EFFECTS OF CULTURAL COGNITIVE STYLES ON USERS' EVALUATION OF WEBSITE COMPLEXITY

Completed Research Paper

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Abstract

The internationalization of websites requires compelling navigation experience for users from diverse cultures. This research investigates the effects of cultural cognitive styles on user perception of website complexity and the subsequent influence on user satisfaction towards the website. More specifically, the website complexity is examined along three dimensions: component, coordinative, and dynamic. Laboratory experiments involving participants from China and United States were used to test the hypotheses. The results showed that the effect of objective complexity on perceived complexity is contingent on cultural cognitive styles. People with holistic and analytic cultural cognitive styles display different perceptions of website complexity. This study extends website complexity literature to the cross-cultural context. It also suggests pragmatic strategies for website design practitioners to improve website design in order to attract international audiences.

Keywords: Cultural cognitive perspective, Cross-cultural website usability, Component website complexity, Coordinative website complexity, Dynamic website complexity

Introduction

Globalization has driven many organizations to have an international presence on the web by developing multilingual websites for people all over the world. However, customizing websites to local markets requires attention to design characteristics that goes beyond simple translation (Fang and Rau, 2003, Cyr and Trevor-Smith, 2004, Rau and Liang, 2003). Various studies in the area of cross-cultural psychology have uncovered significant differences in the way people process information (Miyamoto et al., 2005, Boduroglu et al., 2009). A range of cultural preferences and biases have been identified to impact cross-cultural website usability. If organizations do not pay attention to these cultural preferences and biases, they are likely to encounter cultural barriers and will not be able to communicate effectively with their target audiences in other cultures on the web. On the other hand, a culturally-competent website whose design characteristics match target users' cultural preferences can enhance user navigation experiences and improve the communication between the organization and its users. So ensuring the design characteristics of cross-cultural websites to address the psychological preferences inherent in each culture is important.

Website complexity is one of the most important design characteristics that can influence the quality of communication between an organization and its customers (Geissler et al., 2001, Stevenson et al., 2000, Hall and Hanna, 2004, Nack et al., 2001). Designing a website of optimal complexity level can enhance users' navigation experience and improve their attitude toward the organization's online presence. A quick scan and comparison of popular electronic commerce websites operating comparable businesses in North America and East Asia (e.g., Taobao vs. eBay for C2C businesses, Yahoo! Chinese vs. Yahoo! U.S. as portal sites) reveal that Westerners and Easterner may have different perceptions and expectations of website complexity. In the literature, through comparing the amount of information on the homepages between governmental institutions in East Asia and North America, Masuda et al. (2008) have uncovered that East Asian-made homepages were more verbose and contained more links than North American ones.

Despite the observation and deployment of varying levels of website complexity between the West and the East, there has been no theoretical explanation for this phenomenon. To fill this knowledge gap, our study employ the cultural cognitive perspective to theorize and validate that the distinct cognitive styles of Westerners and Easterners result in their differential perceptions and preferences of website complexity.

Cognitive style literature has posited that different cultures produce distinct cognitive styles that influence how one processes environmental information and stimuli (Markus and Kitayama, 1991, Nisbett et al., 2001, Goldstein and Blackman, 1978, Miyamoto et al., 2005). As imbued in cultural values and social practices over time, an individual forms particular style of perceiving, organizing, and responding to stimuli. The culturally-shaped cognitive styles are manifested as people of Western culture tend to engage in an analytic cognitive style, whereas people of East Asian culture tend to perceive and think in a holistic cognitive style (Markus and Kitayama, 1991, Nisbett, 2003, Nisbett et al., 2001).

Searching and browsing websites involve sophisticated scene and information processing, cultural cognitive styles could shape how an individual attends to and processes the various information stimuli at the website, which in turn would influence the evaluation of the website. Thus, our research question is: how does a user's cultural cognitive style affect his/her perception of website complexity characteristics, and consequently determine user satisfaction? More specifically, we examine website complexity along three dimensions: component, coordinative, and dynamic. Our study has important theoretical and practical implications. Despite the effort on examining factors influencing website usability, work that systematically investigates complexity characteristics across cultures is sparse. Therefore, we seek to fill this gap by exploring the influential role of cultural cognitive styles on user navigation experience. This study is expected to contribute to the literature by adding a cultural dimension to our knowledge on website complexity issues. For practitioners, our findings are expected to provide website design strategies for companies who want to attract international audiences. By tailoring website complexity to target users' distinct cultural cognitive styles, companies can produce compelling navigation experience for users from diverse cultures and make their online presence more effective.

Literature Review

Objective Website Complexity and Perceived Website Complexity

According to Nadkarni and Gupta's (2007), website complexity is a multi-faceted concept and can be reflected in three dimensions, namely component complexity, coordinative complexity, and dynamic complexity.

Objective component website complexity focuses on the visual aspect of website design and is usually discussed at the web page level (Nadkarni and Gupta, 2007, Geissler et al., 2001). It represents the visual density of information cues such as text, graphic, video, and animation presented on a web page. It is determined by the amount of distinct information cues on the web page that need to be processed by users (Nadkarni and Gupta, 2007). A complex web page is manifested as long web page length, many images, words, animations and links displayed on it (Geissler et al., 2001, Tarasewich, 2003).

Objective coordinative website complexity describes the structural aspect of website design. It refers to the interdependency among different web pages configuring the website (Nadkarni and Gupta, 2007, Wood, 1986). In other words, it is the organization and hierarchical layout of different web pages that constitute the entire website. As illustrated by previous literature, presentation depth, which is the number of pages that a user has to go through from the website homepage to a page with no more forward links, is one significant manifestation of coordinative complexity (Nadkarni and Gupta, 2007). As the higher the presentation depth, the more complicated the logical relationships among groups of information on the web pages and the more traverse decisions have to be made by users. Thus, a deeper hierarchical structure of a web site is generally correlated with high coordinative complexity level.

Objective dynamic website complexity focuses on the semantic aspect of website design. It describes the ambiguity of the information at the website (Nadkarni and Gupta, 2007). Prior literature suggests two key web elements influencing the dynamic complexity of a website (Palmer, 2002, Nielsen, 2000, Shneiderman, 1998, Schubert and Selz, 1998, Bucy et al., 1999). First, the ambiguity of the hyperlinks at a websites may increase dynamic complexity. The ambiguous expression of hyperlinks may make it difficult for users to decide which web pages to visit, lead users to irrelevant or unexpected web pages, and increase their efforts to find the needed information. Second, the popup advertisements will also increase dynamic complexity. Popup advertisements could distract a user's visual and cognitive attention to the target information on the web page and therefore increase the information processing load on the user.

Component, coordinative, and dynamic complexity of a website can be captured at objective level and perceptual level. At the objective level, website complexity can be reflected by the technical aspects of a website, containing a range of system design characteristics. At the perceptual level, website complexity is in the eye of the website visitors (Te'eni, 1989, Campbell, 1988). Perceived website complexity describes users' personal perceptions and interpretations of the objective website complexity design characteristics (Agarwal and Venkatesh, 2002, McKinney et al., 2002). A website may generate varying complexity perceptions in different users due to their differences in background and experience (Te'eni, 1989).

Studies have also observed the effects of perceived complexity on important user evaluation of website usability. Some studies suggest high perceived website complexity produces uncertainty and frustration on users, resulting in a negative effect on essential use outcomes, e.g., perceived ease of use (Agarwal and Venkatesh, 2002, Shneiderman, 1998). Moreover, it is suggested that perceived website complexity may determine user perception of website information and system quality (McKinney et al., 2002).

Cultural Cognitive Perspective

Cognitive style is defined as the "tendency displayed by individuals consistently to adopt a particular type of information processing strategy" (Ford et al. 2002). Cultural cognitive researchers have found that an individual's cognitive style can be significantly shaped by the culture he/she lives in (Nisbett et al., 2001). The major reason that a culture can influence an individual's cognitive style is that cultural conventions and social practices can establish distinct patterns as to how people process environmental stimuli (Nisbett and Norenzayan, 2002, Nisbett et al., 2001). The literature in the cultural cognitive perspective

has identified two prominent cognitive styles, namely holistic and analytic cognitive styles (Markus and Kitayama, 1991, Nisbett, 2003, Nisbett et al., 2001).

Holistic cognitive style is generally observed in people from East Asia. They tend to holistically perceive the field as a whole. They can pay attention to relationships between a central object and the field as well as a much wider range of objects simultaneously. Analytic cognitive style is often observed in Westerners. They can detach an object from its context, paying attention primarily to the focal object (Nisbett and Miyamoto, 2005, Chau et al., 2005). Nisbett et al. (2005) have attributed the cognitive difference between the East and the West to the fact that East Asians tend to live in more complicated physical environments and have more complex interpersonal relationship surroundings than Westerners. Over years, environmental differences cultivate the East Asians and Westerners to develop differential perception of and response to the world, leading to distinct holistic and analytic cognitive styles. Culturally marked cognitive styles of holistic Easterners and analytic Westerners are manifested in many social behaviors. For instance, Easterners and Westerners adopt different ways to categorize objects (Ji et al., 2004), develop distinct attitudes towards contradictions (Choi and Nisbett, 2000), and prefer different levels of control when interacting with their environments (Nisbett, 2003).

The cultural cognitive perspective has been employed to explain many differences in information processing between East Asians and Westerners in the psychological literature (Nisbett et al., 2001, Ford et al., 2002, Ji et al., 2000, Kitayama et al., 2003, Boduroglu et al., 2009). Since searching and browsing websites involve sophisticated scene and information processing, our study extends the cultural cognitive perceptive to examine whether individuals' distinct cultural cognitive styles could influence their perception and evaluation of the complexity of a website. Prior to our study, Faiola and Matei (2005) have adopted this perspective to demonstrate that people with distinct cultural cognitive styles have different website design preferences. However, their results only indicated that people perform information-seeking tasks better at the website designed by the designer who shares the same cultural cognitive style. Yet, it is unclear what specific website design characteristics fit a particular culture better and can garner higher website evaluation from the users of that culture. Our study thus extends the existing literature by applying the cultural cognitive perspective to systematically examine the website complexity characteristics and website evaluation outcome.

Research Model and Hypotheses

By integrating the cultural cognitive perspective with website complexity literature, our research model examines how cultural cognitive styles affect the effects of component, coordinative, and dynamic complexity on one's complexity perception and subsequent satisfaction towards the website (see Figure 1).

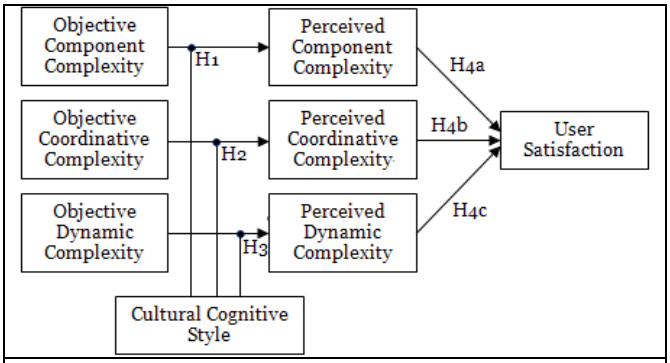

Figure 1. Research Model

The Moderating Role of Cultural Cognitive Style on Component Complexity

We posit that different cultural cognitive styles may affect users' perception of objective website complexity. As mentioned earlier, East Asians tend to have a holistic view of the field, perceiving it as consisting of continuous substances and paying attention to a much wider range of objects simultaneously. In contrast, Westerners see the field as being composed of discrete and unconnected

objects and pay attention primarily to the focal objects (Masuda et al., 2008a, Kitayama et al., 2003, Boduroglu et al., 2009).

Studies have revealed that holistic and analytic cognitive styles can result in differential perceptions of environmental complexity in physical settings. For instance, Easterners are used to visually dense town and city landscapes and pictorial representations (Masuda et al., 2008a, Miyamoto et al., 2006). Miyamoto et al. (2005) have demonstrated that when observing the same pictures with abundant elements, Japanese participants rated them less complex than their American counterparts.

A web page represents a field containing a variety of information cues that the user needs to attend to. Extending the effects of cultural cognitive styles on information processing, we propose that the change in web page component complexity will lead East Asians and Westerners to have differential cognitive responses. When the component complexity of the web page is low, neither Easterners nor Westerners would have significant cognitive load in processing. However, as the number of information cues, such as words, links, graphics and animations, increases on the web page, Easterners would perceive the web page as a whole with continuous components. So their visual perception of component complexity would not increase drastically. On the contrary, because Westerners tend to focus on unconnected and separate components individually, an increase in information cues on the web page would result in much more demand on their cognitive resources, generate heavier cognitive load and lead to higher complexity perception. Thus, we hypothesize:

H1: *The effect of objective component complexity on perceived component complexity is stronger for people with analytic cultural cognitive style than people with holistic cultural cognitive style.*

The Moderating Role of Cultural Cognitive Style on Coordinative Complexity

Keeping the information contents constant, a website with high coordinative complexity that is characterized by deeper hierarchical structures (Nadkarni and Gupta, 2007), will present the user with web pages containing high-level and categorized information initially and require the user to go through the hierarchy to find the web page with detailed target information. On the other hand, a website with low coordinative complexity presents more information on each web page and users can more directly access to detailed information without clicking through many intermediate web pages. However, when interacting with such a website, the user needs to attend to more complex relationships among different information on each web page.

We posit that users' perception of objective coordinative complex website would be influenced by their particular cultural cognitive style. Two mechanisms underlie the influence. First, individuals from the holistic and the analytic cultures adopt different ways to categorize objects. Given Easterners' attention to the relationship and context, they tend to group objects and events on the basis of functional relationships and part-whole relationships. Westerners, in contrast, may group objects more on the basis of category membership. For example, when categorizing "Monkey, Panda, and Banana", Easterners would be more likely to categorize "Monkey and Banana" into one group as "Monkey eats Banana". On the contrary, Westerners are more likely to categorize "Monkey and Panda" together as "Monkey and Panda are both animals" (Ji et al., 2004). Thus, Westerners are more capable of processing information that is presented in highly categorized way and less competent in handling the information embedded in intricate relationship networks. When exploring a website of high coordinative complexity, which is configured by deeper website structure with highly categorized information on web pages, Westerners may feel more comfortable with the more structured and categorized information presentation. In contrast, with a focus on relational-contextual basis, East Asians may be less contented with the highly categorized information. They may feel it tedious and effortful to go through many levels to obtain the needed information. They would prefer a website of fewer levels of hierarchy, i.e., low coordinative complexity, as they are more able to figure out the relationships among a great deal information and locate the target information on one particular web page.

Second, the focus on the focal object and the separation of it from its context enable Westerners to develop a stronger confidence and belief in the controllability of the object than Asians (Nisbett, 2003). They desire to have more control in their interactions with environmental stimuli (Ji et al., 2000). Therefore, they will have a greater sense of success if they are given more opportunities to make decisions

and control the course of actions (Nisbett and Miyamoto, 2005, Simon, 2001). In the context of the evaluation of coordinative website complexity, Westerners could be more willing to click through a lot of links to locate the information they want. This process would not result in significant browsing burden to them. Instead, they gain the satisfaction of exerting control over their behaviors. On the contrary, East Asians' focus on the context where the focal object is embedded may drive them to prefer to see a bigger picture instead of isolated and high-level objects. They may prefer a website with a flat hierarchy and more comprehensive information on each web page to the one with a low structural hierarchy and categorized information on each web page. Clicking through the hierarchy to locate the needed information may seem to be unnecessarily laborious to them.

H2: *The effect of objective coordinative complexity on perceived coordinative complexity is stronger for people with holistic cultural cognitive style than people with analytic cultural cognitive style.*

The Moderating Role of Cultural Cognitive Style on Dynamic Complexity

Websites that are high in dynamic complexity have ambiguous hyperlinks and distracting web ads (Nadkarni and Gupta ,2007). They will cause difficulties for users to locate the target information effectively and effectively. We propose that cultural cognitive styles may affect the perception of the ambiguity and uncertainty of the information at a website. East Asians believe in constant change and the harmonious coexistence of opposing factors (Nisbett, 2003). They tend to employ a dialectic thinking (Lloyd, 1990), which involves reconciling or even accepting conflicting attitudes. Because of their orientation towards the whole field, they tend to consider many relevant situational and contextual factors when predicting outcomes. Therefore, they are able to seek "Middle Way" or compromised solutions when encountering contradictions. They may also factor in a wider range of potential variables when predicting future events (Nisbett et al., 2001). Thus, they can more easily find explanations when confronted with unexpected events. In our context, when navigating a website high in dynamic complexity, Easterners would be more receptive to unexpected click streams that are contradictory with their previous anticipation and would have higher tolerance with pop-up advertisements. Thus, the website with high dynamic complexity may not irritate East Asians tremendously.

On the contrary, analytic Westerners adhere to a strong logical thinking. When presented with apparently contradictory propositions, they tend to reject one in favor of the other (Choi and Nisbett, 2000). When encountering illogical and ambiguous information at the website as well as unpredictable hyperlinks, they would feel more confused and unsure about the succeeding web page. If they are directed to a web page whose contents do not match their original thoughts, Westerners will be more surprised. Consequently, they would feel it difficult to navigate through the web site, leading to a stronger complexity perception.

H3: *The effect of objective dynamic complexity on perceived dynamic complexity is stronger for people with analytic cultural cognitive style than people with holistic cultural cognitive style.*

Perceived Website Complexity and User Satisfaction

Web evaluation studies suggest that the perceived website complexity (including perceived component, coordinative, and dynamic website complexity), rather than objective website complexity that determine website evaluation outcome (Te'eni, 1989; McKinney et al., 2002). As one of the most important outcomes, user satisfaction occupies an essential position in information systems research as well as website evaluation research (Palmer, 2002). Since higher perceived website complexity produces uncertainty and frustration in users, it will result in a more unpleasant use and interaction experience at the website (Agarwal and Venkatesh, 2002, Shneiderman, 1998). Thus user satisfaction with the website would be reduced (Stevenson et al., 2000). Thus, we hypothesize:

H4a: *Perceived component complexity will be negatively related to user satisfaction.*

H4b: *Perceived coordinative complexity will be negatively related to user satisfaction.*

H4c: *Perceived dynamic complexity will be negatively related to user satisfaction.*

Control Variables

Prior research has identified a number of factors that may affect users' website navigation experience, including demographic variables (Wood, 1986), user familiarity (Nadkarni and Gupta, 2007, Agarwal and Venkatesh, 2002), and Internet experience (Webster and Ahuja, 2006). We include these factors as covariate in this study to isolate the effects of cultural cognitive factors.

Research Methodology

Experimental Context

Wood (1986) posits that the three dimensions of complexity capture different website design facets independently. In order to clearly examine the interaction effect of cultural cognitive styles with each dimension, the hypotheses proposed in the present study were tested through three independent matching laboratory experiments each with a 2 × 2 design. By crossing culture (Chinese participants representing holistic cultural cognitive style versus participants from the United States as analytic cultural cognitive style) at the websites designed with distinct website complexity (high versus low), the experimental design resulted in four cells.

It should be noted that in order to avoid language bias, these experimental websites were in English for Western participants and in Chinese for Chinese participants. We used the method of "back-translation" to ensure comparability and equivalence in meaning (Brislin, 1970). Thus, six simulated websites in each language were constructed to test the hypotheses. Specifically, the News homepage was used as research context for component complexity. The e-commerce website was served as research context for coordinative and dynamic complexity because the design characteristics of each complexity dimension are especially important and prominent issues in these kinds of websites. The screenshots of the simulated websites were shown as Figure 2, 3, and 4 in Appendix.

Manipulations

For objective component complexity, manipulating the amount of information cues displayed on the homepage is a common way to operationalize it. It is manipulated by the range of homepage length (number of screens); number of links, graphics, words, and animations as suggested by previous studies (Michailidou, 2005, Tarasewich, 2003, Geissler et al., 2001, Nadkarni and Gupta, 2007).

For objective coordinative complexity, the design characteristic is website presentation depth (Stevenson et al., 2000, Nadkarni and Gupta, 2007, Nielsen, 2000). At the low objective coordinative complexity level, the website structure was flat and took subjects very few steps to find the target information. At the high objective coordinative complexity level, subjects had to go through a deep website structure and clicked a lot of steps to locate the target information.

For objective dynamic complexity, design metrics are number of ambiguous links and number of pop-up advertisements (Nadkarni and Gupta, 2007, Shneiderman, 1998). At the low objective dynamic complexity level, the expression of links was specific and can only be interpreted in one way. The links took subjects to desired web page all the time. For example, the link "more promotion products" expresses certain meaning and tells subjects predictable succeeding web page content after clicking. At the high objective dynamic complexity level, subjects had to process some ambiguous links, which means the expression of hyperlink text has several possible interpretations and these would lead them to some unanticipated succeeding web page after clicking. For example, the link "more", which can both be interpreted as "more products" or "more promotion products" is ambiguous and may link subjects to web page contradicting their expectation. They also encountered unexpected pop-up advertisements. The specific design characteristics were displayed in Table 1.

Table 1. Range of Manipulated Dimensions

	Objective Component Complexity	Objective Coordinative	Objective Dynamic

							Complexity	Complexity	
Website Language	Level	Length (No. of screens)	No. of links	No. of graphics	No. of words *	No. of animation	Presentation depth	No. of popup ads	No. of ambiguous links
English	Low	1	103	18	236	0	2	0	0
	High	3	785	56	2608	11	8	2	3
Chinese	Low	1	103	18	576	0	2	0	0
	High	3	785	56	3966	11	8	2	3
*: Due to language expression differences, the no. of words in the two language versions for the same content would be different.									

Cultural Cognitive Style Test

The objective of this cognitive style test is to demonstrate and confirm that the subjects chosen in this study represent two different cultural cognitive styles-holistic and analytic. The grouping test, adopted from Ji and Nisbett's study (2004), was utilized as cultural cognitive style test in this study. As suggested by cultural cognitive perspective, people with holistic style tend to group objects based on relationships and analytic style people tend to group based on categories (Ji et al., 2004). In this test, we presented participants with ten sets of three words (in one of three random orders) and asked them to indicate which two of the three were most closely related. Some examples of the test words were "Monkey Panda Banana" and "Policemen Letters Postmen". Participants' groupings were coded as relational if they suggested an object-context relationship, such as monkey and banana. Groupings were regarded as categorical if they suggested shared features or category memberships, such as monkey and panda.

Subjects

A total of 120 students were recruited in several large universities in China and the United States (half in China, half in United States). Participants recruited in China were Chinese representing holistic cultural cognitive style and those in the United States were Caucasians as analytic style suggested by cultural cognitive perspective (Nisbett, 2003). It was ensured that participants each had lived in the country the majority of their lives and spoke the native language as their primary language. To avoid selection bias, subjects were only apprised that it was an experiment on website navigation experience. The objective of the study was not revealed. Subjects were randomly assigned to two website complexity treatments. Each subject received $10 as an incentive for participation. As an additional incentive, two subjects received an extra of $50 in a lucky draw. A demographic summary of the sample is shown in Table 2.

Table 2. Demographics of the Sample (N=120)

Westerners					Easterners				
Demographic Variable	Sample Composition				Demographic Variable	Sample Composition			
Age	Mean	24.82	Std	1.04	Age	Mean	23.76	Std	.312
Gender	Male	51.7%	Female	48.3%	Gender	Male	53.3%	Female	46.7%
Degree in Education	Some College	5.0%	College Degree	51.7%	Degree in Education	Some College	3.3%	College Degree	53.3%
	Master's Degree	38.3%	Doctoral Degree	5.0%		Master's Degree	38.3%	Doctoral Degree	5.0%

Experiment Procedure

A pilot test was conducted to finalize the manipulation, and refine experimental procedure and instruction (Perdue and Summers, 1986). 30 graduate students were recruited and asked to perform information retrieval tasks in the experiment. Then subjects were requested to fill out a questionnaire including manipulation checks and demographic variables. After the pilot test, we refined our experimental procedure and the understandability of questionnaires was also increased. The sample and data obtained from the pilot test were not included for the subsequent main study.

In the main study, all subjects began the experiment by answering the pre-experiment cognitive style test. Then subjects were then asked to participate in the three experiments in a random sequence. During each experiment, subjects were randomly assigned to one of two objective complexity conditions (high or low). They were requested to browse the experiment websites and complete information searching tasks without time limitation. More specifically, in the component complexity experiment, subjects were requested to find a specific piece of News from the News homepage. Then they were asked to find a computer model that met all the given requirements by navigating the e-commerce website in the next experiment. As for the experiment of dynamic complexity, they were asked to check whether a specific computer model was on the promotion list. After subjects finished information searching task, they were asked to fill out the questionnaire in each experiment. It should be noted that in order to avoid language bias, the questionnaires were in English for Western participants and in Chinese for Chinese participants. During the experiment process, the Internet speed for each participant was recorded by the experiment system and was used as a control variable to control for the impact of Internet speed at different locations.

Measurements

The instruments were developed by adopting and adapting existing validated scales (see Table 3).

Table 3. Operationalization of Constructs

Constructs	Item Description (1-7 Likert scale, 1=Strongly disagree, 7=Strongly agree)	Source
Perceived Component Complexity (COM)	COM1: In general, the homepage content (graphic, text, flash, etc.) was visually dense to me. COM2: The layout of the homepage was visually dense to me. COM 3: In general, the homepage can be described as complex. COM 4: In general, the homepage can be described as crowded. COM 5: In general, the homepage can be described as overwhelming. COM 6: In general, the homepage can be described as has various items.	Adapted from Nadkarni & Gupta (2007) and Wood (1986)
Perceived Coordinative Complexity (COO)	COO1: In general, the website was clearly structured. COO2: The website offered a logical structure that is easy to follow. COO3: The website structure was confusing.	Adapted from Nadkarni & Gupta (2007) and Wood (1986)
Perceived Dynamic Complexity (DYN)	DYN1: The meaning of some link at the website was unclear to me. DYN2: The links at the website provided me clear indication of what content I should expect after I click. DYN3: Some succeeding web page content after clicking was surprising to me. DYN4: The information on succeeding web page from the initial web page was as expected.	Adapted from Nadkarni & Gupta (2007) and Wood (1986)
Satisfaction (SAT)	SAT1: In general, I am satisfied with the design of the website. SAT2: In general, the browsing experience that I have had with the website was satisfactory.	Adapted from DeLone et al. (1992), McKinney et al. (2002) and Palmer (2002)
Familiarity (FAM)	FAM1: My knowledge of the website is high. FAM2: I visit or used to visit the website often. FAM3: I am familiar with the content on the website.	Adapted from Cox et al. (2002)
Internet Experience	The average Internet usage time per day during recent month.	Adopted from Webster & Ahuja (2006)

Data Analysis

Manipulation Check

The manipulation of objective component complexity was assessed by asking subjects to indicate approximately the homepage length (number of screens) and the number of links, graphics, words, and animations approximately. A t-test ($t = 15.83$, $p < 0.05$) showed that subjects in high objective component

complexity level saw more above-mentioned components (mean=5.58, std=1.20) than those in low objective component complexity level (mean=2.12, std=1.21).

We checked the manipulation of objective coordinative complexity by asking subjects to indicate the approximate number of clicks they did in order to find the answer. A t-test ($t = -10.10$, $p < 0.05$) showed that subjects in high objective coordinative complexity level clicked more (mean=6.00, std=1.83) than those in low objective coordinative complexity level (mean=2.72, std=1.73).

To check whether objective dynamic complexity has been manipulated successfully, we asked subjects to indicate whether they have encountered popup or floating advertisements and compare the ambiguity of the website version they have been exposed and the other manipulation version. All the subjects passed the first manipulation check question about advertisement. A t-test ($t = 6.741$, $p < 0.05$) showed that subjects in high objective dynamic complexity level felt their website version to be more ambiguous (mean=5.56, std=1.42) than those in low objective dynamic complexity level (mean=3.50, std=1.89).

Results of Cultural Cognitive Style Test

The cultural cognitive style test results were analyzed by ANOVA. The main dependent variable was the difference between frequency of relationship-based grouping and frequency of category-based grouping. The results showed a main effect of culture ($F=11.24$, $p<0.01$). Eastern participants showed a clear preference for relationships-based grouping (mean=5.60, std=2.75) than Western participants (mean=2.90, std=5.60). It demonstrated that participants in this study represent two different cognitive styles—holistic and analytic.

Measurement Validation

All statistical tests were carried out at a 5% level of significance. Exploratory factor analysis (EFA) was conducted to test the instrument's convergent and discriminant validity for perceptual constructs. Table 4 reports the EFA results with principal component analysis and varimax rotation using SPSS. First, we found a three-factor structure with eigenvalues greater than 1.0. However, the item loading of FAM1 was below 0.6 and was dropped from further analysis because of its distinct meaning from other items of FAM. After that, all items were loaded on target factors with loading above 0.6, and loaded on other factors with loading below 0.36. Thus, discriminant validity was established. Second, the internal consistency reliability was measured by Cronbach's alpha with 0.7 as the cut-off (Nunnally and Bernstein, 1994). The alphas for all constructs were all above 0.7. Thus, convergent validity was established. After measurement validation, items of each construct were averaged as a measure of the target construct.

Table 4. Results of Exploratory Factor Analysis R^2=71.2%

Variables	Cronbach's Alpha	Items	Item loading		
Perceived Component Complexity (COM)	0.90	COM1	**.851**	-.040	-.093
		COM2	**.848**	-.034	-.128
		COM3	**.722**	-.278	.011
		COM4	**.832**	-.308	-.076
		COM5	**.760**	-.363	-.133
		COM6	**.711**	.069	.072
Satisfaction (SAT)	0.90	SAT1	-.237	**.905**	.083
		SAT2	-.102	**.928**	.073
Familiarity (FAM)	0.85*	FAM1	.153	.126	**.508**
		FAM2	-.136	.018	**.893**
		FAM3	-.263	.008	**.857**
Eigen Value			4.54	1.70	1.54

*: Cronbach' Alpha of FAM was calculated based on FAM2 and 3.

Table 5. Results of Exploratory Factor Analysis R^2=74.6%

Variables	Cronbach's Alpha	Items	Item loading		
Perceived Coordinative Complexity (COO)	0.76	COO1	**.781**	-.047	-.052
		COO2	**.896**	-.092	-.163
		COO3	**.822**	-.044	-.256
Satisfaction (SAT)	0.74	SAT1	-.262	-.144	**.818**
		SAT2	-.338	.083	**.823**
Familiarity (FAM)	0.74	FAM1	-.111	**.908**	.000
		FAM2	.129	**.854**	.115
		FAM3	-.250	**.648**	-.278
Eigen Value			3.05	2.03	.89

Table 6. Results of Exploratory Factor Analysis R^2=72.2%

Variables	Cronbach's Alpha	Items	Item loading		
Perceived Dynamic Complexity (DYN)	0.85	DYN1	-.339	**.854**	.057
		DYN2	-.383	**.820**	.050
		DYN3	-.385	**.867**	.009
		DYN4	.156	**.604**	.033
Satisfaction (SAT)	0.91	SAT1	**.903**	-.231	.002
		SAT2	**.917**	-.177	.026
Familiarity (FAM)	0.72	FAM1	-.016	.044	**.883**
		FAM2	.104	.146	**.824**
		FAM3	.016	-.142	**.679**
Eigen Value			3.61	1.95	1.12

Results on Perceived Complexity

Perceived Component Complexity

Among all the five control variables, gender, education, Internet experience were even distributed among four groups. So in order to minimize noise, only the other three control variables, familiarity, age, and Internet speed were treated as covariates in ANCOVA (Stevens, 2009). ANCOVA was first conducted on the perceived component complexity (see Table 7). No covariates had significant interaction with independent variables. In support of Hypothesis 1, the interaction, involving objective component complexity and cultural cognitive style was significant ($F=5.009$, $p<0.05$). As the objective component complexity increases, the perceived component complexity of Easterners with holistic cultural cognitive style changed from 3.42 (std=1.10) to 4.43 (std=0.91). On the contrary, as the objective component complexity increases, the perceived component complexity of Westerners with analytic cultural cognitive style changed from 3.42 (std=1.47) to 5.52 (std=0.76). The effect of objective component complexity on perceived component complexity was stronger for Westerners with analytic cultural cognitive style than Easterners with holistic cultural cognitive style. Thus, Hypothesis 1 was supported (see Figure 5).

Table 7. Results of ANCOVA (Dependent Variable: Perceived Component Complexity) R^2=41.9%

Source		df	Mean Square	F	p
Covariates	Familiarity	1	3.365	2.855	.094
	Age	1	.331	.281	.597
	Internet Speed	1	.938	.796	.374
Main Effect	Objective Component Complexity (COM)	1	55.817	47.360	.000**
	Cultural Cognitive Style (CUL)	1	1.419	1.204	.275
Interaction Effect	COM*CUL	1	5.904	5.009	.027*

*: p<0.05, **: p<0.01

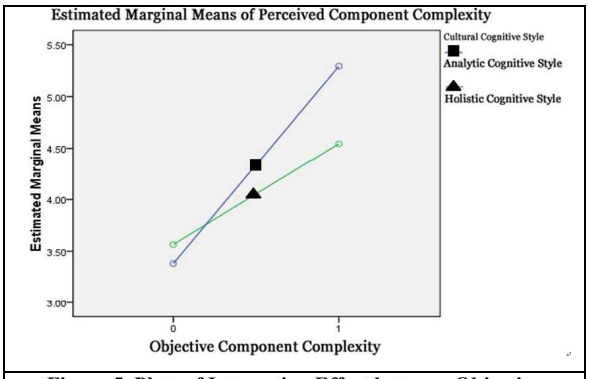

Figure 5. Plots of Interaction Effect between Objective Component Complexity and Cultural Cognitive Style on Perceived Component Complexity

Perceived Coordinative Complexity

Then we conducted ANCOVA on perceived coordinative complexity (see Table 8). No covariates had significant interaction with independent variables. The interaction, involving objective coordinative complexity and cultural cognitive style was significant ($F=4.024$, $p<0.05$). As the objective coordinative complexity increases, the perceived coordinative complexity of Easterners with holistic cultural cognitive style changed from 2.57 (std=0.76) to 3.26 (std=1.27). On the contrary, as the objective coordinative complexity increases, the perceived coordinative complexity of Westerners with analytic cultural cognitive style changed from 2.84 (std=1.16) to 2.73 (std=1.19). The effect of objective coordinative complexity on perceived coordinative complexity was stronger for Easterners with holistic cultural cognitive style than Westerners with analytic cultural cognitive style. Thus, Hypothesis 2 was supported (see Figure 6).

Table 8. Results of ANCOVA (Dependent Variable: Perceived Coordinative Complexity) R^2=10.1%

Source		df	Mean Square	F	p
Covariates	Familiarity	1	3.567	2.967	.088
	Age	1	3.956	3.290	.072
	Internet Speed	1	.276	.230	.633
Main Effect	Objective Coordinative Complexity (COO)	1	2.122	1.765	.187
	Cultural Cognitive Style (CUL)	1	2.387	1.985	.162
Interaction Effect	COO*CUL	1	4.837	4.024	.047*

*: p<0.05, **: p<0.01

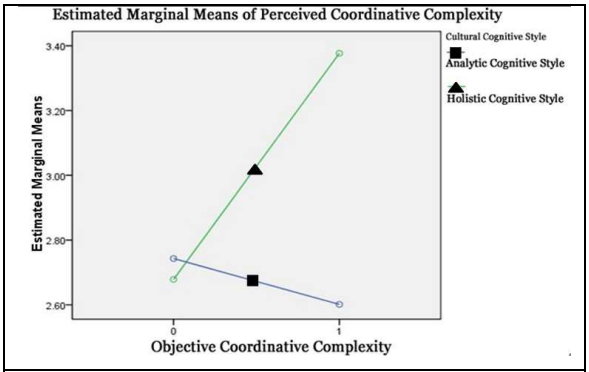

Figure 6. Plots of Interaction Effect between Objective Coordinative Complexity and Cultural Cognitive Style on Perceived Coordinative Complexity

Perceived Dynamic Complexity

After that, ANCOVA was conducted on the third dimension, perceived dynamic complexity (see Table 9). No covariates had significant interaction with independent variables. The interaction, involving objective dynamic complexity and cultural cognitive style was significant (F=16.958, p<0.01). As the objective dynamic complexity increases, the perceived dynamic complexity of Easterners with holistic cultural cognitive style changed from 2.86 (std=.59) to 4.36 (std=.96). On the contrary, as the objective dynamic complexity increases, the perceived dynamic complexity of Westerners with analytic cultural cognitive style changed from 1.87 (std=.78) to 5.00 (std=1.66). The effect of objective dynamic complexity on perceived dynamic complexity was stronger for Westerners with analytic cultural cognitive style than Easterners with holistic cultural cognitive style. Thus, Hypothesis 3 was supported (see Figure 7).

Table 9. Results of ANCOVA (Dependent Variable: Perceived Dynamic Complexity) R^2=58.0%

Source		df	Mean Square	F	p
Covariates	Familiarity	1	1.738	1.478	.227
	Age	1	.001	.001	.979
	Internet Speed	1	.001	.001	.978
Main Effect	Objective Dynamic Complexity (DYN)	1	150.269	127.792	.000**
	Cultural Cognitive Style (CUL)	1	.242	.205	.651
Interaction Effect	DYN*CUL	1	19.468	16.556	.000**

*: p<0.05, **: p<0.01

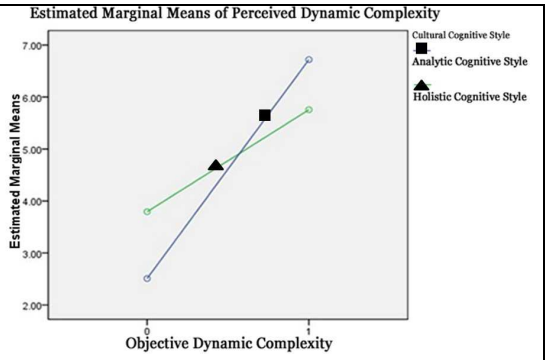

Figure 7. Plots of Interaction Effect between Objective Dynamic Complexity and Cultural Cognitive Style on Perceived Dynamic Complexity

Results on Satisfaction

Regressions were conducted on the dependent variable, satisfaction. After excluding the effects of all manipulated factors and control variables, perceived component complexity still had a significant negative effect on user satisfaction (t=-3.62, p<0.01) (see Table 10). Thus, Hypothesis 4a was supported. Similarly, perceived coordinative complexity also had a significant negative effect on user satisfaction (t=-6.27, p<0.01) (see Table 11), which supported Hypothesis 4b. In addition, perceived dynamic complexity had a significant negative effect on user satisfaction (t=-5.34, p<0.01) (see Table 12). Thus, Hypothesis 4c was supported.

Table 10. Results of Regression (Perceived Component Complexity on Satisfaction)

	Standardized Coefficient		
	Model 1	Model 2	Model 3
Familiarity	.131	.143	.087
Age	.078	.046	.021
Internet Speed	-.063	-.066	-.011
Objective Component Complexity		-.114	.090
Cultural Cognitive Style		-.065	-.097
Perceived Component Complexity			-.404**
R^2	17.4%	21.5%	38.1%
R^2 change	3%	1.6%	9.9%**

**: p<0.01

Table 11. Results of Regression (Perceived Coordinative Complexity on Satisfaction)

	Standardized Coefficient		
	Model 1	Model 2	Model 3
Familiarity	-.027	.000	-.082
Age	.212*	-.264**	-.188*
Internet Speed	.088	-.040	.015
Objective Coordinative Complexity		-.057	.013
Cultural Cognitive Style		-.224*	-.133
Perceived Coordinative Complexity			-.502**
R^2	24%	30.2%	57.1%
R^2 change	5.8%	3.3%	23.4%**

*: p<0.05, **: p<0.01

Table 12. Results of Regression (Perceived Dynamic Complexity on Satisfaction)

	Standardized Coefficient		
	Model 1	Model 2	Model 3
Familiarity	.023	.022	.057
Age	-.227*	-.269**	-.287**
Internet Speed	-.108	-.024	.010
Objective Dynamic Complexity		-.348**	.062
Cultural Cognitive Style		.052	.088
Perceived Dynamic Complexity			-.588**
R^2	24.4%	41.7%	58.3%
R^2 change	5.9%	11.4%**	16.7%**

*: p<0.05, **: p<0.01

Discussion and Implication

Discussion of Findings

This study responds to calls for research aimed at examining cross-cultural information systems design issues, which can contribute to the connectivity and collaboration of the Eastern and Western countries. The major objective of this study is to identify the moderating role of cultural cognitive styles on user perception of website complexity. Four major findings can be derived from this study.

First, the effect of objective component complexity on perceived component complexity is contingent on cultural cognitive styles. The increase of objective component complexity aroused more perception change for analytic Westerners than holistic Easterners. This result resonates with the cultural cognitive perspective (Nisbett and Norenzayan, 2002, Nisbett et al., 2001), which argues that living in more complicated physical and interpersonal environments has led Easterners to develop a lower perception of visually complex world.

Second, the effect of objective coordinative complexity on perceived coordinative complexity is stronger for holistic Easterners than analytic Westerners. In particular, one interesting finding is that as the objective coordinative complexity increases, the perceived coordinative complexity of analytic Westerners decreases. It contradicts with the positive relationship between objective and perceived complexity demonstrated in previous study in the context of a single country (Nadkarni and Gupta, 2007). Our results extend previous understanding by demonstrating that analytic Westerners and Holistic Easterners have distinct perceptions and preferences for website structure. As suggested by prior user interface research, website can either be designed as a "broad" or "deep" structure depending on the number of decisions that must be made on the way to a target node (Galletta et al., 2006). With analytic cognitive style, Westerners tend to be good at processing categorized information and enjoy the movement or controllability over the website by clicking through links. It could possibly diminish their perception of coordinative complexity and employ preference for "deep" website.

Third, as the objective dynamic complexity increases, the perceived dynamic complexity of Westerners with analytic cultural cognitive style increased more dramatically than Easterners with holistic cultural cognitive style. It is consistent with the thought in cultural cognitive perspective that possessing a dialectical thinking, Easterners tend to compromise or hold an accepting attitude when encountered contradictions (Ji et al., 2000).

Fourth, when users have higher perception of website complexity, they are less satisfied with the website. This finding reinforces with prior studies (Agarwal & Venkatesh 2002; Shneiderman 1998). It implies that perceived complexity among users is detrimental to their navigation experience at the website.

Contributions

This study is meant to provide several implications for both researchers and practitioners. From the theoretical perspective, this study makes important contributions to the cross-cultural website usability literature. First, despite the effort on applying website complexity to explore website usability issues in the context of a single country (Nadkarni and Gupta, 2007, Palmer, 2002, Geissler et al., 2001, Stevenson et al., 2000, Hall and Hanna, 2004, Nack et al., 2001), work that systematically investigates complexity characteristics across cultures is sparse. The present study fills the gap by identifying the influential moderating role of cultural cognitive styles on website complexity evaluation. It adds a cultural dimension to our knowledge on user experience of website complexity. Previous website complexity literature mainly focused on the complexity related issues in the context of one single country. Our results point out the importance of including cultural cognitive style as a key construct in the website complexity studies. Existing theories and practices on website complexity evaluation metric may need to be reexamined for their cross-cultural applicability. Future studies may also incorporate cultural cognitive style in testing relationships among website evaluation constructs.

Second, although the role of cultural cognitive styles has been emphasized in the psychology literature (Nisbett et al., 2001, Ford et al., 2002, Ji et al., 2000, Kitayama et al., 2003, Choi and Nisbett, 2000,

Boduroglu et al., 2009), limited number of research has attempted to evaluate its effects on user experience in the online environment (an exception is Faiola & Matei 2005). Therefore, we seek to fill this gap by exploring the cultural cognitive perspective to study website usability issues. We find that the impact of objective website complexity on perceived complexity was different for Westerners with analytic cultural cognitive style than Easterners with holistic cultural cognitive style. Previous studies have applied the cultural cognitive perspective to investigate the information processing behavior in the offline context (Nisbett et al., 2001, Ford et al., 2002, Ji et al., 2000, Kitayama et al., 2003, Choi and Nisbett, 2000, Boduroglu et al., 2009). This study extends the cultural cognitive perspective to the context of online environment and suggests it can also be applied to explain information processing differences when navigating at the website.

Third, our findings suggest that the three dimensions of complexity would arouse different effects on user perception. It broadens existing understanding of website complexity dimensions. Thus, the three dimensions cannot be treated as the same in the cross-cultural context. Future study may take this into consideration when investigating the website complexity issues involving subjects from diverse cultures.

From the practical perspective, this study also suggests a set of pragmatic strategies for website design practitioners to improve their websites in order to produce compelling navigation experience for users from diverse cultures. As trends in globalization, many companies develop multilingual websites for visitors from all over the world. To maximize the satisfaction of users from distinct cultures, website designers may need to manage the complexity of the website accordingly for people with different cultural cognitive styles. Specifically, Western companies may appropriately increase the website complexity by adding more pictures, animations, and web links in order to achieve a visually rich and vivid website for Easterners. When Eastern companies spread out international markets to reach Westerners, they may reduce information components at the website in order to produce comforting user navigation experience and achieve higher user satisfaction.

Future Research

This line of research can be continued in several ways. First, future research could extend the current study by investigating the moderating role of cultural cognitive styles on other user interface designs where globalization is a concern. For example, the website menu design, the organizational information systems design, etc.

Second, we currently have an ongoing experiment to test this research model by using objective measurement, i.e., user performance. Studying outcomes of user performance and satisfaction together will provide a more complete story. It will make the model more useful by explaining variance in additional outcome variables with the same experimental manipulations. It may also eliminate the influence of distinct attitudes towards answering questionnaire for people with different cultural cognitive styles. The research results would be more robust and useful.

Third, it would also be interesting if future study can reexamine this study by using the eye-tracking technology to measure the differences objectively. Besides, priming subjects from the same culture to different cognitive styles is also a promising solution. It may help to eliminate the effect of language or other unrelated cultural distinctions.

Conclusion

In conclusion, this study serves as an initial attempt to investigate the moderating role of cultural cognitive styles on the relationship between three dimensions of objective website complexity and website evaluation outcome. It extends website complexity design research in the cross-cultural context. The findings have useful implications for the management of increasingly common cross-cultural website and provide a foundation for pursuing further research involving cross-cultural website usability. This study suggests that future research in this direction is both theoretically important and practically interesting.

Appendix

Figure 2. Illustration of Component Website Complexity

Figure 3. Illustration of Coordinative Website Complexity

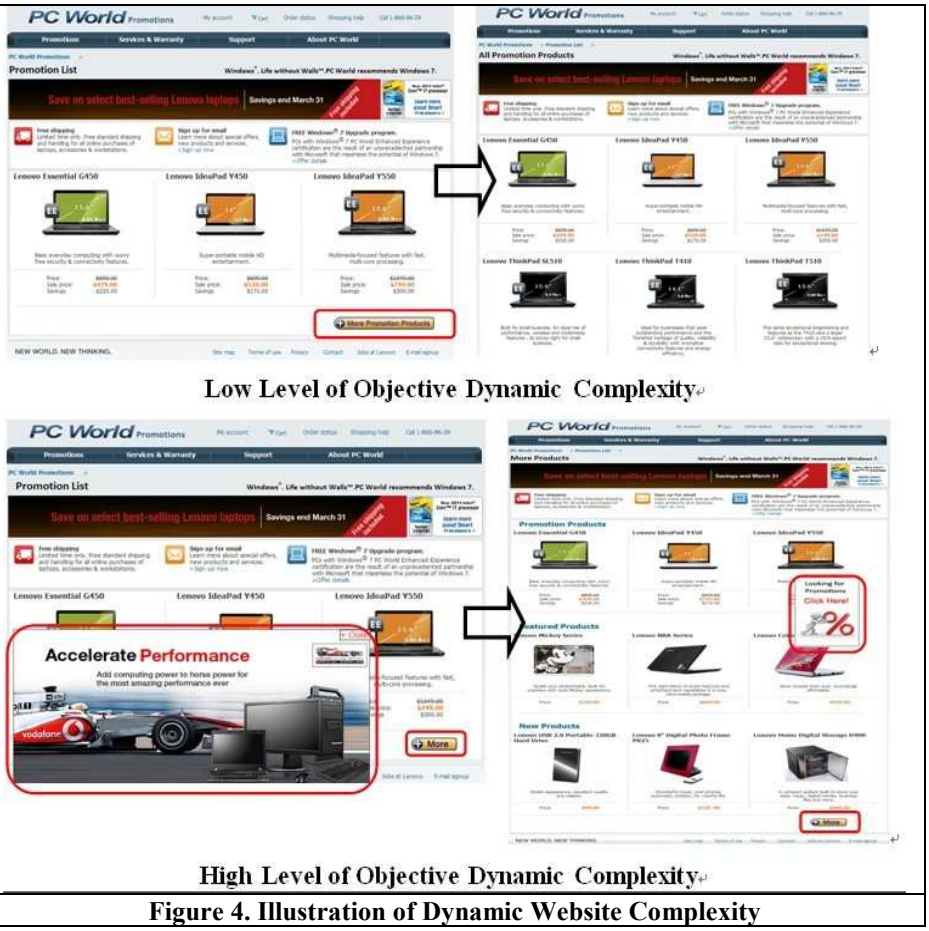

Figure 4. Illustration of Dynamic Website Complexity

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