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Cultural Differences and Their Mechanisms

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Abstract

Growing evidence has demonstrated cultural differences in cognitive processes. Whereas individuals living in interdependent social worlds, as illustrated by East Asian cultures, have been shown to have a more holistic cognitive style, those living in independent social environments, as exemplified by Western cultures, have been shown to have a more analytic cognitive style. Recent evidence has also begun to show the mechanisms underlying cultural differences, both by examining within-cultural differences and by showing effects of socio-cultural contexts on cognitive processes. This chapter aims to highlight dynamic relationships between socio-cultural contexts and cognitive processes by providing an overview of research on cultural differences and their mechanisms. First, we briefly summarize different approaches to studying cultural differences in cognition. Then, we review studies showing cultural differences in various cognitive processes, by focusing on holistic vs. analytic cognition. Finally, we outline recent evidence showing the causes and mechanisms of cultural differences, as well as suggest future directions.

Keywords: culture, cognition, holistic and analytic cognition, mechanisms

Cultural Differences and Their Mechanisms

Studies on cross-cultural differences in cognitive processes have been rapidly accumulating over the past decade across various fields in psychology. These studies have not only shown cultural differences in a wide range of cognitive processes, but have also begun to reveal mechanisms underlying these cultural differences. In this chapter, our goal is to highlight dynamic relationships between socio-cultural contexts and cognitive processes. First, we briefly introduce different approaches to understanding cultural differences in cognition. Next, we review studies showing cultural differences in various cognitive processes, including: attention, categorization, attribution, and dialecticism. Then, we outline recent evidence showing causes and mechanisms of cultural differences and propose directions for future research.

Different Approaches to Cultural Differences in Cognition

Anthropologists and psychologists have been examining the cultural groundings of our cognition for more than a century, prior to the recent re-emergence of interest in cultural differences. There have been at least five approaches to cultural differences in cognition: (i) early studies on visual illusion, (ii) studies on linguistic relativity, (iii) studies on cognitive ability, (iv) studies from the cultural-historical approach, and (v) studies on the socio-cultural system.

Probably the earliest researcher who showed cultural differences in basic perception was Rivers (1901, 1905). Through examining the Torres Straits Islanders and the Todas in Southern India, Rivers found that, compared to a Western sample, the non-Western samples were more susceptible to a horizontal-vertical illusion and less susceptible to the Müller-Lyer illusion. Segall, Campbell, and Herskovits (1966) further reasoned that these differences in visual illusions could reflect differences in ecological and cultural environments. By conducting extensive experiments across 15 societies, Segall et al. found that Western samples which lived

in highly carpentered environments were more susceptible to the Müller-Lyer illusion than non-Western samples which lived in less carpentered environments. On the other hand, they also showed a trend that individuals who lived in open, flat terrain were more susceptible to the horizontal-vertical illusion than those who lived in environments without open vistas. These studies demonstrated that even a process as basic as visual perception can be influenced by cultural and ecological environments.

Research on linguistic relativity is also relevant when discussing cultural influences on cognition. The linguistic relativity (Whorfian) hypothesis, at least its weaker version which states that the language we speak influences how we think, has received some empirical support (for a review, see Lucy, 1997; Hunt & Agnoli, 1991). However, early studies on color terms also presented evidence against the Whorfian hypothesis. Berlin and Kay (1969) showed that there are universal laws underlying basic color terms. Moreover, Rosch Heider demonstrated that Dani speakers recognize focal colors better than non-focal colors, even though their language has only two color terms (i.e., dark and light; Heider, 1972; Heider & Olivier, 1972), suggesting that lack of color terms does not prevent them from perceiving the colors. More recent studies, however, have shown that color terms influence perception by increasing perceived distances at category boundaries (Kay & Kempton, 1984; Robertson, Davies, & Davidoff, 2000; Robertson, Davidoff, & Davies, 2005). Effects of language on cognition have also been demonstrated in a number of other domains, such as spatial orientation (Levinson, 1997), understanding of time (Boroditsky, 2001), category learning (Lupyan, Rakison, & McClelland, 2007), and numerical cognition (Gordon, 2004; Pica, Lemer, Izard, & Dahanne, 2004).

While the previous two approaches focus on specific domains of cognition, some cross-cultural psychologists have focused on cultural differences in general cognitive ability. An

overwhelming amount of studies have shown that Westerners tend to perform better than non-Westerners on intelligence tests developed in Western cultures, even with supposedly “culture fair” tests (e.g., Vernon, 1969). Additionally, exposure to Western-style schooling has been linked to increased performance on these intelligence tests (Ceci, 1991). At the same time, researchers have recognized the difficulty of transferring intelligence tests to other cultures, not only because of issues associated with translating materials and settings, but also because of cultural differences in the meaning and function of intelligence (Greenfield, 1997; Sternberg & Kaufman, 1998).

From the cultural-historical perspective, Cole and his colleagues (Cole, 1996; Cole & Scribner, 1974) have criticized the view that there are cultural differences in a general cognitive capacity which can be measured by general cognitive tasks. Instead, they have suggested the importance of examining specific cognitive performances in proper cultural-historical context and pragmatic activity, where cognitive operations are usually carried out. For example, Kpelle rice farmers in Liberia, who often sell rice in a market setting, were found to be more accurate than American adults in estimating quantities of rice (Gay & Cole, 1967), even though Kpelle adults had difficulty sorting patterned cards according to a simple rule.

With the same emphasis on situating cognitive processes within the demands of cultural and ecological contexts, other researchers have proposed that different social and cultural worlds can foster qualitatively different types of cognition processes (Nisbett, 2003; Nisbett & Miyamoto, 2006; Nisbett, Peng, Choi, & Norenzayan, 2001; Witkin, Dyk, Faterson, Goodenough, & Karp, 1974). Interdependent, collective social organizations have been theorized to foster attention to relationships and to the context. On the other hand, independent, individualistic social worlds have been theorized to encourage individuals to focus on a single

object and one's goal with respect to it without being overly constrained by the surrounding context or others' demands. Researchers have called the style of thinking found in the former socio-cultural system a holistic or field-dependent cognition, and the style of thinking found in the latter an analytic or field-independent cognition (Nisbett, 2003; Witkin et al., 1974).

In this chapter, we mainly focus on the last approach because it is the area where growing evidence has been accumulating in the past decade, by employing a wide range of methodologies. In the following section, we first summarize studies documenting cultural differences in various cognitive tasks, by focusing on holistic vs. analytic cognition. In the latter half of the chapter, we review evidence showing how differences in socio-cultural environments underlie differences in cognitive processes. Although this chapter focuses on cultural differences in relatively general cognitive processes that are assumed to operate across various domains, it is important to note that there are also studies demonstrating cultural influences on domain-specific cognition, such as naïve biology (Medin & Atran, 2004) and naïve psychology (Lillard, 1998; Wellman, Cross, & Watson, 2001).

Cognitive Differences

Attention

Recent studies have shown cultural differences in the visual perception of focal and contextual information. In an illustrative study, Masuda and Nisbett (2001) presented Japanese and American participants with animated video clips of underwater scenes which contained focal fish within a background. When asked to describe what they saw in the scenes, Japanese were more likely than Americans to refer to the background and to relationships between focal objects and the background. Moreover, in a subsequent recognition task, participants were presented with both previously-seen and novel objects, with either the original or a novel background.

Whereas Japanese recognition was facilitated when objects were presented with their original background, American recognition was not influenced by the changes in background, indicating that objects are more bound to their contexts for Japanese.

Cultural differences are not confined to the perception of complex natural scenes. Researchers have also used stimuli stripped of any socio-cultural context. Ji, Peng, and Nisbett (2000) found that Americans were more accurate than Chinese on the Rod-and-Frame Test (Witkin, Lewis, Hertzman, Machover, Meissner, & Wapner, 1954), which measures the ability to focus on a focal object (i.e., rod) while ignoring contextual information (i.e., square frame). Kitayama, Duffy, Kawamura and Larsen (2003) further developed the Framed-Line Task (FLT) to examine the ability to incorporate or ignore contextual information (Figure 1). Participants were first shown a square frame with a vertical line in it and then presented with another square frame of either the same or a different size. In the second square, participants were asked to draw a line that was identical to the first line in either absolute or relative length. As expected, Americans were more accurate than Japanese on the absolute task where they had to ignore the frame, whereas Japanese were more accurate than Americans on the relative task where they had to incorporate the frame.

<Figure 1 here>

Further evidence supporting culturally divergent attentional styles has been provided by a wider range of behavioral measures and stimuli, such as context sensitivity in the Ebbinghaus illusion (Doherty, Tsuji, & Phillips, 2008), susceptibility to a mnemonic context effect (Duffy & Kitayama, 2007), allocation of attention to both contextual information (Masuda & Nisbett, 2006) and to a wider region (Boduroglu, Shah, & Nisbett, 2009) using a change blindness paradigm, attention to contextual information (i.e., vocal tone) using an auditory stroop task

(Ishii, Reyes, & Kitayama, 2003; Kitayama & Ishii, 2002), and eye-movements (Chua, Boland, & Nisbett, 2005; Masuda, Ellsworth, Mesquita, Leu, Tanida, & Van de Veerdonk, 2008; Rayner, Li, Williams, Cave, & Well, 2007). For example, Chua and her colleagues measured the eye-movements of American and Chinese participants while they viewed natural scenes which contained a focal object and its background (e.g., a tiger in a jungle). Whereas Americans looked at the focal objects sooner and fixated on them longer than Chinese did, Chinese made more saccades to the background than Americans did. These findings suggest that Easterners and Westerners are not only reporting and memorizing different things, but are also actually looking at different things.

Recent neurophysiological studies have started to accumulate evidence for neural correlates of cultural differences in attention. A functional magnetic resonance imaging (fMRI) study found that, when viewing focal objects, Americans showed greater activation than did East Asians in the areas associated with object-processing, such as the middle temporal cortex, (Gutchess, Welsh, Boduroglu, & Park, 2006), suggesting that Americans have greater processing of focal objects. Consistent evidence was provided by Lewis, Goto, and Kong (2008), who examined P3 event-related potentials (ERPs) during a three-stimulus oddball task. Whereas European Americans showed larger target P3 amplitudes, indicating their greater attention to target objects, East Asian Americans showed larger novelty P3 amplitudes, indicating their greater attention to events that deviate from the stimulus context. These studies provide neural evidence for Americans' greater attention to focal objects and East Asians' greater attention to contextual information. Further, Hedden, Ketay, Aron, Markus, and Gabrieli (2008) found that when people need to engage in a perceptual task incompatible with their cultural background, it requires greater attentional control. They assessed fMRI responses while American and East

Asian participants performed the FLT (Kitayama et al., 2003) and found that, in both cultural groups, engaging in culturally incompatible tasks (i.e., the relative task for Americans and the absolute task for East Asians) increased activation in the frontal and parietal regions commonly associated with attentional control, more than did engaging in culturally compatible tasks.

Studies reviewed thus far have focused on attention to focal objects vs. contextual information. East Asian holistic perceptual styles, however, seem to extend to attention to discrete features vs. configural relationships when perceiving a single stimulus. In an early study, Abel and Hsu (1949) presented Rorschach cards to China-born Chinese and American-born Chinese participants in the U.S. Their results indicated that whereas China-born participants were more likely than American-born participants to attend to the configuration and perceive the blots as a whole pattern, American-born participants were more likely than China-born participants to attend to discrete parts of the blots. More recently, research demonstrated that, when perceiving faces, Japanese were more sensitive to changes in configural information (i.e., distance between eyes) than Americans (Miyamoto, Yoshikawa, & Kitayama, in press). The existence of cultural differences in face perception also suggests that cultural variation exists even in a domain that is typically viewed as configural and holistic in nature. Such a finding points out the possibility that there is cultural variation in other perceptual processing in which even Westerners are known to show a holistic pattern, such as boundary extension (Intraub, Gottesman, Willey, & Zuk, 1996).

Categorization and Reasoning

If Easterners attend to contextual and relational information more than Westerners do, Easterners may also rely more on contextual cues when categorizing objects. When presented with three objects (e.g., a monkey, a panda, and a banana) and asked to choose the two which

should be grouped together, Chinese children and adults tended to group on the basis of thematic relations (e.g., grouping a monkey and a banana, because monkeys eat bananas), whereas American children and adults tended to group on the basis of categorical relations (e.g., grouping a monkey and a panda, because monkeys and pandas are both animals; Chiu, 1972; Ji, Zhang, & Nisbett, 2004).

These cultural differences in categorization were also observed for more perceptual stimuli. Norenzayan Smith, Kim, and Nisbett (2002) presented a target object and two groups of four objects to participants, and then asked them to judge to which group the target object was most similar (Figure 2). All members of one group shared a single feature with the target object (i.e., the unidimensional rule group), whereas all members of the other group were holistically similar to the target, because they shared a larger number of features with the target object, though no single feature was shared by all members (i.e., the family resemblance group). The results showed that European Americans were more likely than East Asians to choose the unidimensional rule group, whereas East Asians were more likely than European Americans to choose the family resemblance group. Asian Americans showed intermediate responses.

<Figure 2 here>

Researchers have extended these differences in categorization to examine differences in other types of reasoning, such as deductive reasoning. East Asians' reliance on overall similarity, rather than a unidimensional rule, indicates their use of an intuitive strategy to categorize objects. This suggests the possibility that East Asians may also rely more on intuitive plausibility than on formal rules when making deductive inferences. Supporting this possibility, when there was a conflict between logical structure of a deductive argument and the empirical plausibility of the argument's conclusion, Koreans were more likely than European Americans to rely on

plausibility and mistakenly judge valid arguments with implausible conclusions as invalid (Norenzayan et al., 2002). In addition, different reasoning styles are perceived differently across cultures. Asian Canadians judged a company manager who followed holistic intuitions to be more reasonable, competent, and wiser than a company manager who followed analytical rules, whereas European Canadians showed equal preference (Buchtel & Norenzayan, 2008).

Attribution

Differences in perception and categorization of physical objects are likely to extend to the interpretation of social events. In fact, cross-cultural studies have shown that the fundamental attribution error (Ross, 1977)—a tendency to overestimate the internal cause (e.g., personal disposition) and underestimate the external cause (e.g., situational forces) of behavior—is especially strong among Westerners, who tend to focus on focal objects. Early evidence for cultural differences in attribution was provided by Miller (1984). She asked American and Indian adults to describe a behavior of a person they knew and to explain why the behavior was undertaken. American adults were more likely to attribute the behavior to general dispositions of the person than to contextual factors, thus demonstrating the fundamental attribution error, whereas Indian adults were more likely to attribute the behavior to contextual factors than to general dispositions. Morris and Peng (1994) replicated similar cultural differences between Americans and Chinese by using controlled stimuli (i.e., animated displays of fish's behavior).

At the same time, research has suggested that cultural differences in attribution depend on the relative salience of contextual information and the diagnosticity of the behavior. Asians are as likely as Americans to infer that behavior is caused by internal dispositions (thus showing correspondence bias) when a behavior is diagnostic of the actor's attitude, or when situational information either is not salient or is absent (Choi & Nisbett, 1998; Krull, Loy, Lin, Wang, Chen,

& Zhao, 1999; Masuda & Kitayama, 2004; Miyamoto & Kitayama, 2002; Norenzayan, Choi, & Nisbett, 2002). However, when behavior is less diagnostic of the actor's attitude (Miyamoto & Kitayama, 2002) or when situational information is made salient (Choi & Nisbett, 1998; Masuda & Kitayama, 2004; Norenzayan et al., 2002), Americans have still been found to attribute behavior to internal dispositions, whereas Asians have been found to take situational information into greater consideration.

These cultural differences have also been shown with implicit measures of attribution. The type of lexicon one chooses to describe a behavior reflects one's implicit causal judgment (Semin & Fiedler, 1988). If Easterners are more likely than Westerners to spontaneously make situational inferences, they may also prefer to use more verbs, which provide information about the situation (e.g., *Tom helped his mother*), than adjectives, which provide information about the disposition of an actor that transcends situations (e.g., *Tom is helpful*). Supporting this possibility, Maass, Karasawa, Politi and Suga (2006) showed that Japanese used more verbs and fewer adjectives than Italians when describing others. Moreover, in a memory task, Japanese were more likely to unintentionally transform adjectives into verbs, whereas Italians showed the opposite pattern. These findings suggest that situational inferences can occur spontaneously and automatically for Asians, whereas dispositional inferences can occur automatically for Westerners (for relevant findings with Latinos, see Zárate, Uleman, & Voils, 2001; see also Knowles, Morris, Chiu, & Hong, 2001; but also see Lieberman, Jarcho, & Obayashi, 2005).

These differences in causal attribution are likewise reflected in the amount of information considered to explain a behavior. Because a holistic explanation style involves attribution to a larger number of factors (e.g., situational factors, the interaction between personal and situational factors) than does an analytic explanation style, East Asians consider a greater amount of

information than Americans do to explain an event (Choi, Dalal, Kim-Prieto, & Park, 2003). For example, when judging the causal relevance of various items in order to solve a case involving a graduate student who murdered a professor, Korean participants considered a larger number of items (e.g., the graduate student's zodiac sign) as relevant than Americans did. These differences are also found to extend to the temporal dimension. Whereas Chinese and Canadians have been found to be equally likely to attend to present information, Chinese were found to be more likely than Canadians to attend to past information (Ji, Guo, Zhang, & Messervey, 2009). In addition, Japanese participants were shown to be more aware of indirect and distal consequences of a given event than Americans were (Maddux & Yuki, 2006), pointing out the possibility that Asians are also more likely than Americans to attend to future information. Supporting this possibility, a recent study which examined achievement behavior showed that whereas East Asians are more motivated than Americans when a task has utility to fulfill long-term goals, Americans were more motivated than East Asians when a task has utility to fulfill short-term goals (Godes, Durik, Miyamoto, & Harackiewicz, in press).

Dialecticism

If East Asians take a broader range of factors into consideration, they may also tend to tolerate contradictions that are inherent in the factors. Peng and Nisbett (1999) conducted a series of studies to demonstrate how Chinese and Americans approach contradictions. Compared to Americans, Chinese preferred more proverbs involving a contradiction (e.g., "beware of your friends, not your enemies"), indicating a Chinese preference for contradictions. In addition, when approaching contradictory arguments, Chinese tended to seek a middle way by moderately endorsing both views, whereas Americans tended toward polarizing attitudes. This tendency to seek a middle way was also reflected in the way they approached social conflicts, such as

conflicts between mothers and daughters. Chinese were more likely than Americans to attribute the causes to both sides and recommend resolving the conflicts by compromising.

Because of their dialectical thinking, East Asians may take information that contradicts their expectations for granted. Choi & Nisbett (2000) presented participants with a scenario about a good Samaritan (Darley & Batson, 1973), where a religious student who was in a hurry ended up not helping a victim. Some participants received the scenario with the outcome (i.e., the student did not help the victim), while others did not. When no outcome was provided, Koreans and Americans were equally likely to predict that the person would help the victim, suggesting that neither Koreans nor Americans could predict the actual outcome. However, after being told the outcome, Koreans were less likely to be surprised and more likely to report that they could have predicted the outcome than were Americans, thereby demonstrating a stronger hindsight bias.

The dialectical approach toward contradictions can be closely related to beliefs about change, because if opposite sides of a contradiction coexist, it also means that one side can easily transform into the other side. To explore cultural differences in beliefs about change, Ji, Nisbett and Su (2001) presented participants with graphs depicting certain trends (e.g., GDP) over three time points. Americans were more likely than Chinese to predict that current trends would continue, whereas Chinese were more likely than Americans to predict that current trends would slow or reverse direction. These cultural differences in beliefs about change are also manifested in stock market decisions (Ji, Zhang, & Guo, 2008). Canadians were more willing than Chinese to buy a rising stock, whereas Chinese were more willing than Canadians to buy a falling stock.

Summary

In this section, we reviewed evidence showing cultural differences in various cognitive processes, ranging from attention and categorization to attribution and dialectical thinking. Recently, Miyamoto, Talhelm, and Kitayma (2008) conducted a meta-analysis of these cultural differences in cognitive processes and found the overall effect size (Cohen's d) to be 0.56, which is a moderate to large effect (Cohen, 1977). Level of cognitive processing was not a significant moderator, suggesting that these cultural differences in cognitive processes can be as strong in the lower level processes (e.g., eye-tracking measure) as in the higher level processes (e.g., causal attribution task).

Causes and Mechanisms

In the previous section, we summarized cultural differences in a wide range of cognitive processes. Although evidence showing between-cultural differences in cognition is crucial for understanding the nature and scope of cultural influences, such evidence does not specify why there are cultural differences in cognition to begin with. Researchers have proposed that differences in ecological environments and social structures, at a distal level, and everyday practices, at a proximal level, underlie differences in holistic vs. analytic cognitive processes.

Differences in Ecological Environments

Nisbett and his colleagues proposed that cultural differences in cognitive processes can be traced back to the different ecological and social environments of Ancient Greek and Chinese societies (Nisbett, 2003; Nisbett et al., 2001). Chinese civilization was based on large-scale agriculture, which required cooperation and coordination with a substantial number of individuals, in order to effectively perform economic activity. In Chinese society, the social structure was thus complex and hierarchical, and social relations were characterized by mutual dependence. Individuals living in such an interdependent, collectivistic social environment may

have needed to attend to relationships and to the context. On the other hand, the ecological environments of Greek were suited to herding, fishing, and small-scale agriculture—economic activities which did not require cooperation among many individuals. A sense of personal agency and freedom thus became characteristics of Greek society. From living in such an independent, individualistic social structure, individuals within this type of society may have gradually developed the ability to focus on an object and their individual goal with respect to it without being overly constrained by surrounding contexts or others' demands.

In line with this contention, different ecology and social structures have been linked to different cognitive styles (Witkin & Berry, 1975). Berry (1966) compared Temne communities in West Africa with Canadian Eskimo communities. The Temne engage in rice farming and their social relations emphasize conformity and strict social order, whereas the Eskimo engage in hunting and their social structure is more flexible. As expected, Berry found that individuals in Eskimo communities showed more field-independent performance compared to those in Temne communities on the Embedded Figure Test (Witkin, 1950). Summarizing similar studies conducted across twenty communities around the world, Berry (1976) further showed that economic activity of the community correlated with the tightness of social structure, and that the combined index of economy and social structure highly correlated with field-independent cognitive performance.

Although these findings are informative, the communities that were examined differed not only in economic activities, but also in various other aspects, such as languages and ethnicities, which could have been potential confounds. More recently, Uskul, Kitayama, and Nisbett (2008) compared three communities within Turkey that engage in different types of economic activities—farming, fishing, and herding—but share the same language and ethnicity.

Farmers and fishers, whose economic activities require close cooperation among the family members, were more likely to show a holistic perceptual style on the FLT (Kitayama et al., 2003) and to categorize objects based on thematic relations and overall family resemblance than were herders, whose community emphasizes autonomy.

Differences in Social Structures: Regions, Religions, and Socioeconomic Contexts

In order to examine the contention that differences in social structures underlie East-West differences in cognitive processes, recent studies have begun to explore whether individuals who belong to groups or communities that differ in their social structures due to regional, religious, or socioeconomic backgrounds show different cognitive styles even within the same culture.

Regional Differences. Some investigators have contrasted different regions within Europe. Social relations have historically been hierarchical and close-knit in southern Italy and in Central and Eastern Europe, whereas voluntary association between independent individuals was more characteristic of social relations in northern Italy and in Western Europe. If social practices underlie cognitive processes, southern Italians and Central and Eastern Europeans may show more context-dependent cognitive style compared to northern Italians and Western Europeans. In support of this hypothesis, southern Italian high school students were more likely than their northern counterparts to categorize objects based on thematic relations (Knight & Nisbett, 2007). Furthermore, Central and Eastern European college students were more likely than Western European and American students to categorize objects based on thematic relations (Varnum, Grossmann, Katunar, Nisbett, & Kitayama, 2008).

Kitayama, Ishii, Imada, Takemura, and Ramaswamy (2006) focused on another type of regional difference—societies and regions rooted in a history of voluntary settlement. Voluntary settlement in a frontier, which is motivated by pursuit of personal wealth and freedom, has been

theorized to foster social structures which place few restraints on individuals and promote independent agency (Turner, 1920). To examine the effects of voluntary settlement, Kitayama and his colleagues compared a voluntary settlement society in Japan (i.e., Hokkaido) with a non-voluntary settlement society in Japan (i.e., mainland). Those who were born in Hokkaido were more likely than those in mainland Japan to show an independent social orientation and to attribute the cause of behavior to internal rather than external causes, thereby exhibiting an analytic pattern of cognition. Furthermore, voluntary settlement led North American societies to be even more independent than Western European societies. On the FLT, North Americans showed a more analytic perceptual style compared to Western Europeans, who in turn showed a more analytic perceptual style than did Japanese (Kitayama, Park, Sevincer, Karasawa, & Uskul, 2009).

Religious Differences. The religious beliefs and practices one is exposed to may also influence characteristics of social structures. Dershowitz (1971) contrasted Orthodox Jewish boys, whose families stress strict adherence to specified religious structures, with secular Jewish and Protestant boys, whose social settings involve looser social constraints. As expected, Orthodox Jewish boys showed more field-dependent cognitive performance than did Protestant boys, and secular Jewish boys fell between the two groups. More recently, Colzato, van den Wildenberg, and Hommel (2008) contrasted Calvinists and atheists in the Netherlands, who were matched with respect to race, age, sex, and intelligence. In Dutch neo-Calvinism, there is a principle of *sphere sovereignty*, which emphasizes independence and autonomy of each sphere of society. Emphasis on the segregated, independent sections in social structures was hypothesized to lead Calvinists to focus on parts within a field without attending much to the larger field. Supporting this hypothesis, compared to Dutch atheists, Dutch Calvinists were

relatively faster at identifying small letters embedded within larger letters, which is assumed to reflect their analytic, focused perceptual style.

Socioeconomic Differences. Socioeconomic backgrounds provide social contexts in which one is embedded as well. By examining a community sample of adults with different educational backgrounds, Na, Grossman, Varnum, Kitayama, Gonzalez, and Nisbett (2010) showed that compared to people with lower educational attainment, those with higher educational attainment are more likely to show an analytic cognitive style. In addition to objective SES, subjective perception of one's social class has also been shown to predict holistic patterns of cognition. Those who perceive themselves to be lower on the social class ladder tend to prefer contextual explanations for various social events compared to those who perceive themselves to be higher on the social class ladder (Kraus, Piff, & Keltner, 2009). Moreover, various socio-cultural factors have been shown to explain SES differences in cognition, such as a sense of control and perceived influence (Kraus et al., 2009; Miyamoto & Ji, 2010) or inflated self-views (Grossman & Varnum, in press).

Differences in Everyday Practices

Cultures differ not only in the social structures at a distal, abstract level but also in the nature of daily practices at a proximal level. Ecological and social environments influence and shape what kind of daily practices people in the community are likely to be exposed to and to engage in. Through participating in these practices, people's cognitive processes may become attuned to cultural ideas and beliefs that are embodied in these practices.

Cultural Products. Cultural ideas and beliefs are embodied in cultural products and environments to which individuals are exposed in daily life (for a meta-analysis, see Morling & Lamoreaux, 2008). For example, by randomly sampling hotels, public elementary schools, and

post offices in small, medium, and large cities in both Japan and the United States, and taking photographs at each selected location, Miyamoto, Nisbett, and Masuda (2006) showed that Japanese perceptual environments are more complex and ambiguous than American perceptual environments (Figure 3). Moreover, exposure to complex and ambiguous Japanese perceptual environments encouraged attention to the overall context for individuals from both cultures, whereas exposure to simple American perceptual environments fostered attention to a few salient objects. Another example of cultural products is mass media coverage. When covering Olympic athletes, American mass media focuses more on personal characteristics of athletes, whereas Japanese mass media focuses more on the background and others surrounding athletes (Markus, Uchida, Omoregie, Townsend, & Kitayama, 2006; see also Lee, Hallahan, & Herzog, 1996; Morris & Peng, 1994). Being exposed to such cultural products may lead people to make attributions characteristics of each culture. Moreover, the relations between cultural products and cognitive styles may be bidirectional. Those who have a holistic cognitive style might be more likely than those with an analytic cognitive style to create products and environments that include more contextual information. Supporting this contention, when asked to take photographs or to draw landscape pictures, East Asians include a larger amount of context or background than Americans do (Masuda, Gonzalez, Kwan, & Nisbett, 2008). These findings suggest that cognitive styles and cultural environments can mutually sustain and reinforce each other. Not only do cultures influence individuals, but individuals also actively create and sustain cultures.

<Figure 3 here>

Socialization Practices. Pedagogical and parental practices have been known to differ across cultures. Whereas Chinese and Japanese preschool teachers tend to support a larger class

size and engage children in various group activities, American preschool teachers tend to value a smaller class size and encourage personal choice and verbalization of thinking processes (Tobin, Wu, & Davidson, 1989). The educational practices of Asian preschools appear to lead children to attend to complex relationships among group members, whereas the educational practices of American preschools seem to guide children's attention to the target of one's goal. In addition to pedagogical practices at school, there are cultural differences in parental practices that take place at home. When playing with toys, Japanese mothers were more likely than American mothers to engage infants in social routines, such as greeting and exchange, whereas American mothers were more likely than Japanese mothers to label toys for infants (Fernald & Morikawa, 1993; Tamis-LeMonda, Bornstein, Cyphers & Toda, 1992). American mothers' emphasis on labeling objects could be said to lead infants to focus on objects, whereas Japanese mothers' emphasis on social practices could direct infants' attention to relationships or to the context in which an object is located. Reflecting this emphasis on labeling objects, American mothers tend to produce more nouns than verbs when talking with their toddlers, whereas Mandarin-speaking mothers tend to produce more verbs than nouns when talking with their toddlers (Tardif, Gelman & Xu, 1999). Such cultural differences in communication practices can guide children's attention to either the object (i.e., noun) or to the relationship between the object and the field (i.e., verb).

Proving Causality by Manipulating General Cultural Mindsets

Although the previous studies based on between-group comparisons suggest that different cognitive styles are associated with different social structures or practices, between-group comparisons do not provide direct causal evidence. Some researchers have tried to test causal mechanisms underlying cultural differences by experimentally manipulating culture. There are

mainly two approaches to the experimental manipulation of culture: biculturalism and cultural mindset priming.

Biculturalism. The bicultural approach capitalizes on the fact that some individuals are bicultural (e.g., Asian Americans) and thus might have internalized two cultural knowledge systems (e.g., Asian and American cultural meaning systems). If this is the case, priming one cultural knowledge system (e.g. Asian cultural meaning system) should increase the accessibility of declarative and procedural knowledge (e.g., situational attribution) that belongs to the primed knowledge system. Various studies have provided support to this contention. Hong Kong Chinese have been found to make more situational attributions (thus showing more holistic cognitive patterns) after being exposed to Chinese cultural icons, such as a Chinese dragon, than after being exposed to American cultural icons, such as the American flag (Hong, Morris, Chiu, & Benet-Martínez, 2000). Recalling experiences that highlight either one of biculturals' identities has also been shown to influence patterns of attribution (Peng & Knowles, 2003). For example, Chinese Americans produced more situational attributions after recalling an experience that made their Asian identity salient than after recalling an experience that made their American identity salient.

At the same time, there are individual differences among bicultural individuals in whether cultural priming increases the accessibility of the primed cultural knowledge system. The ways bicultural individuals integrate their two identities have been shown to influence the direction of cultural priming (Benet-Martínez, Leu, Lee, & Morris, 2002). Cultural priming leads Chinese American biculturals who perceive their two identities as compatible (e.g., "I am both") to show culturally congruent patterns of attribution, replicating Hong et al.'s (2000) findings. However, those Chinese Americans who perceive their two identities as mutually exclusive (e.g.,

“I am a Mexican in America”) show a reverse pattern: they produce more contextual explanations after being primed with American icons than after being primed with Chinese icons.

Cultural Mindset Priming. Whereas the bicultural approach manipulates culture only among bicultural individuals, the cultural mindset priming approach manipulates culture even among *monocultural* individuals. It starts from identifying critical mindsets that are supposed to underlie cultural differences. Mindset priming manipulations typically ask participants to first work on a task that employs a certain mindset, and subsequently examines whether this mindset carries over to a new context. The cultural mindsets that have been most frequently examined are individualism and collectivism (for a meta-analysis, see Oyserman & Lee, 2008). Multiple procedures have been proposed to prime individualism and collectivism. For example, Gardner and her colleagues primed individualism by making participants focus on first-person singular pronouns (I, my, me, mine), and primed collectivism by making them focus on first-person plural pronouns (we, our, us, ours; Gardner, Gabriel, & Lee, 1999).

These cultural priming tasks have been shown to influence patterns of cognition. Compared to participants who were primed with individualism, those who were primed with collectivism showed facilitated identification of global features (i.e., identifying a large letter composed of smaller letters) and increased recall of objects' location (Kühnen & Oyserman, 2002). There is also neural evidence to suggest that global vs. local perceptual processing is influenced by cultural priming. Lin, Lin, and Han (2008) found that the P1 amplitude at lateral occipital electrodes was larger for local than global targets after being primed with individualism, whereas the pattern was reversed after being primed with collectivism. These findings suggest that individualism priming facilitated local perceptual processing by increasing the extrastriate activity.

Proving Causality by Examining Affordances of Proximal Cultural Practices

Although the manipulation of general cultural mindsets provides strong evidence for a causal factor underlying cultural differences in cognition, such studies locate the source of cultural differences exclusively inside individuals' minds. As we have reviewed in the previous section, cultural differences are also embodied in proximal daily experiences, such as cultural products and socialization processes. Repeated exposure to such different cultural practices may afford and shape people' cognitive styles in a way that reinforces the cultural pattern. For example, Koo and Choi (2005) examined the effect of Oriental medicine training practices. Oriental medicine embodies core aspects of East Asian holistic thinking, such as attention to relations between parts and the whole, and an emphasis on maintaining balance. Koo and Choi reasoned that being exposed to the practices of Oriental medicine may foster holistic ways of thinking. Supporting their hypothesis, students in Oriental medicine considered a larger number of items as relevant to solving a murder case than did students in psychology. Furthermore, the longer the students gained training in Oriental medicine, the larger number of items they considered.

Another example is the aforementioned study on cultural differences in the physical environment. Miyamoto et al. (2006) hypothesized that holistic and analytic cognitive styles are partly shaped by being exposed to culturally specific physical environments that afford such cognitive styles. To test this hypothesis, participants were first exposed to either complex and ambiguous Japanese perceptual environments or simple and organized American perceptual environments (Figure 3). Subsequently, they worked on a change blindness task, which measured their patterns of attention. The results demonstrated that both Americans and Japanese participants were able to identify a larger number of contextual changes, thus showing a more

holistic attentional pattern, after being exposed to the Japanese perceptual environments than after being exposed to the American perceptual environments.

Culturally Contingent Causality

Most studies that examine causes of culturally divergent cognitive styles propose that the same mechanism underlies cognitive processes across cultures. For example, as reviewed above, priming people with collectivism or with complex and ambiguous Japanese environments has been shown to lead to context-dependent, holistic patterns of cognition in both Western and Eastern cultures. However, there might also be culturally contingent sources of cognitive styles. That is, some factors might be linked to holistic cognition in a certain cultural context but not in other cultural contexts.

For example, in Western cultures, a higher sense of control has been linked to more analytic patterns of cognition (Kraus et al., 2009; Miyamoto & Ji, 2010), possibly because those who have control over their surroundings can focus on their goals and the target of their goals without a need to pay much attention to the context. On the other hand, those who are in a position to exert control over others (i.e., leaders) are more likely to attend to relational cues in order to effectively govern the group in Japan than in the U.S. (Misumi & Peterson, 1985). In such a cultural context, influencing others may require attention to contextual cues, leading to a more holistic attentional style. Supporting this possibility, our recent studies have shown that although having control and influence over others leads to analytic patterns of attention among Americans, this effect was non-existent or even reversed among Japanese (Miyamoto & Wilken, in press). These findings highlight the importance of situating causes of perceptual styles in a larger cultural context. Perceptual styles can be shaped by the nature of interpersonal contexts, but how they are shaped depends on the larger cultural contexts in which they are embedded.

Developmental Trajectories

Studies which experimentally manipulate cultural constructs have identified the short-term effects of culture on cognitive processes. Such short-term effects of exposure to cultural contexts might have long-term consequences on cognitive styles. That is, repeated exposure to cultural practices in everyday life may change a habitual cognitive style for individuals as they develop and accumulate experiences in cultural contexts. To examine long-term consequences of exposure to cultural contexts, researchers have examined both the early development of cognitive styles and cognitive changes that happen in the later stages of development.

As summarized above, there are cultural differences in pedagogical and parenting practices. If extended exposure to such socialization practices shapes children's cognitive styles, cultural differences in cognitive styles should become larger as children grow older and gain more experiences in each culture. Developmental studies have provided supporting evidence. In the aforementioned study focusing on causal attribution in India and the U.S., Miller (1984) examined both adults and children (ages 8, 11, and 15 years). Although American adults made more dispositional and less contextual attributions than did Indian adults, the cultural differences were smaller among 15- and 11-year-olds, and no cultural differences were observed among 8-year-olds (Miller, 1984). Interestingly, younger children in both cultures made more contextual than dispositional attributions, suggesting that children in both cultures have a relatively context-dependent, holistic cognitive style. Similar developmental patterns were observed for predictions of changes (Ji, 2008) as well as for perceptual processing (Duffy, Toriyama, Itakura, & Kitayama, 2009). Using the FLT (Kitayama et al., 2003), Duffy and his colleagues found that both American and Japanese 4- to 5-year-olds were more accurate on the relative task than on the absolute task, thus showing a more holistic attentional style. In contrast, older American children

were more accurate on the absolute task than on the relative task, whereas older Japanese children showed the reverse pattern. These findings indicate that children start out from having a relatively holistic cognitive style across cultures and that children increasingly acquire patterns of cognition consistent with their cultural background as they grow older, though the exact age at which cultural differences start to emerge seems to differ across tasks.

Studies have also shown that prolonged experiences in a cultural context foster culturally specific patterns of cognition and perception across the life-span as adults age. Blanchard-Fields, Chen, Horhota, and Wang (2007) examined the degree of correspondence bias among college students and older adults (aged 58-80) in the U.S. and China. Consistent with the previous studies on attitude attribution that did not find cultural differences when situational information was not salient, there were no cultural differences in the degree of correspondence bias among younger adults. However, among older adults, Americans showed a stronger correspondence bias than Chinese, suggesting that longer exposure to cultural contexts reinforced cognitive styles dominant in each culture. A similar pattern was found for categorical clustering in the U.S. and China (Gutchess, Yoon, Luo, Feinberg, Hedden, Jing, et al., 2006). Cultural differences in categorical clustering were larger for older adults (ages 60-78) than for younger adults (ages 18-22). Such age differences have also been observed in an fMRI study (Goh, Chee, Tan, Venkatraman, Hebrank, Leshikar, et al., 2007). When viewing a set of pictures where a focal object or the background varied, although there were no cultural differences in adaptation response among younger adults, older American adults showed a larger adaptation response in areas associated with object-processing (i.e., lateral occipital regions) than did older Chinese adults, suggesting that older American adults engaged their object-processing areas to a greater extent than older Chinese adults did.

Summary

This section reviewed studies which examined the causes and mechanisms of cultural differences in cognitive processes. Both distal and proximal causes have been proposed. Some studies have attributed the cultural differences in cognition to distal causes, such as different ecologies and social structures. At the same time, differences in daily social practices and cultural products have also been linked to cultural differences in cognition. Recent studies have begun to test causal mechanisms using various experimental manipulations. Both activation of general cultural constructs and exposure to specific cultural contexts have been shown to induce patterns of cognition specific to each culture. Furthermore, developmental studies provide evidence that prolonged exposure to cultural contexts fosters culturally specific cognitive patterns.

Conclusion and Future Directions

Emerging evidence suggests that socio-cultural contexts influence cognitive processes. Individuals living in interdependent or collectivistic social worlds, as illustrated by East Asian cultures, have been shown to have a more holistic cognitive style, whereas those living in independent or individualistic social environments, as exemplified by Western cultures, have been shown to have a more analytic cognitive style. Furthermore, recent evidence has begun to show the mechanisms underlying cultural differences in cognitive processes. These studies suggest that participating in certain social and ecological environments fosters divergent cognitive processes both in the short-term (e.g., as shown in priming studies) and in the long-term (as illustrated by developmental studies).

If repeated exposure to one's own cultural practices through developmental processes shapes one's cognitive style, being exposed to and living in different cultural environments

might also change cognitive style. Although some studies have found that East Asians living in the U.S. show more analytic patterns of cognition compared to East Asians living in East Asia (Kitayama et al., 2003; Norenzayan et al., 2002), it is not clear whether the differences are due either to exposure to American cultural practices or to self-selection; East Asians who came to the U.S. might have had more analytic cognitive styles before immigrating than might have East Asians who did not come to the U.S. Studies examining acculturation processes in longitudinal designs would be useful for disentangling acculturation and self-selection effects, as well as for identifying factors that may facilitate (or hinder) dynamic changes in cognitive styles. For example, what distinguishes individuals whose cognitive styles become attuned to the new culture from those whose cognitive styles remain the same? Is there a critical period for acquiring a new cognitive style?

Another direction for future research is to examine consequences of engaging in certain cognitive processes. Although cross-cultural studies in cognition have mainly examined cognitive styles as an end state, cognitive styles may have consequences on the nature of interpersonal relationships. For example, van Baaren, Horgan, Chartrand, and Dijkmans (2004) have shown that participants who are induced to engage in holistic cognitive processing evidence a greater tendency to mimic each other's behavior. Since mimicry works as the "social glue" that fosters empathy and smooth interaction (Chartrand & Bargh, 1999), holistic cognitive styles may have the function of increasing interpersonal closeness, thus leading to more interdependent social relationships. Cognitive styles may also influence other aspects of interpersonal relationships, such as attention to others and sensitivity to others' needs. Research on these interpersonal consequences of cognitive processes could shed light on the bidirectional relationship between cognitive processes and social contexts.

Lastly, although recent studies have sought mechanisms underlying cognitive styles, most studies have been conducted in Western cultural contexts. Although these findings are informative in identifying factors underlying cognitive styles in Western cultures, future research needs to examine whether these factors have the same effects across cultures or whether the factors are grounded in particular cultural contexts. For example, as reviewed above, having control over others leads to analytic patterns of cognition among Americans but not among Japanese, possibly because exerting control requires different cognitive styles across cultures (Miyamoto & Wilken, in press). These findings point out the importance of studying mechanisms not only within Western cultural contexts, but also within other cultural contexts. For example, it is an open question as to whether high socioeconomic status is associated with analytic patterns of cognition across cultures or whether socioeconomic contexts have different cognitive consequences in Eastern cultural contexts.

Human cognition has long been assumed to be a fixed and universal information-processing system, where only the input to the system differs across cultures. However, growing evidence accumulated over the past decade suggests that cognitive processes are shaped through participation in social and cultural environments. It is our hope that advances in studies on the cultural grounding of cognitive processes will contribute to a better understanding of not only cultural diversity, but also the nature of the human mind in general.

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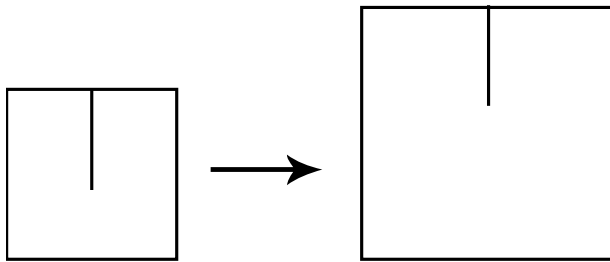
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(a) Absolute task



(b) Relative task

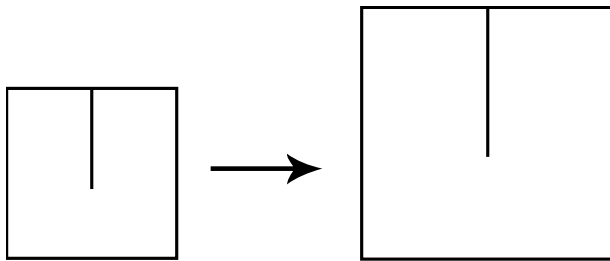


Figure 1. An illustration of the Framed-Line Task (Kitayama et al., 2003). Participants were shown a square frame with a vertical line. They were then presented with another square frame of either the same or different size and were asked to draw a line that was identical to the first line in either absolute length (absolute task) or relative length (relative task).

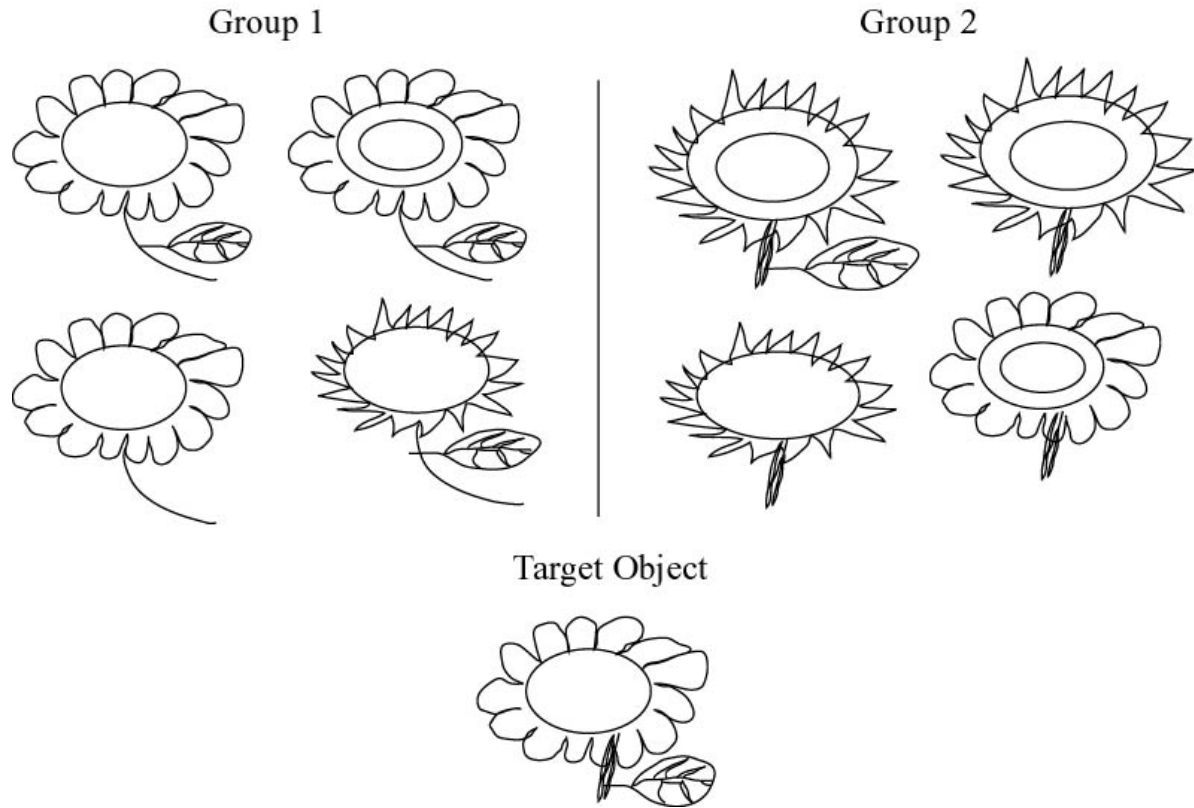


Figure 2. An example of a categorization task (Norenzayan et al., 2002). Participants were asked to judge to which group the target object was most similar. In this example, whereas all the members in group 2 shared a single feature with the target object (the unidimensional rule group), members in group 1 shared a larger number of features with the target object, though no single feature was shared by all members (the family resemblance group). Reprinted from Norenzayan et al. (2002) with permission of Cognitive Science Society, Inc.

(a) American perceptual environment



(b) Japanese perceptual environment



Figure 3. Examples of an American perceptual environment and a Japanese perceptual environment (Miyamoto et al., 2006). Hotels, public elementary schools, and post offices in small, medium, and large cities in both Japan and the United States were randomly sampled, and photographs were taken at each sampled location.