Perception and Cognition

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1. Introduction and Historical Overview

For more than a century, most psychologists have based their discussions of human thinking on the cardinal assumption that basic cognitive processes are the same for all normal adult human beings, whether in the plains of Central Asia, the villages of East Africa, or the urban centers of Europe and North America. Cultural differences influence the content of minds, or the domains of thinking to which cognitive strategies are applied. For example, children in the Amazon might categorize snake varieties with the same interest that children in suburban America categorize video game varieties. Although *what* people think about varies considerably across cultures, the very *habits of thought*--the information processing strategies that people use recurrently in order to know the world around them—have been assumed to be the same everywhere.

Several historical developments in psychology have conspired to uphold cognitive universality as a foundational assumption in much of theorizing and research. First, the origins of psychology have been profoundly influenced by biology (Benjamin, 1988), leading to an assumption of universality in at least two respects: much research on the biological basis of human psychology is conducted analogically in other species. But if we begin with the view that humans in one culture share psychological mechanisms with other species, it follows that these same psychological mechanisms are assumed to be shared universally within humans themselves. Furthermore, to the extent psychology is grounded in biology, it inherits the theoretical foundation of evolutionary theory as well (Barkow, Cosmides, & Tooby, 1992; Pinker, 1997). Because evolutionary reasoning depends on the assumption of a shared species-wide genome, this theoretical foundation encourages psychologists to accept psychic unity as a

given, rather than as a testable hypothesis. Learning theorists that influenced much of early experimental psychology in the mid-twentieth century also believed that they were looking at mechanisms that applied not only to all humans but to most other animals as well. The cognitive revolution, from its earliest development, until nearly the end of the 20th century, rejected the learning theorists' behaviorism yet embraced the same universalistic position that was undoubtedly encouraged by the analogy between the human mind and the computer: brain equaled hardware, cognitive procedures equaled operating principles and native software (Block, 1995). Because the "inputs" could be radically different across cultures given variation in ecological and social conditions, "outputs" in the form of beliefs and behaviors would also be radically different, without affecting the underlying cognitive architecture of the mind.

As the anthropologist Richard Shweder has observed, the major theoretical stances in 20th century psychology presumed a "central processing device. The processor, it is imagined, stands over and above, or transcends, all the stuff upon which it operates. It engages all the stuff of culture, context, task and stimulus materials as its content" (1991, p. 80). But the idea of an autonomous "central processing device" that transcends ecology and context did not always dominate the landscape of psychology. Three major theoretical positions with a long history in psychology and the social sciences proposed that human thinking is profoundly attuned to the sociocultural contexts in which it naturally occurs.

The first challenge originated in none other than Wilhelm Wundt (1916), regarded as the founder of experimental psychology, who held the view that higher cognitive functions were affected by cultural practices, and that when cultures and histories diverged, cognitive processes also diverged. Thus he proposed a cultural psychology that he termed *völkerpsychologie* or "folk psychology" to complement experimental psychology:

> [Folk psychology's] … problem relates to those mental products which are created by a community of human life [e.g., language, religion] and are, therefore, inexplicable in terms merely of individual consciousness, since they presuppose the reciprocal actions of many … Individual consciousness is wholly incapable of giving us a history of the development of human thought, for it is conditioned by an earlier history concerning which it cannot in itself give us any knowledge (Wundt, 1916, p. 3).

A second significant early idea that culture fundamentally shapes thought was that of the influential Russian School of Lev Vygotsky (1978) and Alexander Luria (1971), and their associates in the West, including especially Michael Cole and his colleagues (Cole, 1996; Cole & Scribner, 1974). The Russian School continues to influence a wide range of contemporary research on culture and cognition (Cole, this volume; Hutchins, 1995; Lave & Wenger, 1991; Resnick, 1994; Rogoff, 1990). According to Vygotsky, human cognition develops in a cultural context, which is the accumulated pattern of symbolic and non-symbolic tool-use throughout the historical existence of a group. To the extent that societies diverge in their historical trajectories, different activities and tools become available which then afford different cognitive tendencies.

A third influential idea elaborating the notion that culture influences thought has captured far more sustained attention in psychology and the social sciences than those of Wundt and possibly Vygotsky. The linguistic relativity hypothesis (Whorf, 1956) contends that the particular language people speak affects their thought processes. Given that linguistic conventions vary greatly across cultures, cognitive processes would also vary as a result.

As Tomasello has argued (1999), the idea that human cognition is fundamentally cultural can be understood in the context of an apparent puzzle in human evolutionary history. Humans are genetically highly similar to their primate relatives, and not surprisingly share with them

most of their basic cognitive repertoire. But superimposed on these similarities humans distinctively possess a vast network of complex cognitive skills, involving symbolic communication, complex reasoning skills, as well as elaborate tool use technologies, that are unprecedented in higher primate cognition. The puzzle is that these distinctive features of cognition and behavior emerged very recently, possibly no earlier than about 250 thousand years ago (Foley & Lahr, 1997). Simply put, it is unlikely that so many of these human-specific set of cognitive abilities arose by the usual slow processes of genetic variation and natural selection in such a short time scale. Rather, such rapid changes in cognition could be explained by the emergence of the evolutionarily novel human ability for transmitted culture that operates much faster than genetic transmission (Richerson & Boyd, 2005; Sperber, 1995). Cultural transmission allows information to be passed on not only genetically, but also socially through social learning mechanisms such as mimicry, imitation, instruction (Tomasello, Kruger, & Ratner, 1993) as well as a byproduct of communicative processes such as gossip, conversations and storytelling (Schaller, 2001). Thus, unlike the case of other primates, human children make use of a richly structured cultural context as they develop; this context channels their innate cognitive capacities in new directions and subsequently alters their behavior and cognition in profound ways (Norenzayan, Schaller, & Heine, in press).

Human cognition is therefore culturally dependent in ways that other primate cognition is not. This dependence gives rise to cultural variation in cognition for two reasons.
Human groups occupy vastly different ecological niches (Edgerton, 1971) that may evoke different cognitive habits to solve the same problems of human existence, and as a result their social and psychological practices also diverge in response to the local conditions (Cohen, 2001). Moreover, the cognitive capacities that enable cultural transmission, such as imitation, are biased

towards ingroup members also encouraging the emergence of stable cultural variation (Henrich & Boyd, 1998).

This chapter reviews evidence concerning the assumption of universality of cognitive and perceptual processes. (See Choi, Choi, & Norenzayan, 2004 for a review of cultural variation in judgment and decision making, not discussed in this chapter). The cross cultural evidence reveals marked cultural differences in the cognitive strategies, or habits of thought, recruited to solve a given cognitive problem. Although researchers are only beginning to understand the mediating processes by which cultural experiences shape thinking, these cultural differences are likely tied to different construals of the self, ecological differences in visual environments, in assumptions about the nature of the world, in beliefs about the origins of knowledge, in linguistic conventions, in expertise or familiarity with certain domains of life but not others, and in social practices that promote some cognitive strategies at the expense of others.

We focus on cultural variation in domain-general reasoning and perceptual processes, such as visual perception, attention, rule-based reasoning, exemplar-based classification, numerical reasoning, spatial reasoning, and perceptions of change. We do not examine the growing literature on cross cultural regularity and variation in domain-specific reasoning. There are substantial regularities in some of the ways that people organize their perceptual and conceptual worlds, and these characteristic patterns are often observable from a very early age. The most convincing evidence deals with infants' understanding of the physical world (Baillargeon, 1995; Spelke, 1990; Spelke, Phillips, & Woodward, 1995), reasoning about biological entities across cultures by adults and children (Berlin, Breedlove, & Raven, 1973; Medin, this volume; Medin & Atran, 2004), and children's understanding of mental life across cultures (Avis & Harris, 1991; Callaghan et al, 2005; but see Lillard, 1998). For discussions of

the cross cultural evidence for domain-specific reasoning, see Atran, 1998; Atran, Medin, & Ross, 2005; Callaghan et al, 2005; Medin, Unsworth, & Hirschfeld, this volume; Medin & Atran, 2004; Nisbett & Norenzayan, 2002; Wellman, Cross, & Watson, 2001.

2. The Linguistic Relativity Hypothesis.

The notion that cultural experiences influence thought is famously illustrated in the linguistic relativity or Whorfian hypothesis (Whorf, 1956), or the idea that the particular language people speak affects thought. After a period of intellectual stagnation and inconsistent results, recently there has been a surge of systematic and compelling studies that have examined, and found some degree of support for this hypothesis (e.g., Levinson, 1996; Roberson et al, 2000), although the precise psychological implications of these studies continue to be debated in the literature (e.g., Boroditsky, in press; Levinson et al, 2002; Li & Gleitman, 2002; Gelman & Gallistel, 2004).

In an early attempt, Berlin and Kay (1969) examined color classification across cultures. They found that color names are assigned in terms of an orderly hierarchy. In the few cultures where there are only two color names, these are black and white. If a third color is added, it is red. The next tree color terms are likely to be yellow, blue, and green, etc. Berlin and Kay also concluded that, though boundaries of color terms vary across cultures and languages, the focal point of each basic color (e.g., the most prototypical red in an array of reds) is essentially the same. The work of Berlin and Kay has been interpreted to indicate that there is a universal, physiological basis to color classification.

The pioneering work of Heider (subsequently Rosch) (Heider & Oliver, 1972) supported Berlin and Kay's analysis. Working with Dani tribesmen in New Guinea whose language has only two basic color terms, Heider and Olivier showed Dani and English speakers color chips,

and then tested for recognition of the chips a few seconds later. Using this procedure, memory for color was largely independent of color vocabulary, and consistent with the proposal of Berlin and Kay, focal colors showed better memory than non-focal colors for both English speakers (Americans) and the Dani. This work has been generally taken as clear evidence against the linguistic relativity hypothesis. However, it has been criticized on methodological grounds for its narrow scope, and for lack of subsequent studies confirming the findings of the original studies with other tasks or linguistic groups (Hunt & Agnoli, 1991; Lucy, 1997; Lucy & Shweder, 1979; Saunders & van Brakel, 1997).

Recently, new research has emerged that questions the findings of Heider and Olivier (1972), and offers new evidence for the influence of linguistic color terms on color perception and memory. Roberson, Davies, and Davidoff (2000) sought to replicate and extend the original studies of Heider and Olivier (1972) with the Berinmo of Papua New Guinea, a hunter-gatherer people who speak a language that has only five color terms. In a series of experiments, they found convergent lines of evidence for linguistic relativity in color perception and memory. Berinmo patterns of naming and memory were statistically more similar to each other than Berinmo memory was to English memory patterns; the recognition advantage for focal colors relative to non-focal ones disappeared for both English speakers and Berinmo speakers when response bias was controlled for; category learning for focal versus non-focal colors did not differ. These findings indicate that the Berinmo do not have an underlying cognitive organization of color that favors the foci of the eight English basic chromatic color categories (with the possible exception of focal red). Furthermore, Berinmo speakers' performance in color categorization was considerably poorer than that of English speakers, replicating Heider & Olivier's (1972) finding with the Dani. This was despite the fact that Berinmo and English-

speakers did not differ in a similar visual-spatial memory task that did not involve the color domain. This suggests that the poorer memory performance of the Dani and the Berinmo could be explained by the poorer color vocabularies of Dani and Berinmo, rather than unfamiliarity with a formal test situation or lack of formal education, as Heider & Olivier (1972) suggested.

A recent effort to examine the linguistic relativity hypothesis in number marking has been carried out by Lucy and his colleagues (Lucy 1997; Lucy & Gaskins, 1997). Following an early study by Carroll and Casagrande (1958), they examined the extent to which linguistic differences in number marking affect thought. Yucatec Maya and many other languages (e.g., Chinese, Japanese) differ from English in number marking patterns. In English, discrete shape is implicitly emphasized in many nouns. English numerals therefore directly modify their associated noun without shape information. In Yucatec, however, substance is implicitly emphasized in nouns and Yucatec numerals are always accompanied by a numeral classifier that describes essential shape information needed to count the object. Does this differential emphasis on shape versus substance lead to different patterns of categorizing objects? In non-verbal classification tasks, participants were presented with a triad of objects that differed on substance or on shape (e.g., plastic box, cardboard box, a piece of cardboard). Consistent with the lexical structures of these two languages, Yucatec speakers showed a preference for material-based classification (cardboard box, cardboard), whereas English speakers showed a preference for shape-based classification (plastic box, cardboard box).

The effects of mathematical symbols on numerical reasoning (Dehaene, 1997) have been examined by Miller, Smith, Zhu, & Zhang (1995) (see also Miller & Stigler, 1987). An interesting difference between the Chinese and English languages is that for certain blocks of numbers (especially the 10-20 block), the base-10 structure is less obvious in English than it is in

Chinese. Does this structural difference between the two languages affect the way children learn to count? The answer is yes. The authors examined the development of counting in 3-5 year old Chinese and American children. Results revealed a complex pattern of similarities and differences in number acquisition that indeed reflected the structural differences of English and Chinese counting systems. Namely, no differences in learning to count were found from 1-10, where both cultures rely on rote learning and not base-10 principles. But a difference emerged, favoring Chinese children, for counting in the second decade (10-20), where base-10 principles are first learned, and where Chinese has simpler and more consistent names for 10-20 that is more consistent with base-10 principles. No cultural differences were found for counting from 20-99, where both Chinese and English converge on a common structure of number names. Finally, no cultural differences were found in tasks consisting of object counting and simple mathematical problem solving. Thus, the cultural differences selectively emerged only when the structural differences in number naming were implicated in the number acquisition task.

Whether linguistic differences in counting systems affect numerical reasoning has been investigated in a more dramatic fashion among small-scale cultures that do not have an elaborate number marking system. In a recent study, Gordon (2004) examined reasoning among the Piraha, an Amazonian group that has a one-two-many counting system (see also Pica, Lerner, Izard, & Dehaene, 2004, for a similar study and similar results with the Munduruku of the Amazon). Two main findings emerged. First, counting tasks with varying cognitive demands showed that performance with quantities greater than three were poor. For example, Piraha speakers were shown an array of familiar items (e.g., sticks), and were asked to match these items with the equivalent number of other familiar items (e.g., nuts). Results showed that Piraha

speakers had great difficulty matching an array of items if the array contained more than three items.

Second, despite their poor counting performance for numbers that are not available in the Piraha counting system, the participants' estimation errors in assessing the quantity of objects reflected a constant coefficient of variation, that is, the amount of error increased as a function of the magnitude of the target size. The ratio of this average error to the target size is a constant, suggesting adequate estimation of quantity. Piraha speakers' coefficient of variation was identical to that of English speakers. This indicates that Piraha speakers were sensitive to quantity, were trying hard to get the answers correct, but were insensitive to exactitude of numbers larger than three.

There is growing consensus in the literature that numerical thinking relies on two independent cognitive strategies: one is a primitive "analog" number sense that is sensitive to quantity but is limited in accuracy. This cognitive ability is independent of counting practices, can be shown to operate in human infants and is shared by other non-linguistic higher primates (e.g., Dehaene, 1997). Second, human infants appear to have a cognitive ability that is sensitive to the exactitude of small numbers, possibly up to about three items. But it is only with the emergence of linguistically coded counting systems and cultural practices of counting that children in some cultures are able to count with exactitude numbers larger than three (for other interpretations, see Carey, 2004; R. Gelman & Gallistel, 2004).

Another line of research, by Levinson (1996) and colleagues, focuses on linguistic variation in the coding of spatial location. Speakers of English and other Indo-European languages favor the use of body coordinates to represent the location of objects in relative terms (e.g., "the man is on the right of the house"). In contrast, other languages such as Guugu

Yiimithirr (an Australian language) and Tzeltal (a Mayan language) favor absolute reference in fixed cardinal direction terms ("the man is west of the house"). Is this difference in linguistic convention implicated in cognition? Levinson and colleagues have examined this question in their program of research. In one study, they created non-linguistic tasks that measured performance in locating objects, and manipulated the sensitivity of the two spatial referent systems to rotation. As expected, speakers of Guugu Yiimithirr were unaffected by the rotation manipulation in locating objects accurately. English speakers, in contrast, were thrown off by the same rotation manipulation, being less accurate in locating the objects. In another study, Dutch and Tzeltal speakers were seated at a table and shown an arrow pointing either to the right (north) or the left (south). They were then rotated 180 degrees to a second table where they saw two arrows: one pointing to the left (north) and the other one pointing to the right (south). Participants were asked which arrow on the second table was like the one they saw before. Consistent with the spatial marking system of their languages, Dutch speakers chose the relative solution, whereas the Tzeltal speakers chose the absolute solution. Subsequent research has shown that contextual manipulations can induce English speakers to reason according to absolute spatial reference (Li & Gleitman, 2002). However this is not surprising, given that cardinal location terms, although not salient, do exist in the English language. What is important is that habitual ways of reasoning are systematically related to the dominant ways of talking about space in a given culture.

Linguistic differences may affect reasoning not only about space, but also about time. In English, for example, time is discussed in *horizontal* terms, for example when one says "we are behind schedule," or "let's move the meeting forward." In Mandarin, on the other hand, time is talked about in *vertical* terms: earlier events are said to be shàng or "up", and later events are

said to be xià or “down.” In a series of experiments, Boroditsky (2001) investigated whether thinking about time is affected by this linguistic difference. In one study, English and Mandarin bilinguals were shown fish swimming on a computer screen either vertically or horizontally. Then participants were asked questions about time, such as “does March come earlier or later than April?” Mandarin speakers were faster to confirm that March comes earlier than April after seeing the vertical movement of fish (which is consistent wit the Mandarin linguistic coding of time), whereas English speakers showed the reverse pattern. Interestingly, another study showed that English speakers could be explicitly taught to think of time vertically, which then resulted in patterns of thinking characteristic of Mandarin speakers.

A well-known experimental attempt to test a linguistic relativity hypothesis is Alfred Bloom’s (1981) work on counterfactual or hypothetical reasoning. Bloom noticed that the English language has an explicit linguistic device to code counterfactuals (the subjunctive mode—e.g., “If I were rich, I would travel the world”). Not so in the Chinese language, which instead expresses counterfactual meaning by relying on context, combined with the use of if-then statements. In a series of studies, Bloom gave English and Chinese speakers, as well as Chinese-English bilinguals, controlled counterfactual stories, and found that Chinese speakers did more poorly in counterfactual reasoning than English speakers. However, Au (1983) and Liu (1985) have criticized Bloom’s work, raising questions about the accuracy of the Chinese translations of the stories. Furthermore, there is little doubt that Chinese are capable of counterfactual reasoning in everyday life. The question then, is whether or not the presence or absence of a simple linguistic device to mark counterfactuals facilitates or discourages counterfactual reasoning (Hunt & Agnoli, 1991). As we will see later, there is a case to be made that hypothetical

reasoning is less prevalent in Chinese culture than among Westerners, though for reasons that may have more to do with factors other than differences in grammatical categories.

To summarize, after an initial period of mixed findings, growing new evidence appears to favor the contention that linguistic differences affect thought. Although the strong version of the Whorfian hypothesis--that thinking is entirely determined by the particular language spoken in a community--has been long abandoned, less strong versions of the hypothesis have received empirical support in a variety of cognitive domains. Linguistic differences may result in habitually different ways of thinking because different languages force their speakers to attend to strikingly different aspects of the world (Slobin, 1996). Although there are ongoing debates and controversies in this burgeoning new area of research (Hunt & Agnoli, 1991; Li & Gleitman, 2002; R. Gelman & Gallistel, 2004; Levinson et al, 2002), solid evidence has been found for the cognitive effect of linguistic differences in the coding of spatial location (Levinson, 1996), color categories (Roberson, et al., 2000), and numerical reasoning (Gordon, 2004; Miller & Paredes, 1996; Pica et al, 2004). The work supporting linguistic relativity has profound implications for cognitive psychology, and more specifically, for the cultural mediation of thought. To the extent that societies have diverged in their linguistic conventions, so would cognitive processes, to some degree. Clearly, however, more research is needed to examine the pervasiveness of the influence of language on thought. Furthermore, the tools of experimental psychology can be profitably used to examine in more systematic detail the cognitive processes that mediate the linguistic shaping of thought. Finally, it is important to distinguish linguistic effects from other cultural effects on thought, for example effects due to social practices, beliefs, or expertise in a domain. This is particularly challenging, given that non-linguistic cultural patterns and linguistic conventions tend to be confounded within the same populations.

3. Deductive reasoning in traditional non-literate societies

According to the Vygotsky (1978), human cognition develops in a species-specific medium, that of culture, or the accumulated pattern of symbolic and non-symbolic tool-use of a social group. The various social activities that a child engages in interact with primitive, biologically given cognitive structures. The child gradually internalizes these social activities and develops ever more complex cognitive structures. Cultural variation in cognition emerges to the extent that societies experience different historical developments, which then lead to different social activities and tools, which in turn afford different thought processes that are congruent with the particular historical trajectories of societies.

A pioneering attempt to study how cultural-historical factors transform thought processes was an expedition to Central Asia by Luria and his colleagues in the early 1930s (1971). The purpose of this project was to examine the effects of massive social and economic reforms in remote regions of Central Asia on the logical reasoning of Uzbek peasants. Luria and colleagues presented simple syllogisms in a quasi-experimental format to four groups of people who were at different degrees of modernization: Non-literate women in remote villages who did not participate in formal economic practices; non-literate men who were engaged in traditional farming; young activists involved in collective farming (some of whom were minimally literate); and women attending teacher training schools (Scribner, 1977). If logical reasoning is a universal property of the mind that is impervious to historical changes, then no differences in logical reasoning would be observed among these four groups. However, to the extent that cognitive structures are transformed by historical change in socio-economic and educational conditions, greater exposure to modernization would lead to more reliance on formal logic.

Luria and his colleagues found marked variation in logical reasoning. The strongest results emerged for syllogisms with contents *unfamiliar* to the villagers. Villagers living traditional lives had the most difficulty with problems that did not conform to their everyday experience, suggesting that their responses were driven by a concrete, knowledge-based approach to reasoning. In some extreme cases, this pattern led to the refusal of some individuals to engage in the logical reasoning task at all, on the grounds that the contents of the problems were unfamiliar, making the problem in principle unanswerable. For example, one of Luria's unfamiliar problems was, "In the far north all bears are white. Novaya Zemyla is in the far north. What colors are the bears there?" To which one participant responded, "But I don't know what kind of bears are there. I have not been there and I don't know. Look, why don't you ask old man X, he was there and he knows, he will tell you." (Luria, 1971, p. 271). In contrast, the same unfamiliar problems posed no difficulty to those who had some exposure to schooling.

Several studies on logical reasoning in traditional versus industrialized societies followed the Central Asian investigation of Luria and his colleagues. Most notable are studies conducted with the Kpelle and Vai in West Africa (Cole, Gay, Glick, & Sharp, 1971; Scribner, 1975; Scribner, 1977), as well as with Maya- and Spanish-speaking villagers in Yucatan, Mexico (Sharp & Cole, 1975, cited in Scribner, 1977). Several interesting conclusions can be drawn from the findings of Luria and these more recent studies. First, logical reasoning seems to be facilitated by Western-style schooling. Increases in performance are detected with 2-3 years of schooling. Second, when matched by age and schooling, there is little systematic cultural variation in performance among different non-literate cultures. However, performance in such cultures is somewhat lower than comparable industrialized populations, such as the US. Finally, the most important generalization is that the characteristic reasoning pattern in traditional

societies is a preference for concrete thinking based on direct personal knowledge. Experimental evidence, as well as ethnographic accounts of everyday life, show that the low solution rates do not betray an absence of logical reasoning ability. Rather they indicate an unwillingness to *play the game of logic with the experimenter*, which dictates a hypothetical stance that is often inconsistent with personal knowledge. This fact is evident when the villagers are asked to justify their responses. Justifications overwhelmingly appeal to direct personal knowledge external to the logical problem itself. In the rare cases where justifications do mention the structure of the argument, performance is high. This is true across individuals, as well as for each individual. Thus, whenever an individual agrees to play by the rules of logic, the capacity for logical reasoning with simple syllogisms is impeccable (Scribner, 1977).

However, as will become clear later in this chapter, this preference for concrete reasoning is not limited to non-literate societies. Highly educated, industrialized East Asian samples in China and Korea also are more likely than comparable Western samples to favor concrete, intuitive, knowledge-based reasoning. Thus the preference for formal logical reasoning prevalent in Western cultures may be only partly the result of the introduction of modern institutions such as industrialization. Other cultural factors that have been historically tied to the Western intellectual tradition, such as adversarial debate, contractual relationships, theoretical science, and formalization of knowledge may account for the development of formal logical reasoning as a rhetorical system central to these activities (Becker, 1986; Lloyd, 1990; Nisbett, Peng, Choi, & Norenzayan, 2001).

4. Cultural differences in perception

Whereas Vygotsky, Luria, and their colleagues examined higher level reasoning processes, other cross cultural researchers have looked at whether the cultural environment

affects perceptual processes. Segall, Campbell, and Herskovits (1966) investigated cultural differences in visual perception, and in particular visual illusions. Here we focus on their findings regarding the famous Muller-Lyer illusion. Visual perception is a richly-structured cognitive capacity that every normal-sighted human being is biologically endowed with. However these biologically given visual processes may interact with the ecological properties of the external world, and learned habits of visual inference may be formed as a result of such dependence on ecological regularities. But to the extent that the ecological conditions in which people live diverge, culturally different habits of inference may emerge, even if the biological potential for vision is the same everywhere. Since people in the same cultural group share more or less the same ecological milieu, this question can best be answered by examining natural variation in ecological conditions across human cultures.

Segall et al investigated this question, focusing on one ecological variable—the degree to which the visual environment is carpentered. They proposed the *"carpentered world hypothesis."* According to this idea, in industrialized cultures with a pervasive carpentered environment where right angles abound, people internalize several related perceptual tendencies: to interpret non-rectangular figures as rectangular, to perceive figures in perspective, and to interpret them as two-dimensional representations of three dimensional objects. These tendencies should enhance the susceptibility to some visual illusions, among which the Muller-Lyer illusion (see Figure 1). Segall et al predicted that people in carpentered environments should be more susceptible to this illusion than people in non-carpentered environments. Over a six-year period, psychologists and anthropologists administered visual tests that included European and North American samples, as well as samples in several African societies, and the Philippines. The results supported the hypothesis: although the susceptibility to the illusion was found across

cultures, the average susceptibility to the Muller-Lyer illusion increased as a linear function of how carpentered the environment is. Subsequent research (Stewart, 1973) showed that African school-aged children in Zambia who lived in an urban, carpentered environment showed more susceptibility to the illusion than children in a rural, uncarpentered region of Zambia.

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Perceptual differences between urban industrialized groups and traditional populations have also been found by Witkin and Berry (1975). In this case, however, some traditional populations are more similar to industrialized groups than they are to other traditional populations. Witkin and his colleagues demonstrated that there are substantial individual differences in the extent to which people "differentiate" or decontextualize an object from the field in which it appears (Witkin, Dyk, Faterson, Goodenough, & Karp, 1974; Witkin et al., 1954). People who do this readily are "field independent" and people who do so with more difficulty are "field dependent." They had a number of tests to examine field dependence including the Embedded Figures Test, which shows people's ability to separate a simple object from a more complex background, and the Rod and Frame Test. In the latter test, participants look into a long box, at the end of which is a rod surrounded by a frame. The participant's task is to indicate when the rod is vertical. The rod and the frame can be tilted independently of one another. Field dependence is indicated by the extent to which the position of the frame influences judgments about the position of the rod.

Whereas Segall et al examined the role of the physical environment, Witkin and his colleagues proposed that field dependence is in part the result of a social orientation toward people. An outward orientation toward the social environment encourages an orientation toward the field in general. Witkin and Berry (1975) found that there were substantial cross cultural

differences in field dependence. Farmers, who live in societies where they must coordinate their actions with others, were found to be more field dependent than were people who hunt and gather, or herd animals for a living. The latter sorts of livelihoods require less coordination with the actions of those of others and social, political, and economic role relations tend to be relatively simple. Industrialized peoples have levels of field dependence comparable to those of mobile hunter-gatherers and herders. Like mobile peoples, industrialized peoples have more freedom in their lives and relative simplicity in role relations. There is also experimental evidence that these different orientations cause different perceptual tendencies. Kühnen, Hannover, & Schubert, B. (2001) temporarily induced independent vs. interdependent self-construals among German participants. In the independent priming condition, participants thought about how they are different from their family and friends. In the interdependent priming condition, participants thought about their similarities to their family and friends. Subsequently participants were given the Embedded Figures Test that assesses perceptual processing devoid of any obvious social elements. As expected, an independent self-construal led to a more context-free or field-independent perceptual processing, whereas interdependent self-construal led to more context-bound or field dependent processing.

5. Holistic and analytic reasoning

Recently Nisbett and his colleagues have pursued the proposal that marked cultural differences in modes of reasoning could exist not just between modern industrialized and traditional populations, but between the two industrialized cultural areas: Western (North American, Western European) and East Asian (Chinese, Japanses, Korean). This research has been summarized by Nisbett and his colleagues (Nisbett, 2003; Nisbett & Masuda, 2003; Nisbett

& Norenzayan, 2002; Nisbett et al., 2001; Peng & Nisbett, 1999) as holistic vs. analytic reasoning.

Holistic thought involves an orientation to the context or field as a whole, including attention to relationships between a focal object and the field, and a preference for explaining and predicting events on the basis of such relationships. Holistic approaches rely on experience-based knowledge rather than abstract logic and are *dialectical*, meaning that there is an emphasis on change, a recognition of contradiction and the need for multiple perspectives, and a search for the "Middle Way" between opposing propositions. Analytic thought involves detachment of the object from its context, a tendency to focus on attributes of the object in order to assign it to categories, and a preference for using rules about the categories to explain and predict the object's behavior. Inferences rest in part on decontextualization of structure from content, use of formal logic, and avoidance of contradiction.

This distinction between habits of thought rests on a theoretical distinction made in psychology between two reasoning systems. One system is relatively associative, and its computations reflect similarity and contiguity (i.e., whether two stimuli share perceptual resemblance and co-occur in time); the other system relies on more abstract, symbolic representational systems, and its computations are a reflection of rule structure (e.g., Neisser, 1963; Sloman, 1996). The distinction that Witkin and his colleagues (Witkin et al., 1974; Witkin et al., 1954) made between "field dependence" and "field independence" in the perceptual realm, discussed above, resembles the cognitive distinction as well. The definition of Nisbett and his colleagues is meant to include both conceptual and perceptual aspects of the distinction, and also applies to the belief systems that they regard as underlying those differences.

Although both systems of thought are in principle cognitively available to all normal adult humans, cultural experiences may encourage reliance of one system at the expense of another, giving rise to systematic cultural differences. These differences in cognitive orientation are believed to be rooted in the different social worlds of East Asians and Westerners today. East Asians are more interdependent in their socialization practices, values, and social behavior, than people of European culture, who are in turn more independent. In studies in which participants are asked to spontaneously describe themselves, East Asian students generate self-descriptions that are more likely to reflect their social identities ("I am a Keio student,") or refer to relationships ("I am a brother.") Americans generate self-descriptions that reflect abstract personality traits ("I am curious") more often than Japanese participants (Cousins, 1989). Markus, Mullaly, and Kitayama (1997) found in one study that 50% of Japanese self-descriptions included references to ingroup members, in contrast to only 24% for Americans (see also Rhee, Uleman, Lee, & Roman, 1996). Social harmony is valued over debate and frank discussion in the East, to a far greater extent than in the West (Becker, 1986). For reviews of the literature on social psychological differences between Eastern and Western cultural contexts, see Bond 1996; Fiske, Kitayama, Markus, & Nisbett, 1998; Kitayama, Duffy, & Uchida, this volume; Markus & Kitayama, 1991; Triandis, 1989, 1995.

If so, we might expect to find cognitive differences among contemporary peoples participating in Western and North American cultural contexts. Nisbett and his colleagues conducted a series of studies that investigated this idea. Most (but not all) experiments were conducted with college students, but similar results are obtained with non-student samples. East Asian participants were either Chinese, Korean or Japanese, tested sometimes in their own countries in their native languages and sometimes in the U.S. The great majority of "Westerners"

studied were Americans. The results support several expectations in line with this hypothesis. Below we highlight some cross cultural findings from this research.

Atttention to object vs. field. If Americans attend more to the object and less to the relations between the object and the field, we would expect them to be less field dependent than Asians. To test this possibility, Ji et al. (2000) gave the Rod and Frame Test to Chinese and Americans matched for mathematical ability. Chinese were found to be more field dependent than Americans.

Masuda and Nisbett (2001) investigated attention to field versus focal object using a different paradigm. They showed underwater scenes to Japanese and American participants. Each scene consisted of rocks, plants, inert animals, small fish, and “focal” fish – which were larger, brighter and faster moving than the others. Immediately after observing the scenes, participants were asked to describe what they had seen. Japanese typically began by referring to the context ("it looked like a river") whereas Americans usually began by referring to the focal fish. Americans and Japanese made equal numbers of statements about the focal fish, but Japanese made about 70 percent more statements about the field and twice as many statements about relationships involving inert objects in the background. Participants were subsequently shown a number of objects, some of which had been in the original scenes and some of which had not, and were asked to identify whether they had previously seen the object or not. Some of the objects were shown in their original environments and some were shown in environments not seen before. This manipulation made no difference to the accuracy of Americans, but the performance of Japanese was less accurate when the background was different. Thus object and field appeared to have been bound for the Japanese (Chalfonte & Johnson, 1996; Hedden et al., 2000). When object was removed from the context, memory for the object was poorer.

In a related task, Masuda and Nisbett (2005) examined cultural differences in “change blindness” or a systematic failure to recognize marked changes in surroundings (Simons, 2000; Rensink, O'Regan, & Clark, 1997). For example, when people are asked to watch a videotape and count the number of ball passes between players, they consistently fail to notice the insertion of an unusual character into the scene, such as a person carrying an umbrella or even a person wearing a gorilla costume (Simons & Chabris, 1999). Furthermore, “change blindness” is evident even when participants are explicitly asked to search for changes in the visual field. Although participants often take a long time to detect major changes in a given scene, they are likely to detect changes in salient, focal objects faster than in objects of peripheral interest (Rensink et al., 1997). Masuda and Nisbett showed American and Japanese participants scenes, where changes occurred in focal object information (i.e. color and shape) and contextual information (i. e. background and objects’ location), and participants were asked to identify changes in the scenes. Americans were more sensitive to focal object changes than contextual changes, whereas East Asians were equally sensitive both to the focal object and to the contextual information. This again reveals a greater tendency to attend to focal objects at the expense of the field among analytic thinkers.

More recently, Kitayama and colleagues (Kitayama, Duffy, Kawamura, & Larsen, 2003) developed a new paradigm to test cultural differences in perception. Participants were presented with a square frame, within which was shown a vertical line (see Figure 2). Participants were then shown another square frame of the same or different size and asked to draw a line that was identical to the first line in either absolute length (absolute task), or in proportion to the height of the surrounding frame (relative task). The absolute task is facilitated by the ability to decontextualize, whereas the relative task is facilitated by a contextualized mode of perceptual

processing. The results indicated that Americans were more accurate in the absolute task, whereas Japanese were more accurate in the relative task. In a subsequent study, Kitayama et al showed that Japanese living in America and Americans living in Japan showed an intermediate pattern of accuracy, suggesting possible acculturation effects on perception (although other interpretations, such as self-selection, or different affordances of the perceptual environment, are possible, see Kitayama et al).

Insert figure 2 about here

Recently Chua, Boland, and Nisbett (2005) examined more precisely the mechanisms underlying cultural differences in attention. Chua et al showed Chinese and American students (matched for age and field of study) photographs each representing a focal object on a complex background (e.g., a tiger in a jungle), while their eye-movements were measured. The results showed that Americans fixated more on focal objects than did the Chinese, and looked at the focal objects more quickly. Furthermore, over time Chinese dispersed their attention to the background more than the Americans did. These findings support the idea that cultural experiences affect what people actually attend to in a scene.

Differing orientations of the self may explain the differential attentional and perceptual processing of East Asians and Westerners (Kuhnen et al, 2001). But could it also be that the perceptual environments of East Asia and the West contribute to these differences? If objects are more distinct from the field in the American perceptual environment, attention may be captured mainly by the object. On the other hand, if objects are embedded in the field and boundaries between objects are more ambiguous in the Japanese perceptual environment, attention may be dispersed to the whole field. Earlier we examined evidence for the notion that carpentered perceptual environments enhance vulnerability to certain kinds of visual illusions (Segall et al,

1968). Miyamoto, Nisbett, & Masuda (in press) similarly examined the perceptual environments of Japan and the United States. They took pictures of urban scenes in small, middle, and large size cities in both countries, by randomly sampling places in each city. Using these pictures as stimuli, they analyzed the physical features of the scenes, and found that objects sampled in the U.S stood out from the scenes, whereas objects sampled in Japan were embedded in the scenes.

Causal explanation, prediction, and hindsight. Americans are more inclined to decontextualize the object from its context than are East Asians. We might therefore expect that Americans would be inclined to explain events by reference to properties of the object and that East Asians would be inclined to explain the same events with reference to interactions between the object and the field. There is much evidence indicating that this is the case (for reviews see (Choi, Nisbett, & Norenzayan, 1999; Norenzayan & Nisbett, 2000). Miller (1984) showed that Americans were likely to explain both events that "had a good outcome" and events that "had a bad outcome" by invoking presumed properties the actor. Hindu Indians explained the same events by reference to situational and contextual factors. Similarly, Morris and Peng (1994) and Lee, Hallahan, and Herzog (1996) have showed that Americans explain murders and sports events respectively by invoking presumed dispositions of the individual whereas Chinese and Hong Kong citizens explain the same events with reference to contextual factors.

Norenzayan, Choi and Nisbett (2002b) found that Korean participants were equally willing to make disposition-based predictions in the absence of contextual cues; however Koreans were more responsive to contextual factors when making predictions about how people in general would be expected to behave in a given situation and, much more than American participants, made use of their beliefs about situational power when making predictions about the behavior of a particular individual. Importantly, Norenzayan et al. (2002b) found that Koreans

and Americans endorsed beliefs about the causes of behavior that accorded with their explanations and predictions. Koreans placed more credence in situational theories than did Americans. Choi and Nisbett (1998) found similar results when they examined circumstances in which both Americans and Koreans showed a correspondence bias, that is, they mistakenly attributed behavior to dispositions of a target actor who was operating under social constraints. However Koreans were much more willing to revise their mistaken inferences about dispositions than Americans. Several other studies have replicated this pattern of results, indicating that the correspondence bias, although it can be shown to exist in East Asian groups, is much weaker not only among Koreans, but also among Japanese (Masuda & Kitayama, 2003; Miyamoto & Kitayama, 2002), as well as Chinese (Knowles, Morris, Chiu, & Hong, 2001; for an exception, see Krull et al, 1999). Furthermore, these studies have found that East Asian groups are generally much more willing than Americans to revise their dispositional attributions when social constraints on the actor are salient (e.g., Miyamoto & Kitayama, 2002; see Choi et al, 1999, for a discussion of these issues).

Explanation patterns are different even for non-social events. Morris and Peng (1994) and Hong, Chiu, and Kung (1997) showed participants cartoon displays of fish moving in relation to one another in various ways. Chinese participants were more likely to see the behavior of the individual fish as being produced by external factors than were Americans, whereas American participants were more inclined to see the behavior as being produced by internal factors. Peng and Knowles (2003) also found that Chinese students with no formal physics education were more likely to perceive causality to originate externally to the target object (e.g. gravity, medium, friction, field), whereas a similar group of Americans referred to causes internal to the object (e.g. shape, weight, inertia).

Sensitivity to the role of contextual factors, and attention to the field, may have additional consequences. In a series of experiments, Choi and Nisbett (2000) found that Koreans were more susceptible to the *hindsight bias*, that is, the tendency to believe that one could have predicted some outcome that in fact one could not have predicted. Choi and Nisbett argued that the East Asians' greater susceptibility to this bias might be due to the holistic tendency to attend to an ever increasing number of contextual factors, and to a tendency to causally model events less explicitly. When a large number of possible factors are attended to, and when these factors are not explicitly represented, any given outcome can be readily explained by drawing on any number of interrelated factors, leaving little room for surprise or the experience of inconsistency, thus maximizing hindsight.

The cultural difference in causal explanation was found not only in the locus of attribution but also in the amount of causal information people consider in order to explain a certain event. East Asians have holistic assumptions about the universe dictating that all elements in the universe are somehow interconnected and, consequently, an event or object cannot be understood in isolation from the whole. In contrast, Westerners hold that the universe consists of separate objects that can be understood in isolation from one another. Therefore, East Asians are expected to consider a greater amount of information in order to explain a certain event than Westerners. Choi, Dalal, Kim-Prieto and Park (2003) conducted a series of studies to test this prediction. They provided American, Asian-American and Korean participants with a short scenario of a murder incident along with a list of 97 items of information that might or might not be relevant to the explanation of the incident. Then, participants were asked to eliminate the irrelevant information from the list. Choi et al. hypothesized that East Asians would find it more difficult to judge a given piece of information irrelevant and 'not connected,' and hence to

eliminate it from further consideration than Westerners would. They found the expected pattern, such that Koreans were less likely than Americans to discard a given piece of information.

Similarity and Relationships vs. Categories and Rules. East Asians are more likely to group objects on the basis of similarities and relationships among the objects whereas Americans are more likely to group objects on the basis of categories and rules. Ji, Nisbett, & Zhang (2004) found that adults showed similar tendencies when asked about the association between words. Asked how strong the association was between words in a set, Chinese were more likely to find the association strong if there was a relationship between the words, either functional (e.g., pencil-notebook) or contextual (e.g., sky-sunshine) whereas Americans were more likely to find the association strong if the objects belonged to the same category (e.g., notebook-magazine).

Norenzayan and colleagues (Norenzayan, Smith, Kim, & Nisbett 2002a) presented East Asians, Asian Americans and European Americans with target objects and asked them to report whether the object was more similar to a group of objects to which it shared a strong family resemblance, or to a group of objects to which it could be assigned on the basis of an invariant unidimensional rule (see Figure 3). Thus, a schematic flower could be assigned to a group whose members it resembled most closely, or to a group whose members all shared a single feature that determined category membership (e.g., long stem). East Asians were more likely to regard the target as most similar to the group with which it shared a strong family resemblance whereas Americans were more likely to regard the object as more similar to the group to which it could be assigned on the basis of the deterministic rule. Asian Americans' judgments were in between those of the other two groups.

Insert figure 3 about here

Logical vs. Dialectical and Intuitive Reasoning. East Asians are less likely to decontextualize propositions and reason about them using formal rules than are Westerners. Furthermore, whereas Westerners reason about contradiction by applying a folk form of formal logic which aims to eliminate contradictions, East Asians reason about contradictions by emphasizing the "Middle Way" between contradictory propositions, or by tolerating opposites.

Experimental psychologists have found a "belief bias" in deductive reasoning: more plausible conclusions are judged as more logically valid than less plausible ones (Revlin, Leirer, Yop, & Yop, 1980). In one study, Norenzayan et al. (2002a) presented deductive arguments that were either valid or invalid, and either had plausible or non-plausible conclusions. They found that there was a difference in response bias such that overall Americans showed a stronger tendency to judge arguments to be valid. However regardless of this response bias, there was a culture by conclusion plausibility interaction, such that the belief bias was greater for Koreans than for Americans, but for valid arguments only (see Unsworth & Medin, 2005, for a different interpretation). Importantly, this difference was not due to any difference in abstract logical reasoning ability between the Americans and the Koreans. Koreans made validity judgments in the same way as Americans did when the propositions were formal and abstract. Thus the difference between the two groups apparently resides in the willingness to decontextualize meaningful propositions sufficiently to be able to apply logical rules to their underlying structure.

An important aspect of the Western analytic stance is the belief that talking facilitates thinking. This is not surprising given that analytic thinking is intimately connected to linguistic representation of thoughts. This belief is so culturally ingrained that Western pedagogy takes it for granted that verbalization is a central part of learning. Talking is taken as a near-equivalent

to, and direct evidence for thinking, as reflected in cultural practices such as debating and disputation in the Socratic method of teaching. In East Asian cultures where an intuitive orientation is valued, however, talking is discouraged and silence is valued, as reflected in cultural practices such as silent meditation. Given the divergent cultural beliefs about talking, Kim (2002) examined whether the effect of verbalization on thinking is culturally specific. Asian Americans and European Americans thought aloud while solving reasoning problems such as Raven's Progressive Matrices. Talking impaired Asian Americans' performance but not that of European Americans. A follow up study showed that talking impaired Asian Americans' cognitive performance, but articulatory suppression did not. Conversely, European Americans' cognitive performance was impaired by articulatory suppression, but unaffected by talking, These results suggest that the underlying mechanism for the cultural difference is the differential use of internal speech in thinking. The exact relationship of these findings to the cultural differences in analytic versus holistic thinking remain to be examined. Talking recruits linguistic representation of the problem, and as a result it should facilitate analytic thinking, but inhibit holistic thinking. An interesting open question, then, is whether the cultural differences regarding the effect of talking on thinking are generally the same for all modes of thinking, or they are especially pronounced for analytic tasks.

Many philosophers of science and ethnographers have pointed to a type of "dialectical" reasoning held to be characteristic of East Asians (Liu, 1974; Lloyd, 1990; Needham, 1962/1978; Peng & Nisbett, 1999; Peng, Spencer-Rodgers & Zhong, 2005; Zhang & Chen, 1991). The orientation underlying this approach may be described (in a rather non-dialectical fashion) as a set of three principles.

The principle of change: Reality is a process that is not static but dynamic and changeable.

The principle of contradiction: Contradiction is a constant element of life.

The priniciple of relationship or holism: Nothing is isolated and independent but instead everything is related to everything else.

Taken together, these principles imply an attitude toward contradiction that is very different from that found in the West. Contradiction is to be expected and not necessarily resolved. Propositions that appear contradictory on the surface may both contain some truth, and a constant goal is to search for the "Middle" Way between extremes.

Peng and Nisbett (1999) derived a number of predictions from the set of principles above. Chinese collections of proverbs were found to have a larger proportion of "dialectical" proverbs containing contradictions ("too humble is half proud") than do English collections, and Chinese undergraduates were found to like dialectical proverbs more than American undergraduates. Chinese were more likely to prefer arguments having a dialectical or holistic character rather than a logical structure than were Americans. When asked to deal with inter- and intrapersonal conflicts, Chinese were more likely to say that both sides had some merit whereas Americans were more likely to say that one side or the other was correct.

These different ways of reasoning also emerged in the way persuasive messages were processed. When presented with a plausible proposition, both Chinese and Americans assented to it, but when participants were presented with both the plausible proposition and a less plausible proposition that appeared inconsistent with each other, Chinese and Americans responded in very different ways. Chinese became less confident about the plausible proposition, but Americans became even more convinced of the correctness of the plausible proposition! The Americans' behavior is hard to justify on logical grounds, but is understandable given Western insistence that a proposition must be true or false. Westerners' arguments against the weaker

proposition would serve to strengthen belief in the more plausible proposition. Chinese, in contrast, ended up believing that both propositions were about equally plausible, a tendency that is hard to defend on logical grounds either. This remarkable tendency can be understood as the result of Chinese desire to seek the "Middle Way" and to find the truth in apparently contradictory propositions.

These different modes of reasoning are also implicated in the ways by which self-knowledge is organized. A series of studies found that among East Asian participants, self knowledge is more contextual, flexible, holistic, and dialectical as compared to European American participants (Spencer-Rodgers & Peng, 2003; Spencer-Rodgers, Peng, Hou & Wang, 2003). In one study, when presented with either positive or negative feedback that was counterschematic (i.e., inconsistent with prior self-concepts), Chinese were more likely than Americans subsequently to alter their self-beliefs, suggesting the Chinese had self views that are more dialectical in nature.

The dialectical frame in East Asian cultures has important implications for reasoning about change in events. In a series of studies, Ji, Nisbett, & Su (2001) described various current states and asked whether participants thought the state would continue or change. For example, participants were told about a man who grew up in a poor family, and they were asked to predict whether he would remain poor in adulthood or grow rich one day. For each of four events, Chinese were more likely than Americans to think that the future would be different from the past. Ji et al. also presented participants with alleged recent trends in world events that participants were unlikely to have direct knowledge of, for example, participants were told that the world's economy has been growing in the last decade, and were asked to predict whether this trend would go up, to go down, or remain the same. Chinese participants were more likely to

predict that the next step would halt or reverse the direction of change, whereas Americans were more likely to predict that the trend would continue in a linear fashion. In one study, Chinese participants were more likely to predict reversals of trends in all but 1 of 12 cases (Ji et al, 2001).

Recently, Choi, Koo, and Choi (2005) devised a multifaceted self-report tool, the Analysis-Holism Scale (AHS), to measure analytic-holistic thinking style (examples of items, "everything in the universe is somehow related to each other"; "it is more desirable to take the middle-ground than to go to extremes" "It is more important to pay attention to the whole than its parts"). They then demonstrated that it adequately differentiated between-culture groups (Americans versus Koreans) and within-culture groups (Korean students in Oriental Medicine versus other majors) as expected. Furthermore, the scale predicted analytic versus holistic solutions in tasks that measured attention, categorization, causal reasoning, and perceptions of change. Those with high scores in the AHS paid attention more to the field than to the object, categorized objects more based on similarity than on rules, considered a greater amount of information in causal explanation, and possessed a cyclic view of change more strongly than those with low scores in the AHS.

Normative Considerations Regarding Cultures Differences in Reasoning. So far our discussions of cultural variation in cognition have been descriptive, without addressing the related important normative issue of how to evaluate the accuracy and practical value of different modes of thought. This is a particular challenge for the universalist position that argues for the "psychic unity" of humankind. If all of humanity shares the same invariant mental processes, how then to explain cultural differences that are observed? The strong universalist position has offered two possible answers to this challenge. One is that cultural differences are either non-existent or are superficial appendages that mask underlying deep similarities. The second

universalist answer views cultural differences in terms of a deficit model. In this view, there is a true universal human mind (often implicitly assumed to approximate the Western ideal), and any observed deviation from this ideal mind is evidence for cultural or individual deficit. In this view cultures may be ordered in terms of having more or less of an inherently desirable thing (such as logical rules, the use of probabilistic principles, etc).

We find both versions of this universalist position problematic. We disagree with the superficial culture interpretation, and in this chapter we have presented considerable evidence that cultural differences in cognition are real and central to cognitive functioning. Yet we reject the deficit model of these cultural differences and consider them ethnocentric projections unless it is established that the same processes are valued across cultures and to the same extent. Instead we favor evaluating modes of thought in terms of the task goals and the very cultural values and practices in which they are embedded.

Consistent with the view that normative judgments themselves vary across cultures, many East Asian scholars have noted that in East Asian cultures logic does not enjoy the normative status that it does in the West. In Japanese culture, for example, “to argue with logical consistency is thus discouraged, and if one does so continuously one may not only be resented but also be regarded as immature” (Nagashima, 1973, p. 96). These normative evaluations may even affect interpersonal judgments. Ji et al (2001) found that people who see events as changing cyclically (a dialectical pattern of reasoning) are judged to be wise more so by Chinese participants than by Americans. Recently Buchtel & Norenzayan (2005) asked participants to rank the importance of acting in a logical or an intuitive manner in impersonal and interpersonal contexts. Americans ranked logic higher than intuition, whereas Koreans ranked these two about equally. In a second study, American and Chinese participants read about a company manager

who made a decision either consistent with a procedural rule or consistent with intuition, and were asked a variety of questions that assessed their impressions of the target. Of particular interest, Chinese judged the intuition-following actor to be wiser and more reasonable than the rule-following actor, whereas Americans showed equal preference. These cultural differences were more pronounced in impersonal contexts and were attenuated or disappeared in interpersonal contexts, in which intuition was favored by all. These kinds of result remind us that an important part of cross cultural research is to remain watchful of inadvertently projecting values and judgments about a cognitive tendency to another cultural group that may not share these values and judgments, or may share them in different contexts (see Cole & Scribner, 1974).

The philosopher Stephen Stich (1990) has addressed the normative status of cultural differences in thinking by arguing that "there are no intrinsic epistemic virtues…cognitive mechanisms or processes are to be viewed as tools or policies and evaluated in much the same way that we evaluate other tools or policies" (1990, p. 24). According to Stich (1990; see also Resnick, 1994), if there are culturally diverse ways to conduct the business of everyday cognition, and if there are culturally diverse systems of justification which serve the needs of various cognitive communities, then the reasonable philosophical position would be to evaluate thinking in terms of the local standards of justification, as well as the specific task requirements and inferential goals that vary across contexts.

This is not to say that it is always unreasonable to criticize specific inferential practices, even by the standards of another culture, but that criticism must take into account task goals and cultural contexts. And if we decide to apply the normative criteria of formal logic and probability theory to these modes of thought, we find that the analytic and holistic modes of thought generate a medley of normative and non-normative outcomes. For example, in deductive

reasoning, analytic thinkers tend to decontextualize more than holistic thinkers, but in causal attribution, the former more readily commit the fundamental attribution error than the latter. Conversely, holistic thinkers are more accurate in covariation detection (Ji, et al, 2000), yet they are more vulnerable to hindsight bias (Choi & Nisbett, 2000). Furthermore, in some of the research reported here, European Americans have been shown to make errors, in their efforts to be logically consistent, that actually result in judgments that are incoherent in the sense that one judgment actually follows from the opposite of the other (Peng & Nisbett, 1999). These errors were avoided by East Asian participants, who, however, made logical errors of their own in their attempts to reconcile opposing views. Similarly, Masuda and Nisbett (2005) examined scene perception and found change-blindness in both American and Japanese samples, however Americans showed more change blindness for background objects whereas Japanese showed more change blindness for focal objects. Thus, neither the analytic nor the holistic mode guarantees accuracy in perception and reasoning as defined by probability theory and formal logical principles.

6. Explaining Cultural Differences in Analytic and Holistic Thought

What are the origins of these cognitive differences? To answer this complex question it is important to distinguish between *distal* and *proximal* explanations. Distal explanations are historical analyses that involve social, economic and even geographic factors (Norenzayan & Nisbett, 1999; Nisbett, 2003). Proximal explanations involve individual-level processes including beliefs, knowledge, social experiences, and psychological orientations that have been shaped by these historical developments, are identifiable at the individual level, and could be directly implicated in these cognitive differences. The attempt to answer the distal question must of course be speculative at this time because it involves complex sociological and historical

issues. Nisbett (2003; Nisbett et al, 2001), has noted considerable parallels between contemporary cognitive differences in holistic and analytic thought and studies of ancient Chinese and Greek philosophy, mathematics, and science that have influenced modern East Asia and the West respectively (Becker, 1986; Fung, 1983; Liu, 1974; Lloyd, 1990; Nakamura, 1964/1985; Needham, 1962; Zhang, 1985). Although these two ancient cultures shared many similarities, their metaphysical belief systems were different. Early Greek and Chinese philosophy, science, and mathematics were quite different in their strengths and weaknesses. Many Greek philosophers looked for universal rules to explain events and were concerned with categorizing objects with precision and with respect to their "essences." There was a marked distrust of holistic approaches. Chinese philosophers, especially Taoists, were more pragmatic and intuitive, and were distrustful of formal logic and rational distinctions (Fung, 1983; Liu, 1974; Lloyd, 1990; Nakamura, 1964/1985; Needham, 1962).

Following scholars in several fields (Becker, 1986; Cromer, 1993; Nakamura, 1964/1985), Nisbett and his colleagues argued that the social and economic systems of the two countries encouraged their respective cognitive orientations. China was an agrarian society with strong obligations and clear role relations specifying how to deal with family, clan, and village, and with tight vertical control of social relations. Action was carried out in the context of many role relations. Harmony with one's fellows was believed to be a primary end of the society (Munro, 1969). In contrast, the economy of Greece owed more to herding, fishing, trading and piracy than to cooperative agriculture.

A goal of harmony would tend to encourage attention to the field as a whole whereas the individualistic stance might allow for the luxury of attending to the object alone. Attention to the field would encourage finding relationships between events in the field, whereas attention to the

object might encourage attending to the attributes of the object in order to be able to categorize it and apply rules to it. The harmony goal would tend to discourage debate and encourage consensual heuristics such as *dialecticism* which seek the "Middle Way" and the resolution of opposing positions (Lloyd, 1990). The consequence of the practice of debate is an emphasis on logical consistency and the avoidance of contradiction. Not surprisingly, pedagogical practices also reflect these cultural goals-- critical analysis and argumentation is emphasized in Western classrooms, and experience-based learning is emphasized in Chinese classrooms (for a review, see Tweed & Lehman, 2002).

The cognitive differences in reasoning to some degree mirror differences in philosophical traditions. As provocative as this congruence may be, it is difficult to know at this time if these traditions are directly implicated in such reasoning processes, or whether the influence of these traditions on thinking are mediated through proximal factors.

At this time, the most compelling proximal explanation for the cognitive differences is the differing social orientations of people found in East Asia and Western cultures. As discussed earlier, East Asian children are socialized into a tight social network of mutual obligation and role relations, and as a result develop an interdependent orientation of the self. In contrast, Western children from a young age are socialized into a social network of loosely connected autonomous individuals and as a result develop an independent orientation. An interdependent self-orientation may translate into context-sensitive information processing, whereas an independent self-orientation may encourage an object-focused processing. The cross cultural evidence is consistent with this hypothesis: an analytic mode of processing is more prevalent in Western cultures where people are also more independent, whereas a holistic mode of processing is more prevalent in East Asian cultures where people are also more interdependent. However

research on the direct influence of these orientations on thinking has been sparse. Nevertheless, there is growing experimental evidence that inducing independent versus interdependent self-orientations affect analytic and holistic processing in predictable ways (Kuhnen et al, 2001a: see also Kuhnen & Oyserman, 2002).

A particular way of thinking is also transmitted and fostered through formal education in a society. For example, Koo and Choi (2005) reasoned that Oriental medicine reflects many aspects of East Asian holistic thinking and hypothesized that the exposure to Oriental medicine training would foster the holistic way of thinking. Koo and Choi tested this idea by comparing the students of Oriental medicine and those of non-oriental medicine in Korea in some cognitive domains. They found that the students of Oriental medicine believed in a cyclic pattern of change more strongly than did their counterparts. If a certain event had been increasing or decreasing, the former groups expected the trend would reverse its direction in the future. The students of Oriental medicine also thought that an event was determined by numerous factors and that a given factor could not be dismissed easily while explaining a certain event. Therefore, they considered a greater number of factors in causal attribution. Importantly, a chronological trend emerged such that holistic causal beliefs became stronger the longer students were exposed to training in Oriental medicine, and this trend remained after age differences were accounted for.

7. Caveats and Future Directions

The accumulated evidence for cultural variation in cognition and perception is robust and reliable—these differences emerge from a variety of unrelated paradigms and methodologies, with a variety of samples, and many artefactual explanations have been ruled out (see Nisbett et al, 2001; Nisbett & Masuda, 2003). A meta-analytic review of studies comparing East Asians (Chinese, Koreans, Japanese) and North Americans (excluding Asian North Americans)

indicated that the overall effect size of the cultural difference is moderate to large, and this effect size is as strong for attentional and perceptual tasks as it is for tasks that involve language-based conceptual processes (Miyamoto, Kitayama, & Talhelm, 2006). Not surprisingly, East Asians tested in East Asian countries diverged more strongly than East Asians tested in North America. Now that convincing evidence exists that cultural differences in basic cognitive processes exist, two major challenges lie ahead for cultural psychologists. First, relatively little research has been done about the underlying proximal social psychological factors that explain cultural differences in cognition. Second, most of the research has focused narrowly on comparisons of Western and East Asian participants, with relatively little attention given to most of the rest of the world's cultures, including indigenous as well as industrialized populations in Africa, Latin America, Eastern Europe, the Mediterranean area, and the Middle East.

What factors encourage a holistic mode of processing in East Asian contexts, and analytic mode of processing in Western contexts? This important question is particularly complex since multiple processes are likely to converge to produce the cultural differences, and disentangling them in the laboratory is a challenge. The hypothesis that different orientations of the self in these two cultures are causally responsible, as discussed before, has already received experimental support (Kuhnen et al 2001). Further research can investigate this hypothesis in greater detail and establish the extent to which the cultural differences originate in different conceptions of the self. Although the use of self-report measures of cultural value orientations or self-construal across cultures are vulnerable to serious methodological problems (see Oyserman, Kemmelmeier, & Coon, 2002; Heine, Lehman, Peng, & Greenholtz, 2002), convergent methods that include valid self-report measures, experimental methods, as well as population level measures can be used in future cross cultural research for this purpose. Other factors that are

only beginning to receive attention, are differences in language (Ji, et al, 2004; Tardif, 1996), residential mobility (Oishi, 2004), voluntary settlement patterns (Kitayama, Ishii, Imada, Takemura, & Ramaswamy, in press), the perceptual environment (Miyamoto, Nisbett, & Masuda, in press), exposure to formal education within a culture such as oriental medicine or Western-style schooling (Koo & Choi, 2005; Scribner, 1977), and within-culture religious beliefs and practices (Cohen & Rozin, 1999; Sanchez-Burks, 2002). Greater concerted attention to within-culture analyses of the relationship of social and ecological experiences to cognition will propel cultural psychology into a second stage of inquiry in which cultural differences in psychology are not only discovered, but explained in terms of the critical variables that produce and sustain cultural variation (Heine & Norenzayan, 2006).

More systematic cross cultural research programs are also needed that examine cultures outside of East Asia and Europe and North America (for an example of a research program on cognition in native American groups in Central America and the US, see Medin et al, this volume). Broadening the range of cultures under investigation is important for at least two reasons. First, it facilitates understanding of certain patterns of thought that are highly elaborated in other cultures, but not well-represented in the samples that are currently under investigation. For example, Norenzayan (2005a) recently began exploring fatalistic thinking, characterized by a tendency to see outcomes in life as inevitable and multidetermined, and to attribute these outcomes to powerful agentic external forces, such as fate, destiny, or God. Fatalistic thinking is widespread in some regions of the world, such as the Mediterranean, and in many religious traditions. Not surprisingly, little is known about the psychology of this pattern of belief and thought, given that it is an uncommon form of reasoning in the highly secular Western and East Asian samples that are the object of investigation in most of current cultural psychology.

Second, inclusion of more of the world's cultures allows greater opportunities to test specific hypothesis regarding the transmission mechanisms underlying cultural variation in thinking. For example, if the differences between East Asians and Westerners in analytic-holistic thinking are explainable in terms of degrees of independence-interdependence, then other cultures where independence versus interdependence are prevalent should encourage analytic versus holistic processing, respectively. Kuhnen et al (2001) tested this hypothesis with participants in two individualistic cultures, United States and Germany, and two collectivistic ones, Russia, and Malaysia, and found results consistent with this hypothesis in the domain of perceptual processing. Zebian and Denny (2001) compared integrative thinking (similar to holistic thinking) in a group of European Canadians to an immigrant Middle Eastern group of varying degrees of Western education, and found that the Middle Eastern group was on average more integrative than the European Canadian group. Furthermore, the authors found that exposure to Western style university education resulted in less integrative thinking among the Middle Easterners. Recently, Norenzayan (2005b) tested Canadian, Chinese, and Arabs in perceptual processing and deductive reasoning. Although Chinese as expected showed more holistic processing than Canadians, Arabs were even more holistic than the Chinese! Similarly, Henrich (2005) examined classification and perception among the Mapuche, an indigenous group of farmers in Southern Chile. Although the Mapuche have had little exposure to the cultural traditions of East Asia, their processing patterns were overwhelmingly holistic. Is it possible that the most interesting cultural divide is not the one between West and East, but between the West versus the rest? Are the cultures of the non-Western world, regardless of their cultural exposure to East Asian traditions, predominantly holistic in their cognitive outlook?

Results like these invite more systematic investigation of the specific social and ecological variables that can account for such cultural variation.

8. Conclusions: Universals and cultural particulars in cognition

This chapter examined how cognitive processes are shaped by the cultural context in which they occur. This is not to deny that there are basic process primitives that appear in the human child at a very early age and may have innate components. People everywhere are likely to possess cognitive strategies implicated in domain-specific reasoning such as theory of mind, as well as domain-general ones that realize exemplar-based categorization, depth perception, long-term memory, covariation detection, etc. In fact, cross cultural research is one of the principle ways by which such process primitives can be uncovered (Norenzayan & Heine, 2005; Norenzayan, Schaller, & Heine, in press; see also Cohen, this volume, Medin et al, this volume). However these primitive cognitive structures do not preclude the cultural dependence of human cognition.

A fruitful analogy is to think of the mind as a *toolbox* (Cole, 1996; Resnick, 1994; Stich, 1990; Vygotsky, 1978). Cognitive structures can be thought of as tools for everyday problem solving. Just as the handyman's specialized toolbox is accessed to construct and repair, the mental toolbox is accessed to solve the myriad problems of everyday life. But to the extent that the worlds in which people inhabit are different (or are believed to be so), there emerge different affordances that elicit the use of different tools. In a world joined together by nails, a hammer is a more useful tool than a wrench. In a world held together by nuts and bolts, a wrench is a more useful tool than a hammer.

Based on this reasoning, Norenzayan and Heine (2005) discussed three distinct levels of universals which also encompass three kinds of cultural variation in cognitive processes, giving

rise to 4 types of hierarchically organized classes. From strongest to weakest claims for cross cultural universality, a cognitive phenomenon can be an 1) *accessibility universal* if it emerges across cultures and in the same magnitude; it is a 2) *functional universal* if it emerges across cultures in the same context but differs in magnitude; it is an 3) *existential universal* if it exists in principle in the psychological repertoire of various cultures but is elicited by different contingencies and in different magnitudes; and it is a 4) *non-universal* if it is absent from the psychological repertoire of some cultures. Below we briefly illustrate these distinctions.

At the shallowest level, there may be cultural differences in the cognitive accessibility of thought processes. Societies differ in the cultural practices that they promote, affording differential expertise in the use of a cognitive strategy, or differential knowledge about a domain. The result is that a given cognitive process may be equally available in principle, but differentially accessible in different cultures. As a result, the same phenomenon may emerge across cultures but with systematically different effect sizes. An example of this is cultural variation in the correspondence bias in the attitude attribution paradigm, which refers to the tendency to attribute behavior to an actor's attitude even when the actor is operating under social constraints. In most contexts this bias appears in East Asian samples, but in a much weaker form (Choi et al, 1999).

Differential cultural expertise with a given cognitive process, or differential familiarity with a given domain, may yield an even more dramatic class of cultural variation in reasoning: in principle people may possess similar cognitive repertoires and yet may habitually rely on qualitatively different cognitive strategies to solve the same problems of everyday life. Thus, even if all cultures possessed similar cognitive toolkits (i.e., existential universals), the tools of choice for the same problem may be functionally different. In many studies reviewed in this

chapter, the same problem triggered qualitatively different cognitive responses in the two cultural groups (see Nisbett, et al., 2001). For example, confronted with apparently contradictory propositions, East Asians responded by trying to find the middle way, whereas Americans responded by polarizing their judgments. Research on logical reasoning among traditional peoples also reflects this kind of cultural difference. Whereas Western participants approach many kinds of problems by decontextualizing them and applying logical rules, traditional non-literate folk approach the same problems by reasoning from their knowledge of the argument contents (Cole et al., 1971; Luria, 1931). Different levels of expertise in a domain may also lead to the use of different cognitive strategies to solve the same problem (e.g., Medin & Atran, 2004; Medin et al, this volume).

Finally, the actual existence of particular cognitive processes may differ across cultures in that different cultures may construct complex reasoning strategies out of universal primitive ones, in feats of cognitive engineering, as suggested by Dennett (1995). The invention of symbolic systems such as calendars, number naming conventions, pictographic and alphabetic writing, and formal logic provide examples. Beginning in the West in the 17th century, statistical, methodological and cost-benefit rules having applicability to scientific reasoning as well as to policy analysis and everyday judgment and decision-making began to be developed (Hacking, 1975). There is great variation among members of Western society today in understanding and use of these rules. Similarly, Chinese philosophy developed the ancient Taoist notions of *yin* and *yang* into sophisticated ways of reasoning about change, moderation, relativism, and the need for multiple viewpoints. A case can be made that complex numerical reasoning that goes beyond one-two-many is contingent on a culturally available counting system (Gordon, 2004; Pica et al, 2004), and in that sense it is a non-universal. Quantity estimation, in contrast, appears to be

invariant across cultures in magnitude and likely to be an accessibility universal. This framework highlights the fact that universality and cultural variability are not mutually incompatible, and in fact theories in psychology can gain precision and generality by explicitly articulating both the invariant and culturally variable aspects of cognitive processes.

Human thinking occurs in a cultural context. Yet for most of its history, psychology proceeded as if the study of thinking is unrelated to the cultural environment in which the mind develops and functions. This picture has been changing with the growth of cross cultural research that investigates the ways by which cultural experiences are implicated in human thinking. Cross cultural research is the principal way—perhaps the only way--by which legitimate inferences can be made about human universals, as well as about culture-specific patterns in cognition. As a result, the psychology of cognition and perception promises to be on firmer scientific ground to the extent that it encompasses the world's cultural diversity.

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Figure 1. The Muller-Lyer illusion. Participants are asked to decide if one of the two horizontal lines is longer than the other (in fact they are exactly the same length). The angles-out version (top) is judged to be longer than the angles-in version (bottom).

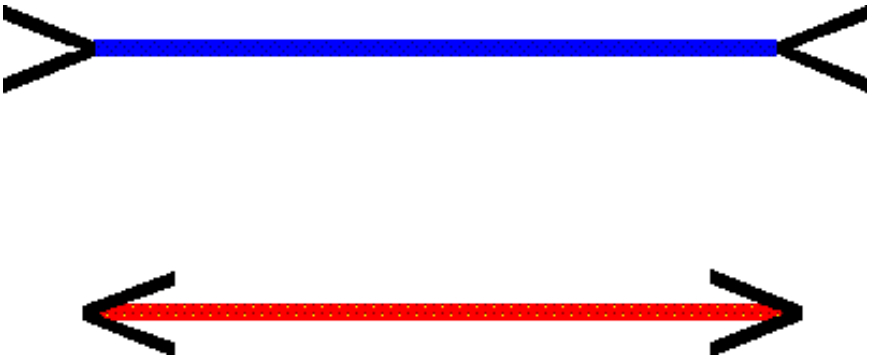

Figure 2. The Framed-Line Test (Kitayama et al, 2003).

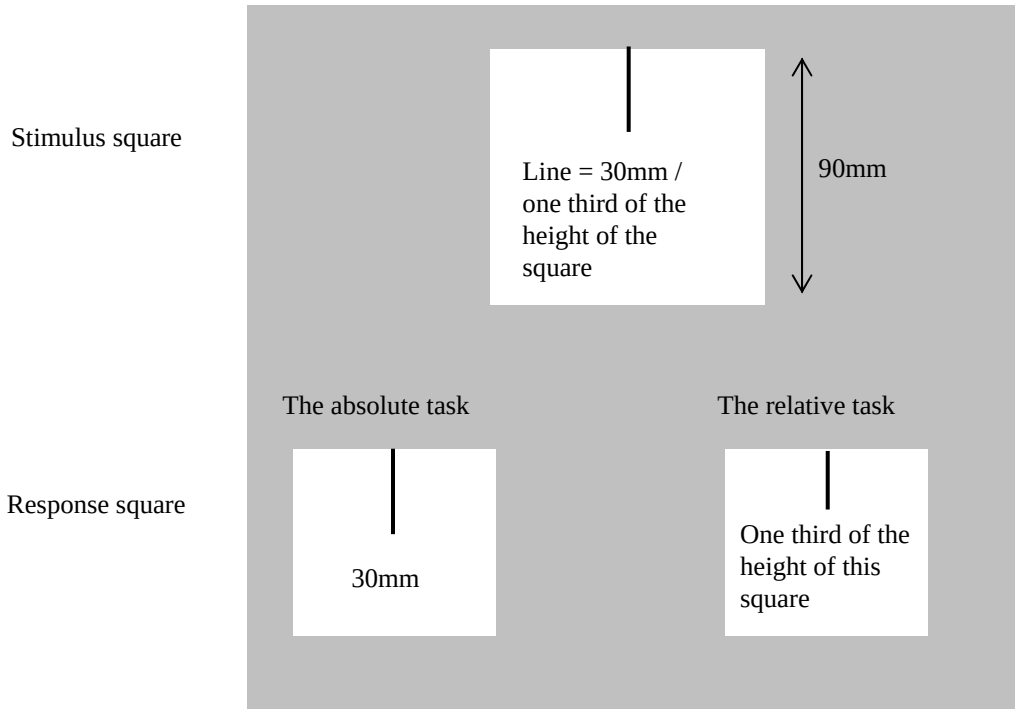

Figure 3. Example of the stimulus sets used in Norenzayan et al (2002) Study 2. Group 1 shares with the target object a strong family resemblance structure, but Group 2 shares with the target object a defining feature, in this case the stem length (short or long).