

general principles to interpret human social behaviors, research of cultural variation emerged as a challenge to this approach. For example, Markus and Kitayama's (1991) classic paper on culture and self promoted greatly searching after cultural variation rather than searching after universal laws in social psychology. This paper proposed a well-known theory of cultural differences in self-concept or self-construal, which inspired brain imaging investigation of cultural differences in neural substrates underlying self-representation (e.g., Han et al., 2008; Heatherton et al., 2006; Sui, Zhu, & Chiu, 2007; Zhu, Zhang, Fan, & Han, 2007). The brain imaging findings are consistent with the biocultural co-constructive framework (Li, 2003) and contribute to the emergence of a new discipline – cultural neuroscience (Chiao & Ambady, 2007; Wexler, 2006).

In this paper, we first reviewed the difference in philosophical thinking of the self between Western and Chinese philosophers. We then introduced empirical psychological research that supports Markus and Kitayama's framework of cultural difference in self-construals. Finally, we reviewed

unified conscious field, which is the subject of our psychological events and body. This rational self or agent is capable of acting freely and assuming responsibility for actions. The self is a logical or purely formal requirement that we can make sense of the characters of our experiences in addition to the experiences. Baars claimed that we consider 'self as the overall, unifying context of personal experience' and 'one way to think of "self" is as a framework that remains largely stable across many different life situations' (Baars, 1997, p. 154). The subject of our psychological events and body 'has to be an entity, such that one and the same entity has consciousness, perception, rationality, the capacity to engage in action, and the capacity to organize perceptions and reasons, so as to perform voluntary actions on the presupposition of freedom. If you have got all of that, you have a self' (Searle, 2004, p. 297).

Although Locke, Hume, and Searle discussed the self based on Descartes's concept, Solomon claimed that 'it is a matter for serious reflection that in our self-absorbed, individualistic society, so much is written and said on self-realization and individual self-identity, while somewhat less has been written, at least on the same level of self-conscious philosophical profundity, on the nature of our relations with one another. Of course, we know the reason for this; our conceptions of self are such that we tend to think that our real or essential or authentic self is ours and ours alone, while relations with other people are secondary to selfhood and, in some sense, "external"' (Solomon, 1990, p. 178). The Western philosophical view of the self has produced strong influence on psychological research of the self. For example, following Descartes statement of 'I think therefore I am', the father of American psychology, William James (1890), emphasized distinctions between the self as a subject (the 'I,') and the self as an object (the 'Me'). Searching invariants of 'I' has been central to contemporary Western psychological research.

The central topic of traditional Chinese philosophy is men rather than the self. The highest form of achievement of a person 'is nothing less than being a sage, and the highest achievement of a sage is the identification of the individual with the universe' (Fung, 1948/2007, p. 10). Different schools of Chinese philosophers suggested distinct way to achieve this goal. The Confucian-centered philosophy, which has two core concepts, i.e., jen (or ren) or human heartedness meaning loving others and yi or oughtness meaning the material essence of duties in society (Fung, 1948/2007, p. 69), claims that 'a person can not exist alone; all action must be in the form of interaction between person and person' (Hu, 1929/2006, p. 107). According to Mencius, the best way to realize human heartedness is to conduct practice of chung (i.e., loyal) and shu (i.e., pardon or forgive) so that 'one's egoism and selfishness are gradually reduced. And when they are reduced, one comes to feel that there is no longer a distinction between oneself and others, and so of distinction between the individual and the universe' (Fung, 1948/2007, p. 124).

greatly the concepts of self in Chinese psychology, which adopted the self as one's social role and relations in empirical research (Zhu, 2007, p. 17).

It should be acknowledged that not all Western philosophers referred to the self only in the sense of personal identity and not all Chinese philosophers discussed the self in the sense of personal relations with others. Although exceptions exist, it is true that Western philosophic thought is dominated by seeking invariants in the self whereas Chinese philosophic thought stresses the relations between the self and others. The cultural disparities in philosophic thinking of the self result in remarkable difference in human social behaviors and possibly in the underlying psychological processes including perception, memory, social cognition, etc. Among the psychological processes related to the self, cultural differences in self-construals have been studied extensively during the last two decades, as described in the next section of this paper.

Cultural Differences in Cognitive Processing of the Self

Distinct concepts of the person and philosophical thoughts of the self in different cultures influence greatly psychological research of the self. For instance, Markus and Kitayama (2003) acknowledged that Shweder and Bourne's (1984) inquiry of whether the concept of the person varies across cultures engendered their own theory of culture-based self-construals (Markus & Kitayama, 1991). Kirmayer (2007) noticed that every system of psychotherapy depends on implicit models of the self, which in turn, are based on cultural concepts of the person. Nisbett and Masuda (2003) also discussed extensively the relation between self-concept in psychology and self-concept in philosophy by comparing Western and East Asian cultures. It makes sense to Westerners to speak of a person with attributes that are independent of sociocultural contexts. This self – a bounded, impermeable free agent – can move from group to group and setting to setting without significant alteration. The self in East Asian cultures, however, is connected, fluid, and conditional and can be understood only in his/her relation to others (Nisbett, 2003).

According to Markus and Kitayama (1991), self-construals are different between Western and East Asian cultures. Specifically, they proposed that Western cultures with emphasis of self-identity lead to an independent self who is inclined to attend to self-focused information and attends to the self more than others (including intimate others such as mother). By contrast, emphasis of fundamental social connection in East Asian cultures results in an interdependent self who is generally sensitive to information related to significant others and attends to intimate others as much as to the self.

Markus and Kitayama (2003) further suggested that different self-concepts shape psychological processes that implicate the self. For example, the independent self predicts better memory of information about the self than that about others (Conway, Wang, Hanyu, & Haque, 2005; Markus

& Kitayama, 1991). This was tested using a self-referential task (Rogers, Kuiper, & Kirker, 1977), in which subjects were first presented with a list of personal traits and asked to judge whether a trait was suitable to describe the self or others. At the end of this encoding phase, subjects were required to recall as many of the words as they could. Typically, self-descriptive traits are better remembered than other-descriptive traits (the self-reference effect) (Klein, Loftus, & Burton, 1989). Interestingly, studies of Westerners found evidence for the self-reference effect over close others such as mother and best friends (Heatherton et al., 2006; Klein et al., 1989), supporting the dissociation between the self and any others in Western cultures. In contrast to the results of Westerners, Zhu and Zhang (2002) and Qi and Zhu (2002) found that, in the self-referential task, Chinese participants remembered equally well the trait adjectives associated with the self and close others (mother/father/best friend), supporting the existence of the interdependent self in East Asian cultures. Our recent work (Sui et al., 2007) further showed that, relative to Chinese culture priming, American culture priming made Chinese subjects use more independent self-statements and fewer interdependent self-statements to describe the self, illustrating the effects of short-term culture exposure on self-construal and its attendant memory processes.

In a study examining cross-cultural difference in autobiographical memory, Wang and Conway (2004) found that European-American adults frequently focused on memories of personal experiences, provided discrete, one-moment-in-time events unique to the individual, and placed a great emphasis on their feelings and personal roles in the memory events. In contrast, Chinese participants intended to describe memories of social and historical events, provided proportionately memories of generic, routine experiences, and focused on social interactions and the roles of other people. The cultural difference in autobiographical memories lends further support to the difference in memory related to the self between Western and East Asian cultures. The aforementioned studies indicate strongly cultural differences in cognitive processes, they do not rule out the existence of cultural universal features of the self. For example, a recent work showed evidence that trait attributes that render the person unique from fellow in-group members exist in both individualistic and collectivistic cultures (Del Prado et al., 2007), suggesting the presence of the individual self-primacy across different cultures.

Cultural Differences in Neural Basis of Self-representation

Recently, psychologists and neuroscientists have tried to inspect potential neural consequences of the cultural differences in philosophic thoughts and cognitive styles. Cultural influences on functional organization of the brain are evident across the life span development (Li, 2003; Wexler, 2006) and have been documented in object recognition (Gutchess, Welsh,

Boduroglu, & Park, 2006), mental calculation (Tang et al., 2006), language processing (Paulesu et al., 2000; Siok, Perfetti, Jin, & Tan, 2004), perceptual experience (McClure et al., 2004), and music processing (Neuhaus, 2003). The findings support the interplay between biology and culture (Shu-Chen Chiao & Ambady, 2007; Li, 2003); that is, not only does

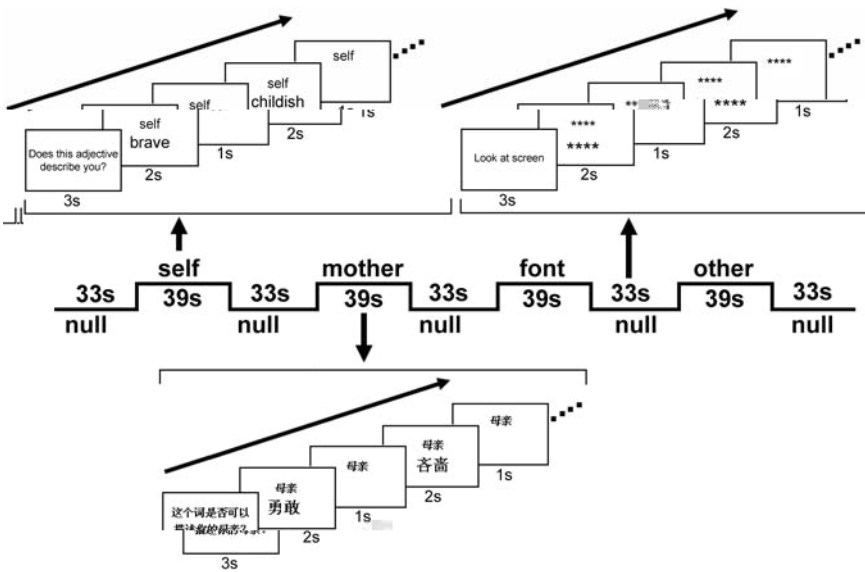


Figure 2 Schema of the design of Zhu et al.'s study (2007). Each trait adjective was presented for 2 seconds and subjects had to judge if each work could describe the self, mother, a public person. Font judgment was used to provide a low-level baseline. The stimuli and procedure of mother, other, and font judgments were the same as those of the self-judgment except that the word 'self' on the screen was replaced by 'mother', 'Bill Clinton' for Western subjects or 'Rongji Zhu' for Chinese subjects, or 'font', respectively. Instructions and trait words were in English for Westerners but in Chinese for Chinese subjects.

terms of the self and a friend. The fMRI results showed that, relative to letter judgment (uppercase vs. lower case), making judgments about the self yielded increased activation in vMPFC, whereas making judgments about a friend did not. The brain imaging results suggest that American subjects used vMPFC to represent exclusively the self.

To uncover cultural differences in the neural basis of self-referential processing, we recently scanned Westerners (English, American, Australian and Canadian) and Chinese young adults, using fMRI, while they performed personal trait judgment regarding the self, mother, or a public person (see Figure 2 for details, Zhu et al., 2007). The subjects also performed a memory retrieval task after the scanning procedure, similar to the previous behavioral research (Rogers et al., 1977; Zhu & Zhang, 2002). Zhu et al. (2007) found that memory of trait adjectives related to self and mother was equally well for Chinese but was better in the former condition for Westerners. The fMRI results showed stronger vMPFC activation in self- than public-person judgments in both Chinese and Westerner, consistent with the previous findings (Kelly et al., 2002). More interestingly, Zhu et al. (2007) found that, relative to public-person judgment, mother judgment also induced stronger vMPFC activation in Chinese subjects but not in

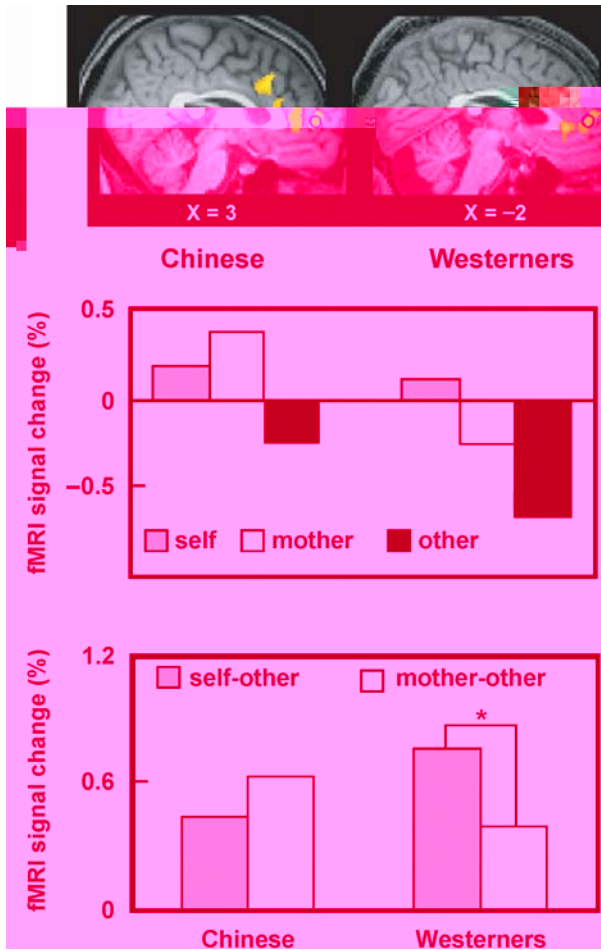


Figure 3 fMRI results of ROI analysis in MPFC from Zhu et al. (2007). (a) Illustration of the locus of vMPFC (marked with blue circles); (b) fMRI signal changes related to self-, mother, and other judgments; (c) Differential percent signal changes (self minus other and mother minus other). The asterisk indicates a significant difference between the self- and mother-reference effects in signal changes.

Western subjects (see the fMRI results in Figure 3). In addition, self-judgment gave rise to increased vMPFC activation compared with mother judgments in Western subjects but not in Chinese subjects. Both the behavioral and brain imaging results support that Chinese individuals use vMPFC to represent both self and mother, whereas Westerners use vMPFC to represent exclusively the self. Similar evidence for the overlap of self- and mother representation in vMPFC in Chinese was reported in Zhang et al. (2006). These brain imaging studies indicate that representations of the interdependent self and the mother overlap in vMPFC, whereas the independent self is exclusively represented

in vMPFC. The vMPFC activity differentiates between the individual self in Westerners and the relational self in Chinese.

Our recent study of self-recognition provided further evidence for cultural influence on neural substrates of self-representation (Sui & Han, 2007). This study used fMRI to assess if self-construal priming can modulate neural activity underlying self-awareness induced during face recognition in one cultural group (i.e., Chinese). The subjects were first asked to read essays containing independent or interdependent pronouns (e.g., 'I' or 'We') in order to prime the independent or interdependent self-styles (Gardner, Gabriel, & Lee, 1999). They were then scanned while they were presented with pictures of self-face or a familiar face and had to judge head orientations (toward left or right) of each face stimulus. fMRI data analysis showed that the right middle frontal activity increased to the self than familiar faces. Moreover, the right frontal activity differentiating between the self and familiar faces was enlarged by the independent relative to the interdependent self-construal priming. The findings indicate that the neural correlates of self-awareness associated with self-face recognition can be modulated by self-construal priming that activates different cultural self-styles. It appears that self-related processing in Chinese can be biased

Acknowledgment

This study was supported by the National Nature Science Foundation of China (project 30630025). We thank Shi-Ying Zhang for his help with an early draft of this paper.

Short Biographies

Ying Zhu graduated with a Chinese equivalent of PhD in psychology in 1966 from Peking University and is now a professor at the Department of Psychology, Peking University. He has been a member of the Executive Committee of Chinese Psychological society since 1989. His research interest focuses on self-related processing by integration of psychology, neuroscience, and philosophy. He has published a number of papers on the self in *Science in China*, *NeuroImage*, *Psychological Science* (in Chinese), and *Acta Psychologica Sinica*

- Conway, M. A., Wang, Q., Hanyu, K., & Haque, S. (2005). A cross-cultural investigation of autobiographical memory: On the universality and cultural variation of the reminiscence bump. *Journal of Cross-cultural Psychology*, *36*, 739–749.
- Del Prado, A. M., Church, A. T., Katigbak, M. S., Miramontes, L. G., et al. (2007). Culture, method and the content of self-concepts: Testing trait, individual self-primacy and cultural psychology. *Journal of Research in Personality*, *41*, 1119–1160.
- Descartes, R. (1912). *Meditations on the First Philosophy, meditation 2 (in English)*, In Everyman's library, 570, Philosophy. London: J. M. Dent and Sons LTD.
- Feng, Y. (2007). *Ideal Life (in Chinese)*. Beijing: Peking University Press.
- Fung, Y. (1948/2007). *A Short History of Chinese Philosophy*. Tian Jin: Tian Jin Social Science Academy Press.
- Gardner, W. L., Gabriel, S., & Lee, A. Y. (1999). 'I' value freedom, but 'we' value relationships: Self-construal priming mirrors cultural differences in judgment. *Psychological Science*, *10*, 321–326.
- Gutchess, A. H., Welsh, R. C., Boduroglu, A., & Park, D. C. (2006). Cultural differences in neural function associated with object processing. *Cognitive, Affective, & Behavioral Neuroscience*, *6*, 102–109.
- Han, S., Mao, L., Gu, X., Zhu, Y., Ge, J., & Ma, Y. (2008). Neural consequences of religious belief on self-referential processing. *Social Neuroscience*, *3*, 1–15.
- Heatherton, T. F., Wyland, C. L., Macrae, C. N., Demos, K. E., Denny, B. T., & Kelly, W. M. (2006). Medial prefrontal activity differentiates self from close others. *Social Cognitive Affective Neuroscience*, *1*, 18–25.
- Hu, S. (1929/2006). *An Outline of the History of Chinese Philosophy (in Chinese)*. Beijing: Uniting Press.
- James, W. (1890). *Principles of Psychology*. New York, NY: Henry Holt.
- Kelly, W., Macrae, C. N., Wyland, C. L., Caglar, S., Inati, S., & Heatherton, T. F. (2002). Finding the self? An event-related fMRI study. *Journal of Cognitive Neuroscience*, *14*, 785–794.
- Kirmayer, L. J. (2007). Psychotherapy and the cultural concept of the person. *Transcultural Psychiatry*, *44*, 232–257.
- Klein, S. B., Loftus, J., & Burton, H. A. (1989). Two self-reference effects: The importance of distinguishing between self-descriptiveness judgments and autobiographical retrieval in self-referent encoding. *Journal of Personality and Social Psychology*, *56*, 853–865.
- Li, S. C. (2003). Biocultural orchestration of developmental plasticity across levels: The interplay of biology and culture in shaping the mind and behavior across the life span. *Psychological Bulletin*, *129*, 171–194.
- Lou, H. C., Luber, B., Crupain, M., Keenan, J. P., Nowak, M., Kjaer, T. W., Sackeim, H. A., & Lisanby, S. H. (2004). Parietal cortex and representation of the mental self. *Proceeding of the National Academy of Sciences of the United States of American*, *101*, 6827–6832.
- Lutz, C. (1992). Culture and consciousness: A problem in the anthropology of knowledge. In F. S. Kessel, P. M. Cole & D. L. Johnson (Eds.), *Self and Consciousness* (pp. 64–87). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.
- Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review*, *98*, 224–253.
- Markus, H. R., & Kitayama, S. (2003). Culture, self, and the reality of the social. *Psychological Inquiry*, *14*, 277–283.
- McClure, S. M., Li, J., Tomlin, D., Cypert, K. S., Montague, L. M., & Montague, P. R. (2004). Neural correlates of behavioral preference for culturally familiar drinks. *Neuron*, *44*, 379–387.
- Neuhaus, C. (2003). Perceiving musical scale structures: A cross-cultural event-related brain potentials study. *The Annals of the New York Academy of Sciences*, *999*, 184–188.
- Nisbett, R. E. (2003). *The Geography of Thought: How Asians and Westerners Think Differently, and Why*. New York, NY: Free Press.
- Nisbett, R. E., & Masuda, T. (2003). Culture and point of view. *Proceeding of the National Academy of Sciences of the United States of American*, *100*, 11163–11170.
- Northoff, G., Heinzel, A., de Greck, M. D., BERPohl, F., Dobrowolny, H., & Panksepp, J. (2006). Self-referential processing in our brain – A meta-analysis of imaging studies on the self. *NeuroImage*, *31*, 440–457.
- Paulesu, E., McCrory, E., Fazio, F., Menoncello, L., Brunswick, N., Cappa, S. F., Cotelli, M., Cossu, G., Corte, F., Lorusso, M., Pesenti, S., Gallagher, A., Perani, D., Price, C., Frith, C. D., & Frith, U. (2000). A cultural effect on brain function. *Nature Neuroscience*, *3*, 91–96.

- Prigogine, I. (1980). *From Being to Becoming: Time and Complexity in the Physical Science*. New York, NY: W.H. Freeman and Company.
- Qi, J., & Zhu, Y. (2002). Self-reference effect of Chinese college students. *Psychological Science (in Chinese)*, *25*, 275–278.
- Rogers, T. B., Kuiper, N. A., & Kirker, W. S. (1977). Self-reference and the encoding of personal information. *Journal of Personality and Social Psychology*, *35*, 677–688.
- Searle, J. R. (2004). *Mind: A Brief Introduction*. New York, NY: Oxford University Press, Inc.
- Shweder, R. A., & Bourne, L. (1984). Does the concept of the person vary cross – culturally? In R. A. Shweder & R. A. LeVine (Eds.), *Culture Theory: Essays on Mind, Self, and Emotion* (pp. 158–199). New York, NY: Cambridge University Press.
- Simon, H. A. (1990). Invariants of human behavior. *Annual Review Psychology*, *41*, 1–19.
- Siok, W., Perfetti, C. A., Jin, Z., & Tan, L. (2004). Biological abnormality of impaired reading is constrained by culture. *Nature*, *43*, 71–76.
- Solomon, R. C. (1990). *The Big Questions: A Short Introduction to Philosophy* (3rd edn). San Diego, CA: Harcourt Brace Jovanovich, Publishers.
- Sui, J., & Han, S. (2007). Self-construal priming modulates neural substrates of self-awareness. *Psychological Science*, *18*, 861–866.
- Sui, J., Zhu, Y., & Chiu, C.-Y. (2007). Bicultural mind, self-construal, and self-and mother-reference effects: Consequences of cultural priming on recognition memory. *Journal of Experimental Social Psychology*, *43*, 818–824.
- Tang, Y., Zhang, W., Chen, K., Feng, S., Ji, Y., Shen, J., Reiman, E. M., & Liu, Y. (2006). Arithmetic processing in the brain shaped by cultures. *Proceeding of the National Academy of Sciences of the United States of American*, *103*, 10775–10780.
- Wang, Q., & Conway, M. A. (2004). The stories we keep: Autobiographical memory in American and Chinese middle-aged adults. *Journal of Personality*, *72*, 911–938.
- Wexler, B. E. (2006). *Brain and Culture: Neurobiology, Ideology, and Social Change*. Cambridge, MA: MIT Press.
- Zhang, L., Zhou, T., Zhang, J., Liu, Z., Fan, J., & Zhu, Y. (2006). In search of the Chinese self: A fMRI study. *Sciences in China, Series C*, *49*, 89–96.
- Zhang, S. Y. (2005). *An Introduction to Philosophy*. Beijing: Peking University Press.
- Zhu, Y. (2007). *Culture and Self (in Chinese)*. Beijing: Beijing Normal University Press.
- Zhu, Y., & Zhang, L. (2002). An experimental study on the self-reference effect. *Sciences in China, Series C*, *45*, 120–128.
- Zhu, Y., Zhang, L., Fan, J., & Han, S. (2007). Neural basis of cultural influence on self-representation. *NeuroImage*, *34*, 1310–1316.