Research Article

Culture and the Physical Environment

Holistic Versus Analytic Perceptual Affordances

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ABSTRACT—*Westerners' perceptions tend to focus on salient foreground objects, whereas Asians are more inclined to focus on contexts. We hypothesized that such culturally specific patterns of attention may be afforded by the perceptual environment of each culture. In order to test this hypothesis, we randomly sampled pictures of scenes from small, medium, and large cities in Japan and the United States. Using both subjective and objective measures, Study 1 demonstrated that Japanese scenes were more ambiguous and contained more elements than American scenes. Japanese scenes thus may encourage perception of the context more than American scenes. In Study 2, pictures of locations in cities were presented as primes, and participants' subsequent patterns of attention were measured. Both Japanese and American participants primed with Japanese scenes attended more to contextual information than did those primed with American scenes. These results provide evidence that culturally characteristic environments may afford distinctive patterns of perception.*

Cultural differences in cognition have been widely documented across various domains (Fiske, Kitayama, Markus, & Nisbett, 1998; Markus & Kitayama, 1991; Nisbett, 2003; Nisbett, Peng, Choi, & Norenzayan, 2001). Whereas people of Western culture tend to engage in context-independent cognitive processes and to perceive and think about the environment in an analytic way, people of East Asian culture tend to engage in context-dependent cognitive processes and to perceive and think about the environment in a holistic way.

In an illustrative study, both Japanese and Americans were shown a short video clip depicting an underwater scene with fish, small animals, plants, and rocks, and were asked to report what they saw in the clip (Masuda & Nisbett, 2001). Americans referred mainly to features of focal fish (large, foregrounded, rapidly moving, brightly colored), whereas Japanese referred more to context and to relationships between focal objects and context (background objects and location of objects in relation to one another). Such cultural differences in attention were also found in other tasks stripped of sociocultural context (Ji, Peng, & Nisbett, 2000; Kitayama, Duffy, Kawamura, & Larsen, 2003). For example, Kitayama et al. (2003) presented participants with a square frame in which a line was drawn. Participants were then shown other square frames of various sizes and asked to draw a line that was identical to the first line in either absolute length or ratio to the surrounding frame. Kitayama et al. found that whereas Americans were more accurate in the absolute task, Japanese were more accurate in the relative task. These findings suggest that the Japanese were paying more attention to the frame (context) than the Americans were.

Although evidence about attentional phenomena is accumulating, a mechanism underlying cultural differences has not been fully explored. In most of the previous cross-cultural studies, cultural differences have been treated mainly as individual differences, which are assumed to be due to socialization (Nisbett et al., 2001). Parents or other individuals may guide children's attention in accordance with their own pattern of attention (e.g., Fernald & Morikawa, 1993). In addition, Asians' relatively greater interdependence or concern with the social world may prompt their greater attention to context (Nisbett, 2003). However, in addition to such chronic effects, culture may influence patterns of attention through a more temporary and situational route. For example, using self-construal priming (Gardner, Gabriel, & Lee, 1999), Kühnen and Oyserman (2002) demonstrated that participants who were primed with interdependent self-construals spontaneously encoded contextual information more than did those who were primed with independent self-construals.

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We examined the possibility that cultural differences in attentional pattern might be directly afforded by cultural differences in the physical environment. On the one hand, if objects are more distinctive and stand out from the background more in the American environment than in the Japanese environment, living in the American environment may direct one's attention to distinctive and focal objects rather than to backgrounds. On the other hand, if objects are more ambiguous and difficult to distinguish from the background in the Japanese environment than in the American environment, living in the Japanese environment may direct one's attention to the whole field rather than to specific objects.

There is some evidence supporting this speculation. Previous research has shown that people are sometimes blind to changes occurring in the environment (Simons & Levin, 1997), especially changes in the periphery or context (Rensink, O'Regan, & Clark, 1997). Employing this change-blindness paradigm, we (Masuda & Nisbett, in press) presented both Americans and Japanese with several pairs of animated clips of scenery (e.g., a farm) that differed in various small details. Some of the changes involved the attributes of the focal objects, that is, foreground, rapidly moving objects, and the other changes were made in the field, or context (i.e., changes in the attributes of nonforegrounded objects and their movements in relation to one another). In general, Americans detected more changes in the focal objects than Japanese did, whereas Japanese detected more changes in the field or relationships between objects than Americans did. These results supported the previous findings on cultural differences in attentional pattern (Masuda & Nisbett, 2001). However, these cultural differences depended on the type of scenery. There were three types of scenery: Japanese scenery (e.g., a Japanese farm or a Japanese city), American scenery (e.g., an American farm or an American city), and culturally neutral scenery (e.g., a construction site or an airport). Both Japanese and Americans detected more changes in the background when viewing the Japanese scenery than when viewing the American scenery, whereas both detected more changes in the attributes of focal objects when viewing the American scenery than when viewing the Japanese scenery. These findings imply that the perceptual environment prompts culturally specific patterns of attention.

Although these findings are suggestive, their implications are limited because the scenes were artificially created and thus may not have accurately represented the perceptual environments of Japan and the United States. One aim of the present study was to compare the perceptual environments of Japan and the United States to determine whether Japanese environments are indeed more complex. The second aim was to examine the effect of exposure to those environments. We hypothesized that culturally specific patterns of attention are afforded by the perceptual environment of each culture. In Study 1, we examined cultural differences in the perceptual environment. In Study 2, we directly tested whether such cultural differences in the perceptual environment actually lead to different patterns of attention. Specifically, we hypothesized that being exposed to the Japanese perceptual environment makes people attend more to contextual information than does being exposed to the American perceptual environment.

SAMPLING SCENERY

In order to sample equivalent perceptual environments across the two cultures, we randomly sampled three types of institutions (hotels, public elementary schools, and post offices) that constitute everyday scenery in both Japan and the United States. Each type of institution was sampled in small, medium, and large cities in both countries. We took digital pictures at each selected location.

Cities

Cities equivalent in population and land area were chosen from Japan and the United States. As shown in Table 1, the population and the land area were about the same for the two cities of each size.

The large cities were New York (i.e., Bronx, Manhattan, Brooklyn, and Queens) and Tokyo (i.e., 23 districts). The medium cities were Ann Arbor, MI, and Hikone (Shiga Prefecture), which are official "sister cities" with similar demographic properties. Each has a large university and is located in the middle of the nation near a large lake. The small cities were

TABLE 1

The Population, Land Area, and Number of Elementary Schools, Post Offices, and Hotels in Each City

City	Population	Land area (km^2)	Elementary schools	Post offices	Hotels
Large cities					
New York	8,008,278	784.77	739	225	78 (152)
Tokyo	8,134,688	621.45	922	1,077	69 (89)
Medium cities					
Ann Arbor	114,024	71.47	21	4	53
Hikone	107,860	98.15	17	20	76
Small cities					
Chelsea	4,398	8.70	3	1	5
Torahime	5,854	9.45	1	1	4

Note. Population and land-area statistics are based on 2000 censuses (Japanese Statistics Bureau Management and Coordination Agency, 2000; U.S. Census Bureau, 2000). The numbers of elementary schools and post offices in New York City include only those located in the Bronx, Manhattan, Brooklyn, and Queens. We used *Frommer's* on-line guidebook (http://www.frommers.com) to obtain a list of hotels in the center of the large cities (Manhattan in New York City and the central 6 districts in Tokyo). The number of hotels in the periphery of New York City (i.e., the Bronx, Brooklyn, and Queens) is based on information obtained from Reference USA (retrieved July 4, 2002, from http://www.referenceusa.com) and is shown in parentheses. The number of hotels in the periphery of Tokyo (i.e., the peripheral 17 districts of Tokyo) is based on information obtained from Internet Townpage (retrieved May 22 to July 14, 2002, from http://itp.ne.jp) and is shown in parentheses.

Chelsea, MI, and Torahime (Shiga Prefecture), whose economies are based primarily on farming. These two cities are located near Ann Arbor and Hikone, respectively.

Locations

As shown in Table 1, the number of public elementary schools is basically equivalent between matched cities, whereas there are about four times more post offices in Japanese cities than in American cities. For both medium and small cities, the number of hotels was about the same across the two cultures. As for megalopolises, it was impossible to obtain complete lists of hotels and compare them across the cultures. Therefore, we used *Frommer's* on-line Web site (http://www.frommers.com; date of search: July 4, 2002), and also consulted other on-line sources, to search for accommodations in New York City and Tokyo (see Table 1 footnote). In order to sample as diverse a group of hotels as possible, we took the rate for a night's stay into account and randomly selected an equal number of hotels from each price range.

We randomly selected 14 schools and 14 post offices from each large city (8 from the central city and 6 from the periphery), 4 schools and 4 post offices from each medium city, and 1 school and 1 post office from each small city. We randomly selected hotels from the pool of hotels at each price range. In total, we selected 14 hotels from each large city (8 from the central city and 6 from the periphery), 6 from each medium city, and 3 from each small city. Therefore, in total, there were 61 locations (42 for large cities, 14 for medium cities, and 5 for small cities) selected from each culture.

Pictures

The pictures were taken with a digital camera, Fine Pix 1400Z (FUJIFILM, Minami-Ashigara City, Japan). The camera was held at the eye level of the first author, who is about 160 cm tall. At each location, pictures were taken in front of the selected institution and one street behind the institution, in four directions at each of these two places. Thus, in total, there were 976 pictures (122 locations $\times$ 2 places $\times$ 4 directions).

At each place, two of the pictures were taken by looking across the street. One was taken facing the building and the other was taken facing outward from the building. When there was a sidewalk, the picture was taken from the curb of the sidewalk. If there was no sidewalk, the picture was taken from the edge of the street in order to capture as many sights as possible. Two more pictures were taken by standing parallel to the street (i.e., looking up and down the street). If there was no sidewalk, the photographer stood as close as possible to the center of the street and aimed at the vanishing point of the street. In the small and medium cities, if there was a sidewalk, the pictures were taken by standing at the curb of the sidewalk and aiming at the vanishing point of the roadway. However, because of the large amount of parking on the streets, the sights from the curb of the sidewalk were mostly blocked by cars in the large cities. Therefore, in the large cities, when there was a sidewalk, the pictures were taken by standing at the middle of the sidewalk and aiming at the vanishing point of the sidewalk, rather than the roadway. Examples of the pictures taken parallel to the street are shown in Figure 1.

STUDY 1A

Method

Participants

Thirty-five American undergraduates (20 females and 15 males) and 33 East Asian international students (20 females and 13 males) at the University of Michigan participated in the study to fulfill their requirement for a psychology course.

Subjective Measures

In total, four scales were employed. Participants were asked, "How ambiguous is the boundary of each object?" (1 = *distinct, clear boundary*; 5 = *ambiguous, unclear boundary*), "How many different objects do there seem to be?" (1 = *relatively few*, 5 = *enormous number*), "To what degree do there seem to be parts of the scene that are invisible?" (1 = *few invisible parts*, 5 = *many invisible parts*), and "To what degree is the scene either chaotic or organized?" (1 = *organized*, 5 = *chaotic*).

Procedure

Half of the pictures were randomly chosen from each location, and an additional 4 pictures were randomly chosen so that the pictures could be evenly divided into six groups (41 Japanese and 41 American scenes in each group). Each participant was randomly assigned to one of those six groups and rated each picture on the four scales just described. The pictures were presented in random order.

Results

Because the reliability coefficient for the four scales was fairly high (Chronbach's $\alpha = .79$), ratings on the four scales were averaged to compute a complexity-ambiguity composite score. Using the composite score as a dependent variable, we performed a 2 (ethnicity of participants: East Asians vs. Americans) $\times$ 2 (culture of pictures: Japan vs. the United States) $\times$ 3 (size of the city: small vs. medium vs. large) analysis of variance (ANOVA). The effect of culture was as predicted, $F(1, 132) = 63.18$, $p < .001$, $\eta_p^2 = .49$. Japanese scenes were judged to be more complex and ambiguous ($M = 2.85$) than American scenes ($M = 2.48$).

In addition, the main effect of the size of the city was significant, $F(2, 132) = 19.22$, $p < .001$. This effect was further qualified by an interaction with culture, $F(2, 132) = 7.77$, $p < .01$. Whereas New York was rated more complex and ambiguous than Ann Arbor and Chelsea (Ms = 2.71, 2.40, and

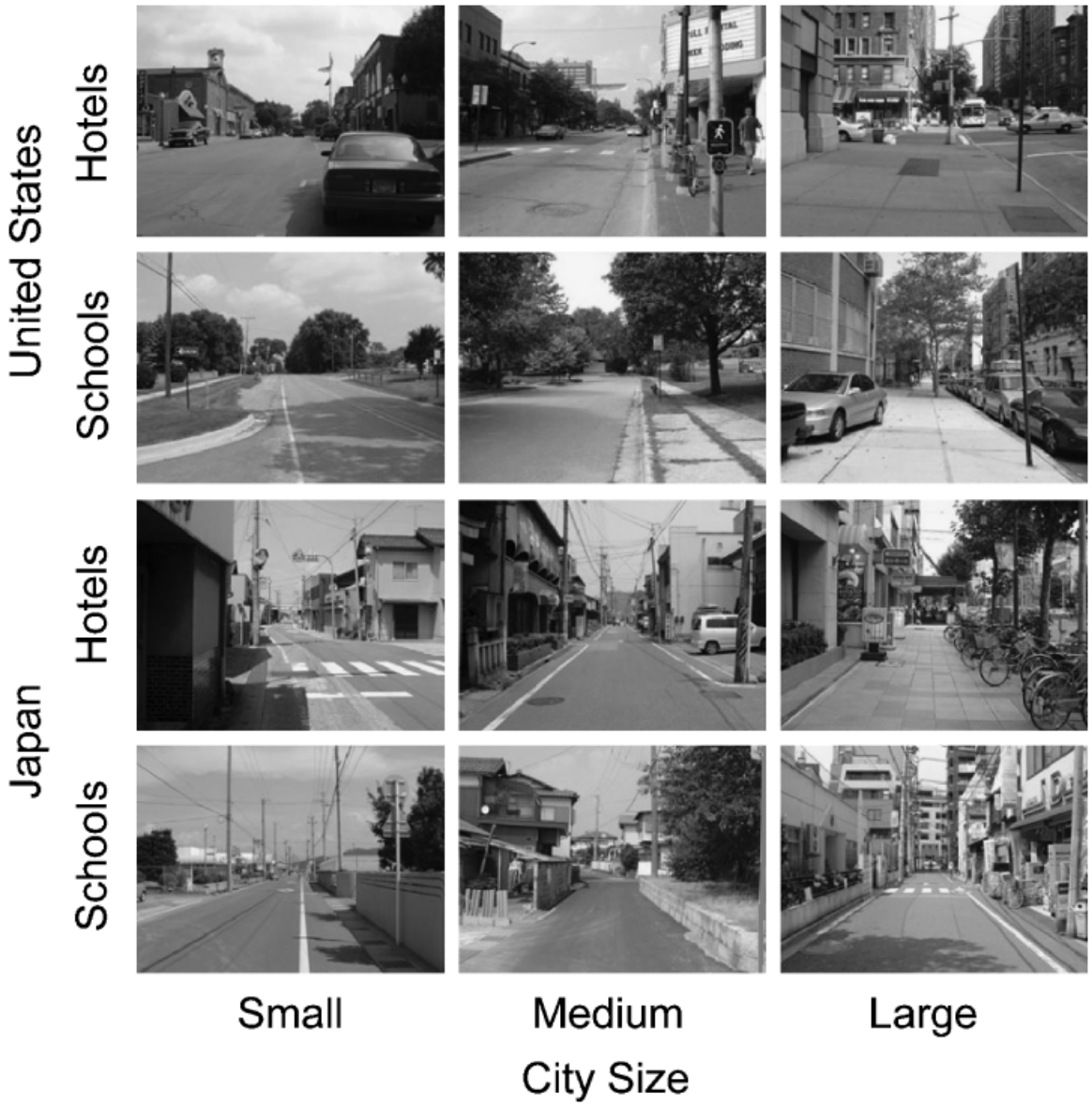

Fig. 1. Examples of the pictures of U.S. and Japanese schools and hotels used in Studies 1A, 1B, and 2.

2.34, respectively), scenes from the three Japanese cities were rated equally complex and ambiguous (*M*s = 2.90, 2.82, and 2.82 for Tokyo, Hikone, and Torahime, respectively). A post hoc contrast comparing large against medium and small cities was significant in the United States, $t(132) = 5.11$, $p < .001$, but not in Japan, $t(132) = 1.20$, n.s. This result may imply that cultural differences in the perceptual environment are larger in the smaller, more rural areas than in the megalopolises. Nevertheless, even the relatively complex and ambiguous New York scenes were still rated as less complex and ambiguous than the Tokyo scenes were, $t(132) = 3.64$, $p < .01$.

Finally, there was a significant main effect of ethnicity, $F(1, 66) = 11.55$, $p < .01$. Perhaps because of their familiarity with complex environments, East Asian participants rated the pictures to be less complex and ambiguous ($M = 2.52$) than American participants did ($M = 2.80$).

STUDY 1B

Method

Stimuli

In this study, all 976 scenes randomly sampled from the perceptual environment of Japan and the United States were analyzed by more objective means.

Objective Measures

As another test of the hypothesis that Japanese scenery has more objects than American scenery, we measured the number of

bounded particles in each picture. Analyses were performed on a Macintosh computer using the public-domain NIH Image program (U.S. National Institutes of Health, 1999).

The "analyze particles" command was used for this purpose. This command counts the number of objects in an image by scanning across the image and outlining the boundaries of objects (U.S. National Institutes of Health, 1999). Particles smaller than the minimum value are ignored. We set the minimum particle size at two levels (50 pixels and 100 pixels) for separate analyses in order to make sure that any effect obtained did not depend on the particular minimum size that we employed.

Procedure for Picture Processing

Before the analyses with NIH Image, the pictures were first processed using Adobe Photoshop in order to control for the number of leaves and to reduce the color to fit the NIH Image software. The number of leaves had to be controlled because they increase the number of objects in the scenery tremendously, even though they do not necessarily contribute to the perceived number of objects. Therefore, we substituted black color for all the green colors in the scenery. This meant that all green objects were turned black. Because there is no plausible reason to assume that there are cultural differences in the amount of green objects other than vegetation, this processing should not have lowered the internal validity. After this substitution, the color of each picture was reduced to black and white to meet the capacity of NIH Image.

Results

In order to test our hypothesis, we performed a 2 (culture: Japan vs. United States) × 3 (location: elementary school vs. post office vs. hotel) × 3 (size of city: small vs. medium vs. large) ANOVA both for the minimum particle size of 50 pixels and the minimum particle size of 100 pixels. In accordance with the results of Study 1A, the main effects of culture were significant for both measures, $F(1, 955) = 19.07$, $p < .0001$, $\eta_p^2 = .02$, and $F(1, 956) = 20.91$, $p < .0001$, $\eta_p^2 = .02$, respectively. Pictures of Japanese scenery had a much larger number of objects than pictures of American scenery.

In addition, the main effects of the size of the city were significant both when the minimum particle size was 50 pixels, $F(2, 955) = 51.35$, $p < .0001$, and when the minimum particle size was 100 pixels, $F(2, 956) = 44.15$, $p < .0001$. Large cities were found to have a larger number of objects than medium and small cities. A post hoc contrast comparing large against medium and small cities was significant for both minimum particle sizes, $t(955) = 5.31$, $p < .001$, for 50 pixels and $t(956) = 4.97$, $p < .001$, for 100 pixels.

STUDY 2

In Study 2, we examined how the cultural differences in the perceptual environment found in Study 1 might afford culturally specific patterns of attention. Employing a procedural priming technique (for an overview, see Smith, 1994), we presented participants with either American or Japanese scenes to evaluate and then asked them to perform a change-blindness task with different pictures (Masuda & Nisbett, in press). The change-blindness task provided a measure of attention to focal objects and to context. We hypothesized that being exposed to the Japanese perceptual environment makes people attend more to contextual information than does being exposed to the American perceptual environment.[1]

Method

Participants

Thirty American undergraduates (20 females and 10 males) at the University of Michigan and 32 Japanese undergraduates (9 females and 23 males) at Kyoto University, Japan, participated in the experiment.

Prime Stimuli

From the 492 pictures used in Study 1A, we selected those taken parallel to the street because judgments of complexity for these pictures correlated well with objective measures. In addition, all the pictures taken in the medium cities (i.e., Ann Arbor and Hikone) were eliminated in order to avoid possible effects of familiarity among the students at the University of Michigan, who might have seen some of the locations in Ann Arbor. In total, 95 pictures from each culture remained to be used as primes.

Measure of Attentional Pattern

In order to measure participants' patterns of attention, we used the change-blindness task from our previous study (Masuda & Nisbett, in press). We employed two pairs of culturally neutral vignettes (i.e., construction site and airport). Each vignette included three or four foregrounded focal objects (e.g., trucks) and several background objects (e.g., buildings and sky). The two scenes in each pair differed in the attributes of some focal objects (e.g., a person was or was not shown in a salient truck) and in contextual information (e.g., the location of a truck, the height of a pole). Each vignette lasted for about 20 s. Participants were presented with a pair of vignettes in sequence and asked to detect changes between the first and the second.

Procedure

Participants were told that we were studying visual image processing and that they would participate in two studies, one using still pictures and the other using animated images. The first part of the study was introduced as a pretest to decide which

[1]We did not anticipate that there would be an effect of the cultural primes on detection of changes in focal objects because in our previous study (Masuda & Nisbett, in press), we found no difference between Japanese and Americans for perception of changes in focal objects in the culturally neutral scenes that we used.

pictures would be used in a main experiment that was allegedly planned for the next term. Participants were randomly assigned to see 95 Japanese or American scenes and were asked to imagine that they were placed in the scenery and to judge how much they liked the scenery using a 5-point rating scale (1 = *not at all*, 5 = *very much*).

Participants were then given the ostensibly unrelated change-blindness task. They were told to detect and write down the changes between the two versions of each animated vignette and were given four trials to view each pair.

TABLE 2

Mean Number of Changes Detected by Culture of Participants, Culture of Prime Scenes, and Type of Changes

	American participants		Japanese participants	
Type of changes	American scenes	Japanese scenes	American scenes	Japanese scenes
Focal	1.66 (0.98)	1.69 (0.84)	1.75 (0.93)	1.53 (1.00)
Contextual	2.07 (0.87)	2.67 (1.22)	2.67 (0.96)	3.17 (1.06)

Note. Standard deviations are in parentheses.

Results

Table 2 presents the mean numbers of detected focal and contextual changes. In order to test our hypothesis, we performed a 2 (culture of participants: Americans vs. Japanese) × 2 (culture of prime scenes: United States vs. Japan) × 2 (type of change: focal vs. contextual) × 2 (type of stimulus: construction site vs. airport) ANOVA. Supporting previous findings of individual differences in patterns of attention, the interaction between culture of participants and type of change was significant, $F(1, 58) = 4.24$, $p < .05$, $\eta_p^2 = .07$. Because of the previous finding that culture had a main effect only on detection of contextual changes (Masuda & Nisbett, in press), we conducted a planned contrast testing the effect of participants' culture on detection of contextual changes only. Japanese participants detected a larger number of contextual changes than American participants did, $t(106) = 2.97$, $p < .01$, $d = 0.56$. Supporting our hypothesis about perceptual affordances, the interaction between culture of prime scenes and type of change was significant, $F(1, 58) = 5.14$, $p < .05$, $\eta_p^2 = .08$. We conducted a planned contrast testing the effect of culture of prime scenes on detection of contextual changes only. Both American and Japanese participants detected a larger number of contextual changes after being primed with Japanese scenes than after being primed with American scenes, $t(106) = 2.97$, $p < .01$, $d = 0.56$.[2] These interactions were not qualified by a three-way interaction involving culture of participants, culture of prime scenes, and type of change, $F < 1$.

DISCUSSION

The present research examined a dynamic way in which cognition may be shaped and maintained by culture and found evidence that culturally specific patterns of attention may be at least partially afforded by the perceptual environment. Study 1 demonstrated that Japanese scenes are more complex and ambiguous than American scenes, suggesting that objects look more embedded in the field in the Japanese perceptual environment. Study 2 further demonstrated that such cultural differences in the perceptual environment can actually lead to different patterns of attention. Both Japanese and Americans who were primed with Japanese scenes attended more to the contextual information than participants primed with American scenes did.

At the same time, we also found that there were within-culture variations, as well as between-culture variations, in the perceptual environment. The perceptual environment in New York City was judged to be more complex and ambiguous than the perceptual environment in smaller cities in the United States. It is possible that people living in New York City attend more to contextual information and thus are more holistic in their cognitive style than people who live in smaller U.S. cities. However, such perceptual affordances may be overridden by other sociocultural mediated processes, such as interpersonal relationships based on independent conceptions of self (Markus & Kitayama, 1991).

The present research suggests a dynamic process through which attention can be shaped and sustained by the perceptual environment. Given the fact that such perceptual environments have been historically constructed and maintained by people repeatedly exposed to a culturally specific perceptual environment, we believe that the current exploration sheds light on possible processes of mutual constitution of cognitive processes and sociocultural environment (Fiske et al., 1998; Kitayama, Markus, Matsumoto, & Norasakkunkit, 1996; Shweder, 1991).

The present research provides no indication of why Japanese (or Asians in general) would prefer relatively complex environments and Americans (or Westerners in general) would prefer relatively simple ones. There is good reason to suspect, however, that the Japanese and U.S. environments do not differ solely because of necessity or chance. When asked to draw scenes or take photographs, Japanese include more context, and emphasize focal objects less, than do Americans (Masuda, 2003). Thus, differential esthetic preference for context may lie behind the construction of the different built environments in the two civilizations.

[2]Whereas all the participants in the present study were exposed to either American or Japanese scenes before working on the change-blindness task, the participants in our previous study (Masuda & Nisbett, in press) were not exposed to any scenes prior to the task and thus may provide baseline information. Data from 26 Americans and 30 Japanese who responded to the two culturally neutral stimuli in Studies 1 and 2 of Masuda and Nisbett (in press) were compared with the present data. For detection of focal changes, the nonprimed participants ($M = 1.80$) did not differ from those primed with American scenes ($M = 1.71$), $t < 1$, or from those primed with Japanese scenes ($M = 1.61$), $t(224) = 1.04$, n.s. In contrast, the nonprimed participants detected fewer contextual changes ($M = 2.29$) than did those primed with Japanese scenes ($M = 2.92$), $t(224) = 3.59$, $p < .01$, but detected as many contextual changes as did those primed with American scenes ($M = 2.33$), $t < 1$.

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