

Cultural Variations in Global Versus Local Processing: A Developmental Perspective

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We conducted 3 studies to explore cultural differences in global versus local processing and their developmental trajectories. In Study 1 ($N = 363$), we found that Japanese college students were less globally oriented in their processing than American or Argentine participants. We replicated this effect in Study 2 ($N = 1,843$) using a nationally representative sample of Japanese and American adults ages 20 to 69, and found further that adults in both cultures became more globally oriented with age. In Study 3 ($N = 133$), we investigated the developmental course of the cultural difference using Japanese and American children, and found it was evident by 4 years of age. Cultural variations in global versus local processing emerge by early childhood, and remain throughout adulthood. At the same time, both Japanese and Americans become increasingly global processors with age.

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Cross-cultural research has repeatedly found cultural variations in perception and cognition (see Medin & Atran, 2004; Nisbett, Peng, Choi, & Norenzayan, 2001 for review). North Americans tend to focus on a central object, whereas East Asians tend to focus on both the central and peripheral objects (Masuda & Nisbett, 2001; Miyamoto, Nisbett, & Masuda, 2006). North Americans also tend to use rule-based categorization, whereas East Asians use a relational categorization (Norenzayan, Smith, Kim, & Nisbett, 2002). Because of these and other groundbreaking studies (e.g., Kitayama, Duffy, Kawamura, & Larsen, 2003; Kitayama & Ishii, 2002; López, Atran, Coley, Medin, & Smith, 1997), the pervasive influence of culture on perception and cognition is now widely

recognized (Bruner, 1990; Lillard, 1998; Markus & Kitayama, 1991).

Curiously, however, cross-cultural research on the East and West differences has largely neglected one of the most frequently investigated dimensions of perception: global (“forest”) versus local (“tree”) perceptual processing (Gasper & Clore, 2002; Kimchi & Palmer, 1982; Navon, 1977). The present research investigated cultural variations in global versus local perceptual processing from a developmental perspective.

Developmental Perspectives

In order to understand the origins of cultural variations in perception and cognition, it is important to take a developmental perspective. Recently, several researchers have initiated such an effort. Imada, Carlson, and Itakura (2013), for instance, modified a paradigm used by Masuda and Nisbett (2001) to investigate cultural differences in the context-sensitivity of perceptual memory. Japanese and American children saw a series of 14 pictures, and were asked to freely describe each picture. Four- to 5-year-old Japanese children were more likely than American children of the same age to describe aspects of the background first. For Japanese children, this tendency grew even stronger with age: 6- to 9-year-old Japanese children were even more likely than the younger Japanese children to describe the background first, whereas American children, remained constant in their tendency to first mention objects that were in the foreground. Imada et al. also found that the Ebbinghaus illusion, in which the perceived size of a circle can be influenced by the size of circles around it, was larger among Japanese children than American children, and particularly among

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older children. Thus, it appears that by at least 4 years of age, Japanese children are already more context-sensitive than their American counterparts, and that this cultural difference is amplified over development.

In another study investigating cultural differences in children's perception and cognition, *Kuwabara and Smith (2012)* found that Japanese 4-year-olds performed better than their American counterparts on a task requiring relational visual matching (the match-to-standard), whereas American 4-year-olds performed better than their Japanese counterparts on a visual search task that required ignoring irrelevant objects (see also *Kuwabara, Son, & Smith, 2011*). In addition, *Duffy, Toriyama, Itakura, and Kitayama (2009)* compared Japanese and American children's perception using the Framed Line Test (*Kitayama et al., 2003*). The Framed Line Test assesses accuracy of reproducing the line absolutely (irrespective of a new frame), or relative to a different frame. They found cultural differences consistent with earlier adult studies among children aged 6 years or older, whereas they did not find any cultural differences among 4- and 5-year-olds. Related to these findings, *Unsworth et al. (2012)* recently examined cultural differences in folkbiological thought, and found that 5- to 7-year-old Menominee Native Americans were more likely than European American children of the same age to categorize objects according to the objects' ecological relations (e.g., food chains). These studies suggest that by age 6, children exhibit their culture's dominant perception and categorization patterns.

Cultural and Developmental Variations in Global Versus Local Processing

As just noted, research investigating the development of cultural differences in perception and cognition has examined either context-sensitivity or relational processing. A few studies with adult participants, however, have examined cultural variations in global versus local processing—that is, whether individuals tend to attend to the “forest” or the “trees.” *Davidoff, Fonteneau, and Fagot (2008)* asked adult participants in Britain and the Himba in northern Namibia to choose which of two options “looks most like” a target, one that shared the same local features or one that shared the same global feature (e.g., *Navon, 1977*). For example, when presented with a circle composed of smaller circles, the options were a circle composed of Xs (the global match) or a square composed of circles (the local match). *Davidoff et al.* found that British adults made global selections over 85% of the time, but the Himba did so just 23% of the time. Interestingly, despite their local processing bias, Himba participants actually outperformed British participants on a task that required them to selectively attend to the global features of a target (*Caparos, Linnell, Bremner, de Fockert, & Davidoff, 2013*), a finding that is consistent with other research showing the Himba are not prone to visual distraction (*de Fockert, Caparos, Linnell, & Davidoff, 2011*). A recent study also found that exposure to an urban environment was positively associated with global processing among the traditional Himba (*Caparos et al., 2012*).

There are conflicting findings as to whether East Asians are more globally or locally oriented. For example, in *Caparos et al. (2012)*, 63 Japanese college students from Kyoto University were as globally oriented as 62 Goldsmiths University of London students, and both were more globally oriented than the Himba. In

another study using compound Navon figures, *McKone et al. (2010)* compared 25 East Asians with 22 White Australians, and found that the East Asians were more globally oriented. From these studies it appears that East Asians are at least as globally oriented as British or Australians on the Navon task.

In contrast, many anthropological studies have shown that Japanese tend to be local processors, or very detail-oriented (*Davies & Ikeno, 2002; Fernandez & Fernandez, 1996; Webster & White, 2010*). An intense focus on details and precision is well-recognized in the presentation of Japanese food, for example (e.g., the 2011 film *Jiro Dreams of Sushi*). Japanese landscape paintings typically include more elements than Western landscapes, suggesting a Japanese tendency to pay attention to details (*Masuda, Gonzalez, Kwan, & Nisbett, 2008*). Similarly, East Asians' professional poster presentations and East Asian universities' websites include more detailed information than those of non-East Asians (*Wang, Masuda, Ito, & Rashid, 2012*). Furthermore, the findings discussed earlier showing that Japanese privilege context/background (*Imada et al., 2013; Masuda & Nisbett, 2001*) could also be interpreted as showing a Japanese tendency to attend to detail. Given the conflicting findings about whether Japanese adults tend to be locally or globally oriented, one goal of the current work is to offer additional data that will directly speak to this issue.

A second goal of the current work is to investigate the development of local and global processing cross-culturally. If there are cultural differences between Japanese and American adults in this aspect of perceptual processing, then an important question concerns when those differences emerge. There has been some developmental research in Western cultures suggesting that the global bias strengthens with development (e.g., *Burack, Enns, Iarocci, & Randolph, 2000; Dukette & Stiles, 2001; Enns, Burack, Iarocci, & Randolph, 2000; Kimchi, Hadad, Behrmann, & Palmer, 2005; Porporino, Shore, Iarocci, & Burack, 2004*). *Scherf, Behrmann, Kimchi, and Luna (2009)*, for example, showed that American children and adolescents (8–17 years) were slower to respond to global than local information whereas young adults (18–30 years) showed the reverse pattern. *Scherf et al.* argued that, with development, visual perception becomes organized around global features because they are more reliable for object identification and recognition. Given that object identification and recognition are important across cultures, we hypothesized that, although there might be differences in how globally or locally oriented participants were, both Japanese and Americans would become more globally oriented in perception with age.

The Present Research

We conducted three cross-cultural studies to explore the developmental trajectories of global versus local processing, using a task designed by *Kimchi and Palmer (1982)* that has been used frequently in studies of perception (e.g., *Gasper & Clore, 2002; Fredrickson & Branigan, 2005; Hicks & King, 2007*). In this task, participants see a target (e.g., a square made up of triangles), and they are asked to choose which of two options is most similar to the target: one that matches the target in global shape (a square made up of squares) or one that matches the target in local features (a triangle made of triangles; see *Figure 1*).

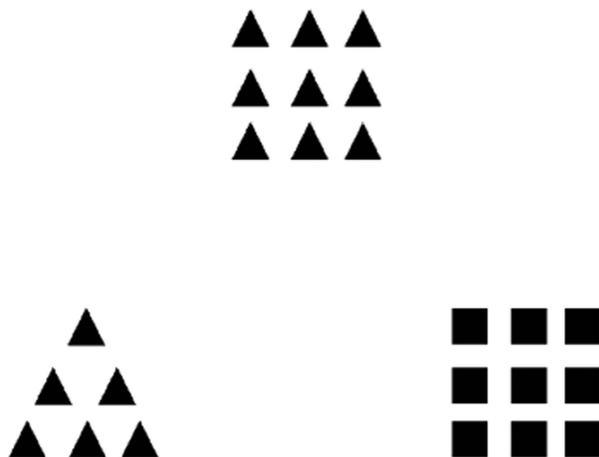


Figure 1. An example of Kimchi and Palmer's (1982) global-local processing task. The top figure is the target figure. The global configuration is square, while the local elements are triangles. Participants are asked to pick one of the two figures below that looks more like the target figure on the top. Here, the left figure is a "local" choice, whereas the right figure is a "global" choice.

Our studies extend the literature on culture and perception in two important ways. First, most previous cross-cultural studies on perception have employed two-group comparisons—comparing Japanese participants to Americans (e.g., Imada et al., 2013; Masuda & Nisbett, 2001; Miyamoto et al., 2006). One main limitation of the two group comparison is that it is difficult to determine the factors that account for the difference. For instance, the United States and Japan are different not only in intellectual tradition (e.g., Confucianism) but also in other cultural dimensions such as individualism-collectivism. As discussed by Norenzayan and Heine (2005), a strategic use of a third group can alleviate this limitation. In Study 1, we employed a three-group comparison of the United States, Japan, and Argentina. Argentina is an ideal third group here because it has the identical individualism-collectivism score as Japan (according to the Hofstede Centre [<http://geert-hofstede.com/>], Argentina and Japan are 46, whereas the United States is 95), yet it has an intellectual tradition more similar to the United States than to Japan (Schimmack, Oishi, & Diener, 2002). Thus, if perceptual styles are affected by the broad cultural dimension of individualism-collectivism, then Japanese and Argentines should be similar to each other, and both should be different from Americans. If perceptual styles are instead affected by the intellectual tradition, then Japanese should be different from Americans and Argentines. Thus, the inclusion of Argentina makes our cross-cultural comparison more informative in terms of potential causes of cultural variations in perceptual styles.

A second important way that our studies contribute to the literature on culture and perception is that most previous research on this topic has examined only one period of life (e.g., early childhood in Imada et al., 2013; Kuwabara & Smith, 2012; young adulthood in Masuda & Nisbett, 2001; Miyamoto et al., 2006). In contrast, we took a life span approach (Baltes, 1987; Bialystok & Craik, 2006) to our investigation and examined young adulthood (Study 1), young to old adulthood (Study 2),

and early childhood (Study 3), together covering ages from 3 to 69 years.

Study 1: Cross-Cultural Comparisons in Perception Among College Students

Method

Participants. Participants were 196 students (age 17 to 25, $M = 19.04$, $SD = 1.14$; 90 males, 85 females) at the University of Virginia, 119 students (age 18 to 23, $M = 20.03$, $SD = 1.01$; 30 males, 89 females) at Kanseigakuin University, and 48¹ students (age 15 to 30, $M = 23.90$, $SD = 3.32$; 17 males, 31 females) at the University of Buenos Aires.

Materials and procedure. At the University of Virginia, participants went individually to a laboratory room, and following informed consent procedures, were seated at a computer where they completed an online survey on subjective well-being, personality, and perception; data from the first two (well-being and personality) were for another project and are not reported here. The perception survey to assess global versus local processing was comprised of 8 of the 24 Kimchi and Palmer (1982) items. On each trial, one target geometric figure was presented, along with two geometric figures that represented a global or local match (see Figure 1). Participants were asked to select the figure that was more similar to the target. The specific instruction was as follows: "Please look at the first figure on top (target figure). Then, please look at two figures below. Which one of them looks more like the target figure?" The Spanish version was as follows: "Por favor observe el siguiente objeto. Es más similar al objeto de la derecha o al objeto de la Izquierda?" The Japanese translation was as follows: まず一番上の図柄(標的図)を見て下さい。次に、標的図のすぐ下にある二つの図柄を見て下さい。下二つの絵柄のうち、標的図により似ていると思う方に丸をつけてください。

The number of global options chosen by each participant was summed to create a global processing index ranging from 0 to 8.

In Japan, participants completed a paper-pencil version of the same survey in Japanese. In Argentina, participants completed the online survey in Spanish. The original English version of the materials was translated into Japanese and Spanish by bilingual psychology doctoral-level students. Then the translated materials were checked and modified by a Japanese psychologist and an Argentine psychologist to ensure the accuracy and naturalness of the translation.

Results and Discussion

First, we conducted a 3 (Nation) \times 2 (Gender) ANOVA on the number of global choices. There was a main effect of nation, $F(2,$

¹ Originally we collected data from 30 other Argentine participants. We did not include them in the data analyses in the text because they were not college students and older than 30 years. To make the Argentine sample as comparable as possible with Japanese and American samples, we excluded these other participants. The inclusion of these 30 participants, however, does not change the pattern of results. For instance, the descriptive statistics are as follows: $M = 6.24$, $SD = 2.44$. T tests against Japan and the United States are very similar to the ones reported in the text, $t(85.90) = 9.59$, $p < .001$, $d = 2.07$, against Japan and $t(233) = 1.08$, $p = .283$, $d = .14$, against the United States.

311) = 52.575, $p < .001$. However, there was no main effect of gender, $F(1, 311) = 2.65$, $p = .104$, or interaction effect between nation and gender, $F(2, 311) = .32$, $p = .729$. An ANCOVA, controlling for age, did not change the main effect of nation, $F(2, 310) = 52.32$, $p < .001$.

Post hoc t tests showed strong support for the intellectual tradition hypothesis over the individualism-collectivism hypothesis. As shown in Figure 2, Argentines and Americans selected significantly more global matches than Japanese, $M_{Argentina} = 6.40$, $SD = 2.20$ versus $M_{Japan} = 3.14$, $SD = 1.31$, $t(61.15) = 9.60$, $p < .001$, $d = 2.46$; $M_{USA} = 5.85$, $SD = 2.58$ versus $M_{Japan} = 3.14$, $SD = 1.31$, $t(262.55) = 11.63$, $p < .001$, $d = 1.44$. Argentines and Americans were not different from each other, $t(214) = 1.35$, $p = .214$, $d = .18$.

We next checked the distribution of the global choices for each nation. Among Americans, 75 out of 168 (44.6%) participants selected the global match on eight of the eight trials, and 11 (6.5%) never did so. Among Argentines, 27 of 48 participants (56.25%) chose the global match on all 8 trials, and only one (2.08%) never did so. Among Japanese, none of the 119 participants (0%) chose the global match on all eight trials, and 4 of 119 (3.4%) never did so. The modal response was 8 global matches for Americans and Argentines, whereas it was four for Japanese.

An outstanding issue in the literature has been whether Japanese are more globally or locally oriented. Whereas some prior research has suggested that Japanese are at least as global in their processing as British people–Americans' close cultural relatives (Caparos et al., 2012), ethnographic reports and some other research would lead to the hypothesis that Japanese would be more detail-oriented than Americans (Davies & Ikeno, 2002; Fernandez & Fernandez, 1996; Webster & White, 2010). Results from Study 1 are more in line with the detail-oriented position: Japanese participants tended to pay more attention to local information than Americans and Argentines. We will offer some speculation for why there are differences between studies in the General Discussion.

A second contribution of this study is to illuminate a possible source of this cultural difference. Previous research on culture and

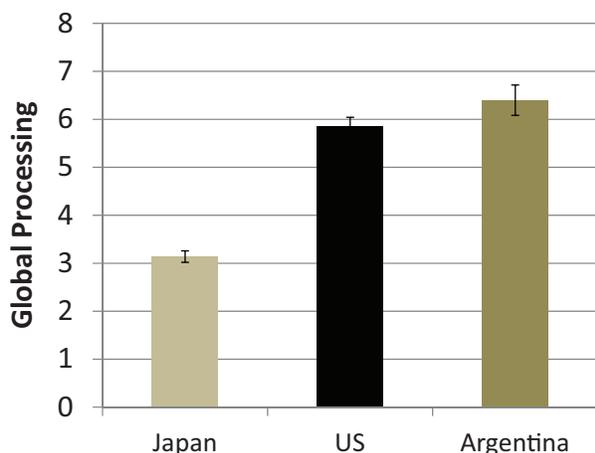


Figure 2. The mean global processing score by nation: Study 1. 0 = 100% local processing; 4 = 50/50; 8 = 100% global processing. Error bars show standard error of the mean. See the online article for the color version of this figure.

perception has relied on two-group comparisons (e.g., Imada et al., 2013; Masuda & Nisbett, 2001; Miyamoto et al., 2006), leaving it unclear whether the differences were due to a broad cultural dimension of individualism-collectivism or different intellectual traditions. To address this issue, we used a triangulation method (Norenzayan & Heine, 2005): The individual-collectivism score for Japan is far more similar to Argentina than the United States (<http://geert-hofstede.com>), but the intellectual tradition of Japan is different from both Argentina and the United States (Schimmack, Oishi, & Diener, 2002). The patterns of cultural variations we found in Study 1, with Argentines being more similar to Americans in global processing than to Japanese, suggest that the difference is due to intellectual tradition rather than a broad cultural dimension of individualism-collectivism, per se. It should be noted, however, that the mode of data collection was slightly different between Japan (paper-and-pencil) and the United States/Argentina (online), and that the mode of data collection could give rise to the patterns of results we found in Study 1.

Study 2: Cross-Cultural Differences in Adulthood

Study 1 showed a clear cultural difference in global processing, but involved a relatively small sample size that was restricted to college-age participants. In keeping with a life span developmental perspective (Bialystok & Craik, 2006), in Study 2, we investigated the development of perceptual tendencies across adulthood in Japan and the United States. In addition, in Study 2, the mode of the data collection was the same in Japan and the United States.

Method

Participants were 952 Japanese ($M_{age} = 45.17$ years, $SD = 13.64$; range = 20 to 69 years; 481 males; 471 females) and 891 American ($M_{age} = 43.71$ years, $SD = 14.01$; range = 20 to 69 years; 438 males, 453 females) adults. The samples were gathered by Nikkei Research Inc. and its U.S. affiliate using a national probabilistic sampling method based on gender and age; hence the samples were both nationally representative in terms of gender and age. (See Figure 3 for information about the number of participants in each decade in each country.) The data were collected in November and December of 2012. The task was identical to the one used in Study 1; here all participants went to a designated website, and completed the online survey in their respective languages.

Results and Discussion

Replicating Study 1, American participants were again more global in processing than were Japanese, $M_{USA} = 6.35$, $SD = 2.47$ versus $M_{Japan} = 5.61$, $SD = 2.31$, $t(1841) = 6.71$, $p < .001$, $d = .31$. To examine possible age and gender variations in global processing, we next conducted a multiple regression analysis, regressing global processing on nation (United States = +1; Japan = -1), gender (male = +1; female = -1), age in years (z scored), a two-way interaction between nation and gender, a two-way interaction between nation and age, a two-way interaction between gender and age, and a three-way interaction among nation, gender, and age. This model explained 6.3% of the variance (see Table 1 for the full results).

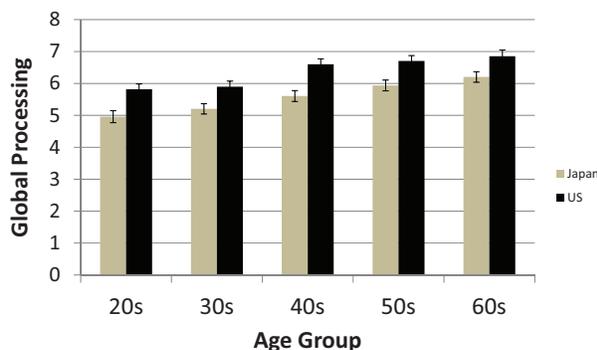


Figure 3. The mean global processing score by age and nation: Study 2. 0 = 100% local processing; 4 = 50/50; 8 = 100% global processing. $N = 157$ Japanese, 193 Americans in their 20s. $N = 210$ Japanese, 179 Americans in their 30s. $N = 191$ Japanese, 191 Americans in their 40s. $N = 193$ Japanese, 185 Americans in their 50s. $N = 201$ Japanese, 143 Americans in the 60s. Error bars show standard error of the mean. See the online article for the color version of this figure.

As shown in Figure 3, age was positively associated with global processing in both countries. Consistent with previous research that has used a narrower age range (e.g., Scherf et al., 2009), as participants got older, they gave more global responses. Men gave more global responses than women, and this gender difference was larger among Americans than among Japanese, as revealed by a significant positive two-way interaction between nation and gender. However, the effect sizes of these findings were small ($\beta = .05$, $d = .10$ to $.11$). Americans were still more global in processing than Japanese, even controlling for age, gender, and all the possible interaction terms, $t(1831) = 7.30$, $p < .001$, $d = .34$.

As in Study 1, we checked the distribution of global choices for Japanese and Americans, separately. Among Americans, 513 out of 891 participants (57.58%) chose the global match on all eight trials, 49 (5.5%) never chose the global match, and only 187 (20.99%) chose the global match four times or less. Among Japanese, 309 out of 952 (32.5%) chose the global match eight times, whereas 25 (2.6%) never chose the global, and 310 of them (32.6%) chose the global match four times or less.

Finally, to check whether results with this new representative sample would align with those of the college samples in Study 1, we analyzed data from the subgroups of participants age 23 years or younger. Consistent with Study 1, American young adults were more global in processing than Japanese, $M_{USA} = 5.83$, $SD = 2.59$, versus $M_{Japan} = 4.49$, $SD = 2.29$, $t(95) = 2.68$, $p = .009$, $d = .55$. American means in Studies 1 and 2 were almost identical, whereas Japanese college students in Study 1 were more local processors than young adults in Study 2. This is most likely to be due to sampling variation: Whereas Japanese participants in Study 1 were students at an elite private university in the Kansai area, those in Study 2 were from a nationally representative sample.

In sum, Study 2 replicated the main finding from Study 1 using a more representative sample: College-aged U.S. participants are more global in their processing than their Japanese counterparts. Second, these cultural differences also held when considering the much larger samples, ranging from 20 to 69 years of age. Third, in both samples global processing increased somewhat across adult-

hood to age 69. Finally, men were slightly more global in their processing than women, particularly in the United States.

Study 3: Cross-Cultural Differences in Early Childhood

An outstanding question is when the observed differences in global-local processing are evident. Kuwabara and Smith (2012) found cultural differences between Japanese and American children's responses to relational matching and visual search tasks by age 4 years, whereas Duffy et al. (2009) did not find cultural differences between Japanese and American children's performance on the Framed Line Test until aged 6 or 7 years. These findings suggest that 4 to 6 years of age may represent a window in which cultural differences in perceptual processing might emerge.

Method

Participants. Participants were 133 children aged 3 to 6 years: 74 Americans (41 boys, 33 girls) and 59 Japanese (27 boys, 32 girls). There were 2, 21, 31, 20, respectively, 3-, 4-, 5-, and 6-year-old American participants; and 1, 17, 12, 29, respectively, 3-, 4-, 5-, and 6-year-old Japanese participants. The mean age was 4.93 ($SD = .816$) for Americans, and 5.17 ($SD = .913$) for Japanese. American children were recruited from a database of children whose families were willing to bring them to a mid-Atlantic university laboratory for research. They were primarily White and of middle- to upper-middle class backgrounds. Japanese participants were recruited in kindergartens in Shinjuku-ward, Tokyo and Sakyou-ward, Kyoto.

Materials and procedures. The study was conducted in English in a university laboratory in the United States and in Japanese in participants' kindergarten in Japan. In order to ensure children understood the task, children first completed a series of warm-up trials, which were similar in structure to the test trials, but did not involve a choice between a global and a local match. The target consisted of a global shape made up of local elements (e.g., a triangle composed of three smaller triangles), and the options were an identical stimulus (e.g., a triangle made up of three smaller triangles) or stimulus that differed on both global and local dimensions (e.g., a square made up of four small squares). The experimenter presented the target and two choices, and said, "See this one [pointing to target], and these two [pointing to the two op-

Table 1
A Multiple Regression Analysis in Study 2

Predictors	b (SE)	β	t	p
Constant	5.98 (.055)		109.19	<.001
Nation	.40 (.055)	.165	7.30	<.001
Age	.45 (.055)	.184	8.13	<.001
Gender	-.13 (.055)	-.05	-2.30	.022
Nation \times Age	-.03 (.055)	-.01	-.505	.613
Nation \times Gender	.11 (.055)	.05	2.06	.040
Age \times Gender	.05 (.055)	.02	.84	.401
Nation \times Age \times Gender	-.04 (.055)	-.02	-.71	.477

Note. Nation (United States = +1; Japan = -1). Age in months (z scored). Gender (male = +1; female = -1).

tions]. Which of these two [pointing to the two options] is more like (in Japanese ‘似ている’) this one [pointing to the target]?”

These warm-up trials were designed to give children practice responding to the test prompt without directing them to attend solely to global or local features (because one option matched on both global and local features and the other did not match on either). Children were given positive feedback if they responded correctly by selecting the identical match (“OK! Let’s see what’s next”) and were corrected if they responded incorrectly (“No, this one [pointing to the match] is more like this [pointing to the target], isn’t it? Let’s try another one.”). Warm-up trials continued for up to six trials, until children responded correctly to three trials in a row, or three of the previous four trials. Over 90% of the Japanese and American children met this criterion in the first three trials, with the remainder meeting criterion within the first four (except one American child who required six warm-up trials).

Following this warm-up, children saw the same eight Kimchi items used in Studies 1 and 2. They were presented one at a time, with the target printed above the global and local matches (as in Figure 1). Across the eight trials, the global match appeared on the left on four trials and on the right on the other four. The same fixed order of presentation was used for each child. For each display, the experimenter used the same wording as in the warm-up trials, asking which option was “more like” the target. Neutral feedback in a positive tone (e.g., “OK!”) was offered on all trials. Given that the same stimuli were used, the global score in this study is directly comparable to that obtained in Studies 1 and 2.

Results and Discussion

Like the adult participants in Studies 1 and 2, American children selected more global matches than Japanese children ($M_{USA} = 5.43, SD = 2.79$ vs. $M_{Japan} = 3.61, SD = 3.68$), $t(105.76) = 3.15, p = .002, d = .61$. Figure 4 shows the mean global processing score for each age group for each nation. Because only one Japanese and two Americans were 3 years old, they are not shown in the figure or analyzed separately. However, these 3-year-olds

were included in a regression analysis reported below. As the figure shows, cultural differences were already evident at 4 years of age, $t(36) = 2.00, p = .053, d = .67$.

Next we conducted a regression to allow a more sensitive index of age (in months). We also controlled for children’s gender, and included all the interaction terms of the key predictors. Specifically, in a multiple regression analysis, global processing score was predicted from nation (United States = 1, Japan = -1), gender (boy = 1; girl = -1), age in months (z scored), a two-way interaction term between nation and age in months, a two-way interaction term between nation and gender, a two-way interaction term between age and gender, and a three-way interaction term among nation, age, and gender. The results of the full regression model are shown in Table 2. This model explained 15.8% of variance, $F(7, 125) = 3.34, p = .003$. Controlling for age, gender, and all the interaction terms, American children were more global processors than Japanese, $t(125) = 3.62, p < .001, d = .64$. Again, consistent with previous research (e.g., Scherf et al., 2009), even within our relatively narrow age range of 3- to 6-year-olds, the tendency to process in a global manner increased with age, $t(125) = 2.06, p = .042, d = .37$. There was also an interaction between gender and age, $t(125) = -2.06, p = .042, d = .37$, such that age differences were larger among girls than among boys (among girls $r = .32, p = .01$; among boys $r = -.08, p = .68$). However, unlike with the adult sample in Study 2, there was no overall gender difference at these ages.

As in Studies 1 and 2, we checked the distribution of the global choices. Among American children, 29 of the 74 (39.2%) chose the global match on eight of the eight trials, seven of the 74 (9.5%) never chose the global match, and 25 of 74 (33.8%) chose the global match four times or less. In contrast, among Japanese children, 19 of the 59 (32.2%) chose the global match on each of the eight trials, 24 of the 59 (40.7%) never did so, and 33 of 59 (55.9%) chose the global match four times or less.

It is conceivable that saying “OK!” to these children after the trial might signal to children that “you were right.” If this were the case, children should have picked the same response from the first trial consistently. There was no evidence of this among American children, as 48.7% of children answered consistently with a global response (39.2%) or a local response (9.5%). In Study 1, without any feedback, 51.5% of Americans chose consistently global (44.6%) or consistently local (6.5%) responses. In Study 2, 63.1% of Americans consistently choose global (57.6%) or local (5.5%) responses without any feedback. Thus, giving the feedback after each trial did not seem to make American children’s responses more consistent than when there was no feedback. In contrast, however, there is some evidence that this feedback made Japanese children’s responses more consistent. Japanese children were indeed far more consistent (72.9%) than Japanese adults in Studies 1 (3.4%) and 2 (35.1%). However, the effect of feedback after each trial could not explain the United States–Japan difference we found. Specifically, to avoid the feedback issue, we compared the very first trial (before getting the “OK!” feedback), and still found that American children were far more global (46/74, or 62.12%) than Japanese (24/59, or 40.67%) at the first trial, $\chi^2(N = 139) = 6.08, p = .014$. Thus, although it is important to further explore the role of communication (e.g., “OK!”), the United States–Japan difference we found could not be explained by it.

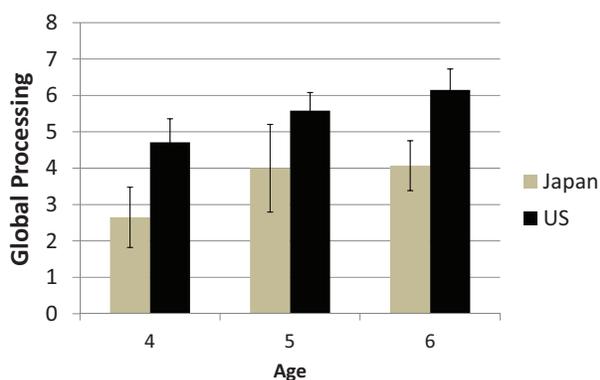


Figure 4. The mean global processing score by age and nation: Study 3. 0 = 100% local processing; 4 = 50/50; 8 = 100% global processing. $N = 17$ Japanese, 21 Americans (4-year-old). $N = 12$ Japanese, 31 Americans (5-year-old). $N = 29$ Japanese, 20 Americans (6-year-old). Error bars show standard error of the mean. See the online article for the color version of this figure.

Table 2
A Multiple Regression Analysis in Study 3

Predictors	<i>b</i> (<i>SE</i>)	β	<i>t</i>	<i>p</i>
Constant	4.42 (.282)		15.67	<.001
Nation	1.02 (.282)	.306	3.62	<.001
Age in Month	.59 (.286)	.177	2.06	.042
Gender	-.16 (.282)	-.05	-.582	.562
Nation \times Age	.16 (.286)	.05	.562	.575
Nation \times Gender	.43 (.282)	.13	1.52	.131
Age \times Gender	-.59 (.286)	-.18	-2.06	.042
Nation \times Age \times Gender	.067 (.286)	.02	.23	.816

Note. Nation (United States = +1; Japan = -1). Age in months (z scored). Gender (boy = +1; girl = -1).

In sum, replicating Studies 1 and 2, we found cultural differences in global processing even before elementary school. Indeed at age 4 years, American children were already more global in processing than were Japanese children.

General Discussion

In three studies, we investigated cultural variations in global versus local processing. Most cross-cultural research on perception has used two-group comparisons—comparing Japanese participants to Americans (e.g., Imada et al., 2013; Masuda & Nisbett, 2001; Miyamoto et al., 2006). The two group comparison makes it difficult to determine the factors that account for cultural differences, as the United States and Japan are different not only in intellectual tradition (e.g., Confucianism) but also in other cultural dimensions such as individualism-collectivism. In Study 1, we used the triangulation method (Norenzayan & Heine, 2005), which helps isolate what could be driving this cultural difference. Argentina is similar to Japan on the individualism-collectivism dimension (and different from the United States), and Argentina is similar to the United States in intellectual tradition (and different from Japan). We found that American and Argentine college students showed a greater global focus than Japanese participants. This pattern of results suggests that differences in intellectual tradition rather than in individualism-collectivism may be a driving force in the differences between Japanese and Americans in global-local visual processing.

Because Study 1 relied on convenience samples of college students, in Study 2, we explored whether cultural variations in global versus local processing would emerge in a nationally representative adult sample of Japanese and Americans. Replicating Study 1, we found that Japanese adults were less globally oriented than American adults, and that adults in both cultures became more globally focused with age.

Because we found cultural differences throughout adulthood, in Study 3, we explored the developmental timing of cultural variations by testing 3- to 6-year-old Japanese and American children. Even among the youngest children studied, the Japanese were already more locally focused than the Americans. In sum, from age 3 to 69 years, our studies consistently showed that Americans are more global in processing than Japanese.

Relation to Previous Research

Our studies address a number of important questions raised by previous research. First, previous research has suggested that East

Asians tend to process information holistically (Nisbett et al., 2001), which could suggest that they should be global processors. Indeed, one study showed that East Asians were more global in their processing than Australians (McKone et al., 2010), and another did not find any difference between Japanese and British college students (Caparos et al., 2012). In contrast, in all three studies reported here, we found that Japanese were less globally oriented processors than Americans.

There are several possible factors that could have led to the different findings. First is sample size: All three of our studies used large samples, and Study 2 in particular used an extremely large and nationally representative sample of Americans ($N = 891$) and Japanese ($N = 952$). In contrast, the two earlier studies used relatively small samples (63 Kyoto students in Caparos et al., 2012; 25 East Asian immigrants to Australia for McKone et al., 2010). Another difference has to do with the representativeness of the samples: Caparos et al. (2012) used Kyoto University students, who are roughly equivalent to Harvard or Yale students, and likely to be intellectual outliers compared to the Japanese participants in the studies reported here. McKone et al. (2010) used East Asian (but not Japanese) immigrants to Australia, and so they too are likely to be very different from the Japanese participants in the studies reported here. A final difference has to do with the tasks used in the various studies: The Kimchi and Palmer (1982) task used here is very different from other tasks used in most of culture and perception research (e.g., triad task, Framed Line Test). Future work will need to involve the collection of more data from diverse samples using diverse tasks, ideally leading to a meta-analysis to provide a better population estimate.

A second important question in the literature that our work addresses concerns the age at which cultural variation in perception becomes evident. Duffy et al. (2009) found that differences between American and Japanese children's performance on the Framed Line Test did not emerge until age 6 years, whereas we documented a difference on the global-local task at 4 years (see also Imada et al., 2013; Kuwabara et al., 2011; Kuwabara & Smith, 2012). One possible explanation for these differing results is that the Framed Line Test requires participants to remember the original line and then reproduce it. That is, Duffy et al.'s task has both perceptual and memory components; our task (and that used by others who found a cultural difference as young as four years) does not have a memory component. As more developmental cross-cultural studies are conducted using a variety of tasks, it is critical to identify task-specific variations so as to discern different developmental trajectories for different cognitive and perceptual processes.

Mechanisms: Where Are the Cultural Differences Coming From?

The observed differences among Japanese, Americans, and Argentines could be due to multiple factors, ranging from genes to family environments to neighborhood environments to macro environments and interactions among all (Bronfenbrenner, 1977; Li, 2003; Oishi & Graham, 2010).

One possible explanation for the cultural differences we observed involves parenting styles and educational practices. From early infancy on, parent-child interactions are different between the United States and Japan. For instance, American parents speak

to infants more often, ask questions more often, and label target objects more often than Japanese parents (Bornstein et al., 1992; Caudill & Schooler, 1973; Fernald & Morikawa, 1993). American parents are more likely to draw infants' attention to the outside world (extradyadic loci of interactions), provide more information about the outside world, and encourage verbalization of their own feelings, whereas Japanese parents are likely to draw infants' attention to the world within a dyad, and tend to emphasize psychological bonding and interdependence (Bornstein, 1989; Dennis, Cole, Zahn-Waxler, & Mizuta, 2002; Doi, 1973; Zahn-Waxler, Friedman, Cole, Mizuta, & Hiruma, 1996; see also Caudill & Plath, 1966 for more cosleeping in Japan). American parents read more books to children than do Japanese parents (Azuma et al., 1981; Kato-Otani, 2004; see Bornstein, 1989 for review). Because American infants receive more pieces of information, on average, than Japanese infants, American infants might learn more quickly than Japanese to focus on the gist information rather than the details. Thus, it is possible that cultural differences in early parenting styles give rise to cultural variations in global versus local processing.

In addition, other aspects of early socialization in Japan also might contribute to increased attention to detail. Lewis (1995) points out how elaboration is valued in Japan, and how children are urged to reflect on the details of their activities. For example, after doing chores, children sit in a circle and reflect carefully on how well they did those chores, a practice referred to as "hansei." When Japanese preschool teachers describe a classroom incident to children, they present in great detail how each child felt and responded (nurturing "omoiyari," or empathy, see also Lebra, 1976). American teachers, even in preschool, seem more likely to stay with the "big picture," and less likely to ask children to consider detail.

In elementary school, educational practices in Japan emphasize reading the same text repeatedly with attention to detail while those in the United States focus on gist-understanding. For example, when the first author's son was a second grader in a public school in Kobe, Japan, his Japanese textbook included a Japanese translation of Arnold Lobel's (1970) *Frog and Toad are Friends* (The story entitled "The Letter"). This is a very short story indeed, only 12 pages (Miki, 2012). Yet for a few weeks, he and his Japanese classmates read and reread it, role-played Frog and Toad, were asked to imagine how Toad was feeling, how Frog was feeling, why Toad did this, Frog did that and so forth. The amount of attention paid to details in the Japanese classes is very different from the American method of extensive reading (Saito, 2002). In many American elementary schools, students spend just a few days on an entire book, then move on to another book, then another one (Hess & Azuma, 1991). Stevenson and Stigler (1992) also observed that "few American teachers expect to cover all aspects of every chapter in the textbook . . . This is not the case in Chinese and Japanese classrooms. Textbooks that contain short lessons, a limited number of practice problems, and practically no ancillary material make it possible for the class to cover every detail contained in every textbook. Through notes taken in class, class exercises, and homework, every child will have had to attend to every word, every problem, and every exercise included in every textbook used during elementary school" (p. 141). Pedagogical techniques in elementary school, then, may continue to foster Japanese children's attention to detail and American children's attention to gist.

There is further evidence that educational practices may be in line with this suggestion, at least at the secondary level. According to the 2009 Programme for International Student Assessment of the Organisation for Economic Co-operation and Development (OECD) survey data, Japanese secondary education does indeed emphasize memorization of a small number of materials (i.e., local, detailed processing) rather than global, gist processing, whereas American and Argentine secondary education emphasizes gist processing with a wider variety of reading materials used in instruction (see Supplementary Materials for our analyses of these data). Cultural variations in educational and parenting practices, beginning even in infancy, could help maintain differential emphasis on global versus local processing between Americans and Japanese. Future research should explicitly test how parenting and educational practices might contribute to global versus local processing.

Genetic differences between Japanese and Americans may also play a role. For instance, fewer than 20% of Japanese typically are the carriers of the L allele of the serotonin transporter gene (5HTTLPR), whereas over 55% of Americans typically are the carriers of the L allele (Chiao & Blizinsky, 2010). Individuals with the L allele of 5HTTLPR are on average happier than those with the S allele (De Neve, 2011; see, however, De Neve, Christakis, Fowler, & Frey, 2012, for mixed findings). Considering that Japanese are less likely to have the L allele than Americans, and that happy moods are associated with a global orientation (Gasper & Clore, 2002), our findings *could* be explained by genetic variations in 5HTTLPR or other genes associated with moods. This possibility is, of course, highly speculative: We are not aware of any studies that have demonstrated a direct link between particular genes and global processing, but it will be important to explore this possibility to discern cultural effects from genetic effects in the future.

Why Different Perceptions in Different Places and Times?

The current findings have several important implications for research on the developmental psychology of culture and perception. First, as shown by previous research (Imada et al., 2013; Kuwabara et al., 2011; Kuwabara & Smith, 2012), children seem to have learned culturally dominant patterns of perception by at least the age of 4 years. We offered some speculation above about how Japanese and American children might develop such different perceptual styles, and here we turn to speculation about why Japanese seem to encourage locally oriented processing, whereas Americans seem to encourage globally oriented processing.

One possibility is cultural adaptation (Boyd & Richerson, 1985). Humans' greatest strength is that we can learn from others without actually trying something ourselves first. Boyd and Richerson documented many examples of the evolution of culture via conformist imitation and modeling (see also Tomasello, Kruger, & Ratner, 1993). Their basic idea is that people recognize individuals or groups who have successfully adapted to a given environment, and then they imitate the successful individuals and groups; this means the behaviors and traits characteristic of the successful people spread widely within a given environment. In Japan, it is possible that early successful individuals were those who were careful and meticulous, that these detail-oriented traits have be-

come cultural ideals over time, and that parenting styles and educational practices are geared toward the development of these traits (Azuma, Kashiwagi & Hess, 1981; Imada, 2012; Kashiwagi & Azuma, 1977).

Indeed, Azuma et al. (1981) found that Japanese 5-year-olds showed more careful and meticulous behavior than American children in the Matching Familiar Figures Test. Children were presented with several pages of line drawings of familiar figures (e.g., kite, cat) on one page (the standard), while a facing page showed an array of five similar drawings, only one of which was exactly like the standard. The task was to select the figure that exactly corresponded to the model. Performance was measured by how long it took children to respond and by their accuracy. American children took 57.5 s to respond to the set of drawings and made 11.4 errors. Japanese children took more time (76.5 s), and also made fewer errors (9.9 s; see Salkind, Kojima, & Zelner, 1978; Smith & Caplan, 1988 for similar results with older children). In the United States, perhaps early successful individuals were those who were adventurous with a big picture, such that these global-oriented traits have become cultural ideals over time, and parenting styles and educational practices became geared toward the achievement of these traits.

A related idea is “evoked culture” (Tooby & Cosmides, 1992). In this conceptualization, humans develop a certain trait because a certain environment evokes (requires) it. Historically, in Japanese physical and social environments, perhaps people had to pay closer attention to others’ opinions and reactions. For example, rice farming requires precise coordination with other villagers, because cultivation of this crop requires the timing of planting, irrigation, and harvest coordinated with other villagers as well as close attention to detail (e.g., water level on the field, inspection of insects, Nisbett, 2003; Talhelm et al., 2014). Thus, the traits such as other-orientation and detail-orientation are evoked in Japanese ecology. In the United States, by contrast, to survive people had to be ready to move, as there were many uncultivated frontiers with potentially better opportunities (Kitayama, Ishii, Imada, Take-mura, & Ramaswamy, 2006; Oishi, 2010). The U.S. ecology evoked adventure and optimism, and as a result, global processing has become a prized goal for socialization.

It should be noted, however, that one’s perceptual style is not fixed. Gasper and Clore (2002) showed, for instance, that happy moods tend to put people in a global-orientation, presumably because happy moods signal that the world is benign, whereas sad moods tend to put people in a local-orientation, presumably because sad moods signal that something is amiss. Indeed, different moods may be advantageous for different tasks (Schnall, Jaswal, & Rowe, 2008). To be adaptive, humans’ perceptual styles must be flexible (Gibson, 1979). All this is to say that although there are cultural variations in baseline perceptual style (e.g., Medin & Atran, 2004; Nisbett et al., 2001), there are also situation-specific variations. Our findings do not mean that Japanese cannot be global processors, or Americans cannot be local processors. It will be important to examine “if . . . then . . .” patterns of perceptions across cultures and developmental periods in the future.

A second notable finding from our research is that Study 2 revealed that both in Japan and the United States, older adults are more likely to be global processors than younger adults. As suggested by Scherf et al. (2009), it might be that as people age, they learn to pay attention to the most reliable cue of object recognition,

that is, overall object shape. In addition, thinking in terms of adaptation, with age responsibilities tend to shift from first-hand, detail-oriented tasks (e.g., data entry, spell check) to big-picture tasks, and thus the perceptual style suitable for the dominant tasks at hand might shift over time. Carstensen, Isaacowitz, and Charles’s (1999) socioemotional selectivity theory suggests that as people age, they tend to come to clearer understanding of what is important and what is not. As a result, they focus on a few important figures and pay less attention to less important ones in life. Socioemotional selectivity could manifest itself as global orientation.

Understanding global versus local processing is important for several reasons. First, different tasks require different types of attention. Task performance is likely to be predicted by the match between the characteristics of the task and an individual’s attention. In order to process lots of information quickly, for instance, one must be able to focus on the gist without being derailed by peripheral pieces of information. To this end, executives of large organizations must be able to process a vast amount of information quickly and discern what is important and what is not to make a quick decision. In contrast, in order to make a perfect product, a perfect sentence, a perfect swing, or perfect anything, one must be able to attend to details. Related to the first point, then, global versus local processing might be related to career success. In an occupation that requires attention to details (e.g., accounting, inspection), persons with the local processing might be more likely to succeed than those with the global processing. In contrast, in an occupation that requires attention to the gist (e.g., CEO), individuals with the global processing might be more likely to succeed. Third, global and local processing might be related to aesthetic preferences. For instance, global processors might enjoy abstract arts (e.g., Jackson Pollack’s drip painting) more than local processors, whereas local processors might appreciate arts with minute details (e.g., Tibetan Buddhists’ sand mandala). Extending the aesthetic preference to larger artifacts such as buildings and landscapes, global processing could give rise to a large scale monument and garden (e.g., the grand palace and garden of Versailles occupy over 2,600 acres), whereas local processing might give rise to smaller scale buildings and gardens (e.g., Ryuanji’s famous Zen garden in Kyoto is about a quarter of an acre).

Several limitations of the current work should be noted. First, although Study 1 used a triangulation method (Norenzayan & Heine, 2005), which is superior to a two-group comparison, the findings from a single triangulation method are vulnerable to the same sampling issues as the two-group comparison. Specifically, if our Argentine sample was an outlier (toward global-orientation), then the pattern of results cannot easily provide support for the intellectual tradition explanation over the individualism-collectivism explanation. Second, we used the two-group comparison in Studies 2 and 3. Thus, the Japan–United States differences in global versus local orientation in Studies 2 and 3 could be driven by multiple factors, not just intellectual tradition and parenting. Third, we relied on a single task, the Kimchi–Palmer (Kimchi & Palmer, 1982) task. Thus, our findings could be specific to this task. Finally, our studies were cross-sectional. It is critical to conduct a cross-cultural longitudinal study using multiple tasks in the future.

Conclusion

Our studies showed that cultural variations in global versus local processing are evident in early childhood, and remain throughout adulthood. At the same time, we found that both Japanese and Americans become more global in their processing across adulthood. Our perceptions are likely to have evolved to be adapted to our local environments (Gibson, 1979). It is important to explore developmental trajectories of perceptions across diverse cultures and ecological conditions, and identify functional links between ecology and perceptions in the future.

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