

Cultural Cognitive Style and Web Design: Beyond a Behavioral Inquiry into Computer-Mediated Communication

Anthony Faiola

Human-Computer Interaction Program
Indiana University School of Informatics at IUPUI

Sorin A. Matei

Department of Communication
Purdue University

Numerous studies have identified links among culture, user preferences, and Web site usability. Most of these studies were reports of findings from a behavioral perspective in explaining how cultural factors affect processes of Web-related content design and use. Based on the research of Vygotsky and Nisbett, the authors propose a broader model, referred to as “cultural cognition theory,” by which Web design, like other types of information production, is seen as being shaped by cultural cognitive processes that impact the designers’ cognitive style. This study explores issues related to Web designers’ cultural cognitive styles and their impact on user responses. The results of an online experiment that exposed American¹ and Chinese users to sites created by both Chinese and American designers indicate that users perform information-seeking tasks faster when using Web content created by designers from their own cultures.

doi:10.1111/j.1083-6101.2006.00018.x

Introduction

Since the creation of the World Wide Web Consortium (W3C) in 1994, much attention has been directed at the design and usability of communication technologies. The W3C’s long term goals for the Web have taken into consideration not only the engineering of new online technologies, but also the ways in which the development of environments might better serve a world community as a forum for the communication and dissemination of information (Vincent & Camp, 2005).

The rapid transition to content (information) delivery through the World Wide Web has confronted researchers, scholars, and professionals in communication technology with many challenges. One of the greatest has been developing cross-cultural Web sites that address the subtle psychological aspects inherent in each culture.

Multiple studies in the areas of cross-cultural behavioral and cognitive psychology continue to uncover significant differences in the way people behave, think, assign value, and engage others. Understanding culture is thus vital in computer-mediated communication (CMC) research. Yet, researchers have put limited effort into investigating cultural differences in the way humans process information and interact with others through online communication technologies. Moreover, these technologies often lack content that is sensitive to the complexity of cross-cultural cognition. In order to explore the role of culturally shaped cognition styles in Web-based communication, we suggest that: 1) Web site design is influenced by cultural factors, and 2) understanding the theoretical issues surrounding cultural cognition can enrich this understudied aspect of Web usability research.

In this article, we propose a new theoretical construct, referred to as cultural cognition theory (CCT), and explore its applicability to understanding Web designer cultural cognitive styles. This reflects a novel approach in the field, since most research in this arena has been directed at understanding the user or learner of Web content. Specifically, we suggest that variations in the cognitive style of Web designers, as reflected in the Web content they design, may create cultural biases that can be detected at the level of Web design, and that can be measured in the degree of efficacy and comfort with which cross-cultural users engage online content.

A Merging of Research Perspectives

For more than a decade, the subject of cross-cultural online communication and web usability has been gaining prominence among multimedia, hypermedia, and communication technology researchers (Bourges-Waldegg & Scrivener, 1998; Burnett & Buerkle, 2004; Choong, & Salvendy, 1999; Danet & Herring, 2003; Del Gado & Nielsen, 1996; Ess & Sudweeks, 1998, 2001; Eveland & Dunwoody, 2000; Herring, 1996; Kim & Allen, 2002; Matei & Ball-Rokeach, 2001; Nielsen, 1990; Preece, 2001; Sears, Jacko, & Dubach, 2000; Wheeler, 1998). Numerous cross-cultural communication (CCC) studies have made links between culture and Web usability (Chau, Cole, Massey, Montoya-Weiss, & O'Keefe, 2002; Faiola, 2002, 2004; Trompenaars, 1997). These include studies that address cross-cultural web design and usability with specific concern for user preferences from a behavioral perspective (Barber & Badre, 1998; Honold, 2000; Larson & Czerwinski, 1998; Liu, Lin, & Wang, 2003; Marcus, 2000; Marcus & Gould, 2000; Tractinsky, 1997; Zahedi, van Pelt, & Song, 2001).

The various threads of this research have focused attention on two converging areas: 1) the computer as a mediator in person-to-person communication, and 2) the person as the receiver and processor of information who is influenced by a complex blend of cultural contexts. What is lacking is a further development that merges these theoretical foci by exploring the cultural cognitive aspects of CMC.

Behavior versus Cognitive Perspectives

At the outset it is important to be clear about the difference in research methodologies between behavioral and cognitive psychology, and the apparent paradox of how the findings of cognitive research are also based on observable behavior. How can researchers be assured that their findings truly reflect cognitive processes, rather than behavioral responses?

The most critical aspect of behavior is its relationship to cognition. Behavior, even if habitual or nonreflective, results from some form of cognition, even when the latter falls under the rubric of what LeDoux (1996) or Goleman (1998, 2001) refer to as “emotional intelligence.” Behavior can only be understood by understanding how people think. This is quite different from what behaviorists believe, i.e., that researchers should avoid peering into the “black box” of human thought and focus instead on observable behavior alone (Steinberg, 2003).

Greene (1995) rejected the behavioral theory that researchers can predict how the mind will respond to stimuli as an intentional system, with a logical capacity and with desires and goals. The mind, he argues, is rational in its processing of thought, but only imperfectly so, being to a certain (and significant) degree unpredictable if judged on the basis of behaviors. He notes that rationality is always imperfect, because humans make mistakes in judgment and memory does not always function properly. Regarding affective computing, Picard (1997) also suggested that emotions play an essential role in decision-making, learning, and other processes that directly influence the mechanisms of rational thinking.

From Hall and Hofstede to Vygotsky and Nisbett

The dramatic shift in psychology from behavioralism to cognitive psychology over the past half century marked a simultaneous shift toward viewing both cognition and behavior from within an individuals’ cultural context. Greene (1995) holds that human action is influenced by three key domains that function as causal factors in the production of action: sociocultural, physiological, and psychological. A cultural perspective on cognition assumes that humans are not only prepared biologically with a variety of physiological and psychological components but also with socially shaped propensities. Hence, the human psychological profile is formed through biological, social, and cultural processes. This profile includes particular ways of adaptation and adjustment to one’s sociocultural environment. The sociocultural shaping of cognition may transpire in the production of action in particular ways in each culture. An assortment of interpersonal and social factors in various cultures may be significant predictors of cognition.

At the same time, the theoretical grounding of much cross-cultural research on web usability is still derived from the behavior-driven perspective that reflects the traditions of Hall (1966, 1976) and Hofstede (1991). Although sensitive to the richness of cultural variation, both Hall and Hofstede assume that culture manifests

at the surface, at the behavioral level. Hall's high/low context model for analyzing interpersonal communication and Hofstede's five cultural dimensions, as derived from behavioral patterns, are useful explanatory frameworks. However, they are limited in that the behaviors they explain are seen as puzzle-like arrangements of recombinant patterns of actions. The cultural landscape is seen to be created by a complex combination of simple and similar behavioral units, emerging from relatively neutral and universal cognitive processes, that is shared across cultures. This is in contradiction with cognitive-oriented psychology, and especially with its variant in which culture inflects cognition (cultural psychology), and through it, shapes behavior. Cognition, in this latter view, is not "transparent" and universal, but a faculty profoundly influenced by culture. In short, while in the behaviorist tradition culture is a product of behaviors and of their infinite possible combinations, from the cultural-psychological perspective behavioral diversity is the product of cultural traits, which are deeply embedded in cognitive processes.

The key notion is that each person or group possesses a collection of experiences constructed over time and stored in memory that makes them who they are and influences how they learn. These experiences are imbued with cultural values and culturally patterned ways of thinking, interacting, and responding to each episode differently.

Cultural Psychology as the Theoretical Underpinning of Cultural Cognition

A powerful cognitive perspective on culture and behavior was proposed by Richard Nisbett (Nisbett & Norenzayan, 2002; Nisbett, Peng, Choi, & Norenzayan, 2001). His theoretical grounding, in significant measure inspired by Vygotsky's early work (1934/1979, 1932/1989) in cultural psychology, is that individual psychology is a cultural product. Nisbett's "cultural psychology" can be defined as an examination of the ways in which cultural traditions and social practices create differences in how people think and feel. These differences in subjectivity and introspection are due to context and the constant dynamics of cultural environments (Shweder, 1990). Nisbett starts from Vygotsky's (1934/1979) idea that cognitive processes emerge from practical activity that is culturally constrained and historically developed. Vygotsky and others of the Russian School spent over a decade elaborating a psychology of higher mental processes by designing an empiricist framework for study. Vygotsky's research was further developed by Soviet psychologist A. R. Luria (1976) in the 1960s and 1970s, and continues to be a basis for reflection, analysis, and empirical inquiry for many international scholars in cultural and psychological anthropology.

Cahan and White (1992) suggest that cultural psychology has become a "second psychology" that should be used to describe higher-levels of mental phenomena as entities given from the language, myths, and social practices among which the individual lives. Vygotsky believed that the field of psychology, which during his time (1920s and 1930s) was influenced heavily by the work of Piaget, was in a profound crisis: "For all its greatness, Piaget's work bears the stigmata of crisis

characteristic of all modern psychology,” which was the lack of a true unified theoretical perspective and its fundamental formalism (Vygotsky, 1932/1989, p. 13).

Vygotsky parted ways with Piaget over their antagonistic theoretical positions on concept formation in educational settings. According to Piaget’s theory of conceptualization, the spontaneous character of a child’s reasoning cannot be reconciled with the scientific logic of adults. Yet, where “Piaget saw confrontation, Vygotsky sought dialogue” (Vygotsky, 1932/1989, p. xxxiv). In Vygotsky’s classic theory of the “zone of proximal development,” a child’s empirically rich concepts might be spontaneous and disorganized. When met with the systematicity and logic of adult reason, however, the weakness of spontaneity was compensated by adult reason (Vygotsky).

As an alternative to formalism and behaviorism, and especially to Piaget’s influential concepts, Vygotsky’s sociocultural theories addressed learning as a shared process in the context of social interaction and discourse. Vygotsky states that, “Directed thought is social. As it develops, it is increasingly influenced by the laws of experience and of logic proper” (Vygotsky, 1932/1989, p. 16). The social cognition learning model developed by Vygotsky (1934/1979) suggests that culture is the primary determinant of individual development. He also suggested that our perception of reality is a product of sociocultural processes and that all knowledge is socially mediated, and therefore is grounded in culture. In addition, Vygotsky believed that there should be a unified theory of psychology regarding the problem of logic and grammar in children’s speech and its functional role in the development of logical operations, as well as the problem of comprehension of verbal thought in communication between children and adults.

Vygotsky’s influence has affected “a wide range of contemporary research on culture and cognition. . . . and stands as a stark contrast to the prevailing assumption of experimental psychology that there are unitary, unchanging, universal cognitive processes that operate across contexts, cultures, and historical periods” (Nisbett & Norenzayan, 2002, p. 8). Nisbett and Norenzayan acknowledge the significance of the research of Luria (1976) and Vygotsky (1934/1979) by promoting the idea that culture fundamentally shapes thought. Ultimately, Nisbett and Norenzayan argue that the very things that define cultural frameworks, such as language and mathematics, are also shaped by, and in turn impact, the most profound acts of cognition.

Cultural Cognitive Style

Cognitive style, as defined by Riding and Rayner (1998), is an individual’s preferred approach to organizing and representing information or, according to Ford, Wood, and Walsh (1994), a collection of strategies that individuals differ by when processing information (p. 79). Goldstein and Blackman (1978) further nuance this view, adding that cognitive styles are the characteristic ways in which people: 1) “conceptually organize their environment,” and 2) spontaneously filter and process stimuli so that their environment assumes psychological meaning. Farnen (1993) suggested

that this process provides a “mediating function for information transformation” (p. 378).

Anthropological and psychological studies of general cognitive processes continue to suggest that cognitive styles are connected to culture (Chen & Ford, 1998; Chen & Macredie, 2002; Lucy, 1992; Luria, 1976; Nisbett, & Norenzayan, 2002; Nisbett, Peng, Choi, & Norenzayan, 2001; Riding & Rayner, 1998; Wood, Ford, Miller, Sobczyk, & Duffin, 1996). As contextually influenced processes of learning develop over time, the mind forms particular styles of planning, strategizing, and problem-solving based on inherent patterns of organized information (Goldstein & Blackman, 1978).

This is particularly well illustrated by Nisbett and Norenzayan (2002), who found that “cultures differ markedly in the sort of inferential procedures they typically use for a given problem” (p. 2). Reviewing a range of studies dealing with linguistics and mathematics, they uncovered the variable differences in knowledge domains, analytical processes, and learning skills (such as deductive rules and schemes for induction and causal analysis) in diverse cultures, and showed how these processes operate on different inputs, for different people, in different situations and cultures. For example, discussing Lucy’s study (1992) on how linguistic differences in number marking patterns affect thought among the Yucatee Maya, Chinese, Japanese, and English, Nisbett and Norenzayan (2002) state that, “consistent with the lexical structures of these two languages, Yucatee speakers showed a preference for material-based classification, whereas English speakers showed a preference for shape-based classification” (p. 8).

What is especially of interest in this literature is the solution given to the problems related to the design and organization of information, which provides a theoretical model for cross-cultural Web design, and which we refer to as cultural cognition theory (CCT). CCT goes to the root of information processing and other complex cognitive systems that are affected by cultural context and the orientation of online communication via culturally-designed Web sites.

Nisbett’s framework for understanding how learners possess culturally marked cognitive styles and use distinct cognitive strategies to execute learning tasks notwithstanding, there has been no significant connection made between cultural cognition and Web design. Based on Nisbett and Norenzayan’s (2002) research in culture and cognition, a possible way to connect the two resides in understanding that cognitive styles are contextually shaped systems of organized information. These culturally influenced cognitive styles, when employed by Web designers, result in information production that is dictated by existing culturally bound patterns of thinking (see also McDonough, 1999). For example, the shaping of designer information production can be identified by a range of Web design components in the developmental stage of site design. In addition to the explicit cultural differences of text, numbers, dates, symbol-sets, and time, more critical are the implicit and less formal dimensions of page format, imagery, color, information architecture, and system interaction.

The assumption here is that differences in cognitive style will drive variations in Web design based on national cultural orientation. By observing the design of graphics, text, and information architecture, we can understand how processes of strategizing by culturally diverse Web designers influence their cognitive skills toward a holistic or analytic orientation.

Cognitive style plays an important role in the development of Web design because it suggests that the designer's information processing habits represent that individual's typical mode of perceiving, thinking, remembering, and problem solving. To build sites that are robust environments for content delivery, Web designers must understand how cognitive style can directly impact Web interface and content design and user interaction, especially in terms of holistic and analytic orientations, and their consequences for user behavior in interactive, hyperlinked media environments.

Hypothesis

The present study explores the relationship between variations in the cultural cognitive style of Web designers as reflected in their Web design, and user performance. The overarching research goal is to answer a simple yet fundamental question: Does the cultural cognitive style of Web designers, as reflected in the Web content they design, help users who share the same cultural background as the designer to perform information-related tasks faster? Formally, the hypothesis we advance is:

H1: Online task time performance of users will be faster when using Web sites created by designers from their own national culture.

One implication is that Web sites created by designers from cultures other than those of the users would cause those users more difficulty in finding information, reading text, and navigating, and would therefore produce an overall sense of uneasiness with the usability and aesthetic aspects of the site. Relevant to the results of this study is the assumption that difficulties experienced by the users would not be assigned to the potentially low quality of the site's design, but rather would be ascribed to the cultural cognitive style employed by the designer.

Method

Users

Our study compares the performance of Chinese and American users while interacting with sites created by American designers from Indiana University Purdue University Indianapolis (IUPUI) and Chinese designers from mainland China in the first year of graduate school at Purdue University. The two cultures were selected because of their importance in the global communication and cultural landscape and the fundamental cultural-cognitive styles that distinguish them. Selecting a comparable sample of Chinese and American Web users was not easy, however. Since the

inception of their discipline, cross-cultural researchers have found it difficult to acquire random or stratified samples. This is especially true if users are living in multiple cities and countries around the world and if the medium chosen for study is the Internet. Our study also had to deal with governmental restrictions for accessing external Web sites in China. As a result, we decided to select a sample of American and Chinese students from a number of American universities. The students were contacted via e-mail, using a convenience sampling technique for the American sample, and a more rigorous methodology for the Chinese students. E-mail lists for Chinese student associations (clubs) at 31 different American university Web sites and personal invitations forwarded by three Chinese professors teaching in the U.S. to their Chinese student contacts were used for inviting students to participate in the study. The American students were recruited from the IUPUI student population in the School of Informatics. One hundred and fifty invitation letters were handed out in three separate classes. The invitation letters contained the same recruiting information that was sent to the Chinese students through e-mail, as outlined above.

The authors believe, in tune with the basic principle of cultural psychology, that cultural influences decrease substantially as humans enter adulthood (Luria, 1971, 1976; Nisbett & Norenzayan, 2002; Vygotsky, 1934/1979, 1932/1989; Zebian & Denny, 2001). As a result, Chinese students accessing American sites while studying in the United States (for an average of three to six years²) are assumed to continue to retain their cultural distinctiveness in terms of cognitive style. Because all of the Chinese students are in their midtwenties, they are at a life stage where cognition has already reached an advanced level of development. Their cognitive style and foundational learning strategies have been internally formalized through language and math during their childhood and adolescence while living in China. These embedded learning skills are the primary building blocks of cognition and require more than a few years to reconfigure (if they can be reconfigured at all).

In total, 1,465 invitations were sent to potential users of the Chinese culture and 150 invitations were given out to American students, for a total of 1,615 invitations. Of this total, 171 (or 11%) responded by visiting the study site, of whom 53 (27 Chinese and 26 American) completed the test (see Table 1 below).

Table 1 Online test invitation letter results

Culture	Bulk E-mails or Personal Invitations Sent, minus 33 E-mails returned undelivered	Participants who visited test site	Participants who finished online tasks
CH	1465	77	27
AM	150	94	26
	1615	171 (11%)	53 (3%)

Treatment

The treatment in this study was interaction with two Web sites: one designed by an American and the other by a Chinese designer. The two sites were translated into English or Chinese and each culture group was split into two groups, such that half of the Chinese students were exposed to the American-designed site and half to the Chinese-designed site, both of which were written in Chinese, while half of the American users were exposed to the Chinese-designed site and half to the American-designed site, both of which were written in English. For both conditions (exposure to American/Chinese sites) and for both ethnic groups, the subjects did not know the national origin of the Web designer, and the content of the sites did not betray in any way the nationality of the designer.

The text provided to both Web designers was in their native language and was related to business training. The Web designers were asked to construct a typical Web site for people of their national origin. The Web sites' layout in terms of typography, graphic elements, and information structure was left to the discretion of the Web designers, so that they would be able to use their culture-specific cognitive toolkit in organizing and presenting the information (see Figure 1 below). It is important to note when reviewing Figure 1 that the Web site home pages (user interfaces) are only a portion of the total interactive experience of the users. Critical to the full experience of the users was the interaction experience of the

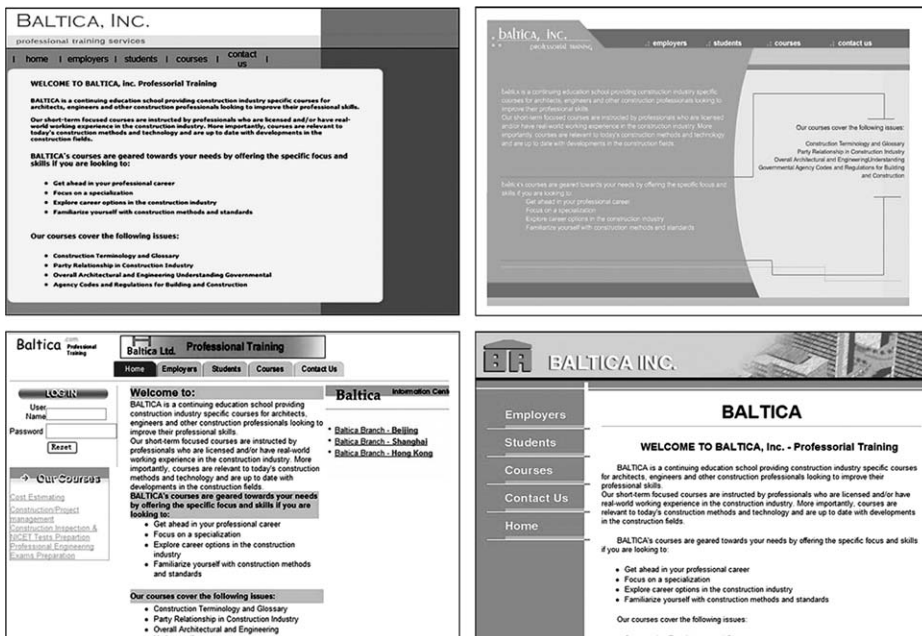


Figure 1 The home pages of the four test sites: The two top web sites were created by American web designers, and the two bottom web sites were created by Chinese web designers.

interrelationship between the home page, the menus, the site's navigation system, and the organization of the information.

Treatment Strength

Treatment strength refers to the number of Web sites delivered to each user. When users came to the online test site, they were only exposed to one of the two sites. The two Web sites were delivered by rotation, depending on the order in which users visited the site (see Figure 2 below). Users were only exposed to one site because of possible multiple-treatment interference, or what we refer to as “accumulated learner advantage.” In this major threat to validity, if subjects were to see multiple sites of the same content, their performance level might improve because of learner knowledge gained from the first site experience.

Dependent variable

The dependent variable was the time required to respond to six online questions (also referred to as tasks) that asked the users to provide answers after interacting with the test Web site. The users were instructed to read the questions that were located in a separate frame (panel) at the bottom of the interface. After a user searched throughout the site, he/she answered appropriately by clicking the “yes” or “no” button, and then clicked the “Next” button to precede to the next question (see Figure 3). At this point, the system recorded that the user had finished the task and the time was recorded. As such, the primary use of the “yes” or “no” function was to give a time-stamp to the system for time-on-task recording in the case of each user.

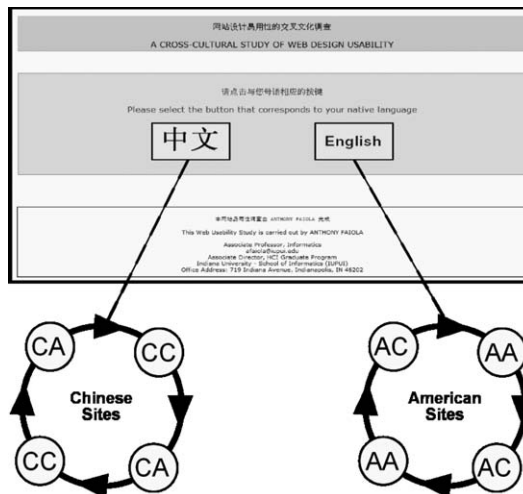


Figure 2 Research portal homepage for the test site. Figure shows the rotation sequence in which each of the language-specific sites were delivered to the users as they visited the site. CA = Chinese site designed by an American; CC = Chinese site designed by a Chinese.

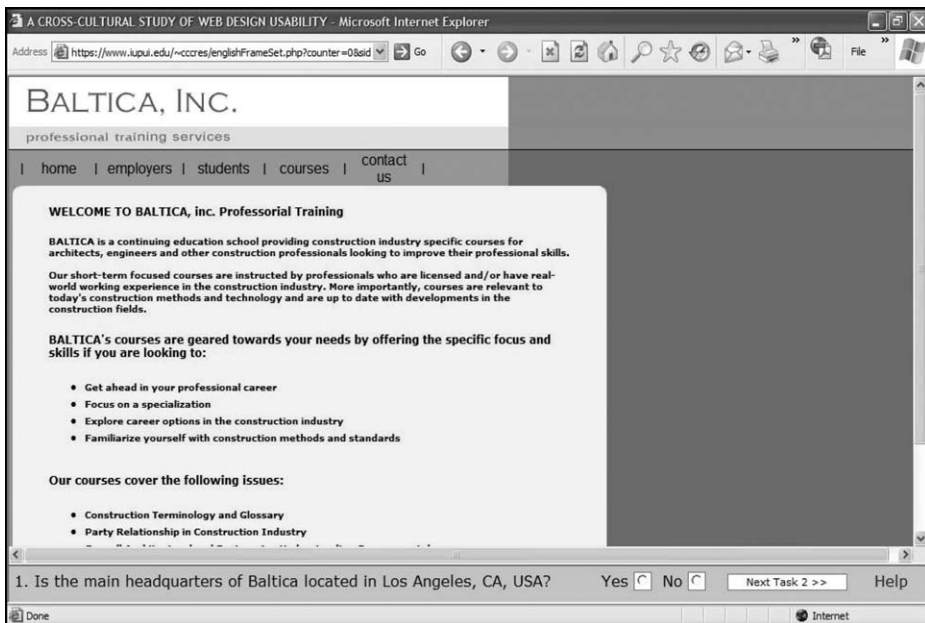


Figure 3 One of the American test Web site tasks with the question panel at the bottom, as well as the “yes” or “no” option buttons, with the “Next” button to proceed.

Each of the six questions was designed to challenge the users in their cognitive strategy as they attempted to find the appropriate embedded answers within the Web site. The questions were designed to range from simple (direct) to more complex, requiring a certain amount of problem-solving to detect variations in task performance.

The questions were inspired by the QUEST Interactive Test Analysis System (Adams & Khoo, 1996).³ This form of measurement allows for the analysis of relative performance by best estimating the probability of performance, low to high, based on the Rasch model analysis (Bond & Fox, 2001). The Rasch model assumes that subjects' performance on a test is determined by their latent trait relative to the difficulty (easy to difficult) of the test item (task). In this model, the parameters are assumed, i.e., that the latent trait is a random effect that varies across subjects, and that test item difficulty is a fixed effect and calibrated on the same scale.

The six questions were as follows:

1. Is the main headquarters of Baltica located in Los Angeles, CA, USA?
2. Can you find the online Employee Application?
3. Are the Baltica courses designed to familiarize the student with construction methods and standards?
4. Does the Baltica Student Admission Application ask you to provide your professional experience?
5. Does Baltica offer a course in Accounting Management?

6. Are there 15 different courses offered in the Construction/Project Management area of Managing the Construction Project?

Data collection

Data were collected by means of an automated tracking system on the local server located in the Indiana University Purdue University Indianapolis (IUPUI) School of Informatics. Recorded data tracked users anonymously, giving each visitor to the test site a tracking number and a date and time stamp for the execution of each task, as well as the post-task questionnaire.

Results

We analyzed the data using an ANOVA 2x2 design with the user's cultural background as the independent variable, interaction with Chinese vs. American designed Web sites as conditions, and task performance times for the six tasks as dependent variables. The results indicated that only the first four tasks provided significant interaction effects, supporting the hypothesis that the cultural cognitive style of web designers (reflected in the web content designed) would facilitate the task performance of users who share the same cultural background with the designer.

The results from analyzing the collapsed performance times for tasks 1–4 are presented in Figure 4 and indicate a significant interaction effect between site (designer) culture and user culture ($F(1, 49) = 9.396, p < .004$). Both the Chinese and American performance times were shorter for tasks performed on sites designed by individuals of the same cultural background as the user. The interaction times

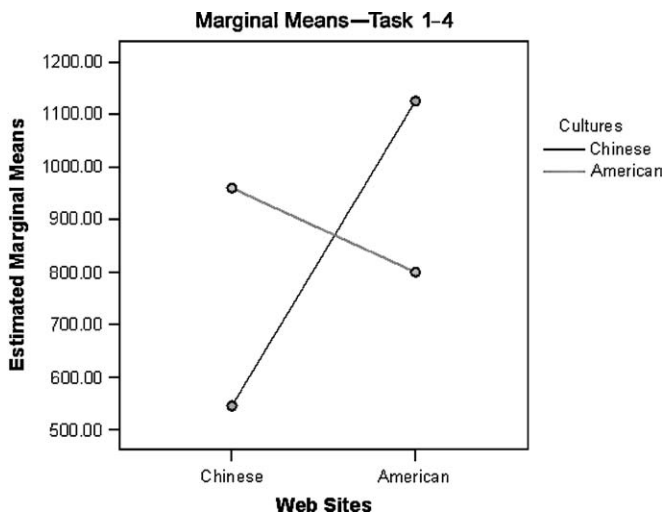


Figure 4 Performance times of users for Tasks 1–4 when using sites created by designers of their own versus the other national culture.

were also shorter, and the interaction effects in the desired direction were statistically significant, for each of the four tasks analyzed individually (see Figures 5 and 6).

The two-way ANOVAs for tasks 5 and 6 did not provide support for our hypothesis. No significant interaction effects were found for either task 5 ($F(1, 49) = .009, p = .923$) or task 6 ($F(1, 49) = .038, p = .847$). Also, despite the fact that in both cases all respondents seemed to perform better when interacting with the Chinese sites, there was no main effect for Web site cultural background (see Figure 4).

Discussion

Pivotal to the theoretical underpinning of this study is the work of Nisbett in cultural cognition theory (Nisbett & Norenzayan, 2002; Nisbett, et al., 2001), which we have extended and applied to studying the cognitive style of Web site designers (Chen & Macredie, 2002; Ford, et al., 1994). These theories suggested a novel approach in CMC research: observing the performance effects of Web sites that are influenced at the design level by different cultural cognitive styles.

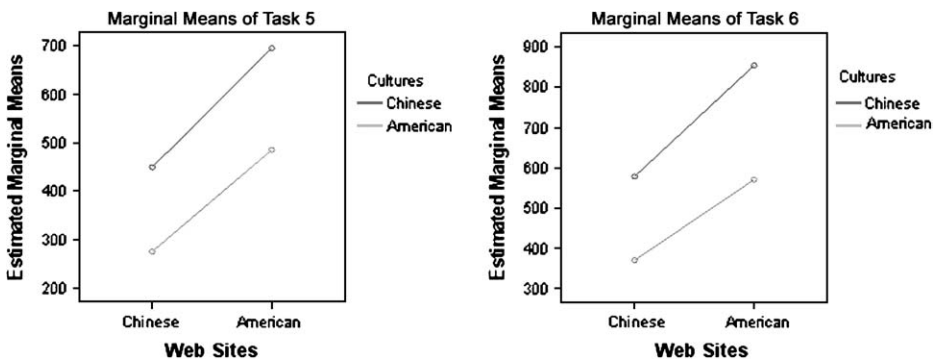


Figure 5 No significant performance times for Tasks 5 and 6 of both cultures.

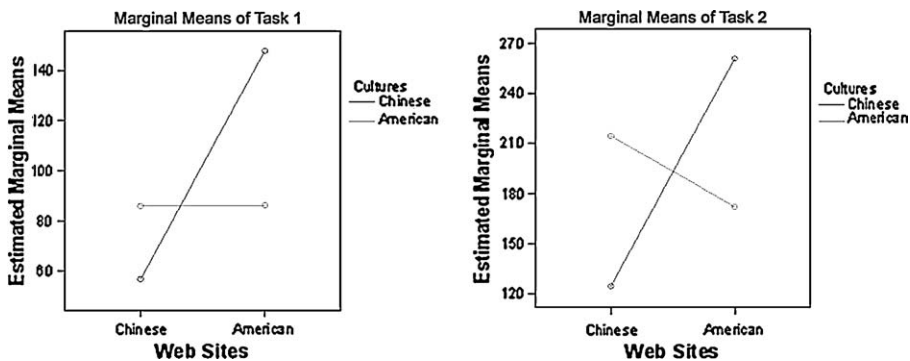


Figure 6 Performance times for Task 1 and 2 of both cultures.

The analysis provided support for our hypothesis in the case of four of the six tasks studied, where respondents performed better on sites created by designers originating from their own culture. The fact that we did not get significant results for tasks five and six may have been due to several factors. First, after task 4, we observed a sharp drop off of user activity, i.e., users began exiting the site without finishing the test. By the time users finished task 4, the accumulated (mean) time had reached 17.23 minutes—a relatively long time in an online test environment, beyond what most test subjects might feel is acceptable (Hara & Kling, 1999; Moore & Kearsley, 1996; Nielsen, 1999). Second, the accumulation of time may have played an additional factor in increased environmental (natural) interruptions. Third, critical incidents (computer system errors) may have been a general factor that distracted the users as they went through each task. In fact, of 171 users who initially entered the test site, only 53 finished all the tasks and 28 stopped at or after task 4 (see Table 2).

The proportion of those who stopped the study at tasks 4 and 5 was nearly the same for both cultures. This suggests, as previous literature has shown, that unmonitored users (regardless of culture) do not fully complete tasks outside of a controlled lab setting (Hartson, Castillo, Kelso, & Neale, 1996; Scholtz, 1999).

In addition, it should be noted that tasks 5 and 6 were more complex than the first four. They required a more rigorous search for answers by navigating throughout the Web site, which demanded more cognitive effort and problem-solving. This might also have contributed to subject attrition and a more negligent approach to answering the questions.

Conclusion: Looking to the Future

The results of this study substantiate that cognitive differences at the design level exist in the form of cultural styles that are perceptible to users. Although the purpose of this study was not to provide Web design recommendations per se, the results strongly suggest that awareness of cultural cognitive style is necessary for the improvement of online communication. Building upon this research, we foresee future work that will better inform Web site designers about how to respond to implicit thinking patterns of cross-cultural users. We intend to improve and extend this research agenda through a larger sample study in the future.

Table 2 Users exiting the test after task four

CUL	Users who visited test site	Users who exited the online test after task #4	Users who finished all 6 online tasks
CH	77	15	27
AM	94	13	26
	171 (11% of total users who received invitation)	28 (16% of total users Who visited the site)	53 (3% of total users who visited the site)

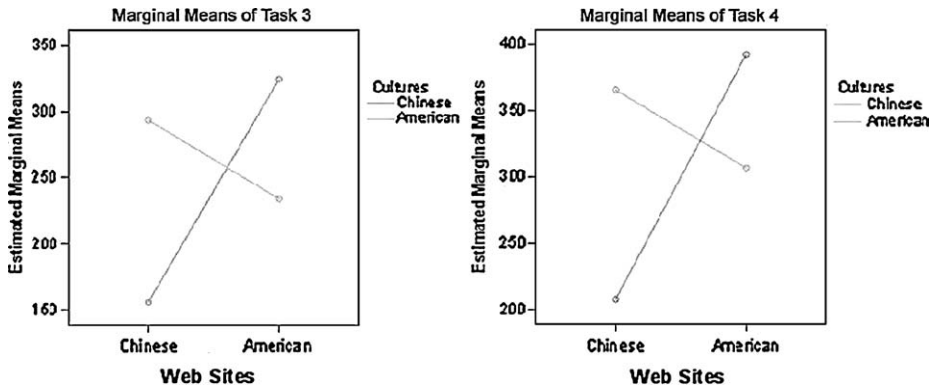


Figure 7 Performance times for Task 3 and 4 of both cultures.

More investigation by researchers in CMC and HCI is needed on international Web design styles. This is especially important considering that most research in cross-cultural Web design has been conducted from a behavioral perspective. Typically, it has been assumed that user performance is a result of either user technical competence or system usability. This perspective ignores the fact that task performance on the Web is a complex outcome, modulated by multiple factors, including those resulting from the cultural consonance between designer and user cultural cognitive styles. This creates the need for considering a new theoretical underpinning for cross cultural Web design and usability research, which makes a more explicit connection among culture, cognition, information production and organization, and Web design. The current study strove to provide such a connection, inspired by the work of Vygotsky and Nisbett.

Measuring user performance is an important early step in exploring the connection between culture, design style, and usability. Further research should explore the emotional operators that intervene both in design and in use processes (Norman, 2004; Scherer, 1997). These operators are known to affect short-term and long-term memory of local and past cultural experiences; as such, they may impact cognitive processes that influence Web design and Web use. This line of research could provide researchers a new perspective on how the look and feel of design conventions are expressions of culturally rooted aesthetic and emotional choices that impact design style and usability.

As Web development continues to proliferate and users become increasingly dependent on effective online communication, researchers should move away from homogeneous design models and routine time-on-task usability testing, and devise test models that can account for cultural cognition and the influence of cultural context on the cognitive style of Web site designers. New opportunities in communication technology are emerging worldwide that bring the promise of universal access for international Web users. At the same time, the rapid transition to the delivery of online information products has forced companies from various sectors

to confront the barriers of language and a broad range of cultural dimensions. We believe that Web technology developers should increasingly take into account the complexity of the cognitive apparatus that intersects with a cultural dimensions, including the human-like responses that users often seek when engaging interactive systems.

Notes

1. America or America(n) refers to users (students) and designers residing in the United States who use English as their primary language. We are keenly aware that cultural boundaries, even within the United States and China, exist on multiple levels, making sampling and interpretation in a study of this kind a challenge. Nevertheless, following in the tradition of cross-cultural research conducted by cultural psychologists and anthropologists, we have done our best to build a methodology that can assure sound results.
2. An assumption was made by the authors regarding the length of the time that the Chinese students had been studying in the United States. This was deduced from the fact that we contacted only university students in campus-based Chinese organizations. These organizations are formed specifically for foreign Chinese students coming to the United States to study (usually) in graduate school. Rarely, if ever, do their members consist of U.S.-born Chinese students. The average stay of graduate students is based on the limitations imposed by graduation policies and visa restrictions. Furthermore, after close contact with Chinese nationals for more than a decade, we have observed that aside from their daily academic studies, Chinese students often remain clustered within their cultural communities, maintaining continuous interaction with friends and family members. As such, their short period of study in the United States continues to be dominated by pre-existing culturally embedded ways of thinking and learning established during the formative years.
3. We also considered a number of consecrated psychometric measures of cognitive styles currently used by cognitive psychologists, such as the Group-Embedded Figure Test (GEFT), the Kirton Adaptor-Innovator Inventory, and the Cognitive Styles Index. However, they were assessed to be too complex and difficult to implement in the web environment.

References

- Adams, R. J., & Khoo, S. T. (1996). *Quest: The interactive test analysis system*. Melbourne, Australia: Australian Council for Educational Research.
- Barber, W., & Badre, A. (1998). *Culturability: The merging of culture and usability*. Retrieved January 10, 2003, from <http://research.microsoft.com/users/marycz/hfweb98/barber/index.htm>
- Bond, T. G., & Fox, C. M. (2001). *Applying the Rasch model: Fundamental measurement in the human sciences*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Bourges-Waldegg, P., & Scrivener, A. R. (1998). Meaning: The central issue in cross-cultural HCI design. *Interacting with Computers Special Issue*, 9(3), 287–309.

- Burnett, G., & Buerkle, H. (2004). Information exchange in virtual communities: A comparative study. *Journal of Computer-Mediated Communication*, 9 (2). Retrieved October 1, 2005, from <http://jcmc.indiana.edu/vol9/issue2/burnett.html>
- Cahan, E. D., & White, S. H. (1992). Proposals for a second psychology. *American Psychologist*, 47, 224–235.
- Chau, P. Y. K., Cole, M., Massey, A. P., Montoya-Weiss, M., & O’Keefe, R. M. (2002). Cultural differences in the online behavior of consumers. *Communications of the ACM*, 45(10), 138–143.
- Chen, S. Y., & Ford, N. J. (1998). Modelling user navigation behaviours in a hypermedia-based learning system: An individual differences approach. *International Journal of Knowledge Organization*, 25(3), 67–78.
- Chen, S. Y., & Macredie, R. D. (2002). Cognitive styles and hypermedia navigation: Development of a learning model. *Journal of the American Society for Information Science and Technology*, 53(1), 3–15.
- Choong, Y. Y., & Salvendy, G. (1999). Implications for design of computer interfaces for Chinese users in mainland China. *International Journal of Human-Computer Interaction*, 11(1), 29–46.
- Danet, B., & Herring, S. C. (Eds.). (2003). *The multilingual Internet: Language, culture and communication in instant messaging, email and chat*. Special issue of the *Journal of Computer Mediated Communication*, 9 (1). Retrieved October 1, 2005, from <http://jcmc.indiana.edu/vol9/issue1/>
- Del Gado, E., & Nielsen, J. (Eds.). (1996). *International user interfaces*. New York: John Wiley & Sons.
- Ess, C., & Sudweeks, F. (1998). Computer-mediated communication or culturally-mediated computing? Challenging assumptions of the electronic global village. *The Electronic Journal of Communication / La Revue Electronique de Communication*, 8 (3–4). Available from http://www.cios.org/getfile/Ess_V8N398 [requires membership in CIOS].
- Ess, C. with Sudweeks, F. (Ed.). (2001). *Culture, technology, communication: Towards an intercultural global village*. Albany, NY: SUNY Press.
- Eveland W. P., & Dunwoody, S. (2000). Examining information processing on the World Wide Web using think aloud protocols. *Media Psychology*, 3, 219–244.
- Faiola, A. (2002). A visualization pilot study for hypermedia: Developing cross-cultural user profiles for new media interfaces. *The Journal of Educational Multimedia and Hypermedia*, 11(1), 51–71.
- Faiola, A. (2004). The second psychology of Vygotsky and Luria: Cross-cultural web design from a cognitive perspective. *Proceedings of the International Scientific and Technical Conference and Russian School of Young Scientists and Specialists: System problems of quality, mathematical modeling and information technologies. Sochi, Russia, Part 2*.
- Farnen, R. F. (1993). Cross-national perspectives on cognitive studies, problem solving, and decision making. In R.F., Farnen (Ed.), *Reconceptualizing politics, socialization, and education: International perspectives for the 21st century* (pp. 376–460). Oldenburg: Library and Information Systems, University of Oldenburg.
- Ford, N., Wood, F., & Walsh, C. (1994). Cognitive styles and searching. *Online and CDROM Review*, 18(2), 79–86.
- Goldstein, K. M., & Blackman, S. (1978). *Cognitive style*. New York: Wiley.

- Goleman, D. (1998). *Working with emotional intelligence*. New York: Bantam.
- Goleman, D. (2001). An EI-based theory of performance. In C. Cherniss & D. Goleman (Eds.), *The emotionally intelligent workplace* (pp. 27–44). San Francisco: Jossey-Bass.
- Greene, J. O. (1995). An action-assembly perspective on verbal and nonverbal message production: A dancer's message unveiled. In D. E. Hewes (Ed.), *The cognitive bases of interpersonal communication* (pp. 51–85). Hillsdale, NJ: Erlbaum.
- Hall, E. T. (1966). *The hidden dimension*. New York: Doubleday.
- Hall, E. T. (1976). *Beyond culture*. New York: Random House.
- Hara, N., & Kling, R. (1999). Students' frustrations with a Web-based distance education course. *First Monday*, 4 (12). Retrieved August 1, 2005, from http://www.firstmonday.dk/issues/issue4_12/hara
- Hartson, H. R., Castillo, J. C., Kelso, J., & Neale, W. C. (1996). Remote evaluation: The network as an extension of the usability laboratory. *Proceedings of the Conference on Human Factors in Computing Systems (CHI'96)* (pp. 228–235). New York: ACM Press.
- Herring, S. C. (Ed.). (1996). *Computer-mediated communication: Linguistic, social, and cross-cultural perspectives*. Philadelphia: John Benjamins Publishing.
- Hofstede, G. (1991). *Cultures and organizations: Software of the mind*. London: McGraw-Hill.
- Honold, P. (2000). Cultural and context: An empirical study for the development of a framework for the elicitation of cultural influence in product usage. *The International Journal of Human-Computer Interaction*, 12, 327–345.
- Kim, K. S., & Allen, B. (2002). Cognitive and task influences on web searching behavior. *Journal of the American Society for Information Science and Technology*, 2, 109–119.
- Larson, K., & Czerwinski, M. (1998). Web page design: Implications of memory, structure, and scent for information retrieval. *Paper presented at the CHI '98 Human Factors in Computing Systems*, Los Angeles.
- LeDoux, J. (1996). *The emotional brain: The mysterious underpinnings of emotional life*. New York: Touchstone.
- Liu, Y., Lin, F., & Wang, X. (2003). Education practice and analyzing behaviour of students in a web-based learning environment: An exploratory study from China. *Online Information Review*, 27(2), 110–119.
- Lucy, J. A. (1992). *Grammatical categories and cognition: A case study of the linguistic relativity hypothesis*. Cambridge, New York: Cambridge University Press.
- Luria, A. R. (1971). Towards the problem of the historical nature of psychological processes. *International Journal of Psychology*, 6, 259–272.
- Luria, A. R. (1976). *Cognitive development: Its cultural and social foundations*. Cambridge, MA: Harvard University Press.
- Marcus, A. (2000). International and intercultural user-interface design. In Constantine Stephanidis (Ed.), *User interfaces for all* (pp. 47–64). New York: Erlbaum.
- Marcus, A., & Gould, E. W. (2000). Crosscurrents: Cultural dimensions and global web user interface design. *Interactions*, 2(4), 32–46.
- Matei, S., & Ball-Rokeach, S. (2001). Real and virtual social ties: Connections in the everyday lives of seven ethnic neighborhoods. *American Behavioral Scientist*, 45(3), 550–563.
- McDonough, J. (1999). Designer selves: Construction of technologically mediated identity within graphical, multiuser virtual environments. *Journal of the American Society for Information Science and Technology*, 50(10), 855–869.

- Moore, M. G., & Kearsley, G. (1996). *Distance education: A systems view*. Belmont: Wadsworth Publishing Company.
- Nielsen, J. (Ed.). (1990). *Designing user interfaces for international use: Advances in human factors and ergonomics*. New York: Elsevier Science Ltd.
- Nielsen, J. (1999). *Designing Web usability: The practice of simplicity*. Indianapolis, IN: New Riders Publishing.
- Nisbett, R. E., & Norenzayan, A. (2002). Culture and cognition. In H. Pashler & D. L. Medin (Eds.), *Stevens' Handbook of experimental psychology: Vol. 2: Cognition* (3rd ed., pp. 561–597). New York: John Wiley & Sons.
- Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic vs. analytic cognition. *Psychological Review*, *8*, 291–310.
- Norman, D. A. (2004). *Emotional design: Why we love (or hate) everyday things*. New York: Basic Book.
- Preece, J. (2001) *Online communities: Designing usability and supporting sociability*. New York: Wiley.
- Picard, R. (1997). *Affective computing*. Cambridge, MA: MIT Press.
- Riding, R., & Rayner, S. G. (1998). *Cognitive styles and learning strategies*. London: David Fulton.
- Scherer, K. R. (1997). The role of culture in emotion-antecedent appraisal. *Journal of Personality and Social Psychology*, *73*, 902–922.
- Scholtz, J. (1999). A case study: Developing a remote, rapid, and automated usability testing methodology for on-line books. *Proceedings of the 32nd Annual Hawaii International Conference on System Sciences* (pp. 2015–2025). IEEE Computer Society Press.
- Sears, A., Jacko, J., & Dubach, E. M. (2000). International aspects of World Wide Web usability and the role of high-end graphical enhancements. *International Journal of Human-Computer Interaction*, *12*(2), 241–261.
- Shweder, R. (1990). Cultural psychology: What is it? In J. Stigler, R. Shweder, & G. Herdt (Eds.), *Cultural psychology: Essays on comparative human development* (pp. 1–43). New York: Cambridge University.
- Steinberg, R. J. (2003). *Cognitive psychology* (3rd ed.). Belmont, CA: Thomson.
- Tractinsky, N. (1997). Aesthetics and apparent usability: Empirically assessing cultural and methodological issues. *Paper presented at the ACM CHI'97*.
- Trompenaars, F. (1997). *Riding the waves of culture: Understanding cultural diversity in business*. London: Nicholas Brealey.
- Vincent, C., & Camp, J. (2005). Looking to the Internet for models of governance. *Ethics and Information Technology*, *6*(3), 161.
- Vygotsky, L. S. (1979). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press. [Translated from the original text published in 1934.]
- Vygotsky, L. S. (1989). *Thought and Language*. Cambridge, MA: MIT. [Translated from the original text published in 1932.]
- Wheeler, D. L. (1998). Global culture or culture clash: New information technologies in the Islamic world — a view from Kuwait. *Communication Research*, *25*, 359–376.
- Wood, F., Ford, N., Miller, D., Sobczyk, G., & Duffin, R. (1996). Information skills, searching behaviour and cognitive styles for student-centered learning: A computer-assisted learning approach. *Journal of Information Science*, *22*(2), 79–92.

- Zahedi, F., van Pelt, W. V., & Song, J. (2001). A conceptual framework for international web design. *IEEE Transactions on Professional Communication*, 44(2), 83–103.
- Zebian, S., & Denny, J. P. (2001). Integrative cognitive style in Middle Eastern and Western groups: Multidimensional classification and major and minor property sorting. *Journal of Cross-Cultural Psychology*, 32(1), 58–75.

About the Authors

Anthony Faiola is an Associate Professor of Informatics and Associate Director of the Human-Computer Interaction Graduate Program at the Indiana University School of Informatics, IUPUI. His research focus is the relationship between cross-cultural cognition and Web design and usability.

Address: Human-Computer Interaction Program, Indiana University–School of Informatics (IUPUI), 535 W. Michigan Street, IT Building, Room 485 Indianapolis, IN 46202 USA

Sorin A. Matei is an Assistant Professor of Communication, School of Liberal Arts, Purdue University. His research focus is sociospatial shaping of communication technology, online social interaction and communities, spatial analysis (Geographic Information Systems) applied to communication systems, and international communication processes and flows.

Address: 2132 Beering Hall, Department of Communication, Purdue University, 100 N. University Drive, West Lafayette, IN, 47907 USA