Cult. Brain
DOI 10.1007/s40167-015-0026-z

ORIGINAL RESEARCH

Activity in cortical midline structures is modulated by self-construal changes during acculturation

Pin-Hao A. Chen · Dylan D. Wagner · William M. Kelley · Todd F. Heatherton

Accepted: 9 January 2015

Abstract Recent immigrants to another culture generally experience a period of acculturation during which they show self-construal changes. Here, we examine how this acculturation period alters brain activity associated with self-referential cognition. Twenty-seven native Chinese-speaking recent immigrants completed a trait-judgment task in which they judged whether a series of psychological traits applied to themselves and, separately, whether these traits applied to their mothers. Participants were scanned at two intervals: within the first 2 months of their arrival in the United States (Time 1), and also 6 months after the initial scan (Time 2). Results already revealed a significant self-vs.-mother differentiation at Time 1 in the medial prefrontal cortex (MPFC) and posterior cingulate cortex (PCC). However, at time 2, this pattern diverged depending on whether immigrants became more or less like their original culture. That is to say, for immigrants who became less like Easterners, the self-vs.-mother difference remained, whereas for participants who became even more like Easterners, the self-vs.-mother difference in cortical midline structures disappeared. These findings support the notion that self-construal changes during the process of acculturation are reflected in the relative engagement of brain structures implicated in self-referential processing (i.e., MPFC and PCC) when judging traits with reference to oneself or a close other.

Keywords Self · Self-construal style · Acculturation · Cultural neuroscience · Medial prefrontal cortex · Functional magnetic resonance imaging

P.-H. A. Chen (✉) · W. M. Kelley · T. F. Heatherton
Department of Psychological and Brain Sciences, Dartmouth College, 6207 Moore Hall, Hanover, NH 03755, USA
e-mail: pin-hao.chen.gr@dartmouth.edu

D. D. Wagner
Department of Psychology, Ohio State University, Columbus, USA

Published online: 21 January 2015

Introduction

One of the best replicated findings in social neuroscience is that cortical midline structures (CMSs), especially the medial prefrontal cortex (MPFC), play a major role in representing knowledge about the self (Denny et al. 2012; Heatherton 2011; Heatherton et al. 2006; Johnson 2006; Kelley et al. 2002; Macrae et al. 2004; Moran et al. 2013; Moran et al. 2006; Northoff and Bermpohl 2004; Northoff et al. 2006; Ochsner et al. 2005; Pfeifer et al. 2007; Wagner et al. 2012). Previous research using participants raised in Western cultures has found that MPFC differentiates self from others including, in some cases, even close others (Han et al. 2013; Heatherton et al. 2006; Ray et al. 2010; Wang et al. 2012; Zhu et al. 2007). By contrast, research using participants raised in Eastern cultures has generally failed to find differentiation in the MPFC between self and close others (Han et al. 2013; Huff et al. 2013; Kitayama and Park 2010; Wang et al. 2012; Zhu et al. 2007). Moreover, the neural differentiation between self and close others was found to be modulated by individual differences in interdependence (Ray et al. 2010) or bicultural identity (Huff et al. 2013). Based on these findings, it has been proposed that the neural differentiation between the self and mother may reflect underlying differences in self-construal styles across cultures (Chiao et al. 2009a, b; Kitayama and Uskul 2011).

Individuals from independent and interdependent cultures typically differ in how they think about their relationships with close others (Han et al. 2013; Kitayama and Park 2010; Markus and Kitayama 1991). For instance, individuals from independent cultures view the self as a unique entity and as being independent from other individuals—even close others. By contrast, individuals from interdependent cultures view the self as being enmeshed within their social network and less differentiated from others. Although individuals from the same culture generally possess similar self-construal styles, there are substantial within-cultural variations (Freeman 2013). For instance, individuals from a culture that is traditionally regarded as more interdependent, such as Chinese culture, vary in the degrees of their independence and interdependence (Green et al. 2005; Li et al. 2006). Frontier settlement hypothesis (Kitayama et al. 2006) extends the idea of within-cultural variations to the topic of voluntary immigration, suggesting that voluntary immigrants to the West might possess more independent self-construal mindsets than those who remain in their Eastern cultures. This hypothesis was examined in a recent study of Chinese immigrants newly arrived to the United States (Chen et al. 2013). In the study, participants made trait judgments for themselves and for their mothers. Contrary to findings from previous studies (Wang et al. 2012; Zhu et al. 2007), these immigrants showed prominent neural differentiation between the self and mother in the MPFC and posterior cingulate/precuneal cortices (PCC). In short, the pattern of brain activity for the comparison of self-vs.-mother was similar to individuals from independent cultures, but not from interdependent cultures. Thus, these findings were generally consistent with what would be expected from the frontier settlement hypothesis.

It seems plausible that even if immigrants are inherently more independent in self-construal, they might potentially show divergent changes in self-construal after settling in a different culture (Berry et al. 2006; Sam and Berry 2010). This process is called acculturation, which can be defined as a period of cultural and psychological adjustment following intercultural contacts (Berry 1997). Individual differences in acculturation can be enormous, even among immigrants who share a cultural origin and further settle in the same region (Nauck 2008). For instance, some might become less interdependent whereas others might become even more interdependent in their self-construal. Given this possibility, it would be expected, then, that these two groups of immigrants would show differential recruitment of CMSs during self and mother-referential judgments after a period of settlement in the United States.

In the present study, we employed a longitudinal approach whereby we followed the same group of immigrants at two time points in order to explore neural changes as a result of acculturation. We hypothesized that Chinese immigrants who became either less interdependent or more independent, that is less like Easterners, would maintain a significant self-vs.-mother difference in CMSs 6 months later. By contrast, those who become either more interdependent or less independent, that is, more like Easterners, would have no such difference 6 months post-settlement.

Materials and methods

Participants

Twenty-nine newly arrived Chinese graduate students (13 females, age range 21–27) who were fluent in both Chinese and English (TOEFL mean score is 102.4 out of 120) were recruited in the current study. Among these twenty-nine participants, 12 of them were previously reported in Chen et al.'s study (Chen et al. 2013). All participants were right-handed with no history of neurological problems, and had normal or corrected-to-normal vision. None of these participants had ever stayed or studied in a foreign country for more than 2 months prior to their arrival in the United States. Since the current study employed a longitudinal approach, all participants finished their first fMRI session within the first 2 months of their arrival in the United States (Time 1), and returned to complete a second fMRI session 6 months after the initial ones (Time 2). Two participants were excluded due to excessive head motions (more than 3 mm in either X-, Y-, or Z-direction) during either the first or second session, leaving a total of twenty-seven participants. Participants were paid $40 for each visit, and given informed consent in accordance with the guidelines set by the Committee for the Protection of Human Subjects at Dartmouth College.

Tasks

Participant performed the same trait-judgment task as in the study by Chen et al. (2013). For each session (e.g., Time 1 and Time 2), four functional runs were collected. The experimental stimuli were projected to participants with an Epson ELP-7000 LCD projector on a screen positioned at the head end of the magnet bore.

Participants viewed this screen via a mirror on the head coil. During each run, participants made trait-judgments for the following conditions: SELF (Does the adjective describe you?), MOTHER (Does the adjective describe your mother?), or FONT (Is this word printed in bold-faced letters?). Each type was presented once in English and once in Chinese for a total of six judgment types. Each trial lasted 2,500 ms and consisted of a ‘cue’ word (SELF, MOTHER, or FONT in either Chinese or English) above a central fixation cross, and a unique trait adjective (e.g. LAZY) displayed below the central fixation cross. The Chinese text was presented in Xin Xi Ming Ti, and the English text was in Calibri (white letters on a black background). A total of 120 Chinese and 120 English words, matched for meaning, were selected from two pools of personality trait words (English words from Anderson 1968; Chinese words from Wang and Tue 2005). The experimental word lists were counterbalanced for word length and valence (half of the words in each list were positive traits, and the remaining half were negative traits). Across participants, lists were rotated through conditions such that trait adjectives that appeared in SELF-judgments for one participant appeared in a different condition (MOTHER or FONT) for other participants. During each of the four functional runs, 60 trials (10 SELF in Chinese, 10 MOTHER in Chinese, 10 FONT in Chinese, 10 SELF in English, 10 MOTHER in English, 10 FONT in English) were pseudo-randomly intermixed with 20 null-event trials such that each trial type followed every other trial type equally often. Null-event trials consisted of a central fixation cross presented on the screen for 2,500 ms. These trials were included to introduce ‘jitter’ into the time series so that unique estimates of the hemodynamic responses for the trial types of interest could be computed.

At the end of both Time 1 and Time 2 scanning sessions, participants completed the self-construal scale (SCS; Singelis 1994). The SCS measures two orthogonal dimensions of self-construal styles, independence and interdependence, which corresponded to two main cultural values, individualism and collectivism (Markus and Kitayama 1991; Triandis 1995). Thus, each participant received an independence score and an interdependence score at Time 1 and again at Time 2. Since there were no prominent changes in the independent self-construal across all participants, we focused our analysis on changes in the interdependent self-construal. In order to examine whether changes in participants’ interdependent self-construal was related to the differential activity for judging traits with respect to self-vs.-mother, we computed change scores for each participants’ interdependent self-construal (i.e., Time 2 minus Time 1). Participants were then divided into two groups (the More-Eastern group and the Less-Eastern group) based on changes in the interdependence scores. Participants who increased in the interdependent self-construal were in the More-Eastern group, whereas those who decreased in the interdependent self-construal were in the Less-Eastern group (changes in the interdependence scores: More-Eastern group: $M = 0.46$; Less-Eastern group: $M = -0.25$). As a result, there were fourteen participants in the More-Eastern group and thirteen participants in the Less-Eastern group. Of the 12 participants who participated in our prior work (e.g. Chen et al. 2013), five were in the More-Eastern group and seven were in the Less-Eastern group. Interestingly, these two groups did not reveal significant changes in their independence scores from Time 1 to Time 2 (More-Eastern: $M = 0.04$; Less-Eastern: $M = 0.02$). Demographic information and SCS scores in each group are listed in Table 1.

Imaging preprocessing and analysis

Participants were scanned on a Philips Intera Achieva 3T scanner with a thirty-two channel head coil. Functional images were acquired using a T2*-weighted echo-planar sequence (TR = 2,500 ms, TE = 35 ms, 90 flip angle and FOV = 240 mm). During each of the eight runs (four runs for each visit), 80 volumes covering the whole brain (36 axial slices, 3 mm thick with 0.5 mm gap, 3×3 mm in-plane resolution) were collected for a total of 640 volumes across both sessions (e.g., Time 1 and Time 2).

The fMRI data were analyzed using SPM8 (Wellcome Department of Cognitive Neurology, London, England) in conjunction with a toolbox for preprocessing and analysis (available at http://github.com/ddwagner/SPM8w). For each functional run, data were first preprocessed to remove sources of noise and artifact, and corrected for differences in acquisition time between slices. Images were then realigned within and across runs for head motion correction, and unwarped to reduce residual movement-related image distortions not corrected by realignments. Data were then normalized into a standard space (3 mm isotropic voxels) based on the SPM8 EPI template that conforms to the ICBM 152 brain template space (Montreal Neurological Institute, MNI). Lastly, a 6 mm full-width-at-half-maximum (FWHM) Gaussian kernel was applied to spatially smooth the normalized images.

For each participant, a general linear model incorporating task effects and covariates of no interest (a session mean, a linear trend to account for low-frequency drift, and six movement parameters derived from realignment corrections) was computed. Based on the findings from our first study (Chen et al. 2013), both of the MPFC and PCC showed greater activity when adjectives were presented in Chinese than in English, suggesting that adjectives presented in Chinese elicited greatest activity in the MPFC and PCC. As a result, in the present study, we restricted the second-level analysis to the conditions where stimuli were presented in Chinese. Contrast images comparing SELF-judgments to MOTHER-judgments in Chinese at Time 1 and at Time 2 were created for each participant, and entered into a second-level, random-effects analysis. Furthermore, in order to examine whether there were

Table 1 Demographical information and SCS scores at Time 1 and Time 2 in each group

	More-Eastern group	Less-Eastern group
N	14 (6 female)	13 (7 female)
Age (mean)	24	24.23
Independence score at Time 1	4.65 (0.46)	4.96 (0.67)
Interdependence score at Time 1	4.77 (0.37)	5.05 (0.36)
Independence score at Time 2	4.69 (0.53)	4.99 (0.55)
Interdependence score at Time 2	5.23 (0.40)	4.79 (0.37)

any whole-brain differences between two groups at Time 2, a whole-brain two-sample t test comparing two groups' SELF > MOTHER contrasts was computed. In addition, to ensure the whole-brain differences between the two groups at Time 2 were not due to the fundamental differences between groups at Time 1, we computed another whole-brain two-sample t-test comparing SELF > MOTHER contrasts between two groups at Time 1. Monte Carlo simulations using AFNI's AlphaSim were used to calculate the minimum cluster size at an uncorrected threshold of $p < 0.005$ for a whole-brain correction of $p < 0.05$. Simulations (10,000) were performed on the volume of our whole-brain mask using smoothness estimated from the residuals obtained from the GLM and resulting in a minimum cluster size of 73 contiguous voxels for all whole-brain testing.

Since the present study primarily sought to examine the self-vs.-mother neural differentiation in the MPFC and PCC, we conducted a region-of-interest (ROI) analysis at the MPFC and the PCC. To obtain a MPFC and a PCC ROI in an unbiased manner, a spherical MPFC ROI (10, 52, 4; 8 mm radius) and a spherical PCC ROI (12, −48, 51; 8 mm radius) were defined based on Kelley et al. (2002) because these coordinates had been proven to reliably reflect self-referential activity in several studies (Chen et al. 2013; Heatherton et al. 2006). Parameter estimates for the contrast of self-vs.-mother were extracted for the MPFC and PCC ROI. In order to represent the difference between SELF-judgments and MOTHER-judgments, two difference scores from parameter estimates (SELF > MOTHER-judgments in Chinese at Time 1 and SELF > MOTHER-judgments in Chinese at Time 2) were calculated within each group. For each ROI, a two-group comparison t test was made at Time 1 and Time 2, respectively.

Results

Behavioral results

Consistent with findings from our prior work (Chen et al. 2013), there was no difference between participants' independence and interdependence scores at Time 1 in either the More-Eastern group, $t(13) = 1.07$, $p = 0.30$, or the Less-Eastern group, $t(12) = 0.42$, $p = 0.67$ (see Table 1). However, participants in the More-Eastern showed a marginally significant trend towards lower interdependence scores than participants in the Less-Eastern group at Time 1, $t(25) = -1.96$, $p = 0.06$.

fMRI results

An initial examination of all participants at Time 1 replicated the patterns observed in Chen et al. (2013). That is, adding an additional 17 participants to the original 12 participants produced the same pattern of results: considered as a whole, there was significantly greater activity in MPFC and PCC for trials involving self than trials involving mother (see Fig. 1a; Table 2).

At Time 1, there was no difference between the subsequently More-Eastern group and Less-Eastern group both when analyses at the whole-brain level and

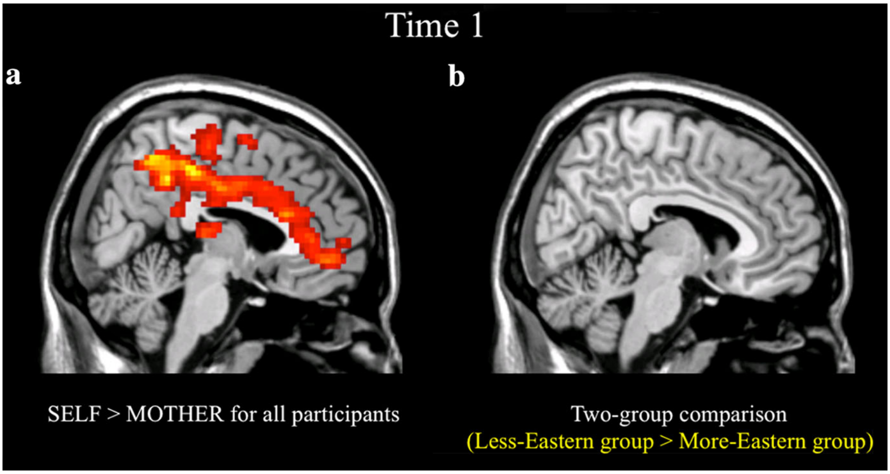

Fig. 1 Whole-brain analysis for the SELF > MOTHER contrast for all participants and for the two-group comparison at Time 1 ($p < 0.05$, corrected). **a** All participants showed a significant self-vs.-mother differentiation in the MPFC and PCC. **b** Results showed no difference in the self-vs.-mother differentiation between these two groups at Time 1

Table 2 Brain regions showing greater SELF-vs.-MOTHER differentiation for all participants at Time 1

Brain region	Side	BA	*t* value	Coordinates of peak activation		
				x	*y*	*z*
Precuneus/PCC	R	31	6.87	9	−48	45
Precuneus	L	31	6.82	−9	−39	45
Medial prefrontal cortex (MPFC)		10	5.93	0	51	−3
Middle occipital lobule	R	19	6.30	45	−84	18
Fusiform gyrus	L	20	6.30	−48	−18	−30
Postcentral gyrus	R	40	5.98	60	−24	18
Thalamus	R		5.91	9	−21	9
Superior temporal gyrus	L	22	5.39	−63	−39	18
Inferior temporal gyrus	L	20	5.36	−60	−51	−18
Middle frontal gyrus	R	9	4.90	30	30	36
Supplemental motor cortex	L	6	4.14	−9	−6	69

The table reported the locations of peak coordinates for significant clusters ($p < 0.05$, corrected). Coordinates were in Montreal Neurological Institute (MNI) stereotaxic space

BA Brodmann's area (approximate)

within the MPFC, $t(25) = 0.24$, $p = 0.81$, and the PCC ROI, $t(25) = 0.13$, $p = 0.89$ (see Figs. 1b, 2). However, at Time 2, the Less-Eastern group showed greater self-vs.-mother differentiation than the More-Eastern group in bilateral MPFC, Precuneus/PCC, superior temporal gyrus, supramarginal gyrus, and several

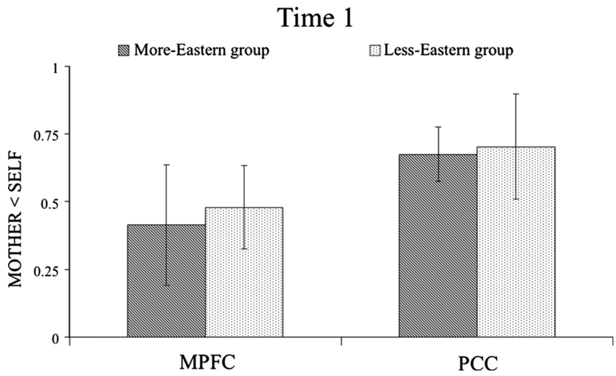

Fig. 2 Analysis of difference scores from parameter estimates (SELF > MOTHER contrast) in the MPFC and PCC ROI. Both of the Less-Eastern and the More-Eastern group showed no difference in the self-vs.-mother differentiation in the MPFC and PCC at Time 1

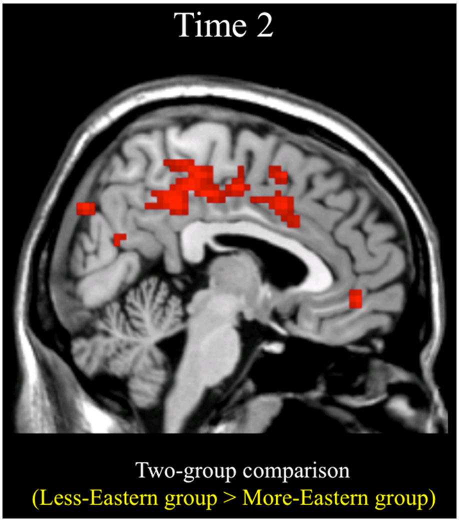

Fig. 3 Whole-brain analysis for the SELF > MOTHER contrast for the two-group comparison at Time 2 ($p < 0.05$, corrected). The Less-Eastern group showed a significantly greater self-vs.-mother differentiation than the More-Eastern group in the MPFC and PCC at Time 2

other regions at the whole-brain level (see Fig. 3; Table 3). Looking within the MPFC and PCC ROI, we also found that the Less-Eastern group had greater activity in the self-vs.-mother contrast than the More-Eastern group in the MPFC, $t(25) = 2.58$, $p = 0.01$, and in the PCC ROI at Time 2, $t(25) = 2.49$, $p = 0.01$ (see Fig. 4).

Discussion

In the current study, we investigated whether changes in immigrants' self-construal would also be reflected in the degree to which CMSs differentiated between self-

Table 3 Brain regions showing greater SELF-vs.-MOTHER differentiation in the Less-Eastern group than in the More-Eastern group at Time 1 and Time 2

Brain region	Side	BA	*t* value	Coordinates of peak activation		
				x	*y*	*z*
Time 1						
Lingual gyrus	L	18	4.07	−21	−72	−12
Fusiform gyrus	L	20	3.03	−24	−63	−15
Time 2						
Medial prefrontal cortex (MPFC)	R	10	3.72	15	48	−3
Medial prefrontal cortex	L	10	3.30	−9	51	−3
Precuneus/PCC	L	31	5.42	−18	−66	39
Middle cingulate cortex	L	24	5.39	−6	−3	36
Middle cingulate cortex	R	24	5.30	9	6	33
Superior temporal gyrus	R	22	5.26	63	−51	15
Middle temporal gyrus	R	20	4.08	48	0	−24
Middle occipital gyrus	L	19	3.95	−48	−75	6
Postcentral gyrus	R	2	3.90	42	−27	39
Supramarginal gyrus	R	40	3.52	42	−42	36
Precentral gyrus	R	43	4.09	60	−9	12
Superior temporal gyrus	L	41	3.49	−57	−36	15
Supramarginal gyrus	L	40	3.15	−54	−45	27

The table reported the locations of peak coordinates for significant clusters ($p < 0.05$, corrected). Coordinates were in Montreal Neurological Institute (MNI) stereotaxic space

BA Brodmann's area (approximate)

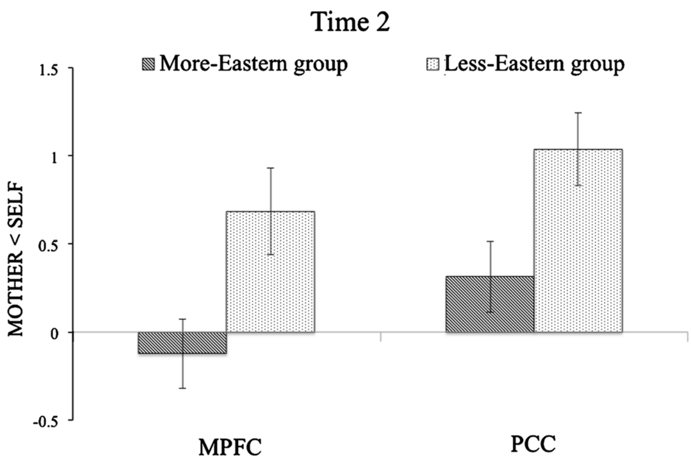

Fig. 4 Analysis of difference scores from parameter estimates (SELF > MOTHER contrast) in the MPFC and PCC ROI. The Less-Eastern group showed a significantly greater self-vs.-mother differentiation than the More-Eastern group in the MPFC and PCC at Time 2

and mother-referential judgments. Interestingly, these immigrants showed divergent changes in the interdependent self-construal, but not in the independent self-construal 6 months later. In line with our hypothesis, individuals who became less interdependent demonstrated a significant self-vs.-mother differentiation in the MPFC and PCC 6 months later, whereas those who became more interdependent had no such differentiation.

Consistent with our previous finding (Chen et al. 2013), both groups of immigrants showed robust neural differentiation of self and mother in the MPFC at Time 1, which was within the first 2 months when they arrived in the United States. In addition, both groups of immigrants also reported similar independence and interdependence scores at Time 1, suggesting that these Chinese immigrants might be more independent than prototypical Chinese participants in the self-construal, at least, within the first 2 months of their arrivals in the United States. This finding may be in line with the hypothesis that voluntary immigrants who move to frontiers, such as foreign countries, are inherently high in the independence self-construal (Kitayama et al. 2006; Varnum and Kitayama 2011).

Our findings also suggested that some immigrants might undergo certain fundamental changes in the self-construal during settlement in the United States. According to acculturation research, there are four types of acculturation strategies: integration, assimilation, separation, and marginalization (Berry 1997; Berry et al. 2006; Sam and Berry 2010). Among these four types of strategies, individuals who use an assimilation strategy abandon their original cultural values and attempt to accept the host country's cultural values. In the present study, Chinese immigrants who became less interdependent may be using an assimilation strategy. Since these immigrants became less like Easterners, they apparently maintain prominent self-vs.-mother differentiation in the MPFC 6 months later (Chen et al. 2013; Heatherton et al. 2006; Zhu et al. 2007). By contrast, immigrants who became more interdependent may be employing a separation strategy. Different from assimilation, separation strategy strongly emphasizes the maintenance of immigrants' own cultural values. Thus, immigrants who used this strategy would be more likely, in the long run, to become even more like prototypical Chinese participants (Wang et al. 2012; Zhu et al. 2007). Since these immigrants became more like Easterners, they would be expected to show reduced self-vs.-mother differentiation in CMSs during acculturation. Since these two groups of immigrants take different strategies initially, these individuals may have different degrees of bicultural identity integration (BII) (Benet-Martínez and Haritatos 2005). Biculturalists with high BII perceive having two cultural identities in a more harmonious way than those with low BII (Benet-Martínez 2010; Ramírez-Esparza et al. 2006). As a result, high BII biculturalists tend to show culturally congruent behaviors based on external cues (Benet-Martínez et al. 2002). For example, these biculturalists might show greater CMS activity for general than contextual self-judgments when being primed with Western-culture values. By contrast, when being primed with Eastern-culture values, these individuals might show greater CMS activity for contextual than general self-judgments (Chiao et al. 2009a). It would be interesting to follow immigrants in the More-Eastern group or those in the Less-Eastern group to see which group would become biculturalists with high BII in the future.

In addition to our findings in the MPFC, we also found that these two groups of immigrants showed differential PCC activity for the contrast of self-vs.-mother 6 months later. Although the posterior cingulate cortex/precuneus (PCC) is commonly reported in neuroimaging studies of self-referential processing (Kelley et al. 2002; Moran et al. 2006; Moran et al. 2011; Northoff et al. 2006; Northoff and Bermpohl 2004; Summerfield et al. 2009), the clear role of this region in differentiating one's self from close others remains unclear. The PCC is involved in diverse mental processes, but particularly plays a central role in autobiographical memory retrieval (Cavanna 2006; Northoff and Bermpohl 2004; Vann et al. 2009). A speculative hypothesis for the difference in PCC activity that we observed is that the greater PCC activity for self-judgments than mother-judgments may reflect the ease of retrieving autobiographical memory when engaging self-judgments, but not mother-judgments. It is possible that immigrants in the More-Eastern group might retrieve autobiographical memory only when engaging self-judgments at Time 1. However, at Time 2, since these immigrants became even more like Easterners, they might retrieve autobiographical memory not only when engaging self-judgments, but also when engaging mother-judgments at Time 2. Thus, high PCC activity for both self- and mother-judgments may explain the lack of self-vs.-mother differentiation at Time 2.

Although most of the findings from the present study were consistent with our hypothesis, one unexpected finding was that the primary change of immigrants' self-construal occurred in their interdependence self-construal, but not in their independence self-construal. It is possible that the time interval between Time 1 and Time 2 is too short to see changes occurring in both dimensions in the self-construal. It is also possible that within the first few months of settlement in another culture, immigrants might change primarily in their original culture values, but not in the host cultural values (Ryder et al. 2000). After years of settlement in the host culture, changes in the self-construal might gradually reveal in the dimension of host cultural values. Thus, we might expect that immigrants who became less interdependent would also become more independent after years of settlement in the United States.

There are several limitations in the current study. First, aside from the self-construal scale, no other acculturation assessment tools were collected. For example, the Suinn-Lew Asian Self-identity Acculturation Scale (Suinn et al. 1987) may be useful to confirm our hypotheses that immigrants who show changes in their interdependence self-construal would also reveal changes in their Asian self-identities. Second, this study lacks explicit scales to measure subjective intimacy between one's self and one's mother. It is possible that individuals who became less interdependent also felt less close to their mothers. Third, participants in the More-Eastern group had slightly lower (though marginally significant) interdependence scores than those in the Less-Eastern group at Time 1. However, the More-Eastern group and the Less-Eastern group showed no neural differences in the self-vs.-mother differentiation at Time 1. This finding suggested that this marginal difference in the interdependence score at baseline might not reflect the neural differentiation between the self and mother at baseline. Lastly, all of the immigrants in our study are those who move from the Eastern culture to the Western culture. It is possible that the direction of movement may influence the result. Future studies ought to test whether immigrants who move from the Western culture to the Eastern culture also show the same changes in the self-construal.

The current findings explored a relatively understudied topic in the field of cultural neuroscience, which is whether cultural differences in neural responses are aligned with behavioral changes during the process of acculturation. The present study demonstrates that a longitudinal approach can help cultural neuroscientists explore individual differences in the process of acculturation. By incorporating contemporary neuroimaging methodology into traditional acculturation research methods (Chen et al. 2015), cultural psychologists may be better equipped to understand the complex process of acculturation.

Acknowledgments This study was supported by a grant from the National Institute of Mental Health (R01MH059282) to T. F. Heatherton.

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