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THE INFLUENCE OF HOLISTIC AND ANALYTIC COGNITIVE STYLES ON ONLINE INFORMATION DESIGN

Toward a communication theory of cultural cognitive design

Although studies have linked culture to online user preferences and performance, few communication researchers have recognized the impact of culture on online information design and usability. It is important to ask if people are better able to use and prefer Web sites created by designers from their own culture. We propose that to improve computer-mediated communication, Web site design should accommodate culturally diverse user groups. First, a body of research is presented that aligns East Asian cultures with more holistic cognitive styles and Western cultures with more analytical cognitive styles. Building on this contrast, a theory of cultural cognitive design is proposed as a means of understanding how cognitive styles that develop under the influence of culture lead to different ways of designing and organizing information for the Web.

Keywords Cognitive styles; computer-mediated communication; cross-cultural; usability Web design

Introduction

With culturally diverse user groups communicating through the World Wide Web (WWW), we are encouraged to broaden our understanding of culture and education (Rheingold 1993; Walton & Vukovic 2003; Burnett & Buerkle 2004). However, research shows that these groups have different ways of acquiring information online due to differences in their cognitive

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styles. A recent body of research in information technology has found a relationship between how culture shapes cognitive styles and how people acquire information online (Chau et al. 2002; Chen & Macredie 2002; Lin 2003; Graff et al. 2004). A study by Chen and Macredie (2002) is representative of research that indicates how cognitive style affects online learning. Users with different cognitive styles, for example, exhibited different learning preferences when navigating a hypermedia system. Lin's (2003) mediated communication model proposes that communication technology is integral to the ongoing social relationships of those who use it.

Graff et al. (2004) found that individual differences in cognitive styles vary principally with nationality. They argued that the design of online computer-assisted learning modules should consider differences in learning styles that impact attitudes. Chau et al. (2002) outlined a four-factor model based on different online behaviors of cross-cultural users from a study that showed that Hong Kong users tended to use the Web for social communication more than US users. These findings have great implications for site designers targeting international users.

Research of this kind shows that individual and cultural differences have an impact on how people search for information online. This confirms the importance of designing content and navigation to support user characteristics, preferences and learning styles from a cultural perspective. Moreover, while the problem of acquiring information from the users' side may vary because of cultural differences in cognitive development and learning styles, cultural preferences may also influence designers of online information (Chau et al. 2002; Faiola & Matei 2005a). Hence, to deliver content to millions of worldwide users, Web content must be organized with sensitivity to cultural differences.

As the strategic planning of Web design has fallen upon new media, computing and communication professionals, many cultural issues have surfaced but with limited resolution. Scholars need to rethink the challenges posed by computer-mediated communication (CMC), especially those related to content design (Omar 1992; Igbaria & Zviran 1996; Jones 1997; Utz 2000; Blanchard 2004; Wiley 2004). For example, since the mid-1990s, accessibility and usability have been discussed extensively among information technologists, who see the Internet as the next frontier in content delivery. Until recently, however, few practitioners have recognized the impact of culture on content design and the organization of online information, including the psychological aspects of human–computer interaction (HCI) that affect site usability (Herring 1996; Hillier 2003; Vishwanath 2003). It is essential, therefore, to focus on how the cultural cognitive styles of local Web designers affect how users experience Web sites.

Thus far, the most prominent research in interface design and usability has been conducted in CMC and HCI (Ito & Nakakoji 1996; Nielsen 1999;

Sears et al. 2000; Zimmerman et al. 1997). Studies of cross-cultural usability have gained attention by linking culture and Web use (Bourges-Waldegg & Scrivener 1998; Kim & Allen 2002), and cross-cultural studies from a behavioral perspective have also proven relevant to these topics of research (Honold 2000; Marcus & Gould 2000; Zahedi et al. 2001; Chau et al. 2002; Preece & Maloney-Krichmar 2005).

A call to action among CMC scholars is necessary to address these issues. This action could take the form of an investigation into the range of cognitive styles of multiple cultures currently converging on the Web. Specifically, researchers should construct a theoretical underpinning to examine the differences in the ways that Web sites are designed and used to acquire online information (Eveland & Dunwoody 2000; Kim & Allen 2002; Liu et al. 2003). Finally, they should provide both theoretical and practical guidance to Web site designers so that they are able to design with sensitivity to the cultural context to support better online communication.

To deepen our understanding of cross-cultural CMC, the authors suggest a theoretical perspective that is already gaining support from cognitive anthropology and holds that cognition becomes cultural through processes of cognitive development (Berry 1993; Haake et al. 1995; Henrich & Boyd 2002; Kim & Allen 2002). This view undermines theories that assume cognitive style to be a biological universal. The authors hold that it is important for designers of online mediated tools to take cultural cognitive styles into account (Chen & Macredie 2002; Faiola & Matei 2005b).

Research comparing East Asian and Western cultures provides both theoretical and practical guidance to Web site developers on the relationship between cultural context and online communication (Marcus 2003; Murphy & Kraidy 2003). Based on CMC research, we examine the influence of cultural cognition on Web design in terms of the contrast between the more holistic cognitive styles of East Asia and the more analytical cognitive styles of the West. Cultural differences result in different methods of organizing online information. The authors refer to this impact of culture as cultural cognitive design (CCD).

The social shaping of cognition

Five dimensions of cultural behavior

Researchers have given much attention to the richness of cultural variation as depicted by Hofstede (1991) in his work in the 1970s and ‘80s on social and organizational behavior, in which he interviewed IBM employees from 53 countries. From this sizeable dataset, he conducted a statistical analysis from which he observed several patterns of cultural behavior. According to

Hofstede's explanatory framework, the cultural landscape consists of a complex combination of behaviors, emerging from relatively universal cognitive processes. In Hofstede's model, five cultural dimensions are presented that provide a system of comparative measure by which cultural-specific behavior and values can be relationally scored to compare cultural differences and similarities. Within the 53 countries, Hofstede identified five dimensions, with indices for each dimension, normalized to values of 0 to 100 (Hofstede 1980).[1]

Web practitioners have transformed Hofstede's theory into practice by applying five major Web site design concepts: metaphor, mental models, navigation, appearance, and interaction (Honold 2000; Marcus & Gould 2000; Marcus 2003). Marcus expressed his unique analysis of cross-cultural Web design through the extreme differences of Hofstede's five cultural dimensions and their interrelations. By juxtaposing the five dimensions and their relationship to Web site design, a general cultural framework emerged that showed how various national cultures are located in the matrix of behavior and value systems. Specifically, Marcus and Gould (2000) hold that the power distance (PD) of a culture may influence the way users access information. For example, a design manifestation might include a shallow or deep website hierarchy and variations in how frequently national and religious symbols are used. Other design elements related to power distance could include an emphasis placed on expertise and authority, certifications and official stamps, prominence given to leaders, and the importance of security and restrictions of access versus openness and transparency.

It is important to note that Hofstede's theoretical model is based on research that attempted to identify patterns of cross-national cultural behavior. For example, in East Asia, sensitivity to the group and community is encouraged, while in Western cultures, individual choice is promoted. However, when applying Hofstede's behavioral model to the design of online information, Marcus (2002) points out that although the definitions of dimensions and components are not universally accepted, they are stable enough for us to consider the relationship between cultural behavior and Web design. In this way, Web designers might be better enabled to map particular user interface elements to one or more cultures with some reliability.

Cultural cognition and social behavior

Although Hofstede's work provides a starting point for reflecting on the impact of culture on behavior, it adopts a behaviorist perspective that subsumes internal mental operations and structures (e.g. attention, memory and cognition) under the label of 'intervening variables'. It therefore neglects to consider how language and culture influence cognition. Hence, as Cole

(1996) argues, 'human thinking and human culture must be assumed to be intrinsically intertwined' (p. 34). In addition, behaviorism did not generate research explicitly designed to test hypotheses about the influence of culture. For this reason, early research in methodological behaviorism merely gave culture the status of an independent variable. As Cole (1996) explains, the working definition of culture for behaviorists was 'different cultural circumstances provide different stimuli to their members, who, in consequence, learn different kinds of responses' (p. 32).

Moving beyond Hostede's behaviorist perspective, the authors hold that correlations between cultural cognition and Web design can further assist in understanding how culture shapes the cognitive styles of designers in their production of online media. By comparing observations of participants from East Asian countries with those from Europe and the Americas, researchers have documented cultural differences in cognition (Choong 1996; Peng et al. 2001; Liu et al. 2003). The cultural perspective assumes that human beings come biologically prepared with physiological and psychological abilities that are amenable to sociocultural shaping. The human psychological profile is thus formed through biological and social processes, which include particular ways of attuning to the sociocultural environment (Greene 1995).

Cognitive psychologists have argued that cultural diversity is based on embedded cognitive processes that shape behavior. For example, Nisbett (2003) and others have argued that cognition is not universal, but profoundly influenced by culture. Moreover, groups that share and pass on constructed experiences are imbued with cultural patterns of thinking and responding (Berger & Luckmann 1966). Hence, culture is primarily developed cognitively, where behavioral diversity is the product of cultural traits, which are deeply embedded in cognitive processes. Moreover, human experiences are molded in the matrix of social values, ethical concerns and formative learning, and these experiences constitute the central framework of the mind.

Vygotsky (1978 [1930/1935], 1989 [1934]) treats learning as being shared within the context of social interaction and discourse. Cultural traditions and social practices, he argues, produce a profound difference in the way people think, feel and interact, making an individual's psychology a product of culture. He stated that directed thought is social and, as it develops, is 'increasingly influenced by the laws of experience and of logic proper' (1979, p. 16). Differences in the way people think are often attributable to culture (Shweder 1990). Vygotsky suggests that culture is the primary determinant of individual development. He also notes that our perception of reality is a product of sociocultural processes and that knowledge is socially mediated and thereby grounded in culture. Vygotsky's contribution to psychology was invaluable in that he focused on the 'process of individual–environment interaction by which development takes place' (Valsiner 1988, p. 165).

More specifically, Vygotsky argued that prominent activities that define cultural frameworks and influence cognition include language and mathematics (Vygotsky 1989 [1934]). As a continuation of this theory, Luria (1976) showed that literacy and schooling are important factors in cognitive development. Cross-cultural psychologists and cultural anthropologists have maintained that cognition depends on cultural context and is influenced by formal education. Studies that support this view show that language and culture affect thought (Cole et al. 1971; Vygotsky 1989 [1934]; Cole 1996; Segall 1966). Likewise the 'linguistic relativity hypothesis' argues that human language structures influence mental development (Bloom 1981). This direct link between culture-specific languages and cognitive development suggests that thought and language are inseparable (Von Humboldt 1988). Studies of number marking (Lucy 1992), the use of pronouns to identify individual tendencies, and linguistic variation in the coding of spatial location (Levinson 1996) all support the claim that language differences affect thought.

A short line can be further drawn between language and communication. As Sperber (1996) suggests, communication and cognition act upon culture in terms of the distribution of ideas. According to epidemiological theory, because the qualities of the human mind are defined relative to the ecological context, some ideas are more easily processed than others. Such ideas are picked up in all cultures and they spread with ease (Atran et al. 2005). For example, the various inferential procedures that take place during communication are critical to cognitive development (Peng et al. 2001; Henrich & Boyd 2002). A summary of findings suggests that cognition operates on different inputs for different people in different situations and cultures, all using culture-driven rules of deduction and schemes for induction. What was established was that some inferential systems are more readily incorporated into certain reasoning styles than others (Nisbett 1992).

Cultural cognitive style based on holistic and analytic reasoning

There is great disparity between East Asian and Western cultures in their philosophical approaches to the world. The roots of these differences are noted by Woelfel (1987) in his historical contribution, beginning with pre-Socratic thought in a time when Eastern thinking 'mingled freely with emerging Greek ideas' (p. 302). This period, however, abruptly ended with (1) the birth of classical science in about the seventh century BCE, (2) the separation of human and non-human phenomena into nature and ethics (Woelfel 1987), and (3) a division between Eastern and Western thought issuing from an epistemological inquiry in the West that separated knowledge of true forms

(noumena) from what is experienced through the senses (phenomena). While Western thought sought absolute truth in perfect and unchanging knowledge, the Eastern view accepted a changing world that is always in motion (Woelfel 1987). Hence, Hall's (1989) remarks about what transpires from within specific cultures cannot be overstated, where he says, 'people can see their own system of logic as synonymous with the truth … the only road to reality' (p. 9).

In their discussion of continuity versus discreteness, Nisbett and Norenzayan (2002) assert that the intellectual difference between the ancient Chinese and Greeks was that the Chinese held that the world was made up of overlapping and interpenetrating objects. In contrast, the traditional Platonic position was that individual objects have properties that are themselves universals. In the Eastern view, the whole and its parts are inseparable: 'each "one" defines the other, and indeed is the other' (Kincaid 1987, p. 332).[2] Kincaid makes a critical point in highlighting the principle of 'mutual causality,' in which what exists between the part and the whole results in the blossoming of society. The Chinese, for example, tend to see matter as continuous and interpenetrating and events as the result of an interaction between object and field. Moreover, while many non-Western cultures uphold the inseparability of basic elements (Galtung 1981), they also relate the constituent parts of any problem to the integrated whole. In contrast, the Western view focuses on logic and systems of classification, according a greater role to reason.

Studies continue to support the hypothesis that if cultural differences influence cognitive processes, cognitive differences among contemporary peoples should also reflect the ancient division between the more holistic viewpoint of East Asia and the more analytical viewpoint of the West (Nisbett et al. 2001). To further support an argument for this dichotomy of cultural perspectives, we present a short collection of empirical findings that give evidence of holistic and analytic cognitive styles when applied to communication strategies. In the first study, Littlemore (2001) compared taxonomies with preferences for holistic and analytic cognitive styles. Although culture was not a central component of the hypothesis, the test model, based on the Nijmegen Taxonomy (Poulisse & Bongaerts 1994), examined the psychological processes behind the conceptual and linguistic levels of language production (Littlemore 2001). The model provided an empirical communication framework that was subdivided into holistic (comparison-based) strategies and analytic (description-based) strategies. An analysis of the data was performed by noting how learners compensated for missing words. They were classified according to the conceptual strategy that they used.

Littlemore's (2001) hypothesis states that the possession of a particular cognitive style enabled individuals to complete related tasks more quickly. Based on reaction times, participants were then labeled 'holistic' or 'analytic'. Results of

the study showed that holistic students tend to use communication strategies that are based on comparison, while analytic students tend to use strategies that focus on the features of the target item. Here, no connection was made to the social context of culture-specific cognitive styles (i.e. holistic or analytic). Nevertheless, the study provided statistical evidence that individual differences in communication strategies were attributable, at least in part, to cognitive style. The findings also provided insight into the 'nature of the relationship between cognitive styles and communication strategies' (Littlemore 2001, p. 248).

In the framed-line test, Kitayama et al. (2003) examined the hypothesis that Japanese are better at incorporating contextual information than North Americans. Participants from both cultures were presented with a vertical line within a square frame and a second square frame of the same or a different size. They were then asked to draw a line in the second frame that was identical to the first line either in absolute length (the absolute task) or in proportion to the height of the surrounding frame (the relative task). Kitayama et al. (2003) posited that Japanese, because of their contextual sensitivity, would have an advantage over North Americans in performing both tasks. Test findings supported the hypothesis that Japanese participants were more accurate in the relative task, but North Americans were more accurate in the absolute task. Hence, the participants 'tended to show the cognitive characteristics common in their host culture' (Kitayama et al. 2003, p. 201).

Ji et al. (2000) have also documented the influence of culture on cognition and communication. They found that Chinese and American children and adults displayed differences in the degree of association between words in a set. The 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 some category (e.g. notebook–magazine)' (p. 25).

Choong and Salvendy (1999) investigated the impact of cultural cognitive style differences on the computer performance of 40 participants from mainland China and 40 from the USA. The independent variables were knowledge representation (abstract and concrete associated with analytic thinking) and interface structure (functional and thematic associated with holistic thinking) of an information system. The impact of cultural differences on performance was especially prominent. Their findings indicated that Chinese participants began with advantages associated with concrete representation and with thematic structure in terms of initial performance time and error rate. For American participants, the error rate was lower with a functional interface structure.

Ultimately, the results of their study confirmed the results of past studies, which found that the Chinese have a different cognitive style from Americans. More importantly, it was validated psychologically (Chiu 1972), as well as

practically, on computer usage for Chinese participants. These findings further support the abovementioned studies and provide insight for software designers as to how to design computer interfaces that suit users from each culture.

The impact of cognitive style on cultural cognitive web design

Both Segall et al. (1990) and Berry et al. (1997) argue that the reason it is difficult for researchers to arrive at an understanding of culture is because there are so many external and internal influences that affect the way people interact with and process information. For instance, in China, the Internet has changed the way people understand the world, namely, through a very personal interactive experience of working with online information. Undoubtedly, the Web has provided an avenue for Western influences. This is because online information, in large part, incorporates American and European technologies that embody Western ways of thinking, for example, software displays that represent particular Western ways of designing the graphic user interface, with its menus and feature sets, as well as the basic system architecture. In each case, these graphic and system configurations represent the particular cognitive schema of Westerners. As a result, Western cultural thinking, as disseminated through the WWW, has had a lasting influence on Asian cultural thinking. In turn, these influences affect the way cross-cultural users develop cognitively in their understanding of online information.

Cognitive style

Building on the notion of cognitive development and cultural context, studies from psychological anthropology and information science suggest that culture is directly linked to cognitive style (Wood et al. 1996; Chen & Ford 1998; Riding & Rayner 1998). For instance, Ford et al. (1994) state that individuals from different cultural backgrounds differ in the cognitive strategies they employ when processing information. Ford et al. defined cognitive style as a 'tendency for an individual consistently to adopt a particular type of (learning) strategy' (p. 79). Goldstein and Blackman (1978) further defined cognitive style as a contextually influenced process of learning that develops over time, in which the mind forms a particular style of planning, strategizing and problem-solving based on patterns of organizing information and environmental conditioning. In short, cognitive styles are thinking and learning strategies related to information processing, including the characteristic ways in which people: (1) 'conceptually organize their environment' (Goldstein &

Blackman, p. 2) and (2) spontaneously filter and process stimuli so that their environment assumes psychological meaning.

Various researchers have used different terms to describe the dichotomy of Western and East Asian cognitive styles (Ford et al. 2002). For example, the cognitive psychologists Witkin and Goodenough (1981) termed these cognitive styles as 'field-dependence' and 'field-independence', whereas Pask (1988) refers to them as 'holist' and 'serialist' approaches. If Americans have an analytic cognitive style that separates the object from its environment, they are more 'field-independent' than East Asians. To Witkin and Goodenough (1981), field-independent learners tend to experience the components of a structured field analytically, as separate from their background, and to impose structure. By contrast, East Asians are more field-dependent, less analytical, and thrive more in situations where learning is less structured. In other words, they are less adept at structuring and analyzing activities. On the other hand, they are able to perceive stimulus globally, as a gestalt. See Table 1 for a further discussion of the differences between field independence and dependence.

Pask (1988) suggested that holists have a tendency to adopt a global approach to learning, preferring to examine the interrelationships among topics in the learning process. They do this by first focusing on building a broad and overarching conceptual frame into which forthcoming items can be fitted. They also prefer to maneuver between theory and the real world, while looking further ahead in the hierarchy of topics (Ford et al. 2002). It is not only exploratory, but a high-risk attention-thinking process that usually moves across a range of tasks before any one is securely completed. Serialists, on the other hand, tend to use a predominantly local learning approach that examines one thing at a time. During this process, they concentrate almost exclusively on separate topics and the logical sequences linking them. With this style, the overall framework of interrelated elements might emerge relatively late in the learning experience. The serialist prefers to move point-by-point in a logical and often linear fashion (Ford et al. 2002).

Cultural cognitive design

Although differences in cultural reasoning can be summarized as holistic or analytical, an adequate connection has not been made between cultural cognition and information design that could identify a theoretical model for cross-cultural Web design. We propose that cultural cognitive design (CCD) theory connects cultural cognition and the contextual shaping of the internal systems that represent the organization and structure of Web information. Culture and cognition affect one another, resulting in a contextual exchange (Nisbett & Norenzayan 2002). As a result, major differences between East

TABLE 1 Holistic and analytic cognitive styles relative to information design for the web.

comparison of holistic and analytic cognitive styles	
holistic perspective: continuity, field relationships, dialectics, and experience-based	analytic perspective: discreteness, object relationships, categories, logic, and abstract analysis-based
as applied to cultural cognitive theory	
1. The world is a collection of overlapping and interpenetrating substances. Matter is by nature continuous.	1. The world is a collection of discrete objects, which can be classified by the subset of universal properties that characterize the object.
2. Parts (objects) exist within a whole (or field) to which they have inseparable relations.	2. Abstracting the object from its context allows events to be explained by properties of the object.
3. The world is organized into relationships and similarities among objects and events.	3. The behavior of objects can be explained by categories and rules that are context- independent.
4. Although it is important to seek principles underlying events, a dialectic that reconciles, transcends, or accepts apparent contradictions often has advantages over a strictly logical account.	4. The development of formal logical systems constrain debate though such principles as non-contradiction.
5. To seek an intuitive and instantaneous understanding through direct perception results in a focus on particular instances and concrete cases.	5. Epistemology should be bound by logic because perception and direct experiential knowledge is unreliable, incomplete, and misleading. The evidence of the senses should be rejected when it conflicts with reason.
as applied to designer's cognitive style	
1. An approach that has often been associated with the right side of the brain and responds more to a figure-ground approach to layout and design with more attention given to relative contrast.	1. An approach that has often been associated with the left side of the brain and responds more to objects of equal importance, where the ability to see the image is directly related to the interrelationship between background and foreground.

(Table continued)

TABLE 1 Continued.

comparison of holistic and analytic cognitive styles	
2. Cognitive style design is described as field dependent, tending toward a global view, with field-dependent individuals that are less analytical and thrive in situations where learning is structured for them (Witkin & Goodenough, 1981).	2. The cognitive style is described as independent, with field-independent learners that are more adept at the analytical structuring of information, i.e., they experience the components of a structured field as separated from their background and impose structure on a relatively unstructured field (Witkin & Goodenough, 1981).
3. Discourages the isolation of the parts by presenting the parts in their relationship to one another so the user can anticipate content as well as structure, e.g., the related grouping of text, icons, or images.	3. Encourages a distinction of the parts with less concern for their interrelationship within the whole, e.g., the clarity of order of interface components with more reliance on text.
4. Design is approached holistically and, therefore, reflects a more intuitive process and a concrete representation of the system.	4. Design is approached analytically and, therefore, reflects a more deliberative process and an abstract representation of the system.
as applied to information representation: web design	
1. Interface design and information architecture provide a broader range of choices for viewing the Web site.	1. Interface design and information architecture typically lack a range of choices for viewing the content.
2. Content is designed in the context of the whole, while attempting to interconnect the various parts, i.e., everything is relative and can usually be understood in relation to the context.	2. Content is structured and divided into distinct but clearly interrelated components so users can focus on each one independently.
3. The information architecture may be represented by a site map that clearly visualizes the site's hierarchy. The look and feel of the site might be considered inseparable from its content or reflect participatory design.	3. The information architecture may be represented by a site map with an outline form with main headings and subheads. The appearance of the site might contain separate units or objects that are valued because of their independent importance.

(Table continued)

TABLE 1 Continued.

comparison of holistic and analytic cognitive styles	
4. The overall information design is intuitive, with a thematic approach to the design of information, i.e., based on the thematic relations among groups. The site metaphor is analogous to a department store with several floors representing the categories.	4. Information design appears more logical with an approach that is more functional based on inferences drawn from the items in the groups. The site metaphor presents a hierarchical organization of the information as broken down into categories and subcategories.

Asian and Western ways of thinking, communicating and interacting greatly influence how each group might understand, interact with and produce information. When we apply CCD theory to Web site design, culturally bound patterns in how Web designers think and behave will dominate. And because holistic and analytical cognitive styles dominate information-producing and information-seeking behavior, these styles are particularly relevant to our model of cultural influence on Web design (Ford et al. 1994; Wood et al. 1996; Ford et al. 2002).

The designing of information for the Web might then suggest a holistic or analytic orientation based on the formation of the Web designer's cognitive style. Farnen (1993) suggests that this notion refers primarily to structure, rather than content. In this case, structure refers to the organization of cognition, whereas content refers to what knowledge is available. Berry's (1987, 1993) research in cross-cultural cognitive style revealed patterns in the way cognitive styles vary across cultures. Although his work is related to subsistence activities, it provides a link between cognitive style and cultural orientation (Zebian & Denny 2001).

The cultural psychological perspective provides a theoretical foundation for understanding cognitive styles. This foundation can help researchers to more succinctly identify the empirical aspects of how culture affects the cognition of the information designer. As suggested above, cultures vary when it comes to analytical processes, definition of knowledge domains, and learning skills (such as deductive rules and schemes for induction and causal analysis). These differences have a direct bearing on how cultural cognition impacts the design and organization of information. This position suggests that cognitive styles are contextually shaped systems that embody how information is organized internally. When Web designers understand and apply these cognitive styles, the information designs they produce will be directed by culturally bound patterns of thinking and acting.

A test model for holistic and analytical cognitive styles

Online information design can be characterized as holistic or analytic, depending on the field dependence of the Web designer who constructs the Web site information. By observing the design of interfaces and information architecture, we can understand how strategizing during production is oriented toward a holistic or analytical style. The assumption here is that differences in culture-specific cognitive styles of Web design will influence the culture-specific form, organization and structure of online information. Table 1 outlines a comparative framework of both perspectives, beginning with our proposed theory of CCD, its application to cognitive style, and finally information design for the Web. Each orientation is broken down into contrasting dimensions from which each culture might view, analyze and synthesize information.

CCD goes to the root of information processing and other complex cognitive systems that suggest that differences in cognitive style will drive variations in Web design based on a culturally rooted holistic or analytic perspective. First, as established above, cultural context influences thinking patterns and information processes. Consequently, information production may reflect the cognitive style of Web designers (graphical and organizational logic), playing a direct role in the development of the WWW. Second, the designers' cognitive styles may also represent their mode of problem-solving in Web design, and, in turn, a specific culturally orientated construction of information may influence a user's interaction experience. Third, depending on the design style employed, these differences may directly impact user preferences and performance while using the Web.

It might be more difficult for users to find information in a Web site created by a designer from a different culture for reasons related to the layout of the interface, the information architecture or the general organization of content. Hence, a preference for a site's information design may reflect improved performance. Of course, unrelated problems in a Web site's design could cause users to experience a range of performance difficulties or design biases.

Ultimately, empirical studies carried out with groups from various cultures using different kinds of Web sites need to answer two key questions. Do users have a preference for Web sites created by designers from their own culture, and do these preferences impact their Web performance? At the same time, does the cognitive style of a Web designer influence his/her building of information in a way that affects the performance and preferences of Web users?

Testing the proposed theory

We present two exploratory studies that focus on the relationship between the cultural cognitive style of Web designers and the preference and

performance of participants from three national cultures. The first was an in-lab study (Faiola & Matei 2005a) consisting of three cultures. A second study (Faiola & Matei 2005b) was performed online using two cultures. The in-lab and online studies concur, insofar as there was a significant tendency for both groups to have a preference for and perform faster on Web sites designed by those of their own national culture.

The in-lab study

An in-lab exploratory study was designed to support the hypothesis that participants would prefer the Web sites designed by those of their own national culture. The in-lab experiment compared the preferences of six Chinese, Russian and American students.[2] Eighteen participants were exposed to six Web sites, all with the same content that focused on business training. Rigorous cross-cultural translation techniques were applied to ensure accuracy and integrity, i.e. there was a parallel translation, double translated forward and backward. Two Web sites per culture were used, taking into account the variability in design styles. The six sites were created by stripping the original text (e.g. Chinese, Russian and English) from each site and replacing it with that of the other two languages (i.e. each of the six sites was developed in the three languages). The shells of the Web sites were left intact, i.e. colors, menu and page structures, information architecture and all other interface elements and attributes. The six Web designers (two from each culture) received the text in Microsoft Word format and were instructed to design a site specifically for their own national culture. Detailed instructions directed each designer to adhere, as much as possible, to those traditional design styles of their own culture related to interface design, layout, typography, graphic elements and information architecture.

The Web sites were presented on six adjacent displays simultaneously. Each cultural group of six participants met at the test lab at different times. Once together, the participants were given 15 minutes to view and navigate each site, while comparing the differences of all six sites in terms of interface design and information architecture. The participants were then given a questionnaire composed of eight questions. In the questionnaire, the participants[4] were asked to indicate which site they preferred in terms of (1) general usability, (2) visual appeal, (3) layout and design, (4) color, (5) symbols and logos, (6) menus and button choice, (7) navigation system, and (8) information organization. Participants were able to compare the sites as they filled out the questionnaire, which they had 30 minutes to complete. As Table 2 shows, Russian, American and Chinese respondents clearly preferred, as measured by the eight-item index, the Web sites designed by people of their own culture.[5] All differences were statistically significant with the Russians at $p < 0.000$ (chi-square = 18.000), the Americans at

TABLE 2 Participants' preference index scores.

		Russian designed sites	American designed sites	Chinese designed sites	
number of American participants	- M	dian	0	4	0
	¿ ¼ Median	6	2	6	
number of Russian participants	.Median	6	0	0	
	¿ ¼ Median	0	6	6	
number of Chinese participants	.Median	0	1	6	
	¿ ¼ Median	6	5	0	
chi-square		18.000	7.200	18.000	
N		18	18	18	
median		.000	.000	.000	
asymp. sig		.000	.027	.000	

p ¿ 0.027 (chi-square ¼ 7.200), and the Chinese at p ¿ 0.000 (chi-square ¼ 18.000). Scale reliability was satisfactory for each index (Cronbach's alpha ¿ 0.9).

The online study

An online exploratory study conducted by Faiola and Matei (2005b) also supports our theory of CCD. The hypothesis of this study stated that the online task time performance of participants would be faster when using Web sites created by designers of their own national culture. In this study, the performance of 27 Chinese and 26 American students was compared, using a convenience sample from both national cultures.[6] As in the in-lab study, participants were given six goal-directed questions. Participants then drew upon their personal cognitive styles to seek answers to each question. To answer all questions required navigation throughout the Web site. The action included the use of the interface menu to understand and seek the necessary information in the Web site hierarchy. However, unlike the in-lab experiment, task questions did not call upon participants to provide subjective assessments of the Web sites. Rather, questions required participants to quickly complete each task sequentially, thereby limiting their time either to reflect on or establish a clear preference. The treatment applied in the online study consisted of two Web sites rather than six, but each site was designed using the same specifications, designer skill level and content.[7] The dependent

measures included responses to the six online questions that required the execution of a time-recorded task.

The collapsed performance times for tasks 1–4 indicated a significant interaction effect between the site culture and participant culture ($F(1,49) = 9.396, p < 0.004$). Both the Chinese and American performance times were significantly shorter for tasks performed on sites designed by individuals of the same cultural background. No significant interaction effects were found for either task 5 ($F(1, 49) = 0.009$, $p = 0.923$) or task 6 ($F(1, 49) = 0.038$, $p = 0.847$) (Faiola & Matei, 2005b).

Discussion on the two studies

In an in-lab experiment, participants were asked to explore and reflect upon the quality of six Web sites, applying an appraisal process from their respective cultures, noted by Norman (2004) as the reflective operations of cognition. We suggest that the in-lab test evoked emotional responses about the sites the participants experienced largely because of the open-ended and qualitative nature of the research questions. Therefore, the results of the in-lab self-reported questionnaire may have allowed more consideration than is typical of a performance-based study (e.g. time-on-task). In this case, reflection played a conjoining role in cultural cognition, wherein affect was inextricably linked to attitudes, expectations and motivations. Norman holds that 'everything has both a cognitive and an affective component – cognitive to assign meaning, affective to assign value' (p. 25). Traditional cognitive approaches to Web site usability have tended to underestimate the influence of emotion on cross-cultural preferences. Although long-established cultural traits become cognitively embedded, spontaneous emotional responses, which draw on evolving values, can quickly change behavior. The in-lab experiment gave the participants time to reflect on their experience of the six Web sites, and this reflection was key to their affective appraisal (Hilgard 1980; Rafaeli & Vilnai-Yavetz 2003).

At the same time, results of an online experiment (Faiola & Matei, 2005b) demonstrated that participants from the same culture as the Web designer performed tasks more quickly. When the influence of cultural preference was introduced, contextual influences triggered emotional processes of appraisal (Study 1) (Faiola & Matei 2005a). However, the participants' cognitive performance in the online experiment also revealed a strong relationship between Web site design and national origin (Study 2) (Faiola & Matei 2005b). In other words, the cultural preferences of participants concurred with their developed cultural cognitive processes. Thus, the in-lab study suggested that participant Web preferences may have been largely driven by emotional responses.

Central to the theoretical underpinning of CCD is the work of Nisbett and his colleagues in cultural cognition theory (Nisbett et al 2001; Nisbett & Norenzayan 2002), which we expanded and applied to social cognition learning (Vygotsky 1978 [1930/1935]), cognitive styles (Ford et al 1994; Chen & Macredie 2002), and Web designer cognitive style (Faiola and Matei 2005a, 2005b). Overall, these theories are in agreement with the results of these two studies, which document similar interaction effects between the cultural cognitive style of Web designers and cultural cognitive style of users.

Conclusion and future directions

The complexities of cross-cultural CMC pose a great challenge to developers of online information. However, theories on cultural cognition and related processes can provide a valuable perspective for understanding the implications of cultural orientations based on cognitive development and style. Hence, the authors first presented a case for establishing a framework to understand how cognitive development influences the cognitive styles of Web designers from diverse cultures. We presented research that suggested that cognitive style has the potential to influence the design of Web sites (Choong & Salvendy 1999; Littlemore 2001; Nisbett et al. 2001; Kitayama et al. 2003). We asked whether variations in cultural cognitive style affect the way that Web site designers structure online information. Next, we presented the idea that information is conceived of and conveyed differently by designers from East Asian and Western cultures. Therefore, online information design can be identified with a holistic or analytic cognitive style, depending on how the designer constructs site content. As demonstrated by the results of two studies (Faiola & Matei 2005a, 2005b), the authors presented assumptions about basic cognitive processes and content distinctions related to holistic and analytic orientations and their influence on Web design, referred to as the theory of CCD.

As the findings suggested, holists tend to adopt a global approach to learning and organizing information; they see clear interrelationships among topics in the discovery process. For example, Chinese are more likely to find a strong association among objects that are functionally or contextually related. Specifically, the format of information in a Chinese-designed Web menu system may often create implicit relationships between its parts and the whole. Conversely, Americans are more likely to find a strong association among objects belonging to the same category. Specifically, sites designed by American designers may emphasize the division of different kinds of information into hierarchical categories that keep most information hidden within the hierarchy of information. The cognitive patterns of these two orientations show clear differences in cultural style and make use of particular cognitive models of designing

information. Hence, these findings suggested that culturally bound patterns of thinking and behaving influence content design.

As the Web continues to expand, the necessity for effective online communication will force researchers to abandon homogeneous Web design models and instead devise methods that measure cultural cognition and the influence of context on the cognitive styles of Web site designers. Future studies should also give more attention to the affective parameters that mediate information design and usability (Scherer 1997; Norman 2004), because these parameters affect short-term and long-term memory and may impact cognitive processes that influence cross-cultural Web design and Web use.

Gradually, trends in research will work towards universal access to the World Wide Web (Adams & Khoo 1996; Stephanidis & Savidis 2001). As a result, Web developers will be more sensitive to the influence of culture on cognition. As ubiquitous computing moves the user's experience beyond the desktop metaphor, an emphasis will be placed on the sociological, cultural and historical context of users (Dourish 2001). This line of research will also offer scholars a new perspective on how the appearance and feel of design conventions express culturally rooted cognitive processes, aesthetics and emotional choices that profoundly shape design style and usability.

Notes

1 The five dimensions consisted of: (1) Power distance, referring to social inequality and the extent to which less powerful members of society expect and accept unequal power distribution, (2) Uncertainty avoidance, referring to how people vary in their anxiety about unknown threats as compared with known and understood ones, (3) Individualism verses collectivism, referring to the contrasting of cultures between those that value personal choice, responsibility and independence to those that value group harmony and loyalty, (4) Masculinity verses femininity, referring to the contrasting of cultures between those that value assertiveness, toughness, competition and goal orientation with those that value modesty, passivity, home life and children, and (5) Long-term orientation versus short-term orientation, referring to the contrasting of cultures between those that value thrift, perseverance and having a sense of shame with those that value tradition, fulfilling social obligations, and saving face (Hofstede 1980).

2 This view developed much later in the West, for example, in Heidegger's (1962) phenomenology, and it is less well accepted.

3 The term 'Chinese' is used to refer to those who are 'culturally' Chinese and not simply those belonging to the Han ethnic group. Moreover, an assumption was made regarding the length of time the Chinese students

had been studying in the US. Only university students in campus-based Chinese organizations were contacted for this in-lab study. These organizations are formed specifically for students coming from China to the US, usually to attend graduate school. Rarely does this population include US born Chinese students. The average stay of graduate students is based on graduation policies and visa restrictions. Furthermore, after close contact with Chinese nationals for more than a decade, we have found that outside of their academic life, Chinese students often remain within their own cultural communities, maintaining relationships with friends and relatives from China. Their short period of study in the US continues to be dominated by existing culturally embedded ways of communicating, thinking, and learning, all of which were well established during their formative years in China. We use the term 'America' or 'America(n)' to refer to participants and designers of the Euro-American cultural heritage residing in the United States and who use English as their primary language.

4 The ages of Chinese, Russian, and American participants ranged from 24 to 33 years (Ch: M ¼ 27, SD ¼ 1.54; Ru: M ¼ 26.33, SD ¼ 4.27; Am: M ¼ 30.16, SD ¼ 3.13). Relevant to the findings were self-reported levels of computer literacy, tracked at three stages: beginner, average, and expert; Ch: 0, 6, and 0, Ru: 0, 4, and 2, and Am: 0, 1, and 5.

5 To test the hypothesis, a median test was performed by collapsing participant data into three preference indices to measure the degree of association between cultural background and participants' preference. The procedure was repeated three times, once for each preference index. Because the data analysis was performed for each culture separately, 24 binary variables resulted (i.e. 3 cultures x 8 combined measures ¼ 24).

6 Because the Chinese test sample was taken from American universities, a question arises concerning cultural cognitive influence upon Chinese students living in the US for several years. One principle of cultural psychology is that cultural influences decrease substantially as people enter adulthood (Luria 1971, 1976; Nisbett & Norenzayan 2002; Vygotsky (1978 [1930/1935], 1989 [1934]); Zebian & Denny 2001). Chinese students accessing American sites while studying in the US (on average three to six years) probably retain their cultural distinctiveness in terms of cognitive style. Because most Chinese students (studying in the US) are in their mid-twenties, their cognitive style has arguably reached an advanced level of development. In other words, their basic thinking strategies were formally internalized through language and maths in their childhood and adolescent years in China. These embedded problem-solving skills are the building blocks of cognition and would take more than a few years (if at all possible) to reconfigure. In this study, 1,465 Chinese students were contacted via email at 31 Chinese student associations at universities in the United States. One hundred and fifty American students were contacted in three courses at Indiana

University Purdue University Indianapolis (IUPUI). The invitation letters that were distributed via email or handed out contained the same recruiting information. Of the total of 1,615 invitations, 171 respondents (11 per cent) began the online study, of which 53 (3 per cent) completed all of the required tasks.

7 An automated tracking system collected and configured task times on a server.

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