

Ethnically-Based Theme House Residency and Expected Discrimination Predict Downstream Markers of Inflammation Among College Students

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Abstract

We examined participation in an ethnically based residential program or “theme house” during the first year of college as a predictor of downstream immune system inflammation among undergraduates. Using a 4-year prospective design, we compared markers of inflammation among Latino/Latina students in a residential theme program with a matched sample of nonresidents. Students provided oral mucosal transudate samples for the assessment of circulating Interleukin 6 (IL-6), an inflammatory cytokine linked to health vulnerabilities. Findings suggest a protective benefit of theme house residency especially among students with anxious expectations of discrimination. Such expectations predicted higher levels of IL-6 after the first year of college among nonresidents only. In years 2–3, following exit from the theme house, the relationship between expected discrimination and IL-6 levels remained positive among nonresidents and was attenuated among residents, controlling for past IL-6 levels. Culturally based spaces may therefore offset the physiological burden of expected discrimination among undergraduates.

Keywords

racial/ethnic discrimination, inflammatory cytokines, immune system, higher education

Adopting culturally sensitive educational programs and spaces may be one means through which universities can provide support to students from underrepresented backgrounds (e.g., Brannon, Markus, & Taylor, 2015; Stephens, Hamedani, & Destin, 2014). University culture tends to reflect the values and norms of dominant ethnic and socioeconomic groups (i.e., White middle-class and upper middle-class backgrounds). However, in studies where the college environment was framed in terms of nondominant (versus dominant) cultural norms, students from an underrepresented group (i.e., first-generation college students) experienced better academic performance and less stress hormone reactivity (Stephens, Fryberg, Markus, Johnson, & Covarrubias, 2012; Stephens, Townsend, Markus, & Phillips, 2012). Research suggests that culturally sensitive contexts may promote students’ well-being by reducing physiological stress responses (see also Murphy, Steele, & Gross, 2007). Related work demonstrates the potential of “identity-safe” environments to reduce students’ vigilance for group-based stereotyping and discrimination (Davies, Spencer, & Steele, 2005), which otherwise taxes students’ cognitive and physiological resources (John-Henderson, Rheinschmidt, & Mendoza-Denton, 2015; Schmader, Johns, & Forbes, 2008). Identity-safe environments may be especially helpful during the college transition because unfamiliar contexts are

characterized by ambiguity about one’s social acceptance and how to interpret other people’s behavior (Mendoza-Denton, Downey, Purdie, Davis, & Pietrzak, 2002; Walton & Cohen, 2011). New contexts call into question how one’s collective identities, specifically, will be regarded and how to maintain a social connection with those groups (Ethier & Deaux, 1994).

One campus setting that embodies the idea of a culturally sensitive environment is a *culturally based theme house* or a residence in which the occupants have a shared interest in and/or membership to a particular cultural group. Although some researchers have examined Greek fraternity and sorority house membership among White students, and ethnically based

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organizations more broadly (Sidanius, van Laar, Levin, & Sinclair, 2004), empirical research on ethnically based theme house residency, and particularly its implications for physiological outcomes, remains scarce. In this research, we examined the role of theme house residency among ethnic minorities in predicting downstream immune system inflammation, which is relevant to numerous health and disease processes (e.g., Cesari, Penninx, & Newman, 2003).

We examined this question by recruiting residents of a Chicano/Chicana and Latino/Latina centered theme house and a matched sample of nonresidents across two cohorts of first-year Latino/Latina students. Using a 4-year prospective design, we tested whether theme house residency and anxious expectations of racial/ethnic discrimination jointly predict markers of inflammation among these students.

Expected Discrimination Among Ethnic Minority Students

The benefits and outcomes associated with theme house residency may depend on the degree to which students worry that others in the university will treat them differently based on their ethnicity. The tendency to anxiously expect racial/ethnic discrimination from others, termed *race-based rejection sensitivity (RS-race)*, has been shown to have adverse consequences for university adjustment and academic performance among minority students (Mendoza-Denton et al., 2002). We expected that students who are especially worried about race-based discrimination would be most likely to benefit from an environment in which one's race or ethnicity is explicitly upheld and valued as is generally the case with a culturally based theme house. Research on the immune health benefits of social support (e.g., Seeman, 1996) and identity-safe environments (e.g., John-Henderson, Rheinschmidt, Mendoza-Denton, & Francis, 2014) in turn suggests that theme house participation may buffer students from the negative physiological effects of expected discrimination.

Perceived racial discrimination predicts immune system inflammation (Brody, Yu, Miller, & Chen, 2015; Doyle & Molix, 2014; Lewis, Aiello, Leurgans, Kelly, & Barnes, 2010; Ratner, Halim, & Amodio, 2013). Inflammatory cytokines, such as Interleukin 6 (IL-6), help the body defend itself against injury and illness; however, repeated and exaggerated activation of inflammatory processes can increase one's risk for illnesses (e.g., cardiovascular disease, autoimmune disease, some cancers; Cesari et al., 2003; Nathan & Ding, 2010). Of particular relevance to the present research, several studies show that the extent to which ethnic minority individuals perceive racial stigmatization and discrimination predicts their circulating levels of inflammatory cytokines (Brody et al., 2015; Doyle & Molix, 2014; Lewis et al., 2010; Ratner et al., 2013). Consistent with previous research (e.g., Moons, Eisenberger, & Taylor, 2010; Ratner et al., 2013), the current research assessed the circulating levels of inflammatory cytokines in oral mucosal transudate (OMT). Both situational and prolonged social stress predict higher levels of inflammatory cytokines in OMT (e.g., Chiang, Eisenberger, Seeman, & Taylor, 2012; Slavich,

Way, Eisenberger, & Taylor, 2010). While the levels of inflammatory cytokines in OMT are only modestly correlated with the levels in blood plasma (Fernandez-Botran, Miller, Burns, Newton, 2011), research suggests that the levels of cytokines in the mouth predict bodily responses characteristic of systemic inflammation (O'Connor, Irwin, & Wellisch, 2009).

The Present Study

We hypothesized that theme house participation would weaken the association between expected racial/ethnic discrimination and circulating markers of inflammation. We reasoned that students with high RS-race levels would benefit from the explicit environmental and interpersonal cues of racial/ethnic identity acceptance inherent to the theme house program. The program should ease coping with negative race-based experiences on campus through identity-based support and validation, which is offered through formal (e.g., culturally sensitive workshops about university life) and informal resources (e.g., frequent contact with in-group members). We tested our hypothesis across two cohorts of students using a prospective design, in which we tracked Latino/Latina residents of an ethnically based theme house and a matched sample of Latino/Latina students who were not residents of the house (hereafter, "nonresidents") over 4 years. Residents lived in the theme house during the first year of college only, although we refer to them as "residents" hereafter for consistency. Residents and nonresidents were matched along with key demographic and psychological variables, measured at matriculation (see Method section).

We examined the interactive effect of theme house participation and RS-race on the circulating levels of IL-6 in OMT at the end of the first year of college (Follow-up 1). Participants completed a second IL-6 assessment 1–2 years after the initial assessment (Follow-up 2). Both residents and nonresidents lived in similar housing environments after the first year of college; as such, we expected that the first follow up would yield a more robust buffering effect. The current research thus provided a unique opportunity to assess residents' inflammatory cytokine levels while in residency and post-residency, as compared to nonresidents.

Method

Sample

We recruited first-year Latino/Latina students from the University of California, Berkeley, across two incoming classes of undergraduate students. Latino/Latina students comprised nearly 12% of the undergraduate student population at the university at the time of students' enrollment. White (30%) and Asian/Asian American (40%) students had the highest representation among undergraduates.

A total of 126 Latino/Latina undergraduates (85 females) enrolled in the study ($M_{\text{age}} = 18.22$, $SD = 1.51$). Participants were recruited at the start of 2 consecutive academic years and will thus be referred to as Cohort 1 ($n = 60$) and Cohort 2 ($n = 66$). Approximately half of participants (52.4%) were recruited

through their enrollment in a culturally based theme house tailored to first-year students with a shared interest in Mexican/Chicano/Chicana and Latino/Latina culture and identities. While open to students of any ethnic background, all theme house residents self-identified as Latino/Latina from the two cohorts recruited for this study. The house programming includes a weekly seminar in which students discuss historical, political, and educational issues of relevance to the Latino/Latina community. Residents also learn about campus resources and how their college experience may be shaped by their social and cultural identities. Students signal their interest in the theme residence on a housing application. The Latino/Latina residence program houses approximately 30 students each year. The residents live together on a single floor of a larger campus dormitory. We invited residents to participate during an information session at the beginning of the academic year, in which we described the study as a longitudinal investigation of students' college experiences.

To populate our comparison group, we recruited a matched sample of nonresidents through a two-pronged strategy. First, we contacted students for whom there was not space in the residential theme program; nine students from this group agreed to participate. Secondly, we advertised the study at welcome events for incoming Latino/Latina students; students attending these events had at least some interest in connecting with resources specifically for Latino/Latina students. We aimed to recruit comparable numbers of residents and nonresidents. Nearly all nonresidents reported living in traditional dormitories on campus and being involved in at least one ethnically based student group.

Procedure

All participants attended an initial study session during their first month on campus where they completed background questionnaires and were asked for written consent to access their standardized test scores. Students received US\$50 for completing the premeasures and for completing daily surveys that are beyond the scope of this article. Participants were recontacted approximately 8 months later, 1 month prior to their spring final exams, to complete follow-up questionnaires and to give an OMT sample via a cheek swab (Follow-up 1). For this and subsequent yearly follow-up surveys, participants received US\$10–15 compensation based on the survey length. Here, we also focus on the annual follow-up that occurred either 1 or 2 years after Follow-up 1 for Cohort 2 and Cohort 1, respectively. At this time, we asked participants to give a second OMT sample. We refer to this follow-up hereafter as Follow-up 2.

Follow-up participation rates were 84.9% ($n = 107$) and 46% ($n = 58$) for Follow-up 1 and Follow-up 2, respectively. Participation rates were slightly higher among residents versus nonresidents (Follow-up 1: 93.9% vs. 75%; Follow-up 2: 50% vs. 41.7%).

Measures

Demographic and background measures. Although we could not randomly assign students to live in the culturally based theme house versus a traditional dorm, we took several steps to ensure the comparability of the resident and nonresident samples. We administered background questionnaires at matriculation, before students had experiences relevant to their resident versus nonresident status. We sought to establish that residents were not more sociable, ethnically identified, or proficient with the Spanish language than nonresidents; these factors could promote participation and comfort in a culturally based residence. As summarized in Table 1, our subsamples did not significantly differ along these dimensions nor did they differ along several other demographic and psychological dimensions.¹ As this table also shows, within-group variability was also comparable across the resident and nonresident samples.

Main predictors and covariates

Rejection sensitivity. Both interpersonal and group-based forms of rejection sensitivity were relevant to our population. Interpersonal rejection concerns (e.g., I'm worried you might not accept me) are important to distinguish from group-based rejection concerns (e.g., I'm worried you might not accept me because of my race/ethnicity or socioeconomic background). The rejection sensitivity construct is premised on the idea that expectations of interpersonal rejection are amplified by anxiety over the possible negative outcome (e.g., Downey & Feldman, 1996; Metcalfe & Mischel, 1999). This idea is reflected in how the construct is measured, such that respondents consider social scenarios and then indicate (1) their anxiety over rejection and (2) their expectation of experiencing rejection.

Using this method, we measured people's anxious expectations about being mistreated on the basis of their ethnic/racial group membership. The measure (see Page-Gould, Mendoza-Denton, & Tropp, 2008) presents six social scenarios in which there is potential for racial discrimination and asks people to indicate on 6-point scales how much they would expect the discrimination to occur and how anxious they would feel about this outcome. Anxiety and expectation scores are multiplied within scenarios, and then these product terms are averaged across scenarios. We measured RS-race levels at matriculation and again at Follow-up 1 ($M = 12.51$, $SD = 8.42$, $\alpha = .90$ and $M = 13.56$, $SD = 9.03$, $\alpha = .90$, respectively) and found that levels were significantly correlated across time points, $r(97) = .74$, $p < .001$. We assessed possible change in RS-race levels as a function of theme house participation and found no evidence of an interaction effect between resident status and RS-race levels over time, $F(1, 95) = .001$, $p > .25$.

To isolate the unique effects of RS-race, we measured anxious expectations of both interpersonal rejection ($M = 10.93$, $SD = 4.34$; $\alpha = .74$; Downey & Feldman, 1996) and rejection stemming from one's socioeconomic status ($M = 8.07$, $SD = 5.14$, $\alpha = .85$; Rheinschmidt & Mendoza-Denton, 2014). These measures of interpersonal and class-based rejection sensitivity,

Table 1. Demographic and Psychological Variables by Resident and Nonresident Subsamples.

Variables	Range	Residents	Nonresidents	<i>p</i> Value
Demographic variables				
Gender: % female		66.7%	68.3%	
Transfer students		6.2%	15.3%	
Years of college completed		2.50 (<i>n</i> = 4)	3.00 (<i>n</i> = 5)	
Age*		17.97 (0.88)	18.49 (1.97)	.064
Social class				
Annual family income	1–6	2.10 (1.09)	2.55 (1.34)	.052
Mother's education*	0–6	1.14 (1.26)	1.45 (1.58)	.236
Father's education*	0–6	1.10 (1.25)	1.50 (1.90)	.179
Cultural background				
Years since moving to United States		10.29 (<i>n</i> = 7)	8.45 (<i>n</i> = 11)	
Mother born outside of United States		92.1%	89.8%	
Father born outside of United States		85.5%	85.7%	
Psychological variables				
Personality (John, Naumann, & Soto, 2008)	1–5			
Openness to experience		3.63 (0.62)	3.67 (0.71)	.742
Conscientiousness		3.70 (0.56)	3.59 (0.61)	.294
Extraversion		3.24 (0.82)	3.45 (0.83)	.179
Agreeableness		3.96 (0.56)	3.95 (0.57)	.879
Neuroticism		3.03 (0.71)	2.88 (0.78)	.275
Ethnic identification (Phinney, 1992)	1–4	3.33 (0.42)	3.25 (0.48)	.294
SAT Reasoning Test combined score out of 1,600		1052.19 (124.17)	1076.98 (142.11)	.316
Language use and proficiency				
Frequency of use—Spanish	1–7	4.36 (1.60)	4.10 (1.43)	.362
Frequency of use—English		6.08 (1.12)	6.29 (0.93)	.286
Proficiency—Spanish		5.52 (1.38)	5.67 (1.34)	.549
Proficiency—English		6.30 (0.79)	6.42 (0.80)	.415
Rejection sensitivity				
Interpersonal (Downey & Feldman, 1996)	1–36	11.68 (4.40)	10.06 (4.15)	.041
Race based (Page-Gould, Mendoza-Denton, & Tropp, 2008)		13.05 (8.69)	11.88 (8.13)	.452
Class based (Rheinschmidt & Mendoza-Denton, 2014)		8.57 (5.17)	7.51 (5.09)	.265
Health status				
Body mass index at Follow-up 1		26.28 (5.80; <i>n</i> = 55)	25.73 (3.92; <i>n</i> = 31)	.646
Self-reported physical health*	1–5	3.31 (1.02)	3.70 (0.81)	.023

Note. Variables were measured at the beginning of the first year unless noted. The range column indicates possible scores from low to high. The format for the resident/nonresident columns is subsample mean (subsample *SD*), unless specified. Sample sizes differ only slightly, unless noted, due to incomplete data; percentages are based on complete data.

The *p* values indicate the statistical significance of *t*-tests assessing differences between subsamples and reflect adjusted values when **p* < .05 for Levene's test for equality of variances.

respectively, were correlated with RS-race, $r(120) = .23$, $p = .01$ and $r(119) = .43$, $p < .001$.

Health status. We collected participants' height and weight in order to determine their body mass index (BMI; $M = 26.08$; $SD = 5.18$), given its relationship with IL-6 levels in previous research (Khaodhiar, Ling, Blackburn, & Bistran, 2004). Participants also indicated their current physical health on a scale from 1 = *very poor* to 5 = *very good* ($M = 3.49$; $SD = .94$). These indices served as covariates in our analyses.

Outcome Measures: Markers of Inflammation

We measured students' circulating levels of an inflammatory cytokine, IL-6, in oral fluids by collecting samples of OMT using an Orasure collective device (Epitope, Beaverton, OR) that was placed between the lower cheek and gum for 2 min.

Students came into the lab to complete the OMT sample collection at the end of their first academic year and again at a year-end follow-up session 1–2 years later (Follow-up 2). We collected all samples in the late afternoon to minimize potential diurnal variations in IL-6. The samples were frozen and stored at -80°C . IL-6 concentrations were determined by an enzyme-linked immunosorbent assay using commercially available kits (R&D systems, Minneapolis, MN). We completed a single OMT measurement at both follow-up time points to index basal or circulating levels of IL-6 (Follow-up 1: $M = 1.52$, $SD = 1.79$; Follow-up 2: $M = 1.13$, $SD = 1.28$).² We modeled this procedure from other longitudinal research using single measures of IL-6 (e.g., Kiecolt-Glaser et al., 2003), as single measures are fairly representative of IL-6 levels over a longer period (Rao, Pieper, Currie, & Cohen, 1994). The intraassay coefficient of variation (CV) was 6.3%, and the interassay CV was 8.2% for Follow-up 1. These values were 6.9% and

Table 2. Demographic and Psychological Variables for the Initial Sample and Follow-Up Samples.

Variables	Initial (N = 126)	Follow-Up 1 (n = 107)	Follow-Up 2 (n = 58)
Demographic variables			
Theme house residents	52.4%	57.9%	56.9%
Gender: % female	67.5%	70.1%	70.7%
Transfer students	10.5%	6.7%	10.5%
Years of college completed	2.78 (n = 9)	2.71 (n = 7)	2.67 (n = 6)
Age	18.22 (1.51)	18.04 (1.12)	18.17 (1.26)
Social class			
Annual family income	2.31 (1.23)	2.28 (1.22)	2.24 (1.23)
Mother's education	1.28 (1.42)	1.26 (1.43)	1.19 (1.48)
Father's education	1.29 (1.60)	1.18 (1.49)	1.19 (1.58)
Cultural background			
Years since moving to United States	9.17 (4.23; n = 18)	9.18 (4.36; n = 17)	7.55 (4.16; n = 11)
Mother born outside of United States	91.1%	91.4%	92.9%
Father born outside of United States	85.6%	86.5%	81.8%
Psychological variables			
Personality			
Openness to experience	3.65 (0.66)	3.63 (0.65)	3.62 (0.61)
Conscientiousness	3.65 (0.58)	3.70 (0.57)	3.68 (0.57)
Extraversion	3.34 (0.82)	3.32 (0.83)	3.33 (0.82)
Agreeableness	3.96 (0.56)	3.95 (0.58)	3.98 (0.53)
Neuroticism	2.96 (0.74)	2.97 (0.78)	2.93 (0.81)
Ethnic identification	3.29 (0.45)	3.28 (0.47)	3.31 (0.41)
SAT Reasoning Test combined score out of 1,600	1063.42 (132.59)	1056.60 (128.92)	1066.79 (144.80)
Language use and proficiency			
Frequency of use—Spanish	4.24 (1.52)	4.22 (1.51)	4.32 (1.48)
Frequency of use—English	6.18 (1.03)	6.22 (1.02)	6.24 (1.00)
Proficiency—Spanish	5.59 (1.36)	5.60 (1.35)	5.69 (1.32)
Proficiency—English	6.36 (0.79)	6.33 (0.83)	6.46 (0.79)
Rejection sensitivity			
Interpersonal	10.93 (4.34)	11.20 (4.56)	11.54 (4.57)
Race based	12.51 (8.42)	12.98 (8.78)	12.18 (8.51)
Class based	8.07 (5.14)	8.42 (5.32)	7.94 (5.02)
Health status			
Body mass index at Follow-up 1	NA	26.08 (5.18; n = 86)	25.53 (4.15; n = 50)
Self-reported physical health	3.49 (0.94)	3.45 (0.95)	3.47 (0.98)

Note. Variables were measured at the beginning of the first year unless noted. The format for the columns by sample is sample mean (sample SD), unless specified. Sample sizes differ only slightly, unless noted, due to incomplete data; percentages are based on complete data.

9.9%, respectively, for Follow-up 2. The amount of total proteins contained in each sample was assessed using the bicinchoninic acid protein assay with bovine serum albumin as the standard (Thermo-scientific, Rockford, IL) to account for possible differences in salivary flow rate (Dickerson, Kemeny, Aziz, Kim, & Fahey, 2004; Follow-up 1: $M = 1067.63$, $SD = 464.13$; Follow-up 2: $M = 1802.20$, $SD = 873.29$). As in previous research (John-Henderson, Jacobs, Mendoza-Denton, & Francis, 2013; Slavich et al., 2010), we found evidence of skewness greater than 1 for IL-6 values (e.g., Antonius, 2003; Follow-up 1: skewness = 3.73, standard error [SE] = .25; Follow-up 2: skewness = 1.70, $SE = .37$) and thus normalized them by log transformation. We added a constant of 1 to each IL-6 value before log-transformation, as recommended when transforming values between 0 and 1 (Osborne, 2002). We checked for participants with basal IL-6 levels more than 3 SD above or below the sample mean and excluded one participant on this basis (Ratner

et al., 2013); this participant also reported a chronic illness. IL-6 levels at Follow-up 1 and Follow-up 2 were not significantly correlated, $r(38) = .19$, $p = .246$.

Results

As Table 2 shows, the initial sample and follow-up samples show similar demographic and psychological profiles. Further, we found no statistically significant differences between residents versus nonresidents at each follow-up, with the exception of higher neuroticism among residents at Follow-up 2, $t(54) = -2.29$, $p = .026$. Students who participated at Follow-up 1 did not significantly differ from those who did not participate on any of the continuous variables listed in Table 2, with two exceptions. Students who completed the follow-up (vs. did not) were higher in both conscientiousness, $t(117) = -2.24$, $p = .027$, and interpersonal rejection sensitivity, $t(118) = -2.26$, $p = .029$. Students who participated in Follow-up 2 did not

differ from those who did not participate along any dimensions in Table 2.

Markers of Inflammation

We tested whether theme house participation could buffer students high in RS-race from higher levels of inflammatory cytokines in OMT. We conducted linear regression analyses using race-based rejection sensitivity and resident status at the beginning of college, as well as the interaction between these two variables, to predict IL-6 levels at the end of the first year (Follow-up 1). Given our interest in the unique effects of RS-race, we controlled for levels of interpersonal rejection sensitivity in all models as in previous work (e.g., Mendoza-Denton et al., 2002) and made sure that the analyses held when controlling for class-based rejection sensitivity.

We also confirmed that the results held when controlling for the demographic and health-related variables of age, gender, transfer student status, socioeconomic status, BMI, self-reported general health, and total protein in the OMT sample. All continuous predictors were standardized. To preserve statistical power across models, we entered covariates into separate regression models predicting the criterion variable (Rheinschmidt & Mendoza-Denton, 2014). We report any changes in the interaction term and its statistical significance as a function of these covariates below.³ Cohort did not have a moderating effect in any of the models below and thus the findings collapse across cohort.

Levels of inflammatory cytokines at Follow-up 1. We observed main effects of both RS-race at matriculation, $B = .36$, $t(80) = 4.49$, $p < .001$, 95% CI [0.20, 0.52], and resident status, $B = -.34$, $t(80) = -3.65$, $p < .001$, 95% CI [-0.52, -0.15], on levels of IL-6 at Follow-up 1, controlling for interpersonal rejection sensitivity. As predicted, these main effects were qualified by a significant interaction effect of RS-race and resident status on levels of IL-6, $B = -.39$, $t(80) = -4.11$, $p < .001$, 95% CI [-0.58, -0.20]. Figure 1 shows the predicted levels of IL-6, using log-transformed values, at 1 *SD* above and below the mean for RS-race. Simple slope analyses revealed a significant positive relationship between race-based rejection sensitivity and IL-6 levels for nonresidents only, nonresidents: $b = .36$, $t(80) = 4.62$, $p < .001$; residents: $b = -.03$, $t(80) = -.57$, $p > .25$. The difference in IL-6 levels between residents versus nonresidents high in RS-race was statistically significant, $b = -.73$, $t(80) = -5.52$, $p < .001$. The interaction effect held when accounting for relevant covariates in separate regression models, $B_s = -.44$ to $-.37$, $t_s = -4.40$ to -3.84 , all $p_s < .001$, all 95% CIs [-0.63, -0.55, -0.24, -0.18].

We conducted a post hoc power analysis using G*Power 3.1 (2016) software (Faul, Erdfelder, Buchner, & Lang, 2009). Our analysis indicated that the interaction effect (partial $R^2 = .15$), which was medium in size ($f^2 = .17$; Cohen, 1992), could be detected at a power of .97 when $p = .05$ (two tailed). Given that we observed a medium-sized effect at Follow-up 1, we determined that we would need at least 48 participants for our

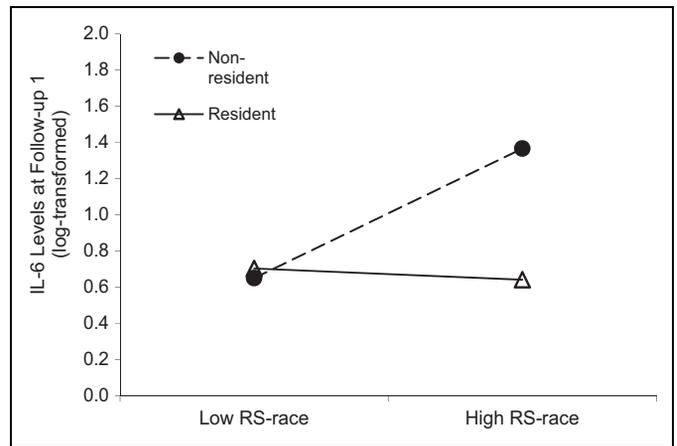


Figure 1. Resident status and race-based rejection sensitivity levels at matriculation predicting levels of Interleukin 6 at the end of the first year (Follow-up 1), controlling for interpersonal rejection sensitivity at matriculation. All continuous predictors are standardized.

subsequent follow-up to detect an interaction effect with a power of .80 when $p = .05$. While we met this target, our focal analysis at Follow-up 2 required data from both follow-ups; therefore, we fell short of this number in our final analysis but gained the ability to account for past IL-6 levels.

Levels of inflammatory cytokines at Follow-up 2. One limitation of the previous analysis is that we did not have an assessment of IL-6 levels at matriculation. To address this issue, we ran a parallel analysis for the subsample that completed Follow-up 2 during the post-residency period while controlling for IL-6 at Follow-up 1, so as to isolate the effects of theme house residency and RS-race levels on IL-6 after accounting for prior levels. First, we regressed RS-race levels and resident status at matriculation, as well as their interaction on IL-6 levels 1–2 years following the initial sample, controlling for interpersonal rejection sensitivity. We observed significant main effects of resident status, $B = -.64$, $t(32) = -5.32$, $p < .001$, 95% CI [-0.89, -0.40], and RS-race at matriculation, $B = .41$, $t(32) = 3.62$, $p = .001$, 95% CI [0.18, 0.63], as well as a trend for the interaction between them, $B = -.25$, $t(32) = -1.87$, $p = .071$, 95% CI [-0.52, 0.02]. The main effect of resident status revealed significantly higher IL-6 levels among nonresidents relative to residents at Follow-up 2. We also observed a main effect of RS-race, suggesting that increases in RS-race mapped onto higher IL-6 levels. Figure 2 illustrates the trend for the interaction effect graphically and reveals a similar, albeit attenuated, pattern to Follow-up 1 (see Figure 2). Notably, the relationship between RS-race and IL-6 levels was positive for both nonresidents and residents. This pattern suggests a weakened protective effect of theme house participation upon moving out of the theme house residence. The positive slope for nonresidents, however, remained steeper than the one for residents, nonresidents: $b = .41$, $t(32) = 3.55$, $p = .001$; residents: $b = .16$, $t(32) = 2.04$, $p = .049$. The pattern of interaction remained consistent after accounting for the covariates in separate

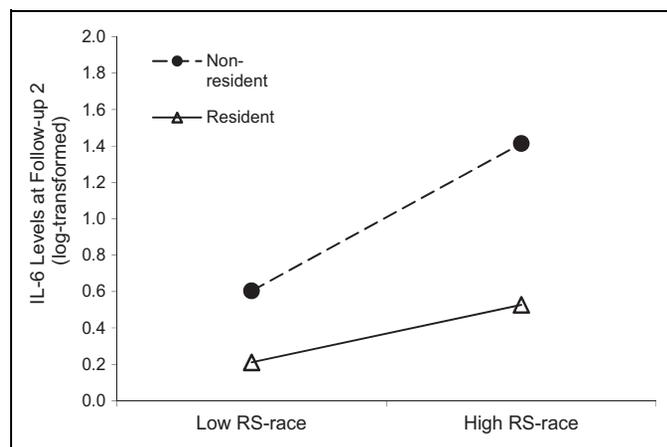


Figure 2. Resident status and race-based rejection sensitivity levels at matriculation predicting levels of Interleukin 6 (IL-6) during the postresidency period 1–2 years later (Follow-up 2), controlling for prior IL-6 levels (Follow-up 1) and interpersonal rejection sensitivity at matriculation. All continuous predictors are standardized.

regression models, $B_s = -.28$ to $-.19$, $t_s = -2.06$ to -1.39 , $p_s = .048$ to $.175$, all 95% CIs $[-0.56, -0.46, -0.002, 0.089]$ but appeared weaker in the model including family income, $B = -.13$, $t(28) = -.81$, $p = .43$, 95% CI $[-0.45, 0.20]$. Family income levels were relatively homogenous in our sample and did not significantly predict IL-6 levels, $B = -.05$, $t(34) = -.81$, $p > .25$, 95% CI $[-0.19, 0.08]$.

Thus, on the whole, we observe our predicted pattern of results after accounting for IL-6 levels at the previous time point.⁴ Our analysis for Follow-up 2 was underpowered due to the small sample size, which limited our ability to detect an interaction effect. However, we observed similar patterns of interaction across the two time points, and these patterns remained stable across models with relevant covariates.

Discussion

In a longitudinal study of Latino/Latina students, we tested whether theme house participation during the first year of college and RS-race levels jointly predicted markers of immune system inflammation. Resident and nonresident samples were well matched across demographic and psychological variables. We found that expected discrimination at matriculation predicted higher levels of circulating inflammatory cytokines in OMT among nonresidents but not residents after the first year of college. Longitudinal analyses revealed that the protective benefit of theme house participation among students higher in RS-race was attenuated 1–2 years after theme house residency when controlling for IL-6 levels at the time of exit. Nevertheless, residents had significantly lower IL-6 levels relative to nonresidents in the post-residency period, after accounting for prior levels. Thus, the protective effect of theme house residency, as indexed by the main effect, persisted across time and with relevant controls. Overall, our findings suggest a protective physiological benefit of theme house residency among

students high in RS-race in particular, albeit one that is diminished somewhat (as might be expected) upon students' exit from the "safe space" that constituted the theme house.

Inflammatory Cytokine Measurement

Previous research has assessed inflammatory cytokines in OMT, as in the current study, and in blood plasma. Measurement of inflammatory cytokines via OMT versus blood plasma may yield different results (Fernandez-Botran et al., 2011). Thus, our OMT levels of IL-6 should not be taken as representative of or directly comparable to those in blood plasma. Despite these limitations, the levels of IL-6 in OMT provide information about localized inflammation of the mouth, which is key entry point to the body for pathogens (Chiang, Sapphire-Bernstein, Kim, Sherman, & Taylor, 2012). Further, salivary levels of inflammatory cytokines map onto important bodily and behavioral responses to stress (e.g., brain activation, emotional reasoning; O'Connor et al., 2009).

While our study focused on healthy young adults, the relative differences between people in markers of inflammation may signal emerging health disparities and different habitual coping responses to college-based stressors (e.g., perceived discrimination). Our research builds directly from work by Ratner and colleagues (2013) showing that the extent to which ethnic minority women perceived their racial/ethnic group to be devalued by other people predicted higher circulating levels of IL-6 in OMT. These findings are consistent with research showing that chronic discrimination predicts downstream markers of inflammation in blood plasma (Friedman, Williams, Singer, & Ryff, 2009). Repeated and exaggerated activation of inflammatory process through situational stressors (e.g., experiences with discrimination) contributes to the disruption of normal immune functioning (see, e.g., McEwen, 1998). In the current study, we found that expected discrimination predicted higher levels of IL-6 over the study period. However, among those high in RS-race, IL-6 levels were relatively lower among residents versus nonresidents at the end of the first year and 1–2 years later. The repeated samples allowed us to control for prior IL-6 levels at the latter time point. Given that we were unable to measure IL-6 levels at matriculation, these within-participant measures may help account for between-person differences in health status. The measures of health status that we collected at matriculation were self-report in nature (e.g., BMI) and could be augmented by physical measurements in future research.

Specifics of the Theme House Program

Our focus on theme house participation reflects an interest in whether this specific type of culturally based organization predicts better college adjustment. Our data could not speak to the exact ingredients of the theme house program that accounted for our effects; however, we suspect that students who are sensitive to identity-based acceptance cues benefit from an environment that both acknowledges and addresses identity-based

concerns. For example, students' race-based experiences may be validated as part of culturally relevant programming. Further, students can seek daily support and validation from in-group peers, who may share similar experiences on campus. The theme house may also offer a physical space in which students feel less vigilant for identity-based social threats and therefore expend fewer physiological resources monitoring their environment (e.g., Schmader, Johns, & Forbes, 2008). These spaces may be helpful to students regardless of identity concerns, as suggested by the stable main effect of theme house participation over time.

The protective benefits of theme house participation are likely multifaceted and may function differently at other universities. We cannot determine whether features of the broader institution (e.g., large, selective, public) influenced our results. This and other single-campus studies (e.g., Sidanius, Levin, van Laar, & Sears, 2010) will be strengthened by replication on campuses with different demographic characteristics, academic selectivity, geographic locations, and political leanings. This study also cannot speak to other formulations of culturally based theme houses, such as cultural "interest" houses in which residents must be at least 50% nonmembers of the cultural group of interest. Research on propinquity effects demonstrates that people are especially likely to befriend others within close proximity of themselves (Festinger, Back, & Schachter, 1950). Following this logic, a culturally based theme program with members of multiple ethnic groups in residence may promote cross-group friendships while remaining a safe space for members of stigmatized ethnic groups. Further research on culturally based theme programs may help universities to better serve students from diverse backgrounds and promote their well-being.

Authors' Note

Portions of this research were presented at the 2012 meeting of the Society for Personality and Social Psychology and incorporated into the first author's doctoral dissertation, which was completed at the University of California, Berkeley.

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Notes

1. We found only two statistically significant differences between the resident and nonresident samples across background variables (see Table 1). All analyses held when controlling for these variables. The nonresident subsample also had a slightly higher percentage of transfer students; all analyses held when accounting for transfer student status.
2. To be prudent, we tested whether recent stress affected our results. Perceived stress during the preceding month, as measured by the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983), did not significantly predict Interleukin 6 (IL-6) levels. Our models held when including this variable as a covariate.
3. The interaction effects hold when entering all covariates simultaneously, with one exception. Specifically, the inclusion of family income in the Follow-up 2 analysis yields a nonsignificant interaction term. We observed the same pattern when using separate regression models and thus describe this pattern in the results.
4. We repeated this analysis (1) without controlling for IL-6 levels at Follow-up 1 and (2) using a change score as our outcome measure. We observed similar results across models.

References

- Antonius, R. (2003). *Interpreting quantitative data with SPSS*. London, England: Sage.
- Brannon, T. N., Markus, H. R., & Taylor, V. J. (2015). 'Two souls, two thoughts,' two self-schemas: Double consciousness can have positive academic consequences for African Americans. *Journal of Personality and Social Psychology, 108*, 586–609. doi:10.1037/a0038992
- Brody, G. H., Yu, T., Miller, G. E., & Chen, E. (2015). Discrimination, racial identity, and cytokine levels among African-American adolescents. *Journal of Adolescent Health, 56*, 496–501. doi:10.1016/j.jadohealth.2015.01.017
- Cesari, M., Penninx, B. W., & Newman, A. B. (2003). Inflammatory markers and cardiovascular disease (The Health, Aging and Body Composition [Health ABC] Study). *American Journal of Cardiology, 92*, 522–528. doi:10.1016/S0002-9149(03)00718-5
- Chiang, J. J., Eisenberger, N. I., Seeman, T. E., & Taylor, S. E. (2012). Negative and competitive social interactions are related to heightened proinflammatory cytokine activity. *Proceedings of the National Academy of Sciences of the United States of America, 109*, 1878–1882. doi:10.1073/pnas.1120972109
- Chiang, J. J., Saphire-Bernstein, S., Kim, H. S., Sherman, D. K., & Taylor, S. E. (2012). Cultural differences in the link between supportive relationships and proinflammatory cytokines. *Social Psychological and Personality Science, 4*, 511–520. doi:10.1177/1948550612467831
- Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*, 155–159. doi:10.1037/0033-2909.112.1.155
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*, 385–396. Retrieved from <http://www.jstor.org/stable/2136404>
- Davies, P. G., Spencer, S. J., & Steele, C. M. (2005). Clearing the air: Identity safety moderates the effects of stereotype threat on

- women's leadership aspirations. *Journal of Personality and Social Psychology*, 88, 276–287. doi:10.1037/0022-3514.88.2.276
- Dickerson, S. S., Kemeny, M. E., Aziz, N., Kim, K. H., & Fahey, J. L. (2004). Immunological effects of induced shame and guilt. *Psychosomatic Medicine*, 66, 124–131. doi:10.1097/01.PSY.0000097338.75454.29
- Downey, G., & Feldman, S. I. (1996). Implications of rejection sensitivity for intimate relationships. *Journal of Personality and Social Psychology*, 70, 1327–1343. doi: 10.1037/0022-3514.70.6.1327
- Doyle, D. M., & Molix, L. (2014). Perceived discrimination as a stressor for close relationships: Identifying psychological and physiological pathways. *Journal of Behavioral Medicine*, 37, 1134–1144. doi:10.1007/s10865-014-9563-8
- Ethier, K. A., & Deaux, K. (1994). Negotiating social identity when contexts change: Maintaining identification and responding to threat. *Journal of Personality and Social Psychology*, 67, 243–251. doi:10.1037/0022-3514.67.2.243
- Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, 41, 1149–1160. doi:10.3758/BRM.41.4.1149
- Fernandez-Botran, R., Miller, J. J., Burns, V. E., & Newton, T. L. (2011). Correlations among inflammatory markers in plasma, saliva, and oral mucosal transudate in post-menopausal women with past intimate partner violence. *Brain Behavior and Immunity*, 25, 314–321. doi:10.1016/j.bbi.2010.09.023
- Festinger, L., Back, K. W., & Schachter, S. (1950). *Social pressures in informal groups: A study of human factors in housing* (Vol. 3). Stanford, CA: Stanford University Press.
- Friedman, E. M., Williams, D. R., Singer, B. H., & Ryff, C. D. (2009). Chronic discrimination predicts higher circulating levels of E-selectin in a national sample: The MIDUS study. *Brain, Behavior, and Immunity*, 23, 684–692. doi:10.1016/j.bbi.2009.01.002
- G*Power Version 3.1.9.2 [Computer software]. (2016). Retrieved from <http://www.gpower.lhu.de/en.html>
- John-Henderson, N., Jacobs, E. G., Mendoza-Denton, R., & Francis, D. D. (2013). Wealth, health, and the moderating role of implicit social class bias. *Annals of Behavioral Medicine*, 45, 173–179. doi:10.1007/s12160-012-9443-9
- John-Henderson, N. A., Rheinschmidt, M. L., & Mendoza-Denton, R. (2015). Cytokine responses and math performance: The role of stereotype threat and anxiety reappraisals. *Journal of Experimental Social Psychology*, 56, 203–206. doi:10.1016/j.jesp.2014.10.002
- John-Henderson, N. A., Rheinschmidt, M. L., Mendoza-Denton, R., & Francis, D. D. (2014). Performance and inflammation outcomes are predicted by different facets of SES under stereotype threat. *Social Psychological and Personality Science*, 5, 301–309. doi: 10.1177/1948550613494226
- John, O. P., Naumann, L. P., & Soto, C. J. (2008). Paradigm shift to the integrative big-five trait taxonomy: history, measurement, and conceptual issues. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), *Handbook of personality: Theory and research* (pp. 114–158). New York, NY: Guilford Press.
- Khaodhiar, L., Ling, P. R., Blackburn, G. L., & Bistrrian, B. R. (2004). Serum levels of interleukin-6 and C-reactive protein correlate with body mass index across the broad range of obesity. *Journal of Parental and Enteral Nutrition*, 28, 410–415. doi:10.1177/0148607104028000410
- Kiecolt-Glaser, J. K., Preacher, K. J., MacCallum, R. C., Atkinson, C., Malarkey, W. B., & Glaser, R. (2003). Chronic stress and age-related increases in the proinflammatory cytokine IL-6. *Proceedings of the National Academy of Sciences of the United States of America*, 100, 9090–9095. doi:10.1073/pnas.1531903100
- Lewis, T. T., Aiello, A. E., Leurgans, S., Kelly, J., & Barnes, L. L. (2010). Self-reported experiences of everyday discrimination are associated with elevated C-reactive protein levels in older African-American adults. *Brain, Behavior, and Immunity*, 24, 438–443. doi:10.1016/j.bbi.2009.11.011
- McEwen, B. S. (1998). Stress, adaptation, and disease: Allostasis and allostatic load. *Annals of the New York Academy of Sciences*, 840, 33–44. doi:10.1111/j.1749-6632.1998.tb09546.
- Mendoza-Denton, R., Downey, G., Purdie, V. J., Davis, A., & Pietrzak, J. (2002). Sensitivity to status-based rejection: Implications for African American students' college experience. *Journal of Personality and Social Psychology*, 83, 896–918. doi:10.1037/0022-3514.83.4.896
- Metcalfe, J., & Mischel, W. (1999). A hot/cool system analysis of delay of gratification: Dynamics of willpower. *Psychological Review*, 106, 3–19. doi:10.1037/0033-295X.106.1.3
- Moons, W. G., Eisenberger, N. I., & Taylor, S. E. (2010). Anger and fear responses to stress have different biological profiles. *Brain, Behavior, and Immunity*, 24, 215–219. doi:10.1016/j.bbi.2009.08.009
- Murphy, M. C., Steele, C. M., & Gross, J. J. (2007). Signaling threat: How situational cues affect women in math, science, and engineering settings. *Psychological Science*, 18, 879–885. doi:10.1111/j.1467-9280.2007.01995.x
- Nathan, C., & Ding, A., (2010). Nonresolving inflammation. *Cell*, 140, 871–882. doi:10.1016/j.cell.2010.02.029
- O'Connor, M., Irwin, M. R., & Wellisch, D. K. (2009). When grief heats up: Pro-inflammatory cytokines predict regional brain activation. *Neuroimage*, 47, 891–896. doi:10.1016/j.neuroimage.2009.05.049
- Osborne, J. (2002). Notes on the use of data transformations. *Practical Assessment, Research & Evaluation*, 8, 1–8. Retrieved from <http://PAREonline.net/getvn.asp?v=8&n=6>
- Page-Gould, E., Mendoza-Denton, R., & Tropp, L. R. (2008). With a little help from my cross-group friend: Reducing anxiety in intergroup contexts through cross-group friendship. *Journal of Personality and Social Psychology*, 95, 1080–1094. doi:10.1037/0022-3514.95.5.1080
- Phinney, J. (1992). The multigroup ethnic identity measure: A new scale for use with adolescents and young adults from diverse groups. *Journal of Adolescent Research*, 7, 156–176. doi:10.1177/074355489272003
- Rao, K. M. K., Pieper, C. S., Currie, M. S., & Cohen, H. J. (1994). Variability of plasma IL-6 and crosslinked fibrin dimers over time in community dwelling elderly subjects. *American Journal of Clinical Pathology*, 102, 802–805. doi:10.1093/ajcp/102.6.802
- Ratner, K. G., Halim, M. L., & Amodio, D. M. (2013). Perceived stigmatization, in group pride, and immune and endocrine activity: Evidence from a community sample of Black and Latina women.

- Social Psychological and Personality Science*, 4, 82–91. doi:10.1177/1948550612443715
- Rheinschmidt, M. L., & Mendoza-Denton, R. (2014). Social class and academic achievement in college: The interplay of rejection sensitivity and entity beliefs. *Journal Of Personality And Social Psychology*, 107, 101–121. doi:10.1037/a0036553
- Schmader, T., Johns, M., & Forbes, C. (2008). An integrated process model of stereotype threat effects on performance. *Psychological Review*, 115, 336–356. doi:10.1037/0033-295X.115.2.336
- Seeman, T. E. (1996). Social ties and health: The benefits of social integration. *Annals of Epidemiology*, 6, 442–451. doi:10.1016/S1047-2797(96)00095-6
- Sidanius, J., Levin, S., van Laar, C., & Sears, D. O. (2010). *The diversity challenge: Social identity and intergroup relations on the college campus*. New York, NY: Russell Sage Foundation.
- Sidanius, J., van Laar, C., Levin, S., & Sinclair, S. (2004). Ethnic enclaves and the dynamics of social identity on the college campus: The good, the bad, and the ugly. *Journal of Personality and Social Psychology*, 87, 96–110. doi:10.1037/0022-3514.87.1.96
- Slavich, G. M., Way, B. M., Eisenberger, N. I., & Taylor, S. E. (2010). Neural sensitivity to social rejection is associated with inflammatory responses to social stress. *Proceedings of the National Academy of Sciences*, 107, 14817–14822. doi:10.1073/pnas.1009164107
- Stephens, N. M., Fryberg, S. A., Markus, H. R., Johnson, C. S., & Covarrubias, R. (2012). Unseen disadvantage: How American universities' focus on independence undermines the academic performance of first-generation college students. *Journal of Personality and Social Psychology*, 102, 1178–1197. doi:10.1037/a0027143
- Stephens, N. M., Hamedani, M. G., & Destin, M. (2014). Closing the social-class achievement gap a difference-education intervention improves first-generation students' academic performance and all students' college transition. *Psychological Science*, 25, 943–953. doi:10.1177/0956797613518349
- Stephens, N. M., Townsend, S. S. M., Markus, H. R., & Phillips, T. (2012). A cultural mismatch: Independent cultural norms produce greater increases in cortisol and more negative emotions among first-generation college students. *Journal of Experimental Social Psychology*, 48, 1389–1393. doi:10.1016/j.jesp.2012.07.008
- Walton, G. M., & Cohen, G. L. (2011). A brief social-belonging intervention improves academic and health outcomes of minority students. *Science*, 331, 1447–1451. doi:10.1126/science.1198364

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