatory stress of the day, with higher self-reported stress anticipation predicting larger CARs the next day (Kramer et al., 2019). From the GUTS model (Brosschot et al., 2018) perspective, positive social information may act as a safety cue and, in turn, result in lower CARs. Indeed, a growing body of literature suggests that more positive social interactions predict smaller CARs the next day (for meta-analysis: Boggero et al., 2017).

Although the CAR has a well-documented association with a variety of social behaviors, it has never been studied in relation to affectionate touch behavior. Further, only two studies to my knowledge have assessed the association between any measures of HPA axis function and affectionate touch behavior in daily life. In Ditzen et al. (2008) they found a daily association between higher intimacy and reduced salivary cortisol in married women. Romney, Robles, Repetti (in prep) found the same association in married women, even when controlling for other positive relationship factors. I aimed to extend these findings outside the context of marriage by using a sample of unmarried young adults and measuring affectionate touch behavior as hugging, instead of interactions that may be reserved for romantic partners, like kissing and handholding. Given evidence that more positive social environments may result in smaller CARs, I posited that more hugging would predict smaller CARs the next day.

Study 1 Method

Participants

These students were part of a larger study that recruited University of California students into a longitudinal study with two timepoints, at the beginning and the end of the first year of college.[2] Participants in this study were only recruited at UC Merced, where I had appropriate staff and storage available for the saliva samples. Participants were recruited through the "Class of 2023" Facebook group. Flyers were also posted in the dormitories and in the freshman dormitory dining halls advertising the study as the "UC Freshman Study" funded by the University of California Consortium on Health Psychology. All students were required to be freshman and at least 18 years of age, living in the on-campus housing. To participate in the moment-to-moment survey portion of the study, participants had to have access to a cellular device with an internet browser.

Only those participants who completed at least one ecological momentary assessment and one saliva sample were included (N = 116), since the primary aim of the study concerns daily hugging,

[2] Study sites included UC Berkeley, Irvine, Los Angeles, Merced, and Riverside.

measured through the ecological momentary assessments, and cortisol, measured in saliva. Three participants were missing the Day 1 waking saliva sample. Two participants were missing the Day 1 30-minutes post-waking saliva sample. Six participants were missing the Day 2 waking and 30-minutes post-waking saliva sample. Thus, the analyses included 111 CAR values for day 1 and 104 CARs values for day 2. I also collected dried blood spots for analyses of peripheral inflammatory markers and the participants wore wrist activity monitors to measure daily activities including movement, cardiovascular reactivity, and sleep. Results from those measures are not detailed in the current study.

The current sample demographics are detailed in Table 1. Most of the sample identified as Mexican (50.4%) or other Latinx (12.4%). The sample was 54% female and participants were either 18 years old (85.7%) or 19 years old (14.3%). Participants were primarily born in the U.S. (83.2%) and were first-generation college students (64.3%). Since participants were adolescents, socioeconomic status (SES) was measured through participants' childhood housing situation. These categories were dummy coded to represent parental home ownership, (0) Parents owned home (*N* = 35.4%) and (1) Parents rented; Parents owned then rented; Unstable; and Parents rented then owned (*N* = 64.6%).

Table 1

Sample Demographics

Variable	Categories	N	%
Sex	Female Male Unidentified	61 49 2	54.0 43.8 1.8
Age	18 years old 19 years old	96 16	85.7 14.3
Ethnicity	Mexican Other Latinx Pacific Islander White Native American Indian Other Other Southeast Asian Chinese Middle Eastern Black	57 14 10 6 5 5 5 4 3 1 1	50.4 12.4 8.8 5.3 4.4 4.4 4.4 3.5 2.7 0.9 0.9
Childhood Housing Situation	Unstable Parents rented Parents owned then rented Parents rented then owned Parents owned home	3 53 8 7 40	2.7 46.9 7.1 6.2 35.4
Student Status	First generation Non-first generation	72 39	64.3 34.8

*Not all possible categories for participant ethnicity are included here, only those endorsed by the participants included in this study. The ethnicities that are not represented in this sample are Japanese and Korean.

Procedure

Hugging EMAs were collected Tuesday-Thursday and cortisol samples were provided on Wednesday and Thursday of the sampling week. Cortisol concentrations were assessed in saliva. Saliva was collected using an absorbent swab (SalivaBio Oral Swab from Salimetrics, Carlsbad, CA). Participants were instructed on proper sampling techniques and handling of the absorbent swab. Participants were told to place the swab directly into their mouth by tipping the tube, so the swab falls into their mouth. They were told that they should not touch the swab with their fingers and to keep the swab in their mouths for approximately two minutes before placing it back in the sampling tube. To ensure the effectiveness of the instructions, participants completed a practice sample in the laboratory with the researcher so the researcher could correct any issues with the participants' self-sampling method. The participants were given the oral swabs in plastic bags that were labelled for each timepoint and were instructed to return the samples to the researchers who waited at drop-off points at their dormitories each day of their saliva sample collection.

Participants were also instructed on the proper timing of the samples. Participants were instructed to collect the first sample immediately upon waking and the second sample 30-minutes after waking. 30-minutes was chosen for the post-awakening sample based on guidelines by Adam and Kumari (2009). Concerns have been raised about participants collecting the saliva sample immediately upon awakening (Stalder et al., 2016). I attempted to increase compliance from participants to collect their saliva samples immediately upon awakening. First, all participants visited the laboratory for training and instruction the day before their first day of data collection. In this training, participants were instructed to complete the saliva sample immediately at awakening and the importance of the timing of the sample was emphasized. Second, participants received text messaged reminders before they woke up to complete the saliva collection (sent at

4:00am each day). The text-messaged surveys also included questions regarding their compliance to the sampling procedure, timing, and behaviors they were instructed to refrain from. Participants responded with *Yes* or *No* when prompted about engaging in eating, drinking, smoking, and exercising between the two morning samples.

Materials

Ecological Momentary Assessment Sampling. The ecological momentary assessments (EMA)s were sent to participants five times per day for three days using a stratified sampling protocol. Each day, moments were randomly sampled within a 3-hour block of time, to sample the entire waking day and to assure that the moments sampled within blocks were random. The earliest 3-hour block of time began at 8:00am and the latest 3-hour block ended at 11:00pm. Participants were instructed to complete the EMA measures as soon as they received them. Responses made 30 minutes after the prompt time may introduce bias because participants may be providing recollections at convenient, and thus not random, times. Thus, EMA surveys were closed at 30 minutes after they were sent so participants would not be able to complete late responses. To assess participant compliance, the number of EMAs completed at the two sampling timepoints was quantified. With five EMA prompts over three days, completion ranged from 1 to 15 EMAs at both timepoints (Timepoint 1 M = 9.83 SD = 3.75) (Timepoint 2 M = 9.32, SD = 3.90).

The first EMA sampling occurred during the first week of classes on Tuesday, Wednesday, and Thursday. At the second EMA timepoint, participants completed EMA prompts on the same days of the week at the end of the semester or quarter. Samples were not requested during finals week to avoid the potentially confounding stress that may occur for students during finals week.

Data Acquisition Interface. The entire EMA survey included five questionnaires that assessed social interactions, mood, and experiences of racism. The expected completion time for each of the five EMA questionnaires was 1-3 minutes. The EMAs were sent via text message to participants' cellular devices. An online service for sending group messages called "Remind" was used to send messages to participants. The text message included a link to the survey that was accessed through mobile internet. Participants were able to text back to the researchers through this service and some participants used this method to communicate with researchers.

Hugging. Participants were asked if they had hugged anyone since their last EMA prompt. Response scale was *Yes* or *No*. Participants' responses were aggregated into one score for each day. *Yes* was scored as 1 point, and *No* as 0. Those values were summed for each day, divided by the number of prompts the participant completed that day, and multiplied by 100 to create a percentage. For example, someone with perfect compliance, who reported hugging at every EMA prompt on one day would have a score of 100% (5/5 or 1) for that day. For someone who reported hugging at 3 prompts and completed 4 total prompts, their score would be 75% (3/4, = .75). The same aggregation method was used for each day. Thus, participants have a unique hug percentage for each sampling day.

Cortisol. Salivary cortisol was collected, stored, and assayed at the UC Merced Psychoneuroendocrinology laboratory. Samples were stored in a -20 ° freezer until the time of assay. The samples were assayed with a chemiluminescence immunoassay technique using an assay kit (Salimetrics Assay #1-3002 Kit, Carlsbad, CA). The lower limit of detection was <.003 ng/mol.

Five identical control samples were included in each assay to express the precision, or repeatability, of immunoassay test results, called inter- and intra-assay consistency. Intra-assay coefficients of variation (CV) ranged from 0% to 118%. The average inter-assay CV was 8.14%. According to Salimetrics recommendations, if the CV between the two duplicates was greater than

15% and the absolute difference between the two duplicates was greater than 0.07, the assay was re-run. This was done because a difference greater than 15% is likely beyond natural biological variability. CAR values were screened for distributional properties and outliers. As is seen in most salivary cortisol samples, the data for the current study are positively skewed. To use the proposed data analytic methods, the data were natural log transformed to approximate a normal distribution. A constant (5) was added to the raw cortisol values to allow for the calculation of a log transformed value. Then the CAR was calculated by subtracting the natural log transformed waking value from the natural log transformed 30-minutes post-waking value. Outliers were defined as those natural log-transformed values that were located more than three standard deviations from the mean for each day of sampling (Day 1: M = 1.64, SD = .048, Day 2: M = 1.639, SD = .047). There were no values in the sample that met criteria for outliers, so no samples were excluded based on these criteria.

Study 1 Data Analytic Plan

Covariates

Cortisol concentrations can be influenced by several factors that are unrelated to the primary research questions for this study. Using the Stalder et al. (2016) guidelines, I corrected for some of these factors through the study methods. For those that could not be influenced by the study procedure or instructions, I opted to control for the influence of these factors on the results by including them as covariates in my analyses (Table 4).

The procedures of my study controlled for several factors that Stalder et al. (2016) suggests influence cortisol. I controlled for the influence of seasonal changes on cortisol by having all participants complete samples at the same timepoints relative to the time of year. Participants also completed samples on the same days of the week to control for the influence of waking times and activities on weekends compared to weekdays. Participants received initial instructions and in-the-moment text messaged reminders to refrain from eating, drinking, smoking, and exercising during the 30-minute period between the first sample and the 30-minutes post-awakening sample. None of my participants self-reported that they engaged in these activities.

Other factors that may influence cortisol according to (Stalder et al., 2016) were included as covariates including sex, ethnicity, medication use, and psychiatric conditions. A relatively consistent finding is an influence of sex; with women exhibiting a larger and more prolonged CAR than men. Thus, sex was included as a covariate. Medications and psychiatric conditions are considered potential confounds for cortisol. Three participants reported taking medications. These medications included Dimetapp (cold symptoms), Loratadine (allergy), and testosterone. A dummy variable was created that indicated whether a participant reported taking no medications (0) or if they reported taking medication (1). No participants reported health or psychiatric conditions.

Participants self-reported on day-to-day factors that may influence cortisol. Since cortisol values start to rise in the morning following a diurnal rhythm whether someone is awake yet or not, participants' waking time was accounted for in analyses. The average waking time in the sample was 7:18am on Day 1 and 7:45am on Day 2. In analyses, the waking time covariate were centered at 7:00am for both days. Participants were instructed to complete their second sample 30 minutes after waking and collecting their first sample. Participants self-reported the timing of their samples and were considered noncompliant if they collected their 30-minutes post-waking sample more than 10 minutes earlier or later than 30 minutes after their self-reported waking time. A dummy variable was created that indicated whether a participant was compliant (0) or noncompliant (1) to the sample timing. There were two non-compliant samples on Day 1 and five non-compliant samples on day 2.

Hugging

Hugging was assessed at both the within person daily level and at an aggregated between person level. Daily $hugs_{wp}$ was the percentages of hugs each day, centered around the average percentage of hugs for all three sampling days. Thus, the variable $hugs_{wp}$ refers to a person's deviation from their average hugs each day. $Hugs_{bp}$ was the average percentage of hugs across all three sampling days.

Cortisol Awakening Response and Lagged Effects

The CAR may be influenced by the events of the previous day (Clow et al., 2010b, 2010a). It is calculated by subtracting the waking sample from the 30-minute post-awakening sample for each of the 2 days, resulting in a unique CAR for each day. Hugging scores (EMA aggregates as described above) were obtained the day before each CAR was obtained. Participants' CAR was predicted from the hugging score from the day before to reflect the influence of the functioning the previous day. Identical models were also assessed for CAR values measured on the same day as the hugging EMA measure.

Data Analyses

To account for the hierarchically nested structure of the data, I used multi-level modeling in HLM (Version 7). Four models were estimated to assess the primary research question (Model 1), with the addition of covariates (Model 2), all covariates related to cortisol parameters (Model 3), and a model with same-day CAR (Model 4). The first level of the model includes the within-persons variables, or the variable collected at the daily level. The second level of the model included the individual or "between-subjects" characteristics. The coefficients estimated were the final estimation of fixed effects with robust standard errors. In Models 1-3, for Level 1 analyses, the variables were lagged to estimate if CAR was associated with experiences from the day before. Three days of EMAs were collected for hugging behavior, but only two days of cortisol data. Thus, only the first- and second-day values for $hugs_{wp}$ were used for the daily analyses. Due to having two days of samples, random intercepts, but no random effects were calculated in the model.

Model 1:

Level-1 Model

$$Next\text{-}day\ CAR_{ti} = \pi_{0i} + \pi_{1i}(daily\ hugs_{wp.ti}) + e_{ti}$$

Level-2 Model

$$\pi_{0i} = \beta_{00} + u_{0i}$$

$$\pi_{1i} = \beta_{10}$$

Model 2:

Level-1 Model

$$Next\text{-}day\ CAR_{ti} = \pi_{0i} + \pi_{1i}(daily\ hugs_{wp.ti}) + e_{ti}$$

Level-2 Model

$$\pi_{0i} = \beta_{00} + \beta_{01}(sex_i) + \beta_{02}(hugs_{bp.i}) + u_{0i}$$

$$\pi_{1i} = \beta_{10}$$

Model 3:

Level-1 Model

$$Next\text{-}day\ CAR_{ti} = \pi_{0i} + \pi_{1i}(daily\ hugs_{wp.ti}) + \pi_{2i}(compliance_{ti}) + \pi_{3i}(waking\ time_{ti}) + e_{ti}$$

Level-2 Model

$$\pi_{0i} = \beta_{00} + \beta_{01}(sex_i) + \beta_{02}(hugs_{bp.i}) + \beta_{03}(SES_i) + \beta_{04}(ethnicity_i) + \beta_{05}(medication\ use_i) + u_{0i}$$

$$\pi_{1i} = \beta_{10}$$

$$\pi_{2i} = \beta_{20}$$

$$\pi_{3i} = \beta_{30}$$

Model 4:

Level-1 Model

$$\textit{Same-day CAR}_{ti} = \pi_{0i} + \pi_{1i}\,(\textit{daily hugs}_{wp.ti}) + e_{ti}$$

Level-2 Model

$$\pi_{0i} = \beta_{00} + \beta_{01}\,(\textit{sex}_i) + \beta_{02}\,(\textit{hugs}_{bp.i}) + u_{0i}$$

$$\pi_{1i} = \beta_{10}$$

Study 1 Results

Hugging and EMA Prompt Completion

Descriptive statistics for hugging and EMA prompt completion for each day are displayed in Table 2. Over the three sampling days, participants completed, on average, three out of five prompts per day (*M* = 8.98, *SD* = 3.8, range = 1-15) and reported hugging in about 15% of their prompts (*M* = 1.35, *SD* = 2.22, range: 0-12).

Intercorrelations for hugging and EMA prompt completion are also displayed in Table 2. Higher reports of hugs on each of the days were related to higher reports of hugs on the other days (correlation range= .55 to .65). The amount of EMA prompts completed was not significantly correlated with the proportion of hugs reported on any of the three days (correlation range=.002 to .02), suggesting that compliance with sample completion was unrelated to the proportion of hugs reported.

Hugging was modeled as a function of study day to assess if hugs were different on any of the study days. Results determined that the number of hugs were not predicted by study day (unstandardized coefficient = -0.004, standard error (SE) = 0.007, p = 0.57).

Table 2

Means, standard deviations, and correlations between hugging and EMA completion for each sampling day.

	N, Mean (SD)	1.	2.	3.	4.	5.	6.	7.
Day 1								
1. Hugs[1]	103, 0.50 (.78)	1						
2. EMA completion	103, 3.20 (1.24)	-.004	1					
Day 2								
3. Hugs[1]	103, 0.56 (1.04)	.61**	.033	1				
4. EMA completion	103, 3.26 (1.30)	-.10	.37**	.09	1			
Day 3								
5. Hugs[1]	105, 0.41 (.88)	.55**	-.07	.65**	-.02	1		
6. EMA completion	105, 3.23 (1.46)	-.11	.44**	-.01	.43**	.113	1	
3-day sum								
7. Hugs	112, 1.36 (2.22)	.81**	-.01	.89**	.02	.86**	.03	1
8. EMA completion	112, 8.98 (3.82)	-.09	.77**	-.02	.77**	.03	.80**	.06

Note. [1] Hugs are the raw number of hugs reported for each day. A percentage that accounts for EMAs completed was used for all final analyses.
** $p < .01$.
* $p < .05$.

Cortisol and Potential Confounding Variables

Table 3 presents descriptive statistics and intercorrelations for cortisol values and sampling times for each of the sampling days. Higher cortisol concentrations at both waking and 30-minutes post-waking were related to higher cortisol concentrations both on the same day and between days (correlation range: .5 to .36).

Cortisol values followed the expected pattern, with cortisol values high upon awakening (Day 1: M = 0.279 ng/mol; Day 2: M = 0.299 ng/mol), with about a 50% increase in the first 30 minutes after awakening (Day 1: M = 0.480 ng/mol; Day 2: M = 0.455 ng/mol). Higher daily waking cortisol values were associated with smaller CARs on both days (correlation range: -.42, -.22).

Table 3

Means, standard deviations, and correlations between cortisol parameters

	N	Mean	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.
Day 1												
1. Waking time[1]	108	7:18am	63.14	-								
2. Minutes between samples	108	31.23	3.46	-.24*	-							
3. Cortisol at waking[2]	109	0.278	.20	-.05	.05	-						
4. Cortisol 30 mins post-waking[2]	110	0.48	2.9	-.21*	-.02	.50**	-					
5. CAR[2]	109	0.20	.26	-.20*	-.06	-.22*	.74**	-				
Day 2												
6. Waking time[1]	105	7:45am	101.7	.162	-.03	-.07	-.14	-.12	-			
7. Minutes between samples	102	31.77	5.38	-.02	.06	-.10	-.03	.06	.09	-		
8. Cortisol at waking[2]	105	0.299	.19	-14	.08	.49**	.38**	.06	-.11	-.001	-	
9. Cortisol 30 mins post-waking[2]	105	0.46	.24	-.14	.14	.38**	.48**	.24*	-.02	.09	.36**	-
10. CAR[2]	103	0.16	.25	-.02	.04	.002	.16	.18	.02	.10	-.42**	.69**

Note. [1] Waking time was coded as minutes since midnight. For ease of interpretation, these values are represented in standard time. Standard deviations should be interpreted in minutes.
[2] Cortisol is in raw form (ng/mol), natural log-transformed values were used in all final analyses.
** p > .01.
* p > .05.

Covariates, Independent, and Dependent Variables

Table 4 displays the descriptive statistics and the correlations between the variables and covariates used in the final models (Models 1-4). $Hugs_{wp}$ represents the person-centered value for hugs each day, or the deviation from a person's average hugs. CAR values represented are natural log transformed. $Hugs_{bp}$ is the overall average percent of hugs reported out of all the EMA samples completed.

$Hugs_{wp}$ each day were significantly correlated, with higher deviations from an individual's average on one day predicting lower deviations on the other day, $r(103) = -.56$, $p<.001$. $Hugs_{wp}$ were not significantly correlated with $hugs_{bp}$ on any of the days. There was no evidence of a correlation with compliance, sex, or SES. Medication use did significantly predict $hugs_{wp}$ on day 2, with those taking medications displaying significantly lower hugs ($M = -25.92$, $SD = 35.71$), compared to those who did not take medications ($M = 1.78$, $SD = 16.0$), $F(2, 100) = 8.09$, $p = .005$. This may be explained by the medications reported, which treated cold and flu and allergy symptoms. Participants reporting medications may have felt sick on the study day and thus may have engaged in less hugging.

The two daily CAR values were not significantly correlated. There was no evidence of a correlation with compliance, medication use, ethnicity, or SES. However, CARs on day 1 were significantly associated with participant sex, with females ($M = 1.66$, $SD = .05$) displaying larger CARs than males ($M = 1.63$, $SD = .034$), $F(2, 105) = 10.76$, $p = .001$.

There were no significant associations between CAR and hugs on the previous day, same day, or the following day (correlation range = .111 to .082).

Table 4

Means, standard deviations, and correlations between variables in Models 1-4

	N	Categories	%	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Sex[1]	110	Female Male	54.5 43.8	-									
2. Ethnicity[2]	112	Latinx Non-Latinx	62.8 37.2	.16	-								
3. SES[3]	111	Stable Unstable	35.7 63.4	.10	.21*	-							
4. Medication use[4]	112	Used meds No med use	2.7 96.4	.04	.003	.01	-						
5. Day 1 Compliance[5]	109	Non-compliant Compliant	1.8 95.5	.01	.04	.04	.02	-					
6. Day 2 Compliance[5]	104	Non-compliant Compliant	5.4 94.2	-.05	.09	.24*	.04	-.03	-				
	N	Mean	SD	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
7. Day 1 $Hugs_{wp}$[6]	103	1.99	16.12	.02	.12	-.10	.06	.01	-.15	-			
8. Day 1 CAR[7]	109	1.65	.048	.31**	-.02	-14	.02	.01	-.07	-.19	-		
9. Day 2 $Hugs_{wp}$[6]	103	0.96	17.10	.03	-.20*	-.03	-.27**	.01	.10	-.56**	.15	-	
10. Day 2 CAR[7]	103	1.64	.05	.06	-.01	.13	.13	.02	-.05	.04	.18	-.13	-
11. $Hugs_{bp}$[8]	103	20.24	30.4	.02	.06	-.03	-.03	-.14	-.01	.04	-.16	.10	.003

Note: [1] 0=male 1=female, [2] Non-Latinx = 0, Latinx = 1, [3] 0 = stable childhood housing, 1= unstable childhood housing, [4] 0=no medication reported, 1=some medication, [5] 0= compliant, 1= non-compliant, [6] the daily deviation from the average percentage of hugs for all 3 days of sampling (wp= within person) [7] Values are natural log transformed, [8] the percentage of hugs across all the sampling days out of the EMAs they completed for all the sampling days (bp= between person)
**p > .01.
*p > .05.

Hugs and CAR

The analyses of the four models are detailed in Table 5. For Model 1, I examined the association between hugs and CAR the next day. CAR the next day was modeled as a function of the daily deviation from participants' own average hug percentage for all the study days (daily $hugs_{wp}$) and a residual component. As hypothesized, participants displayed lower CARs following days where they reported more hugs compared to their average number of hugs for all the sampling days (unstandardized coefficient = -.0005, SE= .0002, p = .011).

For Model 2, I added two additional variables to the model, participant sex and participant's average number of hugs for all the sampling days, both at Level 2. In this model, sex was a significant predictor of CAR, such that being female predicted a larger CAR (unstandardized coefficient = .02, SE= .007, p = .005). I found no association between participant's average percentage of hugs across all sampling days and CAR. Like Model 1, daily $hugs_{wp}$ significantly predicted lower next-day CARs (unstandardized coefficient = -.0004, SE= .0002, p = .034). This means that hugs were related to day-to-day variations in CAR but that individual differences in hugs were unrelated to CAR.

In Model 3, I added all covariates and potential confounds to the model, including sex and participant's average percentage of hugs for all the sampling days. At level 1 I added a daily compliance variable and participant's daily waking time. At level 2, I added SES, ethnicity, and medication use. None of these added variables bore a significant association with CAR. Like Model 2, sex and daily $hugs_{wp}$ predicted next day CARs. Females displayed larger next-day CARs (unstandardized coefficient = .02, SE= .007, p = .004) and daily $hugs_{wp}$ significantly predicted lower next-day CARs (unstandardized coefficient = -.0004, SE= .0002, p = .034).

For Model 4, I examined the association between hugs and CAR on the same day with participant sex and participant's average number of hugs for all the sampling days, both at Level 2. CAR the same day was modeled as a function of the daily deviation from participants' own average hug percentage for all the study days (daily $hugs_{wp}$) and a residual component. There was no significant relationship between CAR and hugs on the same day. Sex was a significant predictor of CAR, such that being female predicted a larger CAR (unstandardized coefficient = .018, SE= .007, p = .01). I found no association between participant's average percentage of hugs across all sampling days and CAR.

Table 5

Hierarchical Linear Models Predicting CAR by Hugging Percentage Using Full Information Maximum Likelihood Estimation

Fixed Effects	Next-day CAR						Same-day CAR	
	Model 1: Daily $Hugs_{wp}$		Model 2: With Sex and $Hugs_{bp}$		Model 3: All Covariates		Model 4: With Sex and $Hugs_{bp}$	
	Unstandardized Coefficient	SE	Unstandardized Coefficient	SE	Unstandardized Coefficient	SE	Unstandardized Coefficient	SE
Intercept	1.65**	.004	1.63**	.005	1.64**	.012	1.64**	.005
Daily $Hugs_{wp}$[1]	-.0005*	.0002	-.0004*	.0002	-.0004*	.0002	.003	.002
$Hugs_{bp}$[2]			-.00004	.0002	-.0005	.0001	-.0001	.0001
Sex[3]			.020**	.007	.020**	.007	.018**	.007
Ethnicity[4]					-.0058	.007		
Medication use[5]					-.018	.015		
SES[6]					.012	.008		
Compliance[7]					-.007	.010		
Waking time[8]					-.00006	.00005		

Note: [1] the daily deviation from the average percentage of hugs for all 3 days of sampling (wp= within person)
[2] the percentage of hugs across all the sampling days out of the EMAs they completed for all the sampling days (bp= between person)
[3] 0=male 1=female [4] Non-Latinx = 0, Latinx = 1, [5] 0=no medication reported, 1=some medication reported [6] 0 = stable childhood housing, 1= unstable childhood housing [7] 0= compliant, 1= non-compliant [8] Waking time was centered around 7:00am
**p > .01.
*p > .05.

Discussion

This study found that more hugs were associated with a smaller cortisol awakening response (CAR) the next day in a first-year college student sample. These findings are in line with previous ecological momentary assessment (EMA) and daily diary studies of HPA axis patterns and affectionate touch, such that increased affectionate touch is associated with reduced cortisol secretion. Previous laboratory studies indicate that affectionate touch from any individual, including a romantic partner, friend, or stranger may decrease hypothalamic activation (Coan et al., 2006) and HPA axis response to stressors (Ditzen et al., 2007; Goldstein et al., 2016). My study is the first to find evidence of this in CAR. I did not find a significant association of hugs on the same day as CAR. In line with previous findings (Stalder et al., 2016), I also found that females displayed higher daily CARs, compared to males.

My findings, obtained through EMA methods, complement and extend past research on the effects of affectionate touch on stress responses in the laboratory (Ditzen et al., 2007; Holt-Lunstad et al., 2008) and in daily life (Ditzen et al., 2008). Ditzen et al. (2008) found that in married couples, increased reports of daily physical intimacy, but not overall mean intimacy for the duration of their study was associated with reduced salivary cortisol secretion. Similarly, I found that smaller CARs were associated with more hugging the day before, but no evidence of an association with a persons' average hugging levels for the duration of the study. The study also extends the research on affectionate touch behavior since I measured affectionate touch as hugs, rather than including behaviors like kissing and hand-holding like those used in (Ditzen et al., 2007) and (Ditzen et al., 2008) that may be limited to the romantic relationship context.

This study is the first to assess associations between hugging and CAR as a marker of HPA axis function. Since the CAR value is made up of the waking and 30-minute post-awakening cortisol concentrations, it is measured before the experiences of the day. Other studies have found that CAR may be particularly responsive to social information. In adolescents, prosocial behaviors with friends are related to lower CARs the next day (Armstrong-Carter & Telzer, 2021). Similarly, reports of providing support to family members also predict lower CARs the next day (Armstrong-Carter et al., 2020). While I knew the specific affectionate touch behavior (hugging), I did not collect information on who the hugs were exchanged with, who initiated the hugs, and the participant's subjective meaning of the hug. To understand if hugs are a receipt of social support, the provision of social support, or a mutual exchange, future studies should collect information on the full context of the exchange. EMA methods like those used in the current study would provide a sufficient study method for accomplishing this, by including prompts about who and why the hugs took place.

The associations I found were specific to previous day CAR and hugs. I did not find that CAR and hugs were associated on the same day. Previous studies suggest that same-day associations may exist between cognitive functioning and CAR (Law et al., 2020; Shi et al., 2018). However, most studies on social functioning also find associations for CAR the next day and not on the same day as their social measures (for meta-analysis: Boggero et al., 2017). The mechanism for the effect of previous day social functioning and CAR is not currently known. However, some studies suggest that the CAR is influenced by sleep, with poorer sleep related to larger CARs the next day (Anderson et al., 2021; Vargas & Lopez-Duran, 2014). Anticipation of stress the following day may also influence the CAR, with more anticipatory stress for the next day predicting increased CARs the next day (Kramer et al., 2019). Considering this, affectionate touch may be acting as a stress-buffer since more hugs may remind people of the availability of their social support networks in helping them face stress. Future research should assess the effects of affectionate touch and other social behaviors on anticipatory stress, and subsequent CARs the next day.

Compared to previous literature on CAR, this sample represented a more ethnically diverse sample made up of primarily Latinx (62%) and Asian and Pacific Islander (19.4%) young adults. This is important due to potential cultural influences on hugging behavior. For example, increased affectionate behavior has been observed in Latinx communities, compared to European-American (Hall, 1966; Remland et al., 1995). These behavioral differences may have cultural and social underpinnings (Burleson et al., 2019; Triandis et al., 1984). While I did not find any association between ethnicity and CAR or daily hugging behavior in the current study, I conducted a more thorough investigation of the influence of acculturation in Latinx young adults on daily hugging behavior in Study 2 of this dissertation.

There were several limitations in this study. First, I was constrained to two days of data to model day-to-day variations in hugging and CAR. More consecutive days would increase my confidence in day-to-day variations. Second, findings from this study are cross-sectional. Future longitudinal research should examine whether daily variations in CAR are found to have similar patterns across multiple timepoints. Since the sample used for the study has a second timepoint, future analyses will allow us to address this question. Lastly, although the focus of the current study was hugging, a review of the literature suggests that multiple acts of affectionate touch may influence stress responsive systems. For example, physical intimacy in romantic couples including massages may down-regulate multiple stress systems (Holt-Lunstad et al., 2008). While there is some precedence for using hugs specifically as an easily reported measure of affectionate touch (Murphy et al., 2018), future studies should allow for reports of all affectionate touch behaviors, which may vary between people and in the context of different social relationships.

These findings contribute to Jakubiak & Feeney's (2016) model of affectionate touch. Their model posits that reduced stress and stress reactivity is a potential mechanism through which affectionate touch impacts relational, psychological, and physical well-being. However, the model doesn't specifically include the HPA axis or the mechanisms through which affectionate touch impacts this system. My study presents a novel association between affectionate touch and CAR the next day, which supports other findings on HPA axis responsivity to affectionate touch. Jakubiak & Feeney's (2016) model could be improved by the inclusion of HPA axis function as a pathway. Furthermore, this pathway should also connect to "interpretation of the touch." As previously theorized, CARs may be a measure of the amount of stress anticipated for the day. Thus, the interpretation of the affectionate touch may influence the perception of stress and the HPA axis.

Overall, these findings complement and build on previous research findings that affectionate touch influences HPA axis functioning, by adding the finding that lower CARs are associated with more hugging the previous day. Considering the Generalized Unsafety Theory of Stress (GUTS) (Brosschot et al., 2018), affectionate touch may act as a safety cue that is considered when anticipating stress for the next day. This reduction in anticipation of stress may result in a decrease in perceived energetic demand for the next day, reflected in reduced CARs. Future studies should unpack this potential pathway by investigating the effect of affectionate touch on subjective stress measures and anticipatory stress measures. To allow further interpretations about support provided or received, more context on the affectionate touch behavior should be measured, including hugging partners and the subjective meaning of the hug.

Study 2: The Relationship Between Changes in Hugging Behavior and Changes in Acculturation over the First Year of College for Latinx Students

In Study 1 I found that on days when people reported more hugs, they experienced smaller CARs the next day, indicating that more affectionate touch may provide safety signals to the brain that promote lower production of the stress responsive hormone, cortisol. However, returning to Jakubiak & Feeney's (2016) model of affectionate touch, a persons' personal, situational, and cultural factors influence the effect that affectionate touch has on the interpretation of touch, relational-cognitive changes, and well-being outcomes. For the second study of this dissertation, I assessed freshman students who identified as Latinx[3] to assess how personal, situational, and cultural factors influence hugging behavior.

For many students, college may represent the first time they are living outside of their family context. Thus, for students with non-American or non-white backgrounds, this may represent a time when their cultural and situational factors that influence affectionate touch behavior change. In 2011, a survey across 30 colleges and universities showed that 26% of the student population was raised by foreign-born parents (Schwartz et al., 2011). However, despite the growing population of first- and second- generation immigrant students, most staff and faculty at certain universities remain European-American. For example, within the University of California (UC) system, over half of the faculty and staff identify as U.S. born white (UC Regents, 2015).

Culture is defined as a dynamic system that provides the information and knowledge needed to skillfully navigate one's social environment (Dressler & Jaskyte, 2004; Kitayama, 2002). For many, culture acts as a gauge for what is considered "normal" (Kim & Lawrie, 2019).

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[3] A person of Latin American origin or descent (used as a gender-neutral or nonbinary alternative to Latino or Latina).

Although culture can define nonethnic and nonnational groups (i.e. social classes, religions), it is often used to describe groupings of people by ethnicity and/or geography. Culture plays an important role in relationships, and the key constructs that define cultural research involve the interactions between people.

Although there are norms and cultural scripts that exist within groups of people, individuals within groups have a unique relationship to their own culture. Furthermore, an individual's identity may change as their cultural and social context changes. Acculturation is the process that occurs when two groups of people with differing cultural identities come into continuous first-hand contact, which results in subsequent changes in the cultural patterns of either or both groups (Sam & Berry, 2010). At the individual level, acculturation refers to the changes in attitudes, behaviors, beliefs, and values that result from encountering a different culture.

Acculturation does not occur on a linear scale, with a person moving along an axis from one culture and becoming more like another culture. Rather, bicultural individuals may simultaneously hold cultural values from two or more different cultures. For example, the Acculturation Rating Scale for Mexican Americans (ARSMA-II), one of the most common acculturation assessment scales for Latinx and/or Hispanic populations, takes an orthogonal approach with four quadrants to allow for high or low identification with Mexican culture and high or low identification with European-American culture (Cuellar et al., 1995).

Acculturation is not limited to foreign-born immigrants; second-generation immigrants raised by foreign-born parents grow up in family contexts where the heritage culture is present in their home. Many second-generation immigrants are connected to their family's home countries through visits to the country of origin, stories, and frequent communication with relatives abroad (Kasinitz, Mollenkopf, Waters, & Holdaway, 2008; Portes & Rumbaut, 2006). Second- and first-generation U.S. immigrants balance their own cultural heritage with the U.S. mainstream culture around them (Schwartz & Unger, 2010).

As a potentially culturally driven interaction, affectionate touch behavior and norms vary between cultures and geographic regions. In some cultures, failing to greet someone with a kiss may be considered a violation of a social norm, or be viewed as a social slight. However, in other cultural contexts, kissing as a first-time greeting may be considered highly invasive. In questionnaire studies, compared to European-Americans, Hispanic-Americans are more likely to endorse physical embraces as their way of showing affection (Triandis et al., 1984), and are more likely to report personal comfort with affectionate touch (Burleson, Roberts, Coon, & Soto, 2018).

The findings on positive attitudes toward affectionate touch in Latinx participants are reflected in observational studies. In one study, couples' touching behavior was compared between Britain and Puerto Rico. The researchers found that couples in Puerto Rico engaged in more physical affection and casual touching (Jourard, 1966). In another observational study of 22 Asian and Latinx subjects, Latinx male-female dyads were more likely to embrace on a college campus than Asian male-female dyads (Regan et al., 1999). When viewing touching behavior in a school setting, Latinx people were more likely to view a teacher touching a pupil as appropriate compared to their Anglo counterparts (Guegen, 2004).

Norms and cultural scripts within Latinx cultures related to emotional expression and interpersonal contact may explain the higher observed rates of affectionate touch. Simpatía is a Spanish term that has no direct English translation. Like schadenfreude or hygge, the lack of a perfect translation of simpatía into English highlights the cultural embeddedness of the term. Simpatía is defined as the emphasis on creating and expressing emotional positivity and avoiding negativity in the service of smooth and enjoyable social interactions (Triandis et al., 1984).

Simpatía is established as a key component of Latinx culture and indeed, in studies comparing Latinx individuals and individuals from other ethnic groups, Latinx individuals endorse simpatía higher than non-Latinx individuals (Holloway et al., 2009). However, although simpatía is defined by warmth and positivity in relationships, it has not been directly linked to affectionate touch attitudes or behaviors.

In addition to the impact of culture or geographic region of origin on affectionate touch norms, there is also variability in affectionate touch preference for individuals. In one study, while higher acculturation to European American culture was related to decreased personal comfort with affectionate touch, the correlation was small $r = -.14$ (Burleson et al., 2019). This suggests that an individual's comfort with affectionate touch and their cultural identification may influence their affectionate touch separately. A lack of well-validated measures of personal comfort with affectionate touch may also play a role in this derisory association. A Latinx person can be a part of a community in which expectation and comfort with affectionate touch is high, while holding their own individual preferences for affectionate touch. However, despite there being both cultural and individual differences in affectionate touch preference and potentially behavior, in studies comparing cultural norms, individual differences are often not measured and sometimes not even discussed. Furthermore, the context in which an individual resides can also greatly influence their attitudes toward affectionate touch in social exchanges. For example, compared with Mexicans, Chileans, or Spaniards living in their countries of origin, both Hispanic Americans and European Americans were less likely to endorse greeting with a kiss as important for good communication (Johnson, Lindsey, & Zakahi, 2001).

The current study is a longitudinal examination of acculturation and hugging behavior. Prior studies have established a cross-sectional relationship between acculturation and attitudes toward affectionate touch, with higher acculturation to Anglo culture predicting decreased comfort with affectionate touch. However, acculturation is not a fixed trait. It is the result of a continuous process that occurs in response to adjustments in the cultural environment. Thus, to properly examine the relationship between acculturation and affectionate touch, it is important to measure if changes in acculturation result in changes in affectionate touch. Furthermore, the transition to college may pose an opportunity for acculturation since the cultural context may not match the home context. I hypothesized that acculturation would change over the first year of college, characterized by decreases in Latinx acculturation and increases in Anglo acculturation. I hypothesized that those changes would predict changes in hugging behavior, with decreases in Latinx acculturation and increases in Anglo acculturation predicting decreases in hugging behavior. (See Figure 1a). To account for the home context, the effect of the demographics of the home community on changes in hugging behavior were be assessed. To assess participants' identification with the specific Latinx cultural value simpatía, the effect was similarly tested as an effect on changes in hugging behavior. Personal attitudes toward affectionate touch were also considered in the study, as a potential factor that influences the changes in hugging behavior (See Figure 1b). My ultimate plan is to assess all these factors in one moderated mediation model, however due to limitations in my preferred statistical package, I assessed separate mediation and moderation models.

Figure 1a
Conceptual Diagram for Multiple Mediator Model

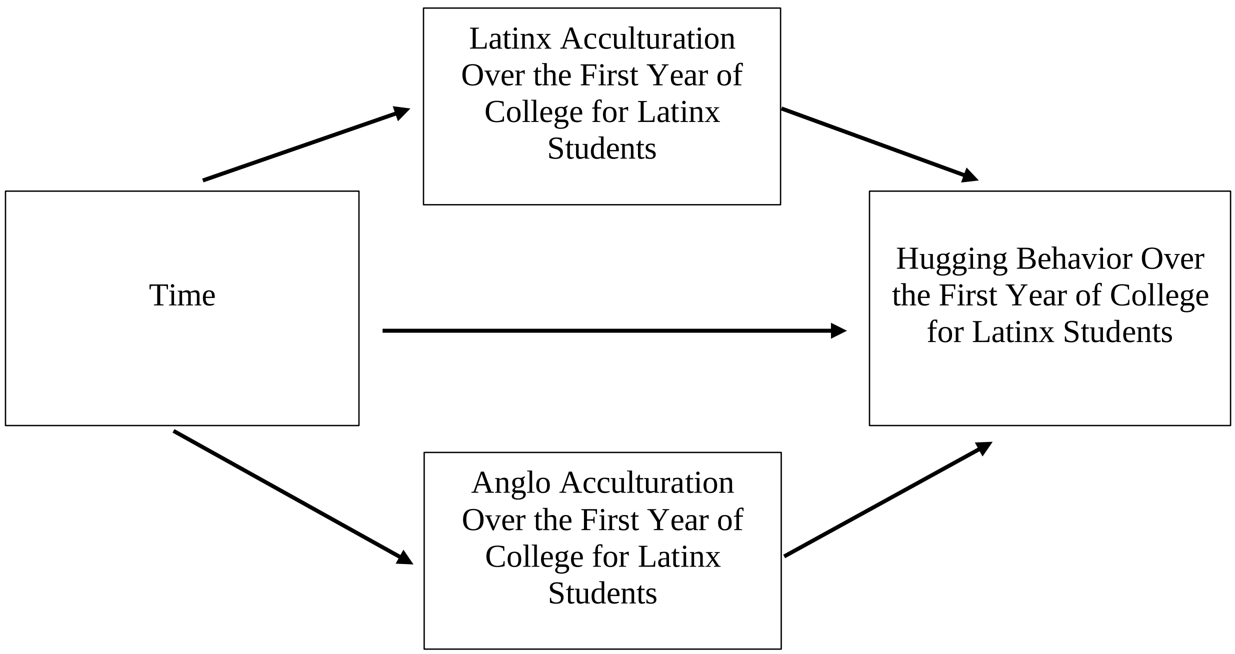
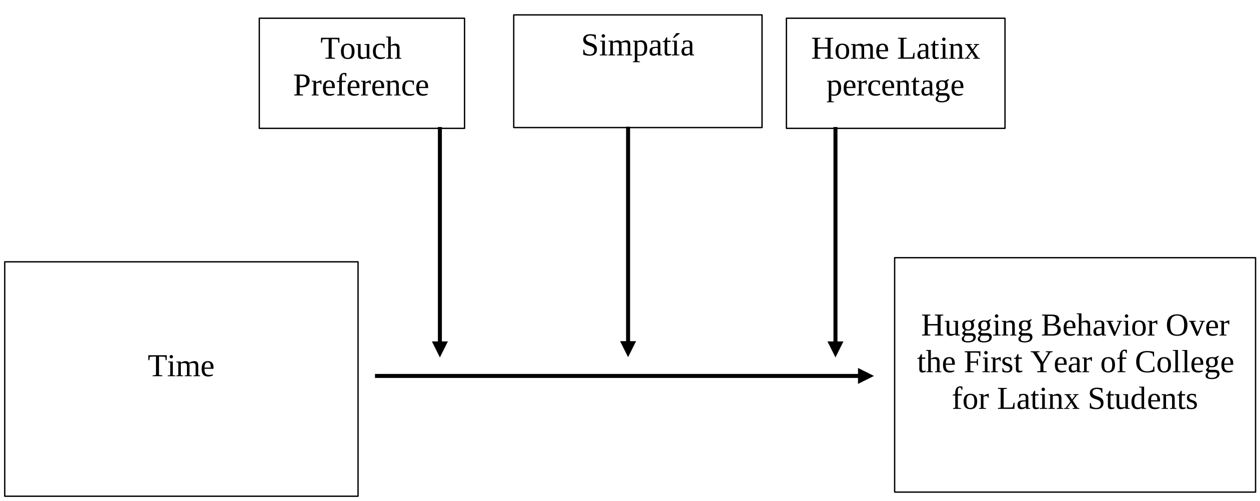


Figure 1b
Conceptual Diagram for Moderation Model



Study 2 Method

Participants

The participants in this study are a subsample of students who self-identified as Hispanic and/or Latinx from the larger study described in Study 1.

At Timepoint 1, 176 Hispanic and/or Latinx students were recruited. Only those participants who completed at least one EMA at both timepoints are included in this current sample (N = 81), since the primary aim was to assess change between the timepoints. All participants from timepoint 1 were contacted to complete timepoint 2 measures, however, there was still attrition between sampling timepoints (N = 95). One potential cause of attrition has been identified at Merced. During spring semester, one of the dormitory buildings flooded and all students residing in this building were required to move out. The dormitory manager informed the study team that this caused many students to move home and discontinue their education for the semester.

Most of the sample identified as Mexican (86.4%), although Puerto Rican, Cuban, and other South/Central American cultural backgrounds are also represented in the sample (13.6%). Participants were primarily born in the United States, (N = 73, 90%) and their home communities ranged in Hispanic and/or Latinx population percentage from 12-97% (M = 62.60, SD = 24.09). Of those participants born outside the U.S. (8, 9.9%), the average amount of time they had resided in the U.S. was about 12.63 years (range= 5-18 years, SD=3.73).

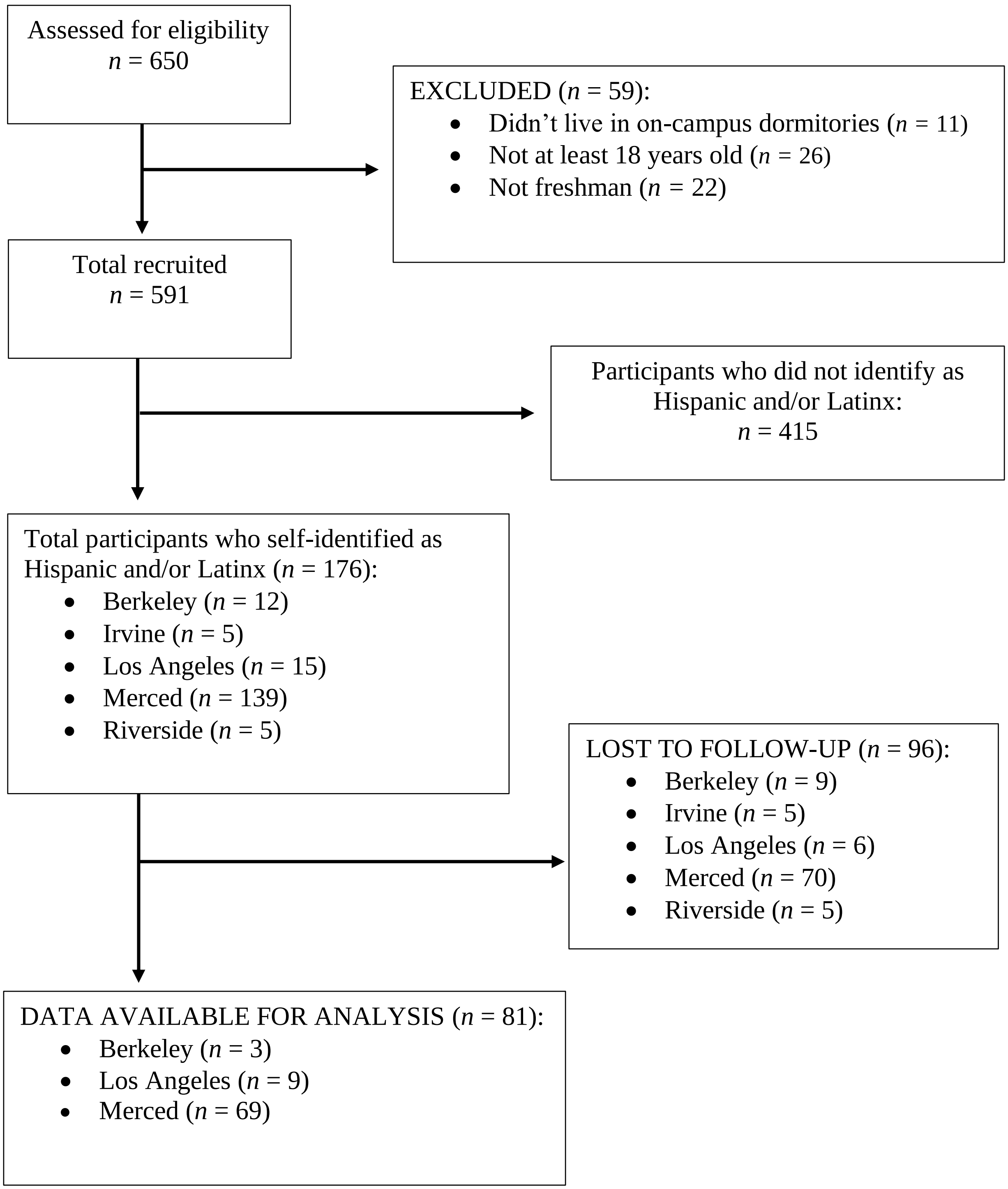
Table 1

Sample Demographics

Variable	Categories	N	%
Sex	Female Male Unidentified	53 27 1	65.4 33.3 1.2
Age	18 years old 19 years old	73 8	90.1 9.9
Ethnicity	Mexican Other Latinx	70 11	86.4 13.6
Campus	Berkeley Los Angeles Merced	3 9 69	3.7 11.1 85.2
U.S. born	US born Non-US born	73 8	90.1 9.9
Childhood Housing Situation	Unstable Parents rented Parents owned then rented Parents rented then owned Parents owned home	3 42 4 7 25	3.7 51.9 4.9 8.6 30.9
Student Status	First Generation Non-First Generation	69 12	85.2 14.8

Figure 2

Flow Diagram of Participant Inclusion



Procedure

Procedures were identical to those described in Study 1. However, the current study included a survey battery of self-report questionnaires at both timepoints in addition to the EMA sampling. The entire survey battery took approximately 35-45 minutes to complete and included demographics questions, measures of physical, social, and emotional functioning and well-being, and other questionnaires. The acculturation and simpatia questionnaires were included in this survey battery. Home zip codes were requested in a later survey and were used to locate information regarding the Latinx demographic of participants' home communities. An identical survey battery was administered at both timepoints, along with the EMA prompts described in Study 1.

Materials

Acculturation Questionnaire. Participants completed the Brief Acculturation Rating Scale for Mexican Americans-II (BARSMA-II), a 12-item scale for assessing Latinx orientation and Anglo orientation (derived from Cuellar et al., 1995). Five items assessed Latinx orientation, and seven items assessed Anglo orientation (Appendix A). While the BARSMA-II was developed for Mexican individuals. There is also evidence of validity in other Latinx samples, including Puerto Rican, Cuban, and Central/South American (Torres et al., 2012).

Participants who indicated that they identify as Hispanic and/or Latinx who also endorsed that they spoke Spanish were prompted to complete the BARSMA-II. The five items used to assess Latinx orientation included items like "I enjoy Spanish TV" and "I think in Spanish." The seven items used to assess Anglo orientation included items like "I enjoy speaking English." and "I have a lot of Anglo friends" (Appendix A). Respondents rated items on a 5-point scale ranging from 1 "Not at all" to 5 "Almost always." The final scores are calculated by creating an average Latinx acculturation and an average Anglo acculturation score. This is obtained by adding the raw scores for each item and dividing by the number of items for both the Latinx orientation and the Anglo orientation scales.

In the current sample (Timepoint 1, *N* = 81, Timepoint 2, *N* = 78), Latinx acculturation scores ranged from 1.20 to 5 at Timepoint 1 (*M* = 3.56, SD = 1.03) and 1-5 at Timepoint 2 (*M* = 3.65, *SD* = 1.07). Anglo acculturation scores ranged from 2.86 to 4.71 at Timepoint 1 (*M* = 3.83, *SD*= .436) and 2.14 to 5 at Timepoint 2 (*M* = 3.71, *SD* = .527).

Touch Preference Questionnaire. Participants completed the Social Touch Questionnaire (STQ), a 20-item scale meant to assess their personal preference for touch (Wilhelm et al., 2001). Respondents rated items on a 5-point scale ranging from 0 “Not at all” to 4 “Extremely.” The sum of the items ranged from 0 to 80, with higher scores on this measure indicating increased preference for affectionate touch. The STQ is correlated with a measure of social anxiety, the Social Phobia and Anxiety Inventory (*r* =.59), with lower social anxiety correlated with higher scores on the STQ (higher individual preference for affectionate touch) (Wilhelm et al., 2001). In the current sample, scores on the STQ ranged from 1.83 to 4.33 (*M* = 2.97, *SD* = .473).

Simpatía Questionnaire. Respondents evaluated the importance they place on different aspects of simpatía in the 10-item simpatía scale initially developed by Griffith, Joe, Chatham, & Simpson (1998) and shortened and validated in a 10-item scale (Sotomayor-Peterson et al., 2012, 2013). Respondents rated items on a five-point scale ranging from 1 “not important” to 5 “extremely important,” with higher scores reflective of higher importance. The 10 items were averaged for a final score between 1 and 5.

Due to errors in the online administration of this survey at UC Merced, self-reported simpatía is missing for 48 participants (N = 33). Scores ranged from 2.40 to 5 (M = 3.86, SD = .50).

Home Community Latinx Demographic Percentage. A subsample of participants (N = 75) reported their home zip code. I used 2020 census data to obtain the ethnic percentage breakdown of the zip codes provided by participants. The percentage of Latinx individuals residing in the home zip codes of participants ranged from 12% to 97% (M = 62.60%, SD = 24.10).

Ecological Momentary Assessment. The EMA methods used in Study 2 were the same as those described in Study 1. The first EMA sampling occurred during the first week of classes at Merced and between the first and the third week at Los Angeles and Berkeley. The sampling days of the week were Tuesday, Wednesday, and Thursday at all 3 campuses. At the second EMA timepoint, participants completed EMA prompts at the end of the semester or quarter. Samples were not requested during finals week to avoid the stress that may occur for students during finals week.

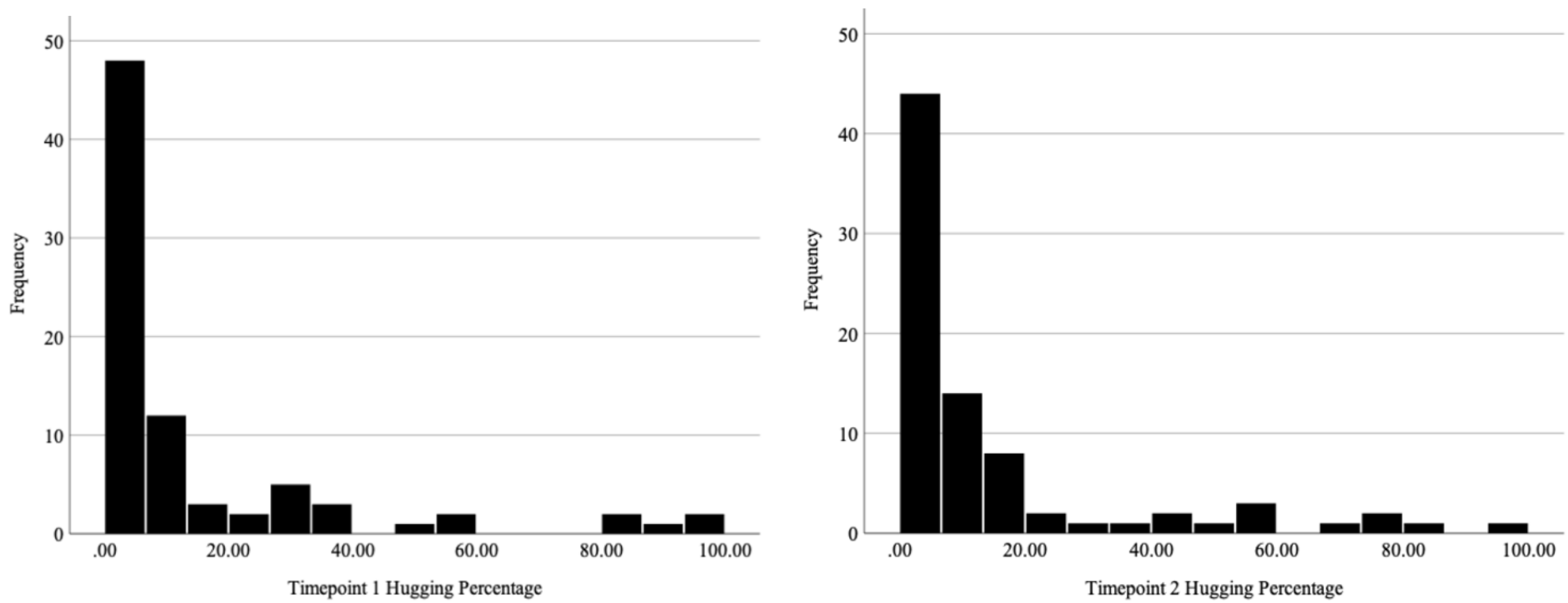
Hugging. Participants were asked if they had hugged anyone since their last EMA prompt. Response scale was *Yes* or *No*. Participants' responses were aggregated into one score for each timepoint. *Yes* was scored as 1 point, and *No* as 0. Those values were summed across the 3 days for timepoint 1 and timepoint 2. At each timepoint, this summed value was divided by the number of samples the participant completed then multiplied by 100 to create a percentage score. For example, someone with perfect compliance, who reported hugging at every EMA prompt across the 3 days at timepoint 1 would have a score of 15/15 or 100% for timepoint 1. For someone who reported hugging at 9 prompts and completed 12 total prompts their score would be 9/12 or 75%.

The same aggregation method was used at timepoint 2. Thus, participants have one hugging score for each timepoint.

On average, participants reported hugging in 26.82% of the prompts at timepoint 1 (SD = 37.27) and 13.5% of the prompts at timepoint 2 (SD = 22.79). On average, participants completed 9.83 out of 15 EMA prompts (SD = 3.74) at timepoint 1 and about 9.32 (SD = 3.92) at timepoint 2. Hugging percentage was significantly correlated between timepoint 1 and timepoint 2, $r(81) = .276$, $p = .013$). The amount of hugs reported was significantly correlated with the amount of EMAs prompts completed at timepoint 1, $r(81) = .465$, $p > .001$) but not at timepoint 2, $r(81) = .191$, $p = .088$.

Figure 3

Timepoint 1 and 2 Hugging Percentage Distribution



Note. Hugging percentage was calculated by summing each EMA response across the 3 days, dividing by the number of samples the participant completed, then multiplying by 100.

Study 2 Results

Descriptive Statistics and Correlations for All Study Variables

Table 4 includes the means, standard deviations, and correlations between all study variables. Latinx acculturation scores at Timepoint 1 were significantly correlated with Latinx acculturation scores at Timepoint 2 $r(78) = .85$, $p <.001$. Anglo acculturation scores at Timepoint 1 were also significantly correlated with Anglo acculturation scores at Timepoint 2 $r(78) = .25$, $p = .03$. However, Latinx and Anglo acculturation scores were not significantly correlated at Timepoint 1, $r(81) = .20$, $p = .07$ or at Timepoint 2, $r(78)$, $= .06$, $p = .60$. Timepoint 1 Latinx acculturation was not significantly correlated with Latinx acculturation change from Timepoint 1 to Timepoint 2. However, Latinx acculturation at Timepoint 2 was significantly correlated with Anglo acculturation change from Timepoint 1 to Timepoint 2.

Simpatía was not significantly correlated with Latinx or Anglo acculturation in the sample, at Timepoint 1 or Timepoint 2. Since simpatía was missing for a subsample of participants, I assessed if there were systematic differences between those participants who were missing simpatía compared to those who were not on all the variables used in the study. There were no significant differences between those who completed the simpatía questionnaire and those who did not on any of the variables used in the final models of the study.

Acculturation scores at Timepoint 1 did not differ for participants born inside of the United States and outside of the United States, on Anglo acculturation, $t(78) = -.75$, $p = .46$, or Latinx acculturation, $t(78) = -.61$, $p = .54$. Timepoint 1 acculturation scores were also not significantly correlated with participants' home Latinx and/or Hispanic demographic percentage, $r(73) = .22$, $p = .06$). Students at Merced had significantly lower Anglo acculturation scores at Timepoint 1 compared to students from Berkeley and Los Angeles, $F(2, 79) = 5.90$, $p = .02$. Females had higher

Latinx acculturation scores at both Timepoint 1, $F(2, 79) = 10.42$, $p = .001$ and Timepoint 2, $F(2, 79) = 10.85$, $p = .002$.

Latinx and Anglo acculturation did not significantly change between timepoints, respectively, $F(1, 77) = 1.01$, $p = .32$, $F(1, 77) = 3.25$, $p = .08$. Latinx and Anglo acculturation scores at Timepoint 1 were not significantly correlated. However, the change in Latinx and Anglo acculturation between Timepoint 1 and Timepoint 2 was significantly correlated, $r(78) = .41$, $p<.005$.

Hugging percentage at Timepoint 1 was significantly correlated with hugging percentage at Timepoint 2 $r(81) = .44$, $p<.001$ and the change in hugging percentage from Timepoint 1 to Timepoint 2 $r(81) = -.53$, $p<.001$. Latinx acculturation change was significantly correlated with hugging percentage at timepoint 1 $r(78) = .25$, $p<..03$, and the change in hugging percentage from Timepoint 1 to Timepoint 2 $r(78) = -.24$, $p<.032$. Hugging percentage did not significantly change between timepoints, $F(1, 80) = .02$, $p = .89$.

Table 4

Means, standard deviations, and correlations between all study variables

	N	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Sex[1]	80	-	-	1												
2. Home Latinx demographic	75	62.60	24.10	.003	1											
3. Campus [2]	81	-	-	.004	-.38**	1										
4. Touch Preference	80	2.97	.47	-.07	-.08	.06	1									
5. Simpatia	33	3.87	.50	.304	-.05	.17	.16	1								
Timepoint 1																
	N	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
6. Latinx acculturation	81	3.57	1.03	.35**	-.22	.102	.01	.24	1							
7. Anglo acculturation	81	3.83	.44	.06	-.04	.26*	.14	.33	.20	1						
8. Hug %	81	13.94	24.83	-.10	-.02	-.13	.14	.04	-.13	.02	1					
Timepoint 2																
	N	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
9. Latinx acculturation	78	3.65	1.08	.36**	-.25*	.16	.04	-.01	.85**	.07	.02	1				
10. Anglo acculturation	78	3.71	.53	.01	-.13	.11	-.10	-.17	-.07	.25*	.03	.06	1			
11. Hugs %	81	13.54	22.80	-.07	.08	-.03	.19	.003	-.13	-.07	.44*	-.11	-.03	1		
Change Scores																
	N	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
12. Latinx acculturation	78	.06	.59	.086	-.08	.08	.02	-.42*	-.19	-.28*	.25*	.36*	.23*	.01	1	
13. Anglo acculturation	78	-.12	.59	-.06	-.09	-.07	-.17	-.35*	-.23*	-.51**	.04	.002	.71**	.03	.41**	1
14. Hugs %	81	-3.08	25.06	-.04	.18	-.16	-.04	.01	-.06	-.11	-.53**	-.19	-.07	.41**	-.24*	.01

Note. [1] 0=male 1=female, [2] Merced= 0, Non-Merced (Los Angeles and Berkeley)= 1.
** $p < .01$.
* $p < .05$.

Figure 3a

Latinx Acculturation Change by Individual Participants

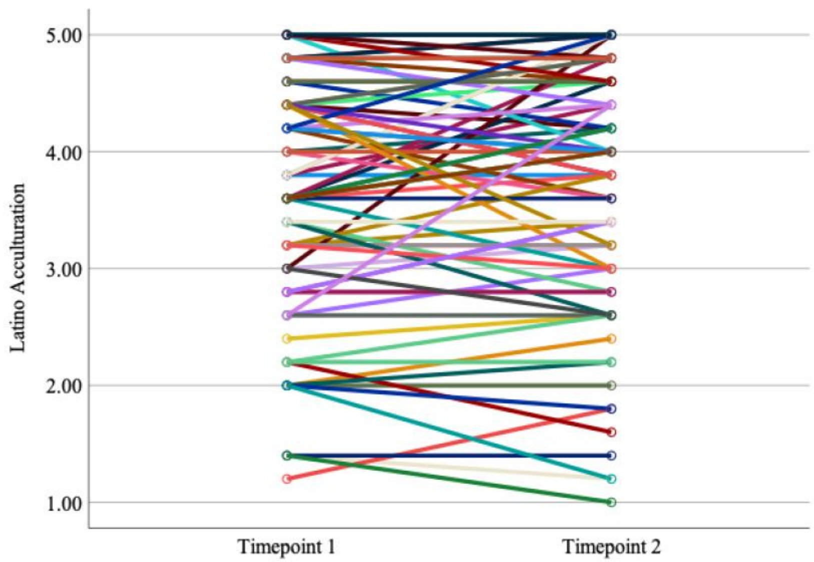
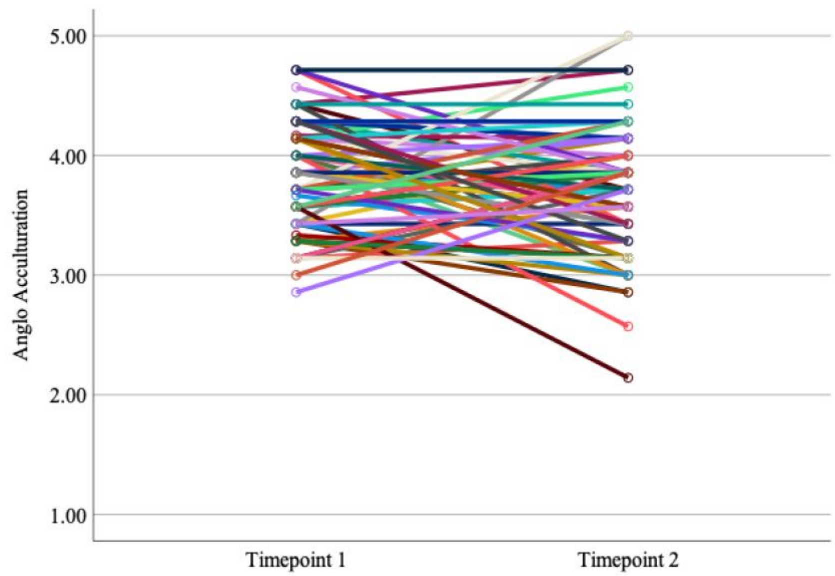


Figure 3b

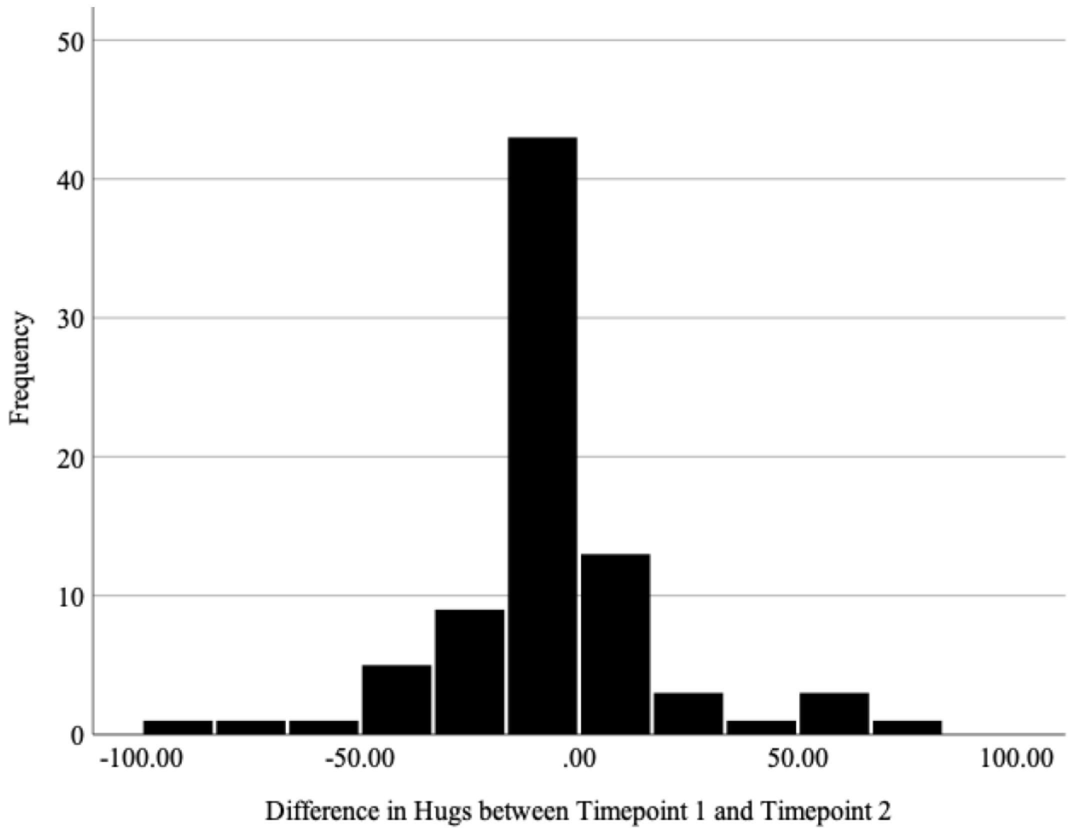
Anglo Acculturation Change by Individual Participants



The histogram of the hugging percentage change from Timepoint 1 to Timepoint 2 indicates a unimodal distribution. No covariates were included in the model since all individual differences should not have changed between timepoints (Montoya, 2019).

Figure 7

Hug Percentage Change from Timepoint 1 to Timepoint 2



Mediation and Moderation Analyses

I estimated a multiple mediator model and a moderation model for repeated measures using the "Mediation and Moderation in Repeated-Measures Designs" (MEMORE) (akmontoya.com) macro for SPSS. This outcome for both models is the difference in *Y (hugging)* between the timepoints. The multiple mediator model for repeated measures (Montoya & Hayes, 2017) was used to estimate how changes in Latinx and Anglo acculturation predict the difference in hugging. The moderation model for repeated measures (Montoya, 2019) was used to estimate how the difference in hugging depends on individual affectionate touch preference, simpatía, and the percentage of Hispanic and/or Latinx people in the home zip code. Since the repeated measures mediation and multiple moderator methods used in this study are relatively new procedures, I have provided the associated equations (Equation 1 and 2), tables with equation interpretations (Table 2 and 3), and both the path (Figure 1a and 1b) the statistical path diagrams (Figure 2 and 3).

Equation 1 represents the multiple mediator model for repeated measures, where total (*c*), direct (*c*'), and indirect effects were estimated through both Latinx (a_1b_1) and Anglo acculturation (a_2b_2). Using this model, I obtained estimates of indirect effects for both Latinx and Anglo acculturation and each indirect effect without the effects being confounded with the indirect effect of the other acculturation measure. Since this is a two-timepoint within-participant design, acculturation was the difference between measurements of the same mediator (Latinx or Anglo) between timepoints. This model employs a path analytic framework using OLS regression, with a significant indirect path from X to Y indicating a statistically significant mediation, opposed to earlier models that require estimation of each of the pathways to test for mediation (Judd, Kenny, & McClelland, 2001). The X or "predictor" in the mediation equation is non-existent in the data, rather, the effect of X is carried in the difference scores between timepoint 1 and timepoint 2 and is denoted in the conceptual diagrams as "time" (See Figure 1a). I used the bootstrapped confidence intervals method from 5000 bootstrap samples for determining significance of the indirect effect. Coefficients for Equation 1 are displayed in statistical diagram form in Figure 2 and are interpreted in Table 2.

Equation 1

$$Y_{hugs2i} - Y_{hugs1i} = c + e_{yi} \qquad \text{(a)}$$

$$M_{LA2i} - M_{LA1i} = a_{1i} + e_{M1i} \qquad \text{(b)}$$

$$M_{AA2i} - M_{AA1i} = a_{2i} + e_{M2i}$$

$$Y_{hugs2i} - Y_{hugs1i} = c' + b_1 (M_{LA2i} - M_{LA1i}) + b_2 (M_{AA2i} - M_{AA1i}) + \qquad \text{(c)}$$

$$d_1 \left(0.5(M_{LA1i} + M_{LA2i}) - [\overline{0.5(M_{LA1i} + M_{LA2i})}]\right) + d_2 \left(0.5(M_{AA1i} + M_{AA2i}) - [\overline{0.5(M_{AA1i} + M_{AA2i})}]\right) +$$

$$e_{yi^*}$$

Note: Latinx Acculturation is denoted by *LA*, Anglo Acculturation is denoted by *AA*
*Not the same as other e_{yi}

Equation 2 represents the additive moderation model for repeated measures that was used to assess and probe interactions between time and individual touch preference, simpatia, and the home Latinx demographic. I determined to use the pick-a-point approach for probing significant interactions. Coefficients for Equation 2 are displayed in statistical diagram form in Figure 3 and are interpreted in Table 3.

Equation 2

$$Y_{hugsi2} - Y_{hugsi1} = b_{02} - b_{01} + (b_{12} - b_{11}) W_{TP1i} + (b_{22} - b_{21}) W_{S2i} + (b_{32} - b_{31}) W_{HLD3i} + e_{i2} - e_{i1} \qquad \text{(a)}$$

$$Y_{Di} + b_0 + b_1 W_{TP1i} + b_2 W_{S2i} + b_3 W_{HLD3i} + e_i \qquad \text{(b)}$$

Note: Touch preference is denoted by *TP*, Simpatia is denoted by *S*, Home Latinx Demographic is denoted by *HLD.*

Mediation Model

The effects and interpretations for the multiple mediation model for repeated measures are detailed in Table 2 and the paths are in statistical diagram form in Figure 2. Results for the total effect, indirect, specific indirect and direct effects will be discussed, then, the a and b paths. A paths are the effects of time on the mediators. B paths are the effects of the mediators on the outcome, controlling for time.

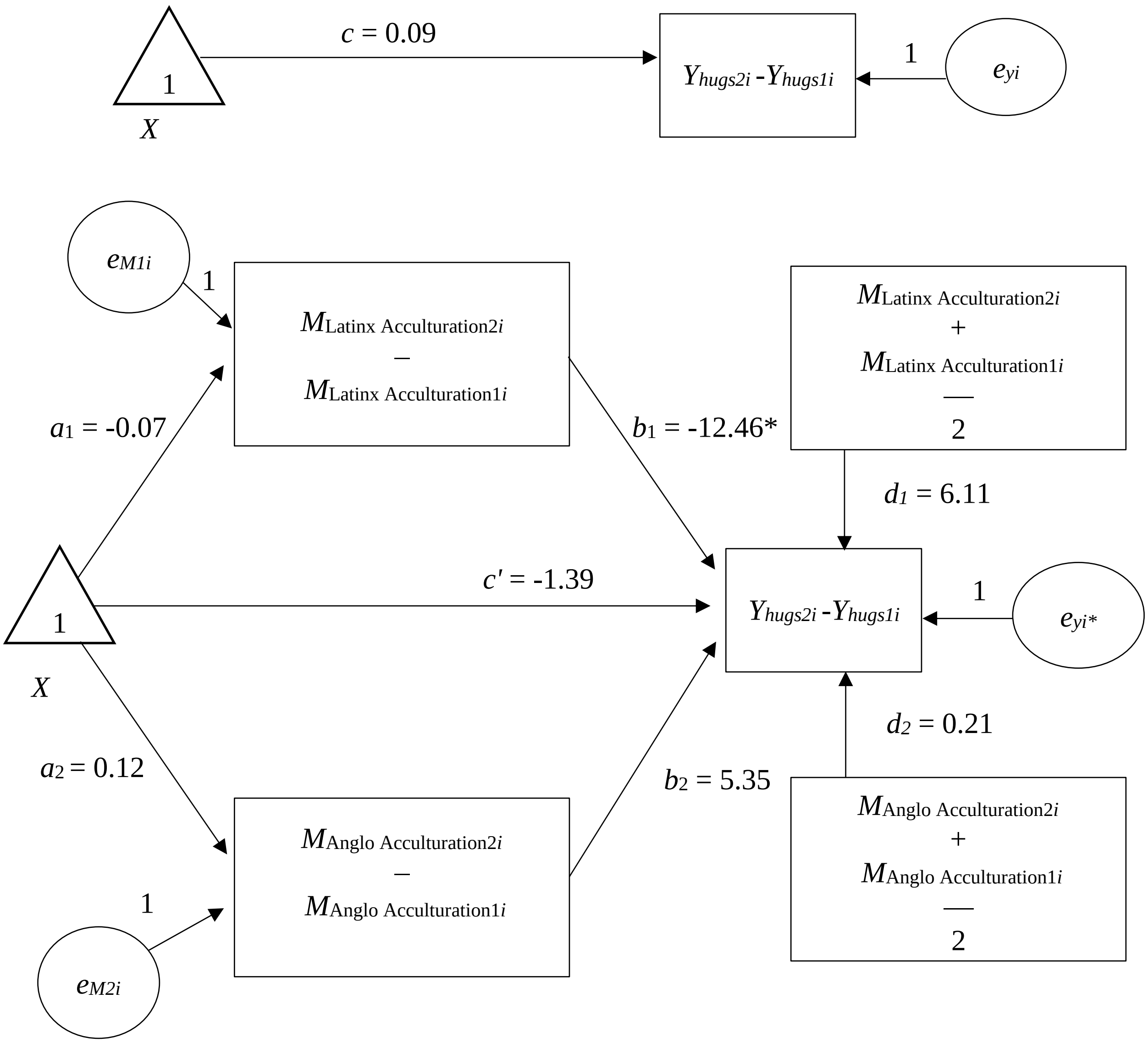
I did not find evidence that the total effect of hugs was different from 0, c = .09, 95% CI [-5.6, 5.8]. Meaning, I did not find evidence that the percentage of hugs changed from timepoint 1 to timepoint 2. This was also the case when controlling for Latinx and Anglo acculturation in the direct effect, c'= -1.39, 95% CI [-7.30, 4.52].

I also did not find evidence for the total indirect effect, the sum of the two indirect effects, coefficient = 1.48, 95% bootstrap CI [-.41, 4.31]. When broken down into the specific indirect effects of Anglo and Latinx acculturation, controlling for the effect of the other mediator, neither specific indirect effect was significantly different from 0, Latinx coefficient =.83, 95% CI [-.82, 3.36], Anglo coefficient = .65, 95% CI [-.56, 3.07].

The effect of time on acculturation was not different from 0, a_1 (Latinx) = -.07**,** a_2 (Anglo) = .12, thus I did not find evidence that acculturation changed between timepoints. However, the effect of Latinx acculturation on hugs was different from 0, coefficient = -12.46, 95% CI [-23.31, -1.60], $t(73) = -2.29$, $p = .025$. This suggests that as Latinx acculturation increased, hugging behavior decreased between the timepoints or with every one unit increase in Latinx acculturation score, we would expect a 12 percentage point decrease in hugs. The effect of Anglo acculturation on hugs was not different from 0 (coefficient = 5.35, 95% CI [-5.61, 16.31]).

Figure 2

Statistical Diagram Demonstrates the Mediated Path (M to Y) Represented by Figure 1b Path Diagram



Note. *Not the same as other e_{yi}

Table 2

Multiple Mediation Model for Repeated Measures Effects and Interpretations

Variable	Effect	Interpretation
a_1	-.067	The effect of time on Latinx acculturation
a_2	0.12	The effect of time on Anglo acculturation
b_1	-12.46*	The effect of Latinx acculturation on change in hugs, controlling for Anglo acculturation
b_2	5.35	The effect of Anglo acculturation on change in hugs, controlling for Latinx acculturation
c'	-1.39	Direct effect of time on hugs
c	0.09	Total effect of time on hugs
a_1b_1	0.83	Specific indirect effect of time on hugs through Latinx acculturation
a_2b_2	0.65	Specific indirect effect of time on hugs through Anglo acculturation
$a_1b_1+a_2b_2$	1.48	Total indirect effect of time on hugs through acculturation
d_1	6.11	How much the effect of Latinx acculturation on hugs differs between Timepoint 1 and Timepoint 2
d_2	0.21	How much the effect of Anglo acculturation on hugs differs between Timepoint 1 and Timepoint 2

Moderation Model

The effects and interpretations for the additive moderator model for repeated measures are detailed in Table 3 and the paths are in statistical diagram form in Figure 3. Results for each of the effects of the moderators on the relationship between time and outcome are discussed below.

I did not find evidence for a significant effect of any of the proposed moderators. The effect of touch preference on hugging behavior change was non-significant, coefficient = -4.48, 95% CI [-19.94, 10.98]. The effect of simpatía on hugging behavior change was non-significant, coefficient = -.40, 95% CI [-19.38, 18.52]. The effect of the Latinx home demographic on hugging behavior change was non-significant, coefficient = -.08, 95% CI [-.46, .30].

Figure 3

Statistical Diagram Demonstrates the Moderated Paths (W to Y) Represented by Figure 1b Path Diagram

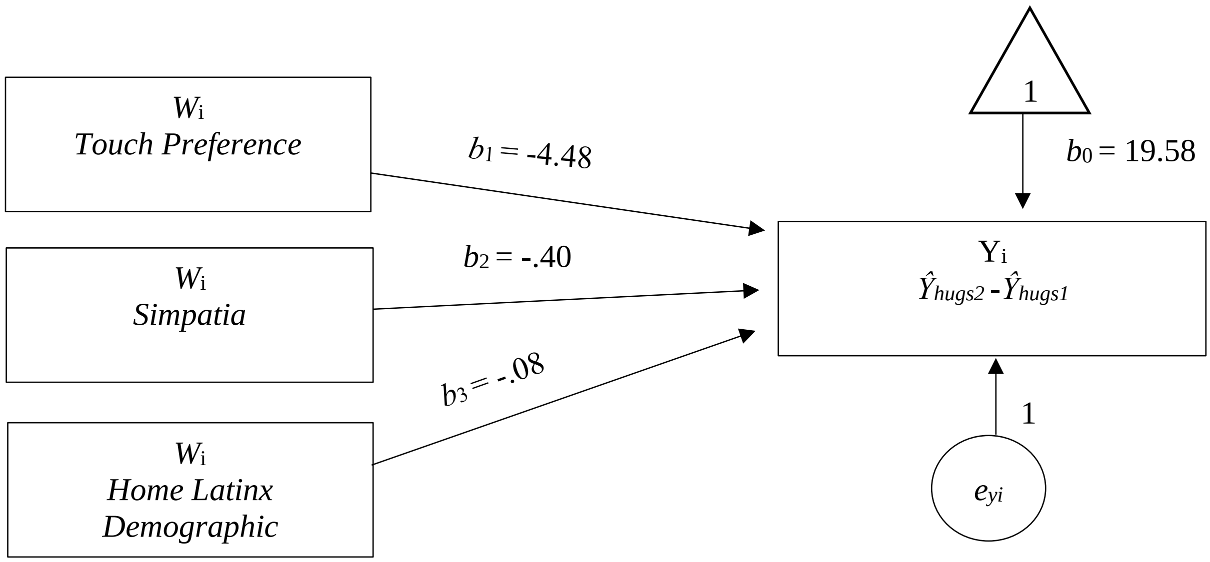


Table 3

Additive Moderator Models for Repeated Measures Effects and interpretations

Variable	Effect	Interpretation
b_1	-4.48	The effect of touch preference on the change in hugs
b_2	-.40	The effect of simpatia on the change in hugs
b_3	-.08	The effect of home Latinx demographic on the change in hugs

Study 2 Discussion

The present study is the first to test the association between changes in acculturation and affectionate touch behavior. I sought to assess if changes in cultural identity predicted changes in hugging, in a sample of Latinx college students. Cultural identity was measured through both Latinx and Anglo (European American) acculturation. I hypothesized that acculturation would change over the first year of college, due to the change in context. However, I found no evidence of mean-level change in Latinx or Anglo acculturation in the sample between the beginning and the end of the first year of college. I also did not find evidence that acculturation was related to hugging or mean-level change in hugging between the two timepoints. I hypothesized that changes in hugs would depend on personal preference for affectionate touch, identification with the Latinx cultural value, simpatıa, and the Latinx demographic of an individuals' home community. I did not find evidence of an effect of any of these effects.

I found that increases in Latinx acculturation were related to decreases in hugs from the beginning to the end of the first year of college. This effect contrasts the consensus of previous literature; that Latinx people engage in more affectionate touch behavior, compared to European Americans. Since increased Anglo acculturation is related to lower comfort with affectionate touch (Burleson et al., 2019), increased Latinx acculturation may predict increased comfort with affectionate touch, thus resulting in more affectionate touch behavior. However, it is important to note that I did not find any association between Latinx and Anglo acculturation in the study. Furthermore, Latinx acculturation was not associated with other expected variables, including the Latinx cultural value, simpatia. This finding is difficult to interpret in the context of currently available literature. The analyses revealed that the relationship does not appear to be driven by statistical outliers and it is consistent with the bivariate correlation.

There are several reasons why I may not have found evidence for the primary hypotheses. To start, I did not find evidence that acculturation changed between the beginning and end of the first year of college for the average student in the sample. Acculturation research suggests that individual acculturation changes when intercultural contact occurs (Sam & Berry, 2010). While college may typically represent a time of intercultural contact for Latinx students, the sample may have been unique. Specifically, most of the sample was from UC Merced. 53% of UC Merced students identify as Latinx, compared to other UCs, for example, like Berkeley (16% Latinx) and Los Angeles (18% Latinx) (2020 University of California Fall Enrollment at a Glance report). Future research should assess acculturation change over the course of college at schools where more intercultural contact may be occurring.

In previous studies, higher Anglo acculturation scores predict decreased comfort with affectionate touch in Latinx people (Burleson et al., 2019). However, I did not find evidence that acculturation was related to touch preference or hugging. The acculturation measure used in the current study is in line with similar research. However, there may be some issues with this commonly used measure. For example, the items in this measure primarily concern the use of Spanish and English language and media. Future research may benefit from implementing measures of acculturation that approximate cultural values around social interactions, instead of language and media use. The simpatia questionnaire used in the current study may provide one such measure. While I did not find associations between simpatia and hugging behavior in the sample, this may have been due to the sample suffering from a large amount of missing data, due to an administration error in this measure.

Perhaps most surprising, I did not find an association between personal preference for affectionate touch and the actual affectionate touch behavior, hugging. This may have been due to the measure of affectionate touch preference. The social touch questionnaire (STQ) (Wilhelm et al., 2001) used in this study includes a variety of items that assess a range of affectionate touch behaviors and preferences. Burleson et al. (2019) conducted a factor analysis of these items to identity and separate the constructs it measures. In their analysis, they identified two constructs. The constructs were “comfort with touch, particularly affectionate, personal, or intentional” and “discomfort with touch, primarily casual, impersonal, or incidental.” These authors opted to use only the items that loaded onto the first construct in their study, since they were interested in intentional affectionate touch in the context of relationships. My study may have benefitted from a similar subscale creation since I was also aimed at assessing comfort with intentional affectionate behavior.

Lastly, while I assessed how potential moderators would influence change in hugs, I did not test the impact of these moderators on the relationship between acculturation and hugging behavior. To address this question, I plan to assess a full moderated mediation model for repeated measures designs, combining methods described by Montoya (2019) and Montoya & Hayes (2017) in order to test several additional study questions. The hypotheses for the simple main effects for this model are: 1. For someone who is low in simpatía (the Latinx cultural script that emphasizes warmth in social interactions), as their Anglo acculturation increases (self-identification with European American culture increases), their hugs will decrease. 2. For someone who is high in simpatía, changes in acculturation will not predict change in hugs. 3. For a person who has a high preference for affectionate touch, as acculturation changes, hugs will not change. 4. For someone who is low in their touch preference, as acculturation changes, hugs will decrease.

Based on my experiences with this study, I have some recommendations for future researchers studying acculturation, affectionate touch, and studies that assess both or similar factors. First, social behaviors like hugs should employ measures of acculturation that are aimed at assessing multiple aspects of cultural identity. Additionally, similar measures should be developed for other ethnic groups to assess the association between affectionate touch and cultural identification across other cultures. Future studies on affectionate touch behavior should assess both participants' views toward affectionate touch and their behavior. While I did not find evidence that self-reported preference for affection touch was related to affectionate touch behavior, this may be due to the specific measures I used. However, it may also indicate that participants' views about their own preferences and may not be predictive of their behavior.

While I did not find evidence of an association between changes in acculturation and changes in hugging behavior, this study may provide timely contributions for theory development. For example, in Jakubiak & Feeney's (2016) model of affectionate touch, their inclusion of "culture" may be inadequate. They list it as one factor among a list of other potential moderators on the relationship between affectionate touch and interpretation of touch. The actual interplay between one's culture, their beliefs, personal comfort with affectionate touch, and changes in cultural context is much more complicated. Future studies should examine culture as a changing influence on affectionate touch behavior that interacts with individual preferences for affectionate touch, identification with various aspects of culture(s), and the current and changing environment in which social exchanges occur.

Appendix A

BARSMA-II

Do you identify as Latinx? This includes Latino/a, Hispanic, Chicano/a, Colombian, Guatemalan, etc.

Note: Anglos means white, English-speaking Americans

Instructions: Please indicate the extent to which the following statements apply to you.

Options: Not at all, Slightly, Moderately, Very, Extremely

I enjoy Spanish language TV.
I enjoy speaking Spanish.
I enjoy Spanish language movies.
I enjoy reading books in Spanish.
I speak Spanish.
I think in Spanish.
I enjoy reading in English.
I speak English.
I write letters in English.
I enjoy English language movies.
I associate with Anglos.
I think in English.
My friends are Anglo.

Simpatía Questionnaire

When interacting with other people, how important is it for you:

To be able to openly share your feelings.
To show respect for others.
To avoid conflict at all costs.
To control your emotions.
To show loyalty.
To obey or fulfill others' wishes or requests.
To show agreement with opinions that are different from your own.
To show good manners and be polite no matter what.
To make others feel comfortable.
To avoid being rude or insulting.

Options: Not important, A little important, Somewhat important, Extremely important

Social Touch Questionnaire

Indicate how characteristic or true each of the following statements is of you.

I generally like when people express their affection towards me in a physical way.
I feel uncomfortable when someone I don't know very well hugs me.
I get nervous when an acquaintance keeps holding my hand after a handshake.
I generally seek physical contact with others.
I feel embarrassed if I have to touch someone in order to get their attention.
I consider myself to be a 'touchy-feely' person.
It annoys me when someone touches me unexpectedly.
I'd feel uncomfortable if a professor touched me on the shoulder in public.
I'd be happy to give a neck/shoulder massage to a friend if they are feeling stressed.
I feel uncomfortable if I make physical contact with a stranger on the bus or subway.
I like being caressed in intimate situations.
As a child, I was often cuddled by family members (e.g. parents, siblings).
I would rather avoid shaking hands with strangers.
I greet my close friends with a kiss, cheek-to-cheek.
I feel comfortable touching people I do not know very well.
I feel disgusted when I see public displays of intimate affection.
It would make me feel anxious if someone I had just met touched me on the wrist.
If I had the means, I would get weekly professional massages.
I hate being tickled.
I like petting animals.

Options: Not at all, Slightly, Moderately, Very, Extremely

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