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Family type and cognitive function in older Chinese Americans: acculturation as a moderator

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ABSTRACT

Objectives: Acculturation to the mainstream culture and the settlement contexts could shape cognitive function of older immigrants. Guided by ecological theory, this study examines the interaction effect between individual acculturation and ecology of family on cognitive function among older Chinese Americans.

Methods: Data were derived from the Population Study of Chinese Elderly in Chicago ($n=3,019$). Family types included *tight-knit (high solidarity and low conflicts), unobligated-ambivalent (high solidarity and conflicts), commanding-conflicted (low solidarity and high conflicts)*, and *detached (low solidarity and low conflicts)*. Acculturation was measured via language ability, media use, and ethnic social relations. Cognitive function was evaluated by global cognition, episodic memory, working memory, processing speed, and mini-mental state examination. Multiple regression analyses and interaction terms were used.

Results: Older adults in the commanding-conflicted type had the lowest cognitive function. After controlling confounding variables, higher levels of acculturation ($b=0.009$, SE = 0.003, $p < .01$) were associated with higher levels of global cognition. Acculturation buffered the negative impact of having a commanding-conflicted relationship with children on global cognition ($b=0.070$, SE = 0.016, $p < .001$). Language ability, media use, and ethnic social relations played a unique role in the relationships between family types and cognitive domains.

Conclusion: Acculturation to the dominant culture is identified as a cultural asset for cognitive function in older Chinese Americans. Social services could protect cognitive function of older immigrants in the commanding-conflicted type through enhancing cultural participation. Future research could test how affective and cognitive aspects of acculturation affect health.

Introduction

Literature has broadly explored racial and ethnic disparities in cognitive health (Lines & Wiener, 2014). Asian Americans trace their roots to more than 20 countries in East and Southeast Asia and the Indian subcontinent, accounting for a population of 22.2 million in 2017 (United States Census Bureau, 2017). Because the number of older immigrants from many individual Asian countries in the United States is relatively small, they are frequently lumped into one "Asian" category in research studies (Mayeda, Glymour, Quesenberry, & Whitmer, 2016). However, Asians are diverse in ethnicity and in their immigration experiences in the United States. As collectivistic groups, the family unit is central to all Asian families; however, some family practices may differ in Asian American families. Each group also has unique religious beliefs that influence cultural traditions (Paik, Rahman, Kula, Saito, & Witenstein, 2017).

Asian Americans have lower rates of dementia incidence than non-Latino whites, with some subgroup heterogeneity such that dementia incidence is slightly higher among Japanese and Filipino Americans as compared with Asian and Chinese Americans (Mayeda, Glymour, Quesenberry, & Whitmer, 2017). As research using cognitive tests to evaluate cognitive function in different Asian American ethnic groups

is rare, studies focusing on a homogeneous population could be meaningful in informing healthcare interventions and programmatic policies aimed at protecting cognitive function. Chinese Americans constitute the largest segment of the Asian American population. One study on older Chinese Americans reported that global cognition declined by 0.039 standard score units and working memory declined by 0.055 standard score units per year (Li, Ding, Wu, & Dong, 2017). However, it remains unclear how immigration contexts and process (e.g. immigrant families, acculturation) affect the cognitive function of older Chinese Americans.

Family relationships and cognitive function

The acculturation framework proposed by Berry (1997) could be categorized into three main contextual areas: prior immigration context, immigration context, and settlement context (Cabassa, 2003). Immigrant families are one of the understudied settlement contexts. Family can influence how the individual adapts and integrates to the mainstream culture. For older Chinese immigrants, language and cultural barriers they encounter in receiving communities increase their reliance on family, adult children in particular (Simon et al., 2018). Family

provides an important shelter for aging-in-place and more research is warranted to understand the role of multi-faceted family relationships in older immigrants' health.

The intergenerational solidarity theory depicts six aspects of family relationships: structural, associational, functional, affectual, consensual, and normative solidarities (Bengtson & Roberts, 1991). Structural aspect refers to the structure of family, such as family size and the geographical proximity between family members. Associational aspect highlights contact frequency and pattern between family members. Functional aspect is defined as the support exchange and resource sharing across generations. Affectual aspect focuses on emotional relationships among family members, encompassing both positive and negative relationships. Consensual aspect refers to the degree of agreement between family members in terms of values, attitudes and beliefs. The normative aspect is specific to norms or expectations of family obligations (Bengtson & Roberts, 1991).

Cognitive function is an important aspect of successful aging (Fiocco & Yaffe, 2010). Most studies on family relationships and cognitive function have been conducted in western countries. Empirical evidence has shown that larger family size (*structural*), more frequent intergenerational interactions (*associational*), and higher upward and downward family support (*functional*) were associated with better cognitive health among older adults in the United States, Australia, and Europe (Barnes, De Leon, Wilson, Bienias, & Evans, 2004; Burn & Szoeke, 2015; Ihle et al., 2018). A few studies were conducted in Asian countries. For example, the Korean Longitudinal Study of Aging reported a protective effect of non-visual contact with children on parents' cognitive decline (Kim & Chon, 2018). Frequent in-person contact was associated with an increased risk of cognitive decline over a 4-year period among Korean older adults aged 75 and above (Lee & Kim, 2016). However, most research has relied solely on one aspect of family relationships regardless of the variations of other aspects of family relationships. Indeed, individuals experience different aspects of family relationships simultaneously.

According to the variations in the different aspects of family relationships, four family types were hypothesized in the literature: *tight-knit (or harmonious, amicable)*, *detached*, *ambivalent*, and *conflicted* (or *disharmonious*) (Ferring, Michels, Boll, & Filipp, 2009; Katz, Lowenstein, Phillips, & Daatland, 2005; Silverstein & Bengtson, 1997). These four family types have also been identified in older Chinese Americans (Guo, Stensland, Li, & Dong, 2019). To date, only one study has explored the relationship between different family types and cognitive function (Li, Guo, Stensland, & Dong, 2021). That study found that not all family types are protective of cognitive health of older family members in Chinese population, and in particular, the conflicted type was associated with the poorest global cognition as evaluated by episodic memory, working memory, processing speed, and mini-mental state examination (MMSE) after controlling confounding variables (Li et al., 2021).

Acculturation in immigrant families

The association of family relationships with cognitive function among older Chinese immigrants evolves within the context of acculturation to the majority culture. While there is no widely accepted conceptualizations for acculturation, (Arends-Toth & van de Vijver, 2006), two theoretical perspectives have dominated acculturation research: unidimensional model and bidimensional model. In Gordon's unidimensional model, individuals are placed on a continuum of cultural orientation ranging from an exclusively heritage culture to exclusively mainstream culture (Gordon, 1964). In the unidimensional model, acculturation is considered a linear process. In contrast, the Berry's bidimensional model proposes that acquiring or adhering to a new dominant culture is independent of maintaining the original culture. The acculturation process is shaped by both the wish of immigrants to maintain their culture of origin and the degree to which they desire involvement in the new society and contact with natives. In the bidimensional model, acculturation is regarded as a process in which both heritage and mainstream cultural identities are free to vary independently (Berry, 1997). Bidimensional acculturation measure have a great potential for the identification of independent influences of the original culture and the new culture (Matsudaira, 2006). Flannery, Reise, and Yu (2001) suggested that a unidimensional scale may be useful as a concise proxy measure of psychological acculturation and that a bidimensional scale is more appropriate for more precise theoretical investigations.

Acculturation is not only multidimensional in terms of the independence of heritage culture and receiving culture orientations but also has multiple domains that are assumed to change, such as language, media preferences, food preferences, and ethnic identity (Celenk & Van de Vijver, 2011; Matsudaira, 2006). Arends-Tóth and van de Vijver (2004) proposed a three-level model of acculturation domain specificity: cluster of domains (public and private), specific life domains, and specific situations. Other researchers categorized acculturation domains as behavioral acculturation (behavioral aspect), value acculturation (cognitive aspect), and identity-based acculturation (affective aspect) (Cuéllar, Arnold, & González, 1995; Schwartz, Unger, Zamboanga, & Szapocznik, 2010), with behavioral measures as the initial and most popular measures used to assess acculturation (Marin, Sabogal, Marin, Otero-Sabogal, & Perez-Stable, 1987). There are many existing acculturation scales that tap on behavior, but very few on other aspects of acculturation.

Immigrant family members acculturate at different rates, which negatively influences family relationships (Ho, 2010). In western countries, such as the United States, the dominant cultural norms encourage individual self-reliance and autonomy. By contrast, in Asian countries, such as China, collectivism and interdependence of generations are endorsed (Kim & Silverstein, 2021; Li & Dong, 2020; Triandis, 2018). It is commonly assumed that the younger generation is more receptive to the receiving country culture than the older generation, who are more likely to maintain their original culture (Phalet & Güngör, 2009). The different levels of acculturation across generations and the cultural value discrepancies that accordingly arise have been highlighted as potential sources of misunderstandings and conflict within immigrant families (Li, Chen, & Dong, 2020; Miranda, Bilot, Peluso, Berman, & Van Meek, 2006; Rooyackers, De Valk, & Merz, 2016).

Acculturation and cognitive function

Increasing evidence has shown that higher levels of acculturation are associated with better cognitive function. Minority older immigrants with higher levels of acculturation have better social integration and access to healthcare services, which could

benefit cognitive function (Fratiglioni, Paillard-Borg, & Winblad, 2004). In contrast, low levels of acculturation may play a negative role in cognitive function. When major difficulties are experienced during acculturation and challenges in the host country exceed the individual's capacity to cope, serious psychological disturbances could result. (Berry, 1997).

The protective role of acculturation to the receiving culture in global cognition and cognitive domains has been supported by empirical studies in different ethnic populations. For instance, higher levels of acculturation to the U.S. culture were associated with better performance on processing speed (evaluated by Symbol Digit Modalities Test) and higher scores on a composite indicator of overall neuropsychological testing among African Americans (Kennepohl, Shore, Nabors, & Hanks, 2004). A study among Spanish-speaking older adults in the United States showed that better adoption of the mainstream culture was associated with better working memory (evaluated by Digit Span) (Acevedo, Loewenstein, Agrón, & Duara, 2007). Better acculturation to the dominant culture was also correlated with better cognitive function (measured by MMSE) in a study of Turkish immigrants in Denmark (Nielsen, Vogel, Gade, & Waldemar, 2012). Higher adoption of the U.S. culture was associated with global neuropsychological functioning, working memory, and processing speed in a study of HIV + Caribbean Latinas/os (Arentoft et al., 2012). Additionally, a study of an ethnically diverse group of participants from Hispanic, Asian, or Middle-Eastern descent showed that higher levels of adaptation to the U.S. culture were correlated with better performance on processing speed (assessed by the WAIS-III Digit Symbol and Digit Span, TMT Part A, and Stroop B test) (Razani, Burciaga, Madore, & Wong, 2007). In short, acculturation to the mainstream culture was associated with better global cognition, working memory, processing speed, and MMSE. In immigrant families, the cognitive health of older immigrants is related to both family relationships and acculturation (Miranda et al., 2006), but little is known about the joint effect of family relationships and acculturation on cognitive function of older immigrants.

Research framework

The ecological theory outlines the mutual accommodation between person and immediate environment. Bronfenbrenner's model in which micro-, meso-, exo-, and macrosystems compose an individual's ecosystem is a commonly applied ecological theory to this setting (Bronfenbrenner, 1979). Acculturation involves the micro-, macro-, and chronosystem (Baldwin-White, Kiehne, Umaña-Taylor, & Marsiglia, 2017). Different domains of acculturation involve in different ecosystem. The microsystem is the most immediate environment to individuals and comprises interactions between the individual and their surroundings. The behavioral domain of acculturation occurs in the microsystem. The macrosystem represents customs and cultural values. Value acculturation and identify-based acculturation take place in the macrosystem.

This study focused on behavioral acculturation, including language, ethnic social relations, and media use, which occurs in the microsystem. In the microsystem, family constitutes a key setting where older adults participate in daily activities and maintain meaningful family relations (Bronfenbrenner, 1986; Guo, Li, Liu, & Sun, 2015), which are important stimuli for

cognitive function. Acculturation to the mainstream culture connects older immigrants to boarder communities to receive more resources to achieve healthy cognitive aging (Tang, Zhang, Chi, Li, & Dong, 2020). Family relationships and degree of acculturation substantially affect older immigrants' adaptation to the host country and shape their cognitive health through an active and socially integrated lifestyle, social networks, and leisure activity (Fratiglioni et al., 2004; Li et al., 2021; Tang, Chi, Zhang, & Dong, 2018). Indeed, family relationships and acculturation may be compensatory to each other, if one buffers the negative impact of the other. It is not well established whether family relationships and behavioral acculturation are two mutually interdependent micro-systems influencing immigrants' cognitive function. In light of the central role of the microsystem in cognitive function, the literature on the interaction between behavioral acculturation and ecology of family life with regard to cognitive health is surprisingly sparse.

The present study

This study expands on these limitations by examining the interaction effect between family types (tight-knit, unobligated-ambivalent, detached, and commanding-conflicted) and level of behavioral acculturation on cognitive function of older Chinese Americans. We proposed that behavioral acculturation is a moderator according to Berry's acculturation framework, which could buffer the negative impact of stressors from the immigration context (Berry, 1997). As research shows that having a commanding-conflicted type of family relationship is associated with lower cognitive function compared with other family types in this immigrant population (Li et al., 2021), we test the hypothesis that behavioral acculturation to the mainstream culture moderates the negative relationship between commanding-conflicted family type and cognitive measures (i.e. global cognition, episodic memory, working memory, processing speed, and MMSE).

Methods

Sample

Data were derived from the PINE Study, a community-engaged, population-based epidemiological study of older Chinese Americans aged 60 and older in the greater Chicago area from 2011-2013 (Dong, 2014). The inclusion criteria were: 1) age 60 or above, 2) self-identifying as Chinese, and 3) living in the greater Chicago area. The baseline cohort was 3,157, with a response rate of 91.9% (Dong, Wong, & Simon, 2014). In-person interviews were conducted by trained multicultural and multilingual interviewers. The study was approved by the institutional review board at Rush University Medical Center in Chicago, Illinois. Written informed consent was obtained from all participants. As this study aimed to measure the relationship between family relationships (especially intergenerational relationships), acculturation, and cognitive function, participants who had at least one child ($n = 3,019$) were included in the study sample.

Measures

Cognitive function
A validated Chinese version of Mini-Mental State Examination (MMSE), a widely used screening tool for dementia, was used in this study to measure general cognition (Chiu, Lee, Chung, &

Kwong, 1994; Folstein, Folstein, & McHugh, 1975). We used four additional cognitive tests, including immediate recall (EBMT) and delayed recall (EBDR) of the East Boston Story Test (Albert et al., 1991), the Digit Span Backwards assessment (DB) from the Wechsler Memory Scale-Revised (Wechsler, 1987), and the oral version of the 11-item Symbol Digit Modalities Test (SDMT) (Smith, 1982). The raw scores from the five tests were converted (by subtracting the overall mean then dividing by the standard deviation) to Z scores. Then all MMSE, EBMT, EBDR, DB, and SDMT Z Scores were averaged to yield a global cognitive summary.

A composite measure of episodic memory was created by converting the raw EBMT and EBDR measures to Z scores, which were then averaged. This methodological approach to measuring and constructing cognitive domains has been widely used in previous research (DiNapoli, Wu, & Scogin, 2014). DB remains the prevalent approach to evaluate working memory capacity. We asked participants to repeat 12 groups of numbers backwards, which requires an active manipulation of the information held in short-term memory. SDMT was used to test processing speed, which requires visual scanning, tracking, and motor speed. For episodic memory, working memory and processing speed, higher scores indicate better performance in each domain. We used the continuous measure of global cognition, MMSE, episodic memory, working memory, and processing speed.

Typology of family relationship

We used Latent Class Analysis (LCA) to construct a typology of family relationships among the PINE respondents (Guo et al., 2019). Indicators for LCA are commonly dichotomized to prevent problems with sparseness (Silverstein, Gans, Lowenstein, Giarrusso, & Bengtson, 2010). Eight indicators for measuring structural, associational, functional, affectual, and normative aspects of family relationship were dichotomized including: (1) living arrangement (1 = living with children), (2) frequency of contact (1 = having weekly contact with children), (3) upward support (1 = children helped with Activities of Daily Living or Instrumental Activities of Daily Living), (4) downward support (1 = taking care of grandchildren), (5) emotional closeness (1 = feeling very or extremely close to children), (6) conflict (1 = children being demanding or critical), (7) filial expectation (1 = having high filial expectation), and (8) filial receipt (1 = children provided high filial piety). The model specification and evaluation was described elsewhere (Guo et al., 2019). Through comparing Akaike's Information Criterion (AIC) and Bayesian Informal Criterion (BIC), a four-class model was chosen, which consisted of unobligated-ambivalent (n = 1,402), tight-knit (n = 1,175), detached (n = 315), and commanding-conflicted (n = 127) types.

The *unobligated-ambivalent* class is characterized by intergenerational solidarity and conflict coexisting in strongly bonded relationships, typified by the highest contact, moderate support exchanges, emotional closeness, family conflict, and relatively low expectation and actual receipt of filial piety. The *tight-knit* class is characterized as a traditional family type in Chinese culture, exemplifying high intergenerational solidarity and low intergenerational conflict. Those in this class endorsed high levels of solidarity on most domains, including co-residence, intergenerational contact, emotional closeness, downward support provided by parents to children, actual receipt of filial piety as well as the lowest level of intergenerational conflict. The *commanding-conflicted* class is characterized by the highest level of filial expectation and upward support provided by children to parents, the lowest level of emotional closeness,

and the highest level of intergenerational conflict. The *detached* class is characterized by the absence of intergenerational solidarity and conflict.

Acculturation

In light of the unidimensional model, we used the Short Acculturation Scale for Hispanics (SASH) (Marin et al., 1987), a continuous measure with items evaluating language preference, ethnic social relations, and media use related to acculturation to determine where individuals fall along this theoretical continuum. We used the version of SASH which has been modified for a Chinese population and has been used with U.S. Chinese older adults in previous research (Mao, Wu, Chi, Yang, & Dong, 2020). It includes twelve items measuring the ability and preference to speak English (language ability), use and engage in American media (media use), and socialize with Americans (ethnic social relations) (Marin et al., 1987). Five items were used to evaluate language ability: 1) "In general, what language do you read and speak?"; 2) "What was the language you used as a child?"; 3) "What language do you usually speak at home?"; 4) "In which language do you usually think?"; and 5) "What language do you usually speak with your friends?". Three items were used to measure media use: 1) "In what language are the T.V. programs you usually watch?"; 2) "In what language are the radio programs you usually listen to?"; and 3) "In general, in what language are the movies, T.V., and radio program do you prefer to watch and listen to?". Four items were used to evaluate ethnic social relations: 1) "Your close friends are?"; 2) "You prefer going to social gatherings/parties at which the people are?"; 3) "The persons you visit or who visit you are?"; and 4) "If you could choose your children's friends, you would want them to be?". Respondents rated their ability and/or preference on a 5-point Likert scale, ranging from 1 = only Chinese/all Chinese to 5 = only English/all Americans (i.e. who were not ethnically Chinese). In our study, overall acculturation sums ranged from 12 to 60, with a higher score indicating a higher level of acculturation (alpha = 0.91). We further examined the three domains in acculturation (language preference, media use, and ethnic social relations) by summing the items in each domain.

Covariates

Covariates included demographic factors, social economic status, and health-related factors. Demographic factors used in the analyses were age (in years), gender (self-reported), marital status (1 = married; 0 = other status), and years in the United States. Economic status measures included education (years of education completed) and annual personal income. Health-related factors included physical function and depressive symptoms. Physical function was measured by Activities of Daily Living (ADL; alpha = 0.92) (Katz & Akpom, 1976), ranging from 0 to 24. Depressive symptoms were measured by the Patient Health Questionnaire-9 (PHQ-9; alpha = 0.82) (Spitzer, Kroenke, & Williams, 1999), ranging from 0 to 27. Health behaviors include smoking (1 = Yes) and alcohol consumption (1 = Yes).

Data analysis

Analysis of Variance (ANOVA) and Kruskal Wallis tests compared acculturation and cognitive function among different family types. Linear regression models with interaction terms were applied to test if acculturation moderated the negative impact

of family relationship type on global cognition, episodic memory, working memory, processing speed, and MMSE. Family type was a dummy variable in regression models. The unobligated ambivalent typology, the most common family relation type in our sample featured by mixed intergenerational solidarity and conflict, was used as the reference category in the regression analyses. This approach is based on the criterion suggested by Hardy (1993) that a reference group should contain a sufficient number of cases to allow for a reasonably precise estimate of the subgroup mean. Furthermore, a bivariate analysis showed that the unobligated ambivalent type had higher global cognition, episodic memory, processing speed, and MMSE than other types (Table 1). In other words, the unobligated ambivalent category was at the upper boundary in cognitive function, which may provide an array of coefficient estimates that can be interpreted relative to some anchor or ceiling group (Hardy, 1993). Model A contained the focal independent variable of family type, the hypothesized moderator, acculturation, and the control variables. We centered acculturation, which is a continuous variable, and added the interaction term of centered acculturation and family type to Model B. We tested Variance Inflation Factor (VIF). As a rule of thumb, a variable whose VIF values are greater than 10 may merit further investigation. Tolerance, defined as 1/VIF, is used to check on the degree of collinearity. A tolerance value lower than 0.1 is comparable to a VIF value above 10. It means that the variable could be considered as a linear combination of other independent variables. In our study, the VIF values for all study variables are below 10 and all tolerance values are above 0.1, suggesting that multicollinearity might not be a serious problem. In sensitivity analysis, robust regression with removing outliers were applied. Unstandardized coefficients (b), standard errors (SE), and p-values were reported. All statistical analyses were conducted using SAS, version 9.4.

To examine the direction of the interaction effect, we ran the interaction model at three levels of acculturation: high (1 standard deviation above the mean value of acculturation), medium (mean level), and low (1 standard deviation below the mean value of acculturation). This is a common strategy when there is no clear theoretical or practical guidance on the specific values of the moderator (Cohen, Cohen, West, & Aiken, 2003; Hayes & Matthes, 2009). In our sample, acculturation ranged from 12 to 60 with a mean value of 15 (SD = 5). We then ran three regression models based on level of acculturation using the scores of 12 (low), 15 (medium), and 20 (high). We used 12 rather than 10 (i.e. 1 standard deviation below the mean value of acculturation) as the cut point for low levels of acculturation because 12 was the lowest score in our acculturation measure.

Results

The study sample had a mean age of 72.9 years (SD = 8.3). More than half of the participants (58.0%) were female. On average, they had 8.6 years (SD = 5.0) of education. Most (85.1%) had an annual income of less than US $10,000. Table 1 shows that older adults in the detached type had the highest acculturation level, while those in the commanding-conflicted type had the lowest acculturation level. Regarding differences in cognitive function by family types, older adults in a commanding-conflicted family type had the lowest score in all cognitive tests.

Family types and global cognition

As presented In Table 2, Model A indicates that older adults in detached (b = −0.088, SE = 0.038, p < .05) or in commanding-conflicted (b = −0.132, SE = 0.057, p < .05) family types were more likely to have lower global cognition than those in an

Table 1. Acculturation and domains by family types.

	Unobligated-Ambivalent $N = 1,402$	Tight-knit $N = 1,175$	Detached $N = 315$	Commanding-Conflicted $N = 127$	P Value
Age, mean (SD)	72.487 (8.003)	72.931 (8.439)	73.680 (8.468)	74.549 (9.201)	<.05
Female, n (%)	806 (57.49)	742 (63.15)	135 (42.86)	69 (54.33)	<.001
Education, n (%)					<.01
0	80 (5.71)	84 (7.17)	15 (4.90)	12 (9.52)	
1-6	507 (36.21)	464 (39.62)	113 (36.93)	63 (50)	
7-12	498 (35.57)	400 (34.16)	107 (34.97)	40 (31.75)	
13-16	272 (19.43)	196 (16.74)	64 (20.92)	10 (7.94)	
17 and above	43 (3.07)	27 (2.31)	7 (2.29)	1 (0.79)	
Income, n (%)					<.001
$0-$4,999	453 (32.47)	437 (37.45)	79 (25.82)	35 (28.46)	
$5,000-$9,999	731 (52.40)	590 (50.56)	165 (53.92)	69 (56.10)	
$10,000-$14,999	135 (9.68)	104 (8.91)	35 (11.44)	12 (9.76)	
$15,000 and above	76 (5.45)	36 (3.08)	27 (8.82)	7 (5.69)	
Married, n (%)	987 (70.55)	814 (69.39)	251 (79.68)	96 (75.59)	<.01
Years in the United States, mean (SD)	20.356 (13.151)	18.374 (12.415)	22.773 (14.384)	20.907 (12.569)	<.001
ADL, mean (SD)	0.338 (2.094)	0.346 (1.678)	0.401 (2.429)	1.118 (3.696)	<.001
Depressive symptoms, mean (SD)	2.918 (4.185)	2.038 (3.404)	2.802 (4.665)	3.744 (5.681)	<.001
Smoking, n (%)	400 (28.55)	308 (26.21)	131 (41.59)	48 (37.80)	<.001
Alcohol, n (%)	185 (13.20)	167 (14.21)	56 (17.78)	25 (19.69)	.058
Acculturation, mean (SD)	15.340 (4.857)	14.645 (4.056)	16.337 (7.128)	13.661 (3.320)	<.001
Language Ability, mean (SD)	5.689 (1.718)	5.466 (1.423)	6.057 (2.951)	5.276 (1.029)	<.001
Social Media, mean (SD)	3.947 (2.358)	3.598 (1.933)	4.679 (3.133)	3.500 (1.832)	<.001
Ethnic Social Relations, mean (SD)	5.713 (1.679)	5.583 (1.530)	5.622 (2.137)	4.906 (1.256)	<.001
Global Cognition, mean (SD)	0.005 (0.804)	−0.080 (0.804)	−0.075 (0.857)	−0.357 (0.962)	<.001
Episodic Memory, mean (SD)	−0.002 (0.968)	−0.064 (0.949)	−0.166 (1.074)	−0.365 (1.113)	<.001
Working Memory, mean (SD)	5.109 (2.390)	4.901 (2.397)	5.179 (2.365)	4.215 (2.270)	<.001
Processing Speed, mean (SD)	29.775 (11.853)	28.949 (12.392)	29.506 (10.878)	25.657 (12.542)	<.05
MMSE, mean (SD)	25.529 (4.562)	25.097 (4.617)	25.284 (4.885)	23.496 (6.139)	<.001

Note. Kruskal Wallis tests were used to compared acculturation, language ability, social media, ethnic social relations, and MMSE by family types due to the skewed distribution. ANOVA was used to compare age, years in the United States, ADL, depressive symptoms, global cognition, episodic memory, working memory, and processing speed by family types. Chi square was used to compare female, education, income, marital status, smoking, and alcohol.

unobligated-ambivalent type after controlling for potential confounding variables.

Main and moderating effects of acculturation on global cognition

Acculturation had a main effect on cognitive function. Higher levels of acculturation ($b = 0.009$, SE = 0.003, $p < .01$) were associated with higher levels of global cognition (Model A, Table 2). Acculturation could moderate the negative impact of commanding-conflicted type on global cognition ($b = 0.070$, SE = 0.016, $p < .001$; Model B, Table 2). Figure 1 illustrates the moderating effect of acculturation on the relationship between family type and cognitive function. In each family type, older

Table 2. Association between family type, acculturation, and global cognition.

	Outcome: Global Cognition b (SE)	
	Model A	Model B
Age	−0.026 (0.002)***	−0.026 (0.002)***
Female	−0.059 (0.034)	−0.059 (0.034)
Education	0.081 (0.002)***	0.081 (0.002)***
Income	0.022 (0.011)*	0.022 (0.011)*
Married	0.032 (0.028)	0.034 (0.028)
Years in the US	0.001 (0.001)	0.001 (0.001)
ADL	−0.065 (0.006)***	−0.064 (0.006)***
Depressive Symptoms	−0.017 (0.003)***	−0.017 (0.003)***
Smoking	−0.018 (0.035)	−0.020 (0.035)
Alcohol	0.081 (0.032)*	0.085 (0.032)**
Acculturation	0.009 (0.003)**	0.009 (0.004)*
Unobligated-Ambivalent	1	1
Tight-knit	−0.017 (0.024)	−0.018 (0.024)
Detached	−0.088 (0.038)*	−0.085 (0.039)*
Commanding-Conflicted	−0.132 (0.057)*	−0.044 (0.060)
Unobligated-Ambivalent * Acculturation		1
Tight-knit * Acculturation		−0.005 (0.005)
Detached * Acculturation		−0.003 (0.006)
Commanding-Conflicted * Acculturation		0.070 (0.016)***
Adjusted R²	0.466	0.469

Note. Unobligated-Ambivalent is the reference category in family type. *p<.05, **p<.01, ***p<.001.

adults with higher levels of acculturation had better global cognition. In addition, the moderating effect of acculturation was strongest among older adults in the commanding-conflicted type. In the sensitivity analysis, the interaction effect between acculturation and commanding-conflicted type remained significant (Appendix 1).

Domains of cognitive function

Table 3 represents the interaction effect between family type and overall and domains of acculturation on episodic memory, working memory, processing speed, and MMSE. Overall acculturation moderated the negative association between commanding-conflicted type, episodic memory, working memory and MMSE. In the sensitivity analysis, the interaction terms remained significant (Appendix 1).

Domains of acculturation

Appendix 2 shows the main and moderating effects of language ability, media use, and ethnic social relations on global cognition. Higher levels of American media use ($b = 0.015$, SE = 0.005, $p < .01$) and socializing with Americans (i.e. of non-Chinese ethnicity) ($b = 0.025$, SE = 0.007, $p < .001$) were associated with higher levels of global cognition. In addition, language ability ($b = 0.197$, SE = 0.052, $p < .001$), media use ($b = 0.126$, SE = 0.030, $p < .001$), and ethnic social relations ($b = 0.104$, SE = 0.044, $p < .05$) moderated the negative impact of family type on global cognition. As per Appendix 3, language ability ($b = 0.161$, SE = 0.072, $p < .05$) and social media ($b = 0.101$, SE = 0.041, $p < .05$) could moderate the negative association between commanding-conflicted type and episodic memory. Language ability ($b = 0.758$, SE = 0.176, $p < .001$) and social media ($b = 0.399$, SE = 0.100, $p < .001$) could moderate the negative association between commanding-conflicted type and working memory. Language ability could also moderate the negative association between tight-knit type and processing speed ($b = 0.519$, SE = 0.250, $p < .05$). Ethnic social relations

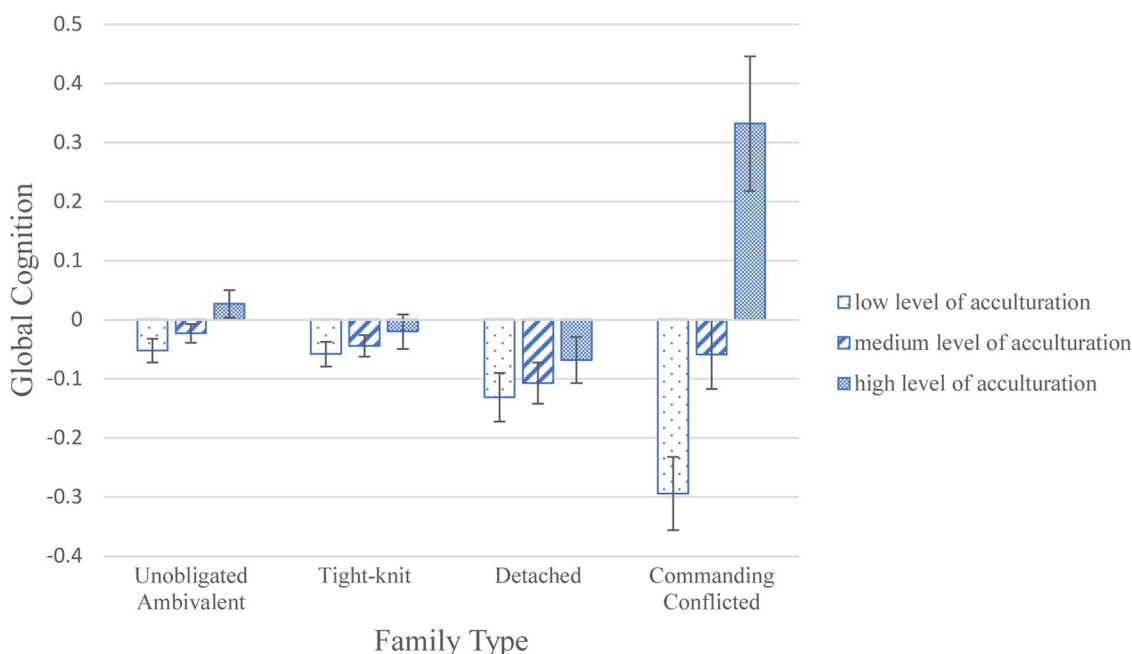
Figure 1. Family type, acculturation, and global cognition.
Note. Low level of acculturation: Acculturation score = 12; Medium level of acculturation: Acculturation score = 15; High level of acculturation: Acculturation score = 20.

Table 3. Association between family type, acculturation, and cognitive domains.

	Outcomes b (SE)			
	Episodic Memory	Working Memory	Processing Speed	MMSE
Age	−0.029 (0.002)***	−0.039 (0.005)***	−0.392 (0.027)***	−0.135 (0.010)***
Female	0.037 (0.047)	−0.394 (0.115)***	−1.019 (0.582)	−0.429 (0.208)*
Education	0.078 (0.003)***	0.201 (0.008)***	1.117 (0.042)***	0.387 (0.015)***
Income	0.022 (0.015)	0.040 (0.036)	0.521 (0.175)**	0.074 (0.064)
Married	0.023 (0.039)	0.065 (0.094)	0.206 (0.479)	0.419 (0.170)*
Years in the US	0.001 (0.001)	−0.002 (0.003)	−0.018 (0.017)	0.028 (0.006)***
ADL	−0.048 (0.008)***	−0.102 (0.020)***	−0.677 (0.100)***	−0.599 (0.039)***
Depressive Symptoms	−0.012 (0.004)**	−0.045 (0.010)***	−0.340 (0.048)***	−0.115 (0.018)***
Smoking	0.017 (0.049)	−0.103 (0.119)	−1.275 (0.597)*	0.031 (0.214)
Alcohol	0.033 (0.045)	0.473 (0.109)***	1.163 (0.566)*	0.391 (0.197)*
Acculturation	0.013 (0.005)*	0.034 (0.012)**	0.102 (0.059)	−0.018 (0.022)
Unobligated-Ambivalent	1	1	1	1
Tight-knit	−0.001 (0.033)	−0.068 (0.081)	−0.395 (0.407)	−0.124 (0.146)
Detached	−0.154 (0.054)**	0.019 (0.130)	−0.254 (0.654)	−0.315 (0.236)
Commanding-Conflicted	−0.041 (0.084)	−0.138 (0.203)	−0.193 (1.191)	−0.465 (0.371)
Unobligated-Ambivalent * Acculturation	1	1	1	1
Tight-knit * Acculturation	−0.009 (0.007)	−0.020 (0.018)	0.122 (0.089)	−0.027 (0.033)
Detached * Acculturation	−0.000 (0.008)	−0.038 (0.019)	−0.079 (0.092)	0.016 (0.036)
Commanding-Conflicted * Acculturation	0.058 (0.023)*	0.219 (0.055)***	0.637 (0.333)	0.341 (0.099)***
Adjusted R^2	0.296	0.304	0.422	0.388

Note. Unobligated-Ambivalent is the reference category in family type. *$p<.05$, **$p<.01$, ***$p<.001$. Covariates include age, sex, education, income, marital status, years in the US, ADL, and depressive symptoms.

could moderate the negative association between commanding-conflicted type and processing speed ($b = 1.881$, SE = 0.863, $p < .05$). Media use ($b = 0.674$, SE = 0.179, $p < .001$) and ethnic social relations ($b = 0.588$, SE = 0.276, $p < .05$) could buffer the negative association between commanding-conflicted type and MMSE. In contrast, the mean difference in working memory between older adults in a detached type and those in an unobligated-ambivalent family type was reduced when language ability was higher (b = −0.120, SE = 0.050, $p < .05$).

Discussion

This study is among the first to explore the relationship between intergenerational family type, acculturation, and cognitive function among older Chinese Americans. Our four hypotheses were supported. Acculturation to the mainstream American culture could moderate the negative associations between commanding-conflicted family type, global cognition, episodic memory, working memory, and MMSE. The cognitive deficit associated with having conflict with children can be at least partially overcome by greater integration of older immigrants into the host society, including higher levels of English proficiency, American media use, and socializing with Americans.

Ecological theory highlights the accommodation of individuals to their immediate social environments. We treated behavioral acculturation and family relations of Chinese immigrants as two mutually interdependent micro-systems. Acculturation to the mainstream American culture can compensate the negative impact of conflicted intergenerational relations on cognitive function in older Chinese immigrants. The increasing level of acculturation in older family members may reduce the acculturation gap between generations and family conflicts, which in turn benefits cognitive function. These findings shed light on prevention and interventions to protect cognitive aging of immigrant populations through strengthening their micro-systems. Social service providers could consider these interdependent relationships between family relations and acculturation when designing programs.

Acculturation is multidimensional, encompassing behavioral, affective (e.g. identity), and cognitive (e.g. cultural norms) aspects (Cuéllar et al., 1995). In our study, we tested three acculturation domains (language, media, and ethnic social relations) from the behavioral aspect. The findings showed that the negative relationship between commanding-conflicted family type and cognitive function might be buffered by cultural practices. These findings could inform future interventions designed to enhance acculturation through improving English proficiency, using and engaging in American media, and building social relationships with American friends and neighbors to protect cognitive function of older immigrants. Future research could test the role of the affective and cognitive aspects of acculturation in the relationship between family type and cognitive function.

The cognitive domains captured in this study, episodic memory, working memory, and processing speed, are fluid cognitive abilities which decline with age. Cognitive decline in these domains are also important indicators of dementia. The findings here suggest fluid cognitive abilities that are disproportionately associated with language ability, media use, and ethnic social relations. Specifically, acculturation in language ability could buffer the negative relationship between commanding-conflicted type, episodic memory, and working memory. One potential explanation is that increasing English proficiency is associated with the learning process, which may stimulate memory and related cognitive function. English proficiency could also enhance social engagement in receiving communities, which may compensate the negative impact of a commanding-conflicted family type. Meanwhile, acculturation in media use could buffer the negative associations between commanding-conflicted type, episodic memory, working memory, and MMSE. Individuals are engaged with information manipulation when using media and the exposure to this additional information requires storage of it, which may promote general cognitive abilities (evaluated by MMSE), episodic memory, and working memory. The use of American media by older immigrants may reduce gaps with the younger generation, which in turn decrease family conflicts and buffer the negative impact of commanding-conflicted family type. In addition, acculturation in ethnic

social relations could moderate the negative relationship between commanding-conflicted type, processing speed, and MMSE, while acculturation in language ability could buffer the negative relationship between tight-knit type and processing speed. Improving English proficiency and building social relationships with American friends and neighbors are associated with increased social networks and interactions which may promote processing speed (Li & Dong, 2018).

These results should be interpreted with caution. First, the acculturation literature is highly fragmented in both how acculturation is assessed and how it relates to health. Our study assessed the behavioral domain of the unidimensional acculturation via language ability, media use, and ethnic social relations. The findings might not be generalizable to the cognitive and affective aspects of acculturation (value acculturation and identity-based acculturation). In addition, the bi-dimensional conceptualization of acculturation has received an increasing attention (Arends-Toth & van de Vijver, 2006; Matsudaira, 2006; Tan, Burgess, & Green, 2021). Future studies could test the relationships between family types, bi-dimensional acculturation, and cognitive function. Second, our study examined a sample of Chinese older immigrants living in the greater Chicago area. The finding may not be generalizable to other immigrant cohorts or other ethnic groups. Third, this was a cross-sectional study, and so the direction of causality would be strengthened by a longitudinal study. Future longitudinal studies could explore the relationships between family dynamic, acculturation, and cognitive aging. Fourth, we have a small number of older adults ($n = 127$) in commanding-conflicted family type. Future study could further test the role of acculturation in cognitive function among older adults in commanding-conflicted family type with a larger sample size. Fifth, Type I error may exist due to multiple comparisons (Buyse, 1989).

Despite these limitations, this study has important theoretical and practical implications. The acculturation framework proposed by Berry (1997) could be categorized into three main contextual areas: prior immigration context, immigration context, and settlement context (Cabassa, 2003). Family type, which was tested in this study is one of the understudied settlement contexts. This study tested the settlement context in Berry's acculturation framework and demonstrated that family type can influence how the individual adapts and integrates into the mainstream culture. Our findings suggest that contextual factors should be incorporated into acculturation research.

Guided by the Bronfenbrenne's ecological systems theory, we tested the interaction effect of family type and individual acculturation on cognitive function of older immigrants. We identified that the behavioral aspect of acculturation (language ability, media use, and ethnic social relations) was a cultural asset and could buffer the negative relationship between family type and cognitive function. These findings provided empirical evidence on how one's microsystem may shape an individual's cognitive health.

Through applying both family and acculturation constructs to understanding older immigrants' cognitive function, our findings showed that older immigrants who are nested in commanding-conflicted types with low levels of acculturation face greater challenges in their cognitive aging and thus could be the focus of programs aiming to enhance cognitive health of older immigrants. Social service providers could consider the interdependent relationships between family relations and acculturation when designing programs. This study also identified the compensatory role of acculturation when intergenerational relations are conflicted. The U.S. population is getting older and more diverse. Social services could help older immigrants, particularly those who are embedded in the commanding-conflicted family type, to be better integrated to the receiving society through promoting cultural participation, which in turn will help them maintain cognitive function and achieve healthy aging.

Future studies could examine other possible mechanisms among family type, acculturation, and cognitive function may exist. For example, older adults' levels of acculturation may affect family types and in turn affect cognitive function (mediating mechanism). Future studies are needed to examine these potential mechanisms. Future acculturation research may incorporate contextual factors (e.g. microsystem) and test the impact of heritage culture and affective and cognitive aspects of mainstream culture on cognitive function among older immigrants. Future research could test the interaction effects of acculturation and family type on cognitive function among other Asian American ethnic groups. Future studies could also test the relationship between family types, acculturation, and cognitive function in clinical and non-clinical populations.

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Appendix 1. Robust Regression on Family Type, Acculturation, and Cognitive Function

	Outcomes b (SE)				
	Global Cognition	Episodic Memory	Working Memory	Processing Speed	MMSE
Age	−0.026 (0.002)***	−0.029 (0.002)***	−0.038 (0.005)***	−0.383 (0.027)***	−0.108 (0.008)***
Female	−0.066 (0.033)*	0.034 (0.048)	−0.417 (0.112)***	−0.877 (0.579)	−0.470 (0.177)**
Education	0.083 (0.002)***	0.081 (0.004)***	0.198 (0.008)***	1.125 (0.042)***	0.323 (0.013)***
Income	0.021 (0.010)*	0.020 (0.015)	0.048 (0.035)	0.393 (0.174)*	0.047 (0.054)
Married	0.050 (0.027)	0.024 (0.039)	0.023 (0.092)	0.253 (0.477)	0.528 (0.145)***
Years in the US	0.001 (0.001)	0.001 (0.001)	−0.003 (0.003)	−0.015 (0.017)	0.021 (0.005)***
ADL	−0.060 (0.006)***	−0.055 (0.008)***	−0.097 (0.019)***	−0.645 (0.100)***	−0.538 (0.033)***
Depressive Symptoms	−0.015 (0.003)***	−0.011 (0.004)**	−0.048 (0.009)***	−0.318 (0.048)***	−0.103 (0.015)***
Smoking	−0.030 (0.034)	0.042 (0.049)	−0.079 (0.116)	−1.054 (0.594)	−0.159 (0.182)
Alcohol	0.057 (0.032)	−0.000 (0.045)	0.394 (0.107)***	1.545 (0.563)**	0.173 (0.167)
Acculturation	0.008 (0.004)*	0.011 (0.005)*	0.030 (0.012)*	0.105 (0.059)	−0.007 (0.019)
Unobligated-Ambivalent	1	1	1	1	1
Tight-knit	−0.011 (0.023)	0.003 (0.033)	−0.076 (0.079)	−0.541 (0.405)	−0.248 (0.124)*
Detached	−0.054 (0.038)	−0.132 (0.054)*	0.077 (0.127)	−0.195 (0.651)	−0.092 (0.200)
Commanding-Conflicted	0.008 (0.060)	0.023 (0.084)	−0.072 (0.199)	0.387 (1.185)	−0.174 (0.315)
Unobligated-Ambivalent * Acculturation	1	1	1	1	1
Tight-knit * Acculturation	−0.000 (0.005)	−0.004 (0.008)	−0.010 (0.018)	0.139 (0.089)	0.006 (0.028)
Detached * Acculturation	0.001 (0.006)	0.005 (0.008)	−0.033 (0.019)	−0.085 (0.092)	0.021 (0.031)
Commanding-Conflicted * Acculturation	0.061 (0.016)***	0.051 (0.023)*	0.228 (0.054)***	0.590 (0.331)	0.264 (0.084)**

Note. Unobligated-Ambivalent is the reference category in family type. *p<.05, **p<.01, ***p<.001.

Appendix 2. Association between Family Type, Domains of Acculturation, and Global Cognition.

	Outcome: Global Cognition b (SE)					
	Model A	Model B	Model C	Model D	Model E	Model F
DEMOGRAPHICS AND LIFE QUALITY						
Age	−0.027 (0.002)***	−0.027 (0.002)***	−0.027 (0.002)***	−0.026 (0.002)***	−0.026 (0.002)***	−0.026 (0.002)***
Female	−0.059 (0.034)	−0.061 (0.034)	−0.061 (0.034)	−0.062 (0.034)	−0.061 (0.034)	−0.059 (0.034)
Education	0.083 (0.002)***	0.083 (0.002)***	0.082 (0.002)***	0.082 (0.002)***	0.081 (0.002)***	0.081 (0.002)***
Income	0.025 (0.011)*	0.026 (0.011)*	0.024 (0.010)*	0.024 (0.010)*	0.025 (0.010)*	0.025 (0.010)*
Marital Status	0.029 (0.028)	0.029 (0.028)	0.033 (0.028)	0.036 (0.028)	0.030 (0.028)	0.031 (0.028)
Years in the US	0.002 (0.001)	0.002 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
ADL	−0.065 (0.006)***	−0.065 (0.006)***	−0.065 (0.006)***	−0.065 (0.006)***	−0.065 (0.006)***	−0.064 (0.006)***
Depressive Symptoms	−0.017 (0.003)***	−0.017 (0.003)***	−0.017 (0.003)***	−0.017 (0.003)***	−0.018 (0.003)***	−0.018 (0.003)***
Smoking	−0.021 (0.035)	−0.023 (0.035)	−0.020 (0.035)	−0.021 (0.035)	−0.021 (0.035)	−0.021 (0.035)
Alcohol	0.084 (0.032)**	0.086 (0.032)**	0.082 (0.032)*	0.084 (0.032)**	0.082 (0.032)*	0.085 (0.032)**
ACCULTURATION AND FAMILY TYPE						
Language / Social Media / Ethnic Social Relations	0.011 (0.007)	0.012 (0.010)	0.015 (0.005)**	0.018 (0.007)*	0.025 (0.007)***	0.022 (0.010)*
Unobligated-Ambivalent	1	1	1	1	1	1
Tight-knit	−0.018 (0.024)	−0.020 (0.025)	−0.016 (0.024)	−0.022 (0.024)	−0.019 (0.024)	−0.021 (0.025)
Detached	−0.085 (0.038)*	−0.085 (0.038)*	−0.092 (0.038)*	−0.090 (0.039)*	−0.078 (0.038)*	−0.074 (0.039)
Commanding-Conflicted	−0.138 (0.057)*	0.002 (0.068)	−0.138 (0.057)*	−0.078 (0.058)	−0.126 (0.057)*	−0.086 (0.073)
ACCULTURATION AND FAMILY TYPE INTERACTIONS						
Unobligated-Ambivalent * Language/Social Media/Ethnic Social Relations		1		1		1
Tight-knit * Language/Social Media/Ethnic Social Relations		−0.005 (0.015)		−0.019 (0.011)		−0.005 (0.015)
Detached * Language/Social Media/Ethnic Social Relations		−0.008 (0.015)		−0.008 (0.013)		0.012 (0.020)
Commanding-Conflicted * Language/Social Media/Ethnic Social Relations		0.197 (0.052)***		0.126 (0.030)***		0.104 (0.044)*
Adjusted R²	0.465	0.467	0.466	0.469	0.466	0.467

Note. Unobligated-Ambivalent is the reference category in family type. *p<.05, **p<.01, ***p<.001.

Appendix 3. Association between Family Type, Acculturation Domains, and Cognitive Domains.

	Outcomes b (SE)			
	Episodic Memory	Working Memory	Processing Speed	MMSE
Unobligated-Ambivalent * **Language**	1	1	1	1
Tight-knit * **Language**	−0.022 (0.021)	−0.033 (0.052)	0.519 (0.250)*	−0.005 (0.093)
Detached * **Language**	0.001 (0.021)	−0.120 (0.050)*	−0.105 (0.233)	−0.003 (0.093)
Commanding-Conflicted * **Language**	0.161 (0.072)*	0.758 (0.176)***	1.114 (0.967)	0.711 (0.315)
Adjusted R^2	0.293	0.304	0.420	0.387
Unobligated-Ambivalent * **Social Media**	1	1	1	1
Tight-knit * **Social Media**	−0.025 (0.016)	−0.068 (0.038)	0.128 (0.188)	−0.077 (0.068)
Detached * **Social Media**	−0.003 (0.018)	−0.058 (0.043)	−0.063 (0.211)	−0.016 (0.077)
Commanding-Conflicted * **Social Media**	0.101 (0.041)*	0.399 (0.100)***	1.079 (0.729)	0.674 (0.179)***
Adjusted R^2	0.295	0.305	0.420	0.389
Unobligated-Ambivalent * **Ethnic Social Relations**	1	1	1	1
Tight-knit * **Ethnic Social Relations**	−0.010 (0.021)	0.001 (0.050)	0.170 (0.249)	−0.048 (0.090)
Detached * **Ethnic Social Relations**	0.017 (0.027)	−0.048 (0.063)	−0.313 (0.308)	0.151 (0.119)
Commanding-Conflicted * **Ethnic Social Relations**	0.094 (0.061)	0.203 (0.150)	1.881 (0.863)*	0.588 (0.276)
Adjusted R^2	0.299	0.298	0.423	0.389

Note. Unobligated-Ambivalent is the reference category in family type. *$p<.05$, **$p<.01$, ***$p<.001$. Covariates include age, sex, education, income, marital status, years in the US, ADL, depressive symptoms, smoking, and alcohol.