

Archival Report

Acculturative Orientations Among Hispanic/Latinx Caregivers in the ABCD Study: Associations With Caregiver and Youth Mental Health and Youth Brain Function

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ABSTRACT

BACKGROUND: Population-based neuroscience offers opportunities to examine important but understudied sociocultural factors such as acculturation. Acculturation refers to the extent to which an individual retains their cultural heritage and/or adopts the receiving society's culture and is particularly salient among Hispanic/Latinx immigrants. Specific acculturative orientations have been linked to vulnerability to substance use, depression, and suicide and are known to influence family dynamics between caregivers and their children.

METHODS: Using data from first- and second-generation Hispanic/Latinx caregivers in the Adolescent Brain Cognitive Development (ABCD) Study ($N = 1057$), we examined how caregivers' acculturative orientation affects their mental health, as well as the mental health and brain function of their children. Neuroimaging analyses focused on regions associated with self- and affiliation-based social processing (ventromedial prefrontal cortex, insula, and temporoparietal junction).

RESULTS: We identified 2 profiles of caregiver acculturation: bicultural (retains heritage culture while adopting U.S. culture) and detached (discards heritage culture and rejects U.S. culture). Bicultural caregivers exhibited fewer internalizing and externalizing problems than detached caregivers; furthermore, youth exhibited similar internalizing effects across caregiver profiles. In addition, youth with bicultural caregivers displayed increased resting-state brain activity (i.e., fractional amplitude of low-frequency fluctuations and regional homogeneity) in the left insula, which has been linked to psychopathology; however, differences in long-range functional connectivity were not significant.

CONCLUSIONS: Caregiver acculturation is an important familial factor that has been linked to significant differences in youth mental health and insula activity. Future work should examine sociocultural and neurodevelopmental changes across adolescence to assess health outcomes and determine whether localized, corticolimbic brain effects are ultimately translated into long-range connectivity differences.

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Acculturation refers broadly to the extent to which an individual retains their cultural heritage and/or adopts the receiving society's culture (1) and has been hypothesized to play an important role in accounting for health disparities, particularly among Hispanic/Latinx populations (2). In the United States, Hispanic/Latinx people are among the largest and fastest-growing immigrant groups (3), and acculturative processes are salient among first- and second-generation and, to some extent, third-generation Hispanic/Latinx immigrants (1). Contemporary views of acculturation draw on Berry's model (4), which casts acculturation as a bidimensional process consisting of receiving/acquiring U.S. culture and retaining heritage culture. This bidimensional conceptualization proposes that individuals can acquire the receiving culture without discarding their heritage culture (1). Research has consistently and extensively supported a bidimensional model of acculturation consisting of distinct

heritage and U.S. cultural orientations (1,5–7). In addition, Berry's model (8,9) proposes 4 distinct acculturative orientations: 1) bicultural (i.e., acquires the receiving culture and retains the heritage culture), 2) assimilated (i.e., acquires the receiving culture and discards the heritage culture), 3) separated (i.e., rejects the receiving culture and retains the heritage culture), and 4) detached (i.e., rejects the receiving culture and discards the heritage culture)¹ (Figure 1).

¹Although Berry (8) originally used the term "integration," the dual endorsement of heritage and U.S. cultures has increasingly been referred to as "biculturalism" (1). Moreover, although Berry used the term "marginalized" to represent detachment from both heritage and U.S. cultures, we use the term "detached" as a better representation of individuals' lack of connection to either cultural stream.

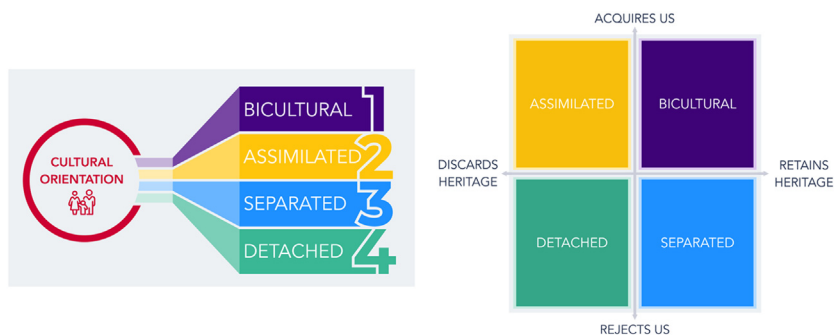


Figure 1. Acculturative orientation profiles. Berry's model proposes 4 distinct acculturative orientations. Among Hispanic/Latinx immigrants in the United States, these profiles include 1) bicultural (i.e., acquires U.S. culture and retains the heritage culture), 2) assimilated (i.e., acquires U.S. culture and discards the heritage culture), 3) separated (i.e., rejects U.S. culture and retains the heritage culture), and 4) detached (i.e., rejects U.S. culture and discards the heritage culture).

A number of studies (6,10–18) have provided mixed support for Berry's model (4) using person-centered methods, such as latent profile analysis (LPA), that empirically derive acculturation groupings. Among recently immigrated Hispanic/Latinx caregivers, detached and bicultural profiles have been identified across heritage and U.S. cultural practices and identity (16). In contrast, 3 profiles were recently identified in a community sample of undocumented Hispanic/Latinx immigrants—bicultural, detached, and separated (13)—while another study identified separated, partially separated, bicultural, and detached profiles (17). Although specific configurations have been observed inconsistently across studies, biculturalism has been consistently identified and characterized as the most adaptive orientation (10–14,16–18). Indeed, individuals who are bicultural have been found to exhibit fewer symptoms of depression (17,19) and anxiety (19), less substance use (12), and higher levels of flourishing and life satisfaction (13) compared with individuals with other orientations.

Despite extensive research with Hispanic/Latinx adults, few studies have addressed how acculturation may be related to adolescent (mal)adaptive development and behavior. Adolescence is a critical developmental stage for identity development (20) during which youth establish a self-identity, as well as a social identity based on group membership. This significant neurodevelopmental period (21,22) is marked by changes in self-referential cognition (23) that are accompanied by maturational shifts in brain structure and function that occur as a result of experiences in one's social environment (24,25). Such shifts occur in the ventromedial prefrontal cortex (vmPFC), insula, and temporoparietal junction (TPJ) (26), which have been linked to self- and affiliation-based social processes (27). In addition to developing a general sense of self and identity, which is a normative developmental task for all adolescents, Hispanic/Latinx youth are tasked with establishing an acculturative orientation. Hispanic/Latinx adolescents experience shifts in acculturation that encompass dynamic changes in values, beliefs, and practices that together reflect their cultural group affiliation. These processes affect one's sense of self and can be broadly shaped by their caregivers' acculturative orientation (28). A caregiver's acculturative orientation affects the degree to which they socialize their children to gravitate toward (or away) from the receiving and heritage cultures (28–30). Thus, it is likely that caregiver acculturation

not only influences caregiver mental health but also has a direct downstream effect on youth mental health. That is, given the strong influence that caregivers have on child and adolescent behavior and psychopathology (31–33), we hypothesize that caregiver biculturalism is associated with fewer mental health problems among their children. Furthermore, drawing on a conceptual framework of adolescent neurobiological susceptibility to social contexts via caregivers and peers (26), we also hypothesize that caregiver acculturation is directly associated with adolescent socioaffiliative neural function.

The overall objective of the current study was to test the hypotheses that caregiver acculturation is associated with youth mental health and brain function. To this end, we first sought to evaluate the acculturative orientations of first- and second-generation Hispanic/Latinx immigrant caregivers in the ABCD (Adolescent Brain Cognitive Development) Study (34). We focused on ABCD Study data acquired at baseline (i.e., 9- to 10-year-old children) to establish an understanding of caregiver acculturation among ABCD Hispanic/Latinx families as an important familial influence at the onset of adolescence. To this end, and building on prior work among adult populations (11,13,14,17), we aimed to empirically validate Berry's model of acculturation further by identifying data-driven groupings of ABCD Study caregivers' heritage and U.S. cultural orientation at baseline using LPA. Consistent with recommended best practices (35), a data-driven approach is critical because it allows researchers to avoid the utilization of arbitrary cutoff thresholds or the inaccurate identification of much-debated acculturation profiles that may not exist in a given sample (36). After we identified acculturative orientation profiles, we investigated associations with caregiver and youth mental health and youth resting-state functional magnetic resonance imaging (rs-fMRI) signatures in self- and affiliation-related circuits. Given the large and demographically diverse ABCD Study sample (37), and consistent with current theory (8–10) and informed by prior results (10–15,17,38), we hypothesized that LPA would reveal 4 acculturation profiles (i.e., bicultural, assimilated, separated, and detached profiles). We also expected that biculturalism would be associated with fewer mental health problems among caregivers and their children. We leveraged prior meta-analytic results to guide analyses of brain regions associated with self- and affiliation-based social processing, including the vmPFC, insula, and TPJ

Acculturation Among ABCD Hispanic/Latinx Caregivers

(27). Finally, we discuss additional research that is needed to more fully understand neurobiological mechanisms linked with acculturative experiences.

METHODS AND MATERIALS

Participants

Participants were selected from the ABCD Study, the largest longitudinal study of brain development and child health in the United States (34). Approximately 11,800 youth ages 9.00 to 10.99 years were enrolled in the ABCD Study across 21 sites in the United States (39). Participants in the ABCD Study were recruited through geographically, demographically, and socioeconomically diverse school systems using epidemiologically informed methods to enroll a population-based, demographically diverse sample (37). Data from the ABCD Study are made available by the National Institute of Mental Health Data Archive (NDA), and the current study used data from the ABCD Curated Annual Release 3.0.

Measures

Caregiver-Reported Demographics. Demographic information was provided at baseline by a child's caregiver, including the child's age, gender, ethnicity, and race as well as the caregiver's age, identity, gender, ethnicity, race, education, and combined family income. In addition, caregivers reported the nativity (i.e., country of origin) for the child, parent/guardian, and grandparents (40).

Caregiver-Reported Acculturation. In the context of the robust culture and environment battery at baseline (41), caregivers completed the Vancouver Index of Acculturation (VIA) in English or Spanish. The VIA is a 16-item bidimensional measure with subscales that separately measure heritage and U.S. acculturation (42). Items addressed a range of topics, including traditions, social activities, media, cultural values, and behavioral preferences (Table S1). Caregivers were asked to provide their heritage culture using an open-ended item with specific examples provided as prompts (e.g., Asian, Black/African American, Native American, Hispanic, Jewish); participants who did not identify a heritage culture were told not to complete the VIA. Initial assessment of VIA data at ABCD baseline indicated high internal consistency across the heritage ($\alpha = 0.92$) and U.S. ($\alpha = 0.90$) subscales, with early data suggesting higher VIA subscale scores for both heritage and U.S. cultures among families at lower risk compared with those at higher risk for adolescent substance use (41).

Caregiver and Youth Measures of Mental Health. In addition to measures of demographics and acculturation, the ABCD baseline mental health battery included measures of caregiver and youth mental health (40). Caregivers completed the Adult Self Report (ASR), which assesses behavioral dimensions relevant to adult psychopathology (43), and the Child Behavior Checklist (43), which assesses behavioral dimensions relevant to child psychopathology. The NDA provides the age- and gender-normed syndrome and DSM-oriented scale scores of the ASR and the Child Behavior

Table 1. Country of Origin and ABCD Site for Total Sample

Country of Origin	<i>n</i> (%)
Argentina	9 (0.9%)
Bolivia	2 (0.2%)
Brazil	17 (1.6%)
Chile	5 (0.5%)
Colombia	39 (3.7%)
Costa Rica	8 (0.8%)
Cuba	59 (5.6%)
Dominican Republic	12 (1.1%)
Ecuador	13 (1.2%)
El Salvador	27 (2.6%)
Guatemala	27 (2.6%)
Honduras	26 (2.5%)
Mexico	406 (38.4%)
Nicaragua	29 (2.7%)
Panama	2 (0.2%)
Paraguay	1 (0.1%)
Peru	27 (2.6%)
Uruguay	3 (0.3%)
United States	312 (29.5%)
Venezuela	33 (3.14%)
ABCD Site	<i>n</i> (%)
CHLA	162 (15.3%)
CUB	16 (1.5%)
FIU	293 (27.7%)
LIBR	44 (4.2%)
MUSC	2 (0.2%)
OHSU	29 (2.7%)
ROC	3 (0.3%)
SRI	43 (4.1%)
UCLA	87 (8.2%)
UCSD	249 (23.6%)
UFL	13 (1.2%)
UMB	12 (1.1%)
UMICH	17 (1.6%)
UMN	6 (0.6%)
UPMC	1 (0.1%)
UTAH	35 (3.3%)
UVM	4 (0.4%)
UWM	2 (0.2%)
VCU	11 (1.0%)
WUSTL	1 (0.1%)
YALE	25 (2.4%)
MSSM	2 (0.2%)

ABCD, Adolescent Brain Cognitive Development; CHLA, Children's Hospital Los Angeles; CUB, The University of Colorado Boulder; FIU, Florida International University; LIBR, Laureate Institute for Brain Research; MSSM, Mt. Sinai School of Medicine; MUSC, Medical University of South Carolina; OHSU, Oregon Health & Science University; ROC, University of Rochester; SRI, SRI International; UCLA, University of California, Los Angeles; UCSD, University of California San Diego; UFL, University of Florida; UMB, University of Maryland at Baltimore; UMICH, University of Michigan; UMN, University of Minnesota; UPMC, University of Pittsburgh; UTAH, University of Utah; UVM, University of Vermont; UWM, University of Wisconsin-Milwaukee; VCU, Virginia Commonwealth University; WUSTL, Washington University in St. Louis; YALE, Yale University.

Checklist; the DSM-oriented scoring was used in the current study.

Hispanic/Latinx Sample Selection

A total of 11,878 ABCD Study participants were recruited at baseline. Data for the analyses presented here were downloaded from the NDA for 2411 participants who completed their baseline assessment for the ABCD Study and responded “Yes” to “Do you consider the child Hispanic/Latino/Latina?” We filtered participant datasets to include only caregivers who 1) completed the VIA, 2) referenced Hispanic/Latinx culture when completing the VIA, and 3) were either first- or second-generation immigrants from Latin America. The resulting sample thus consisted of 1057 caregivers (mean age = 38.31 years, SD = 6.64 years; 90.4% mothers and 9.6% fathers, 70.5% foreign-born) and 1158 children (52.7% male, 91.7% U.S. born) (Table 1). Additional details about the sample are provided in the Supplement.

Neuroimaging Data

Youth participants completed a baseline neuroimaging protocol that included structural MRI and rs-fMRI using high spatial and temporal resolution simultaneous multislice/multiband echo-planar imaging (EPI) (44,45). For Siemens scanners, fMRI scan parameters were as follows: 90 × 90 matrix, 60 slices, field of view = 216 × 216, echo time/repetition time = 30/800 ms, flip angle = 52°, 2.4-mm isotropic resolution, and slice acceleration factor 6. The complete protocols for all vendors and sequences have been provided by Casey *et al.* (44).

Analyses

Latent Profile Analysis. To empirically evaluate Berry’s model of acculturation by identifying distinct groups of caregivers based on their VIA scores (e.g., U.S. and heritage subscales), we conducted an LPA in Mplus 8.7 with a robust maximum likelihood estimator and a sandwich covariance estimator to adjust the standard errors and account for the nesting of participants within site (46,47). A combination of fit statistics and substantive interpretability was used to decide on the number of profiles (48). First, a solution with k profiles was selected only if it provided a significantly better fit than a solution with $k-1$ profiles to balance parsimony and fit. This was determined using the Lo-Mendell-Rubin adjusted likelihood ratio test (LMR LRT), which indicates the extent to which the $-2 \log$ likelihood value for a model with k profiles is significantly smaller than the corresponding value for a model with $k-1$ profiles. Second, entropy values and posterior probabilities of correct classification should be at least 0.70 (49). Third, to ensure stability of the profile solution, each profile had to represent more than 5% of the sample (50). Fourth, the

profiles had to be conceptually and substantively different from one another; one profile could not simply be a variant of another profile.

Caregiver and Youth Mental Health. Next, we implemented the widely used classify-analyze approach (51) and saved profile membership and posterior probabilities for the championed profile model back into the dataset. This approach reduces uncertainty in profile classification and tends not to have the disadvantages associated with a one-step approach but can be biased when entropy is below 0.70 (52). Subsequently, we estimated a series of path models with acculturative orientation as a categorical predictor to determine whether there were differences in terms of caregiver and youth mental health as assessed using the ASR and Child Behavior Checklist data, respectively. All subsequent path models were estimated in Mplus 8.7 (53) with a robust maximum likelihood estimator and a sandwich covariance estimator (46,47) to account for the nesting of participants within site. The Benjamini-Hochberg correction was applied to control for the false discovery rate at .05 due to multiple comparisons (54). Covariates included caregiver education, identity, and nativity, as well as youth gender and family income. Missing data were handled using full information maximum likelihood estimation. Given the presence of siblings in the youth dataset, youth mental health models were estimated using multilevel modeling to account for nesting of children (level 1) with family (level 2) and site (level 3).

Neuroimaging Preprocessing

MRI data were processed using fMRIPrep 21.0.0, a Brain Imaging Data Structure App that automatically adapts a best-in-breed workflow, thereby ensuring high-quality preprocessing with minimal manual intervention (55,56). Anatomical images were intensity corrected, skull stripped, segmented, and spatially normalized to a standard brain template in Montreal Neurological Institute space. Functional MRI preprocessing included motion correction, susceptibility distortion correction, and coregistration. Denoising was performed using AFNI’s (57) 3dTproject (58). Complete details of the MRI preprocessing and analyses are described in the Supplement.

Resting-State fMRI Analyses. Resting-state fMRI analyses were preregistered (<https://osf.io/mkdw3/>). We focused on 5 meta-analytically defined regions of interest (ROIs) associated with self- and affiliation-related processing (27), including the vmPFC, left insula, right insula, left TPJ, and right TPJ (Figure S1). For each resting-state acquisition, voxelwise time series were extracted from each ROI using the unsmoothed, preprocessed, and denoised data via AFNI’s

Table 2. Latent Profile Analysis Model Comparisons

Number of Profiles	AIC	BIC	Adj. BIC	Entropy	Smallest	LMR LRT (<i>df</i>)	<i>p</i> Value
2	5520.457	5555.199	5532.966	0.791	26.68%	468.392 (3)	<.001
3	5376.117	5425.748	5393.987	0.833	4.16%	143.472 (3)	.065
4	5284.536	5349.057	5307.767	0.871	2.37%	93.123 (3)	.188

Adj., adjusted; AIC, Akaike information criterion; BIC, Bayesian information criterion; LMR LRT, Lo-Mendell-Rubin adjusted likelihood ratio test.

Acculturation Among ABCD Hispanic/Latinx Caregivers

Table 3. Standardized Differences Across the Two-Profile Solution

Orientation	Bicultural, 73.3%		Detached, 26.7%	
	Mean	SD	Mean	SD
Heritage Orientation	0.471 (7.790)	0.557 (0.955)	-1.295 (4.760)	0.781 (1.340)
U.S. Orientation	0.392 (7.606)	0.681 (1.086)	-1.079 (5.260)	0.941 (1.501)

The % of the sample meeting each acculturation dimension is shown. Dimensions were standardized and should be interpreted as average z scores indicating how far each profile deviates from average scores in the total sample and from other profiles. Original unstandardized scores are reported in parentheses.

3dmaskave. Averaged ROI time series were generated by calculating the mean voxel value for each time point across nonzero voxels respective to each region. For each ROI, we computed 2 measures of rs-fMRI activity: fractional amplitude of low-frequency fluctuations (fALFF) as a measure of local, spontaneous fluctuations during the resting state (59) and regional homogeneity (ReHo) as a measure of local blood oxygen level-dependent signal coherence (60). In addition, adjacency matrices were constructed for each participant by computing the pairwise Pearson's correlation coefficients between each pair of ROIs, generating a 5×5 connectivity matrix with 10 unique regional pairs. Correlation values were Fisher z-transformed to provide a summary measure of pairwise functional connectivity.

Next, we estimated a series of path models to characterize potential differences across caregiver acculturation profiles in terms of rs-fMRI activity and connectivity. Three separate models were tested for spontaneous fluctuations using fALFF, local signal coherence using ReHo, and functional connectivity using z-transformed correlation coefficients. Path models were estimated in Mplus 8.7 controlling for caregiver education, identity, and nativity, as well as youth gender and family income.

RESULTS**Latent Profile Analysis**

As shown in Table 2, the 2-profile solution provided significantly better fit compared with the 1-profile solution (LMR LRT = 468.392, $p < .001$). Although entropy was higher, Akaike information criterion/Bayesian information criterion were lower for the 3-profile solution, and the LMR LRT trended toward

significance (LMR LRT = 143.473, $p = .065$). Closer examination of the 3-profile solution indicated that the additional profile was not conceptually or substantively different from one of the initial profiles and also only accounted for 4.16% of the sample (see the Supplement). Thus, the 2-profile solution was advanced as the championed model.

Table 3 presents mean z scores for heritage and U.S. cultural orientations across profiles, indicating how far each profile deviated from the total sample average. These z scores can be interpreted as an effect size index. The first profile represented 73.3% of the sample ($n = 775$) and was marked by high levels of both heritage and U.S. cultural orientation. Consistent with Berry's conceptualization, this model was labeled "bicultural." The second profile, labeled "detached," accounted for 26.7% of the sample ($n = 282$) and was characterized by low levels of both heritage and U.S. cultural orientation.

Next, given that entropy was greater than 0.70, we used the classify-analyze approach (51) and saved profile membership and posterior probabilities back into the dataset. The average posterior probabilities were 0.96 and 0.89 for the bicultural and detached profiles, respectively. To ensure clearly defined class membership, we restricted profile assignment to caregivers whose posterior probabilities were 0.70 or higher. Of the 1057 total unique caregivers, 981 (92.81%) had posterior probabilities greater than 0.70, including 747 bicultural and 234 detached caregivers, and there were no significant differences between participants with posterior probabilities above 0.70 and those with posterior probabilities below 0.70 (see the Supplement). Figure 2 illustrates the z scores for heritage and U.S. cultural orientations across profiles. There were no significant differences between profiles in terms of caregiver

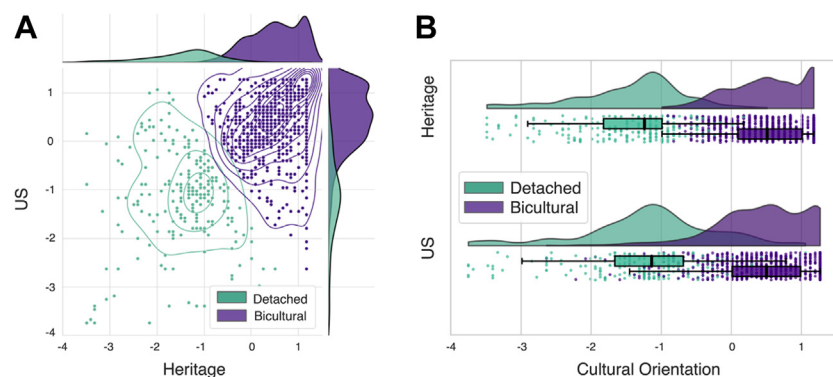


Figure 2. Heritage and U.S. cultural orientations across profiles. Latent profile analysis revealed 2 acculturative orientation profiles among Hispanic/Latinx caregivers in the Adolescent Brain Cognitive Development (ABCD) Study. Cultural orientation subscale scores were normalized across participants, and the resulting z-scored values are shown in (A) a joint kernel density estimate plot (90) and (B) a raincloud plot (91). In both visualizations, the bicultural profile ($n = 747$) demonstrated high levels of both heritage and U.S. cultural orientation (purple), while the detached profile ($n = 234$) exhibited very low levels of both heritage and U.S. cultural orientation (green).

Table 4. Demographic Characteristics for Total Sample and Bicultural and Detached Groups

Caregiver Characteristics	Total Caregiver Sample, <i>N</i> = 1057	Bicultural Caregivers, <i>n</i> = 747	Detached Caregivers, <i>n</i> = 234	Statistics
Caregiver Identity				
Biological mother	955 (90.4%)	682 (91.3%)	206 (88.0%)	$\chi^2_1 = 2.213$ $p = .137$ Cramér's <i>V</i> = 0.05
Biological father	102 (9.6%)	65 (8.7%)	28 (12.0%)	
Caregiver Age, Years	38.31 (6.64)	38.49 (6.48)	37.53 (6.48)	$t_{971} = -1.95$ $p = .051$ Cohen's <i>d</i> = 0.15
Caregiver Nativity				
U.S.-born	312 (29.5%)	163 (21.8%)	71 (30.3%)	$\chi^2_1 = 0.210$ $p = .647$ Cramér's <i>V</i> = 0.02
Foreign-born	745 (70.5%)	532 (78.2%)	163 (69.7%)	
Caregiver Education				
< High school diploma	239 (22.6%)	158 (21.2%)	69 (29.5%)	$t_{975} = -3.840$ $p < .001$ Cohen's <i>d</i> = 0.29
High-school diploma/GED	167 (15.8%)	109 (14.6%)	43 (18.4%)	
Some college	352 (33.3%)	252 (33.7%)	74 (31.6%)	
Bachelor's degree	172 (16.3%)	127 (17.0%)	31 (13.3%)	
Postgraduate degree	123 (11.6%)	98 (13.1%)	16 (6.8%)	
No answer	4 (0.4%)	3 (0.4%)	1 (0.4%)	
Household Income per Year (US\$)				
<\$5000	49 (4.6%)	37 (5.0%)	7 (3.0%)	$t_{853} = -0.436$ $p = .663$ Cohen's <i>d</i> = 0.03
\$5000–\$11,999	65 (6.1%)	48 (6.4%)	14 (6.0%)	
\$12,000–\$15,999	53 (5.0%)	38 (5.1%)	13 (5.6%)	
\$16,000–\$24,999	103 (9.7%)	66 (8.8%)	34 (14.5%)	
\$25,000–\$34,999	126 (11.9%)	89 (11.9%)	23 (9.8%)	
\$35,000–\$49,999	137 (13.0%)	103 (13.8%)	26 (11.1%)	
\$50,000–\$74,999	137 (13.0%)	96 (12.9%)	30 (12.8%)	
\$75,000–\$99,999	115 (10.9%)	82 (11.0%)	26 (11.1%)	
\$100,000–\$199,999	116 (11.0%)	84 (11.2%)	21 (9.0%)	
\$200,000 and greater	21 (2.0%)	14 (1.9%)	4 (1.7%)	
No answer	135 (12.8%)	90 (12.0%)	36 (15.4%)	
Youth Characteristics				
	Total Youth Sample, <i>N</i> = 1158	Youth With Bicultural Caregivers, <i>n</i> = 814	Youth With Detached Caregivers, <i>n</i> = 261	Statistics
Youth Gender				
Female	547 (47.2%)	374 (46.0%)	130 (49.8%)	$\chi^2_1 = 1.149$ $p = .284$ Cramér's <i>V</i> = 0.03
Male	610 (52.7%)	439 (53.9%)	131 (50.2%)	
No answer	1 (0.1%)	1 (0.1%)	0 (0%)	
Youth Nativity				
First generation	96 (8.3%)	71 (8.7%)	20 (7.7%)	$\chi^2_2 = 296$ $p = .863$ Cramér's <i>V</i> = 0.02
Second generation	855 (73.8%)	596 (73.2%)	194 (74.3%)	
Third generation	207 (17.9%)	147 (18.1%)	47 (18.0%)	

Data are presented as mean (SD) or *n* (%).
GED, general equivalency degree.

identity, age, and generational status; family income; or youth gender and generational status. However, there was a significant difference in terms of education, such that caregivers with a bicultural orientation were overrepresented among higher educational attainment categories (Table 4).

Class Membership Effects: Caregiver and Youth Mental Health

Next, we estimated a path model with acculturative orientation included as a categorical predictor (0 = detached, 1 =

bicultural) to determine whether there were significant differences in caregiver mental health across profiles. Results indicated that being bicultural was associated with fewer symptoms of depression and avoidant and inattentive behaviors; however, the association between caregivers' acculturative orientation and inattentive behavior did not survive correction for multiple comparisons (Table 5).

We examined whether there were significant differences between caregiver bicultural and detached profiles in terms of youth mental health. Children of caregivers with a bicultural orientation exhibited significantly fewer symptoms of

Acculturation Among ABCD Hispanic/Latinx Caregivers

Table 5. Class Membership Effects on Caregiver Mental Health

Caregiver-Reported ASR (DSM Scoring)	Estimate (SE)	<i>p</i> Value	FDR-Corrected <i>p</i> Value	95% CI Low	95% CI High
Depression	-1.060 (0.338)	.002 ^a	.016 ^a	-1.723	-0.397
Anxiety	-0.204 (0.458)	.656	.656	-1.103	0.695
Somatic	-0.812 (0.448)	.070	.112	-1.690	0.066
Avoidant	-1.245 (0.469)	.008 ^a	.032 ^a	-2.165	-0.325
ADHD	-1.040 (0.536)	.053	.106	-2.091	0.011
Antisocial	-0.559 (0.378)	.140	.187	-1.299	0.182
Inattention	-1.280 (0.617)	.038 ^a	.101	-2.490	-0.070
Hyperactivity	-0.524 (0.391)	.180	.206	-1.291	0.243

Path models controlled for caregiver education, identity, and nativity, as well as youth gender and family income. The FDR-corrected *p* value used the Benjamini-Hochberg correction.

ADHD, attention-deficit/hyperactivity disorder; ASR, Achenbach Adult Self Report; FDR, false discovery rate.

^aSignificant at $p < .05$.

depression and somatic complaints; however, neither of these findings survived correction for multiple comparisons (Table 6).

Class Membership Effects: Youth rs-fMRI Activity and Connectivity

Finally, we examined whether there were significant differences between caregiver bicultural and detached profiles in terms of youth rs-fMRI activity and connectivity. With respect to spontaneous fluctuations during the resting state (Table 7), children of caregivers with a bicultural orientation exhibited greater fALFF values in the left insula; however, this finding did not survive correction for multiple comparisons. In terms of regional homogeneity (Table 7), children of caregivers with a bicultural orientation exhibited greater ReHo values (even after correction for multiple comparisons) also in the left insula. In terms of pairwise functional connectivity values (Table 8), no significant differences in connectivity between the vmPFC, bilateral insula, and bilateral TPJ were observed among youth with bicultural versus detached caregivers.

DISCUSSION

Acculturation data from Hispanic/Latinx caregivers in the ABCD Study were analyzed and yielded 2 caregiver profiles. Bicultural caregivers ($n = 747$) endorsed high levels of both heritage and U.S. cultural orientation, while detached caregivers ($n = 234$) endorsed very low levels of heritage and U.S. cultural orientation. Theory (1,2,8–10) and prior experimental work [e.g., (11,13,14)] have identified 2 additional profiles,

assimilated (high U.S. and low heritage) and separated (low U.S. and high heritage), which surprisingly were not observed. It is possible that separated caregivers were less likely to enroll their children in the ABCD Study due to mistrust, documentation concerns, and/or reluctance to participate in a high-profile, national, longitudinal study (61). The absence of the assimilated profile in our data might have stemmed from using the VIA, which captures bidimensional acculturation specifically in terms of cultural practices. Given that acculturation extends across multiple domains (1), future research should use measures of heritage and U.S. identification and values to better capture nuances in cultural orientations. That said, it is worth noting past research has not always consistently identified assimilated (16,17,19,62–65) or separated (16,19,63) profiles among adult populations. As a whole, in contrast to results among adolescents and young adults (35), these findings may indicate decreased variability in cultural orientation among adults. Overall, utilization of a data-driven approach allowed for the testing of competing models underlying the data, thereby yielding more ecologically valid findings that reflect the lived experiences of Hispanic/Latinx families in the ABCD Study.

Comparison of ABCD Study bicultural and detached profiles indicated that biculturalism was associated with more positive mental health outcomes, in agreement with a wealth of previous acculturation research (10,66,67). However, these prior studies are characterized by the use of individual rating inventories that separately measure symptoms of a single disorder (e.g., depression). The current work represents the first

Table 6. Class Membership Effects on Youth Mental Health

Caregiver-Reported CBCL (DSM Scoring)	Estimate (SE)	<i>p</i> Value	FDR-Corrected <i>p</i> Value	95% CI Low	95% CI High
Depression	-0.652 (0.318)	.040 ^a	.120	-1.276	-0.029
Anxiety	-0.386 (0.454)	.393	.472	-1.271	0.500
Somatic	-0.850 (0.381)	.026 ^a	.156	-1.597	-0.104
ADHD	-0.371 (0.315)	.239	.359	-0.989	0.247
Oppositional Defiant	-0.036 (0.248)	.886	.886	-0.522	0.451
Conduct	-0.601 (0.410)	.142	.284	-1.404	0.202

Path models controlled for caregiver education, identity, and nativity, as well as youth gender and family income. The FDR-corrected *p* value used the Benjamini-Hochberg correction.

ADHD, attention-deficit/hyperactivity disorder; CBCL, Child Behavior Checklist; FDR, false discovery rate.

^aSignificant at $p < .05$.

Table 7. Class Membership Effects on Youth rs-fMRI Activity

Youth rs-fMRI Activity	Estimate (SE)	<i>p</i> Value	FDR-Corrected <i>p</i> Value	95% CI Low	95% CI High
Fractional Amplitude of Low-Frequency Fluctuation					
vmPFC	0.015 (0.017)	.400	.800	−0.020	0.049
Left insula	0.021 (0.008)	.006 ^a	.060	0.006	0.036
Right insula	0.010 (0.013)	.418	.597	−0.014	0.035
Left TPJ	−0.019 (0.022)	.394	.985	−0.063	0.025
Right TPJ	−0.012 (0.015)	.417	.695	−0.041	0.017
Regional Homogeneity					
vmPFC	−0.004 (0.021)	.850	.944	−0.044	0.036
Left insula	0.030 (0.011)	.007 ^a	.035	0.008	0.051
Right insula	0.025 (0.016)	.112	.373	−0.006	0.056
Left TPJ	−0.015 (0.034)	.668	.835	−0.081	0.052
Right TPJ	<0.001 (0.030)	.995	.995	−0.059	0.059

Path models controlled for caregiver education, identity, and nativity, as well as youth gender and family income. The FDR-corrected *p* value used the Benjamini-Hochberg correction.

FDR false discovery rate; rs-fMRI, resting-state functional magnetic resonance imaging; TPJ, temporoparietal junction; vmPFC, ventromedial prefrontal cortex.

^aSignificant at *p* < .05.

time that the ASR has been used to study acculturative orientations, thus allowing for a more comprehensive evaluation across multiple symptoms and disorders. We observed an interesting pattern of behavioral problems among detached caregivers, including increased avoidant behaviors and symptoms of depression and inattention. When placed in the context of need and motivation for relationships with others, this pattern suggests a diminished approach to and enjoyment of social interactions. It is possible that individuals with a detached orientation experience overall low social affiliation that influences their connectedness to other people and broader social structures. Future work will need to address the extent to which detached orientations may reflect low behavioral activation system (68) sensitivity or anhedonia and low social approach (69–71), resulting in reduced effort to obtain rewards and/or low sensitivity to rewards. Such links would represent significant progress in establishing clinical phenotypes of acculturation that have previously been related to outcomes such as depression (17,19), substance use (67,72), and suicide risk (66).

From a family systems perspective, current findings in the ABCD Study sample indicate potential downstream effects among youth as a result of caregiver acculturation. The results suggest significant, and likely complex, differences in caregiving environments as a result of caregiver health, parenting, and family functioning that collectively and dynamically influence fetal through adolescent development. Emerging patterns of increased symptoms of depression and somatic complaints were observed among 9- to 10-year-old children with detached caregivers, thus identifying a subset of Hispanic/Latinx youth who are at higher risk for adverse outcomes at the beginning of adolescence, a critical socioemotional neurodevelopmental period during which psychopathology often emerges (73,74). Importantly, these results were obtained using caregiver-reported measures, which can be influenced by the depression distortion bias (75) and perhaps provide somewhat limited insight into youth perspectives on acculturation and mental health. Future analyses of subsequent ABCD Study time points should incorporate youth-reported measures. Furthermore, the longitudinal design of

Table 8. Class Membership Effects on Youth rs-fMRI Connectivity

Youth Functional Connectivity	Estimate (SE)	<i>p</i> Value	FDR-Corrected <i>p</i> Value	95% CI Low	95% CI High
L Insula—R Insula	0.020 (0.016)	.202	.673	−0.011	0.050
L Insula—L TPJ	−0.001 (0.017)	.970	.970	−0.035	0.033
L Insula—R TPJ	0.025 (0.016)	.107	>.999	−0.005	0.056
L Insula—vmPFC	0.022 (0.030)	.476	.793	−0.038	0.081
R Insula—L TPJ	−0.007 (0.010)	.490	.700	−0.025	0.012
R Insula—R TPJ	0.016 (0.012)	.199	.995	−0.008	0.040
R Insula—vmPFC	0.022 (0.023)	.326	.815	−0.022	0.067
L TPJ—R TPJ	0.004 (0.018)	.819	.910	−0.031	0.040
L TPJ—vmPFC	−0.010 (0.014)	.471	.942	−0.038	0.018
R TPJ—vmPFC	0.012 (0.019)	.545	.681	−0.026	0.049

Path models controlled for caregiver education, identity, and nativity, as well as youth gender and family income. The FDR-corrected *p* value used the Benjamini-Hochberg correction.

FDR, false discovery rate; L, left; R, right; rs-fMRI, resting-state functional magnetic resonance imaging; TPJ, temporoparietal junction; vmPFC, ventromedial prefrontal cortex.

Acculturation Among ABCD Hispanic/Latinx Caregivers

the ABCD Study provides a unique opportunity to continue following these at-risk Hispanic/Latinx youth, with the aim of more fully understanding divergent trajectories sensitive to stressful family dynamics that arise during adolescence when Hispanic/Latinx youth are developing their own cultural values, beliefs, and practices (28,76). Such analyses would be enhanced by the inclusion of mediating variables related to family conflict, prosocial behaviors, and parenting. Given the comprehensive youth assessments included in the ABCD Study, future research also offers the opportunity to directly assess links between adolescent acculturation and low behavioral activation system sensitivity or anhedonic phenotypes.

We hypothesized that differences in caregiver acculturation would be associated with differences in youth rs-fMRI signatures in self- and affiliation-related circuits. Resting state was considered an important data source in the current study given its links to self-referential processing (77,78), as well as its flexibility in examining a full range of brain systems in the absence of external stimuli and/or task demands (79). In terms of neural differences, youth of bicultural caregivers exhibited greater rs-fMRI activity (both fALFF and ReHo) in the left insula, potentially indicating increased metabolic rate of glucose and oxygen (80); these results are aligned with findings from studies showing that the insula is associated with somatic and depressive symptoms (81,82) and with psychopathology more broadly (83–85). The insula is a complex, multifaceted structure (86). If indeed detached caregivers transmit their acculturative orientation directly to their children and if detached orientations are linked to anhedonia and/or altered reward behaviors, then it is possible that dysregulated insula function is a central neurobiological mechanism of interest given its prominent role in reward processing (87,88). Given the results of the current study, future task-based analyses may be warranted to probe reward-based circuitry [i.e., ABCD's monetary incentive delay task (89)] among youth with bicultural versus detached caregivers. Finally, we note that while differences in rs-fMRI activity (i.e., fALFF and ReHo) were observed, significant effects for long-range connectivity differences were not found. The absence of whole-brain connectivity findings may be due to a number of factors, including methodological issues affecting power and reliability, developmental variability of long-range connectivity patterns, or the lack of an association between caregiver acculturation and youth brain connectivity. Future work should examine neurodevelopmental changes across adolescence to determine whether localized, corticolimbic brain effects among Hispanic/Latinx youth at the ABCD Study baseline are ultimately translated into long-range connectivity differences.

In conclusion, these findings indicate that acculturation is an important factor relevant to ABCD Hispanic/Latinx caregivers' mental health, as well as the mental health and resting-state insula activity of their children. This work demonstrates that the ABCD Study's multisite design and demographically diverse sample offer an opportunity to study participant groups that have historically been underrepresented in neuroimaging research. Furthermore, in the current work, we intentionally did not compare Hispanic versus non-Hispanic participants, which could implicitly provide support for a deficits-based

framework. Instead, we emphasized the diversity of Hispanic/Latinx families in the United States who have diverse family dynamics, life experiences, and health-related outcomes. Moreover, analysis of a subset of the ABCD Study sample creates a space to focus on Hispanic/Latinx culture in a way that is not centered around non-Hispanic, majority experiences. The ABCD Study's robust culture and environment protocol was thoughtfully developed and provided the measures that made this work feasible. Additional population-based neuroimaging studies incorporating other culturally relevant measures of the social and structural determinants of health are urgently needed. Such work will allow for a more complete understanding of neurobiological processes of risk and resilience among individuals from underrepresented, minoritized groups that experience health-related disparities as a consequence of their racial, ethnic, sexual, or gender identities.

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AM and ARL conceived and designed the project. AM, JAP, MCR, WH, and ARL analyzed the data. JAP, MCR, TS, JSF, and KLB contributed scripts and pipelines. WH, ASD, and MTS provided statistical support. JWP, RPL, LMU, CAG, SWH, MS, MRG, and RG provided support for analysis of ABCD measures and results interpretation. AM, JAP, MCR, and ARL wrote the paper, and all authors contributed to the revisions and approved the final version.

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Data used in the preparation of this article were obtained from the ABCD Study (<https://abcdstudy.org>), held in the NDA. This is a multisite, longitudinal study designed to recruit more than 10,000 children ages 9 to 10 years and follow them over 10 years into early adulthood. A listing of participating sites and a complete listing of the study investigators can be found at https://abcdstudy.org/consortium_members/.

The ABCD data repository grows and changes over time. The ABCD data used in this report came from NDA ABCD Release 3.0 (<https://doi.org/10.15154/1520591>). An NDA study was created to associate the analyses reported in this study with the underlying ABCD Study data (<https://doi.org/10.15154/1527751>). Additional information and resources are available on a project page for this study at the Open Science Framework (<https://osf.io/mkdw3/>). The code is available in 2 GitHub repositories, including one for analysis of the Vancouver Index of Acculturation data (<https://github.com/NBCLab/abcd-hispanic-via>) and one for the fMRI preprocessing and analyses (https://github.com/NBCLab/abcd_fmriprep-analysis). Regions of interest and connectivity maps are available in NeuroVault (<https://identifiers.org/neurovault.collection:1276>). High-resolution

figures are available via FigShare (<https://figshare.com/account/home#/projects/143997>).

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