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The Influence of User Culture on Website Usability

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ABSTRACT

Modern web technologies provide a highly customizable and dynamic interaction medium, yet their potential to accommodate individual user preferences and needs is largely untapped. This research empirically demonstrates the significant interaction of user culture with website usability and satisfaction on a set of translated Australian and Chinese websites. By implementing culturally specific design elements it is possible to have a positive influence on user performance and satisfaction, but these relationships are more complex than originally hypothesized. This work highlights the importance of accommodating the different information presentation and interaction styles of culturally diverse users to improve their performance and satisfaction when using the web.

1. Introduction

The Internet is an increasingly global marketplace and it is unreasonable to expect one common website design to suit everyone. Website users from different cultures think and behave differently (Rau et al., 2008), and hence have different needs and desires. These differences will influence their information processing, interaction style, task performance and satisfaction with websites (Reinecke and Bernstein, 2013).

Cultural psychology relates to how a user's emotions and behaviors are influenced by, or rooted in, their culture (Valsiner, 2013). Differences in cultural psychology and environments lead to different preferences for interfaces across different cultural groups (Fraternali and Tisi, 2008). When browsing web pages, users should be able to interact in a way that feels natural and leads to them successfully achieving their aims, rather than learning a new way of working that may not provide a positive user experience (Thompson and McGill, 2012). Research has shown that culturally adapted website designs can allow users to perform their tasks more successfully and experience greater satisfaction with the interaction (Cui et al., 2015; Hsieh, 2014; Reinecke and Bernstein, 2011), whereas improperly handling cultural differences in websites can result in poor user experience (de Souza and Bernardes, 2016; Konstantakis et al., 2017) and contribute to marginalization and exclusion, because of inability to easily participate (Getto and Sun, 2017). Therefore, designing websites for users from different cultural backgrounds is important (Mushtaha and Troyer, 2012).

Website usability includes the ease with which users can interact with the website, the efficiency of the interaction, the number of errors and the general satisfaction of the user (Nielsen, 1993). Website usability focuses mainly on the functional aspects of website use and is only a narrow aspect of website user experience, which is concerned more broadly with all aspects of the user's experience including before and after direct website interaction. Website user experience has been defined as a user's perceptions and responses resulting from the use and/or anticipated use of the website (Bevan et al., 2015).

User satisfaction can be considered as users' subjective perceptions of the website, including impressions of both usability, and aesthetics (Reinecke and Bernstein, 2011). Assessments of the appeal of websites are made rapidly, are lasting, and have an impact on perceptions of usability (Reinecke and Bernstein, 2011; Reinecke et al., 2013). The overall satisfaction of users with a website design is influenced by cultural variables (Al-Khalifa and Garcia, 2014; Kincl et al., 2013) and insight into how web design preferences differ is provided by research comparing web designs prepared for different cultures (Alexander et al., 2016; Hsieh and Hong, 2013; Nordhoff et al., 2018); research has repeatedly emphasized that national culture influences perceptions of attractive and usable design (Hamborg et al., 2014; Hassenzahl, 2004; Reinecke and Bernstein, 2011).

Bringing together an understanding of usability, satisfaction and cultural differences should contribute to providing a better user experience. Realizing the connection between web design preferences,

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culture, usability and user experience multinational companies now offer culturally adapted websites as opposed to a standardized website (Kralisch et al., 2005; Reinecke and Bernstein, 2011). This is connected to important investment decisions (Kralisch, 2005), as users can easily switch to the competition with a single click (Chau et al., 2002), and therefore a culturally adapted website can provide a significant competitive advantage (Reinecke and Bernstein, 2013). Culturally adapted websites should go beyond language or date and time and fully translate the functionality, look, and feel of web pages, according to a user's culture.

To understand cultural differences in user experience, much prior research has relied on Hofstede et al.'s (1991; 2010) and Hall and Hall's (1990) seminal work on cultural factors. Prior research has applied these cultural factors in website design and found that websites incorporating these cultural factors are linked to higher website quality perceptions (Reinecke and Bernstein, 2011), with the design considered more acceptable by users of the target culture (Fraternali and Tisi, 2008). Users prefer culturally adapted websites (Nantel and Glaser, 2008), perceiving them as more reliable (Chu and Yang, 2010), attractive (Corbitt and Thanasankit, 2002; Reinecke and Bernstein, 2011), navigable (Cui et al., 2015), usable (Forer and Ford, 2003), and appealing (Corbitt and Thanasankit, 2002). It has also been found that culturally adapted websites improve the efficiency of those they were intended for (Fraternali and Tisi, 2008; Hsieh, 2014; Reinecke and Bernstein, 2011).

To bridge the dichotomy between the need for websites that cater for individual cultural backgrounds and an inexpensive method to develop them, a new Cross-cultural Web Usability Model was proposed (Alexander et al., 2017a, b). This model offers cross-cultural web design guidelines and a usability measuring instrument that includes a variety of usability attributes suitable to measure the look, feel, and functionality of website designs. This model may be used to adapt web pages at the presentation level, so that web page layout, complexity, colors, and workflows can change for users from different cultural backgrounds.

The research described in this paper builds upon Alexander et al. (2017a,b) to investigate how cultural factors and website design interact to affect user performance and satisfaction. To achieve this objective, two unmoderated, remote usability experiments, using a set of translated Australian and Chinese websites, were conducted. User task performance and satisfaction with a website from their own country or a translated one from another culture were compared using participants from these two culturally distinct countries. The results highlight that cultural differences in the implementation of web attributes in website design do influence performance and satisfaction, but that these relationships are more complex than anticipated.

An often-quoted expression among Human-Computer Interaction (HCI) practitioners is that "the medium is the message" (McLuhan, 1964); that is, that a user's comprehension of and experiences with a system are fundamentally influenced by the way in which is it presented. Thus, we must consider, in a highly dynamic and customizable web environment, how untapped potential may exist to accommodate users from diverse cultural backgrounds, and conversely the possible detriment of adopting formulaic or standardized website structures that do not appreciate individual differences. The remainder of this paper addresses this issue. Section 2 lays the foundations of HCI and cultural dimensions to describe the way that groups differ. Sections 3 and 4 present our hypotheses and explain the experimental methods used to test how cultural factors and website design may influence user task performance and satisfaction. The results, in Section 5, show how website usability differs between cultures and demonstrate that culturally specific websites can increase user performance and satisfaction. The reasons why these differences are present is discussed alongside the limitations of the study in Section 6. This research concludes that consideration of cultural HCI factors does improve user performance and satisfaction, but the relationships are more complex than originally hypothesized.

2. Background

As described above, in this study usability relates to the ease with which users interact with websites, the efficiency of their interaction, and their satisfaction with them (Nielsen, 1993). Usability evaluation is conducted in the context of individual tasks, that is, discrete defined pieces of work (Diaper and Sanger, 2006). The scale of tasks and interpretation of tasks by users can vary widely (Draper, 1993), and when evaluating the usability websites, tasks must be designed so that they are interpreted consistently across types of user.

Cultural psychology relates to how human beings and cultures shape each other. Prior research demonstrates that culture and language shape the brain for information processing and influence the interaction between users and interfaces (Rau et al., 2008). For example, the Chinese language is more dense than English, so the pages of Chinese websites are much more visually crowded when translated for non-Chinese users (Fraternali and Tisi, 2008). This density of information in Chinese websites is associated with higher perceptions of information reliability by Chinese users compared to the perceived reliability of Western websites (Chu and Yang, 2010).

Culture and usability are often merged into a single entity, "cultural usability" or "culturability" (Barber and Badre, 1998; Tsui and Paynter, 2004). The competition in global markets necessitates effective communication that goes beyond the borders of countries and cultures (Röse and Züblke, 2001), focusing attention on website cultural usability research and localization of user interfaces (Barber and Badre, 1998; Cyr and Trevor-Smith, 2004; Rehman, 2018). An underlying premise is that when website users are more comfortable with culturally adapted web pages, they are more likely to perceive the websites as credible (Oyibo et al., 2016), experience satisfaction (Fraternali and Tisi, 2008), and revisit the website (Chakraborty, 2009; Chau et al., 2002; Díaz et al., 2017).

2.1. Previous research

Research on the role of culture in usability has largely relied on the cultural factors of Hofstede et al.'s (1991; 2010) cultural dimensions. Questions have, however, been raised regarding the validity of using these cultural dimensions. These issues include the initial focus on a single company with a particular organizational culture, IBM, at specific points in time (Søndergaard, 1994) and being subject to issues of ethnographic bias (Dimitrov, 2004). Some authors have also criticized the assumption of cultural homogeneity within nations (McSweeney, 2002), and the age of the work, given rapidly changing global environments (Jones, 2007). Despite these concerns, studies replicating Hofstede's working in other groups have largely provided confirmation for the dimensions (Søndergaard, 1994) and studies using Hofstede et al.'s (1991; 2010) cultural dimensions have helped to explain differences in preferences and performance between people from many countries (e.g., Reinecke and Bernstein, 2011; Watson et al., 1994). Studies such as Lee et al. (2008) have also combined Hofstede's dimensions with other sets of cultural dimensions to provide a greater understanding of differences relevant to usability.

Few studies have adapted cultural factors into website design and empirically measured cross-cultural web usability. Ford and Gelderblom (2003) considered the cultural factors of Hofstede (1991) to examine whether cultural factors influence user performance on existing websites identified as exhibiting characteristics associated with different cultural dimensions. The results did not provide enough evidence to support the hypothesis that cultural factors influence user performance, but the performance levels achieved revealed that the usability of web pages increased for all of the users in the study, as a result of incorporating accommodations for high uncertainty avoidance, masculinity, collectivism and high power distance into the designs.

Prior studies have also measured the task performance and satisfaction achieved with culturally specific website designs. Fraternali and

Tisi (2008) showed that user performance increased on e-commerce websites that incorporate the cultural factors from Hall and Hall (1990) that belong to the user's cultural group. Alostatha et al. (2011), Reinecke and Bernstein (2011), Reinecke and Bernstein (2013) and Hsieh (2014) have all conducted studies that showed that culturally adapted web versions increased different aspects of user performance and satisfaction.

Díaz et al. (2017) used Hofstede et al.'s (2010) cultural factors to iteratively create cultural–oriented usability heuristics, as a set of 12 cross-cultural design guidelines that each relate to one cultural dimension. Diaz et al.'s (2017) empirical evaluation included experiments that compared of use of the proposed cultural-oriented usability heuristics with the use of Nielsen's usability heuristics (Nielsen, 1993) and showed that e-commerce websites that display characteristics relevant to specific cultural factors have improved usability. Similarly, Reinecke and Bernstein (2011) developed a culturally adaptive to-do list tool and found striking improvements in objective performance measures as well as measures related to aesthetics and perceived usability.

Alexander et al. (2016) conducted a large-scale study to compare web design preferences of Australian, Chinese, and Saudi Arabian users. This study identified many prominent design elements or cultural markers that are highly prevalent within a particular cultural group. These prominent design elements can be used to match the cultural needs, expectations, and preferences of users from different cultures, and the prevalence of these design elements was mapped to Hofstede et al.'s (2010) and Hall and Hall's (1990) cultural factors, and HCI factors. This mapping focused on differences in user intention and behavioral patterns, which are essential for the culture-centered design process (Shen et al., 2006) and informed the development of cross-cultural web design guidelines (Alexander et al., 2017a). Using these guidelines together with a usability measuring instrument, Alexander et al. (2017b) created a Cross-cultural Web Usability Model that is characterized by iterative analyses which check design choices for cultural appropriateness, relevance, semiotics, functionality, aesthetics, and usability. This enabled a more in-depth understanding of web cultural preferences.

Websites can be designed for a particular culture using the cross-cultural web design guidelines proposed by Alexander et al. (2017a). These guidelines use relationships among cultural factors, HCI factors and web design to better support web developers. The guidelines consider Hofstede et al.'s (2010) cultural factors (including power distance, individualism, uncertainty avoidance, and long-term orientation), and Hall and Hall's (1990) cultural factors (including context, and time perception). The HCI factors in the guidelines include information speed, information density, information frequency, information redundancy, information sequentiality, interaction sequentiality, interaction exactness, interaction speed, and interaction frequency.

The mechanism that websites use to deliver on the HCI factors can be modulated through the presentation of webpages, using web design attributes such as layout, navigation, links, multimedia, color, text, and visual representation. Decisions about these attributes can also guide choices about web features such as hierarchical structure and information complexity. When designing a website, designers can use the cultural factor values of the country from Hofstede Insights (2021) and Hall and Hall (1990). These values can then be categorized as low, medium, or high. For example, uncertainty avoidance, which is a society's tolerance for risk and ambiguity (Hofstede et al., 2010), is high for many living in the USA.

According to Cyr (2013), users from high uncertainty avoidance cultures prefer complete information when navigating a site to minimize ambiguity. Therefore, the USA would be assigned low information frequency, low information redundancy, low interaction frequency, high information sequentiality, and high interaction sequentiality in the HCI domain. When translating these attributes to web features, navigation should be highly structured and hierarchical with few redundant or duplicated links. This example shows how a more holistic view of cultural factors, HCI factors, and choices about web features may accommodate a culturally specific look, feel and aesthetic in web pages.

2.2. Culture-centered design process

The "one size fits all" approach provides a single version of the website design to be used in all cultures, attempting to make user interfaces compatible by standardization (Shen et al., 2006). This standardization may have a homogenizing effect on multi-cultural society by often ignoring socio-cultural context (Gozde, 2013; Shen et al., 2006), leading users to receive disturbing messages or perform counter-intuitive tasks (Al-Badi, 2009; Bezuayehu et al., 2014). Standardization is a problem not only because it may lead to the inability to effectively use a website, but also because it can contribute to marginalization and exclusion if it is a barrier to easily participate (Getto and Sun, 2017). This is particularly important from a user experience perspective. To bridge the knowledge gap between designers and their target users, a culture-centered design process can be used.

The culture-centered design process was introduced by Shen et al. (2006) when studying the use of interface metaphors in China. This approach integrates factors from established concepts of culture-oriented design proposed by Röse and Züblke (2001) into the existing literature on cross-cultural user interface design. The culture-centered design process consists of four iterative stages including analysis of the users' culture, design, implementation, iterative testing and evaluation, and reformulation of design (Aroshine, 2017; Shen et al., 2006). The culture-centered design process approach has been used by authors such as Huiyang et al. (2007), Saidin et al. (2016), Parmaxi and Zaphiris (2016), Saidin et al. (2017), Heimgärtner (2017), and Aroshine (2017), to enable a focus on cultural preferences, cultural factors, and HCI factors and ultimately improve the usability of cross-cultural user interfaces. This process can support developers to apply knowledge about culture-centered user interface design in an application-oriented manner. The research described in this paper contributes to culture-centered design by investigating how cultural differences in the implementation of web attributes in website design influence performance and satisfaction.

3. Hypotheses

Prior research studies by Nielsen (1993), Nielsen (2001), Fraternali and Tisi (2008), and Punchoojit and Chintakovid (2012) were reviewed to identify key usability attributes of website design. Each usability attribute considered in this study is described in the following sections along with the associated hypotheses.

3.1. Effectiveness

Effectiveness in this context is defined as performance on a web page task (Punchoojit and Chintakovid, 2012). Fraternali and Tisi (2008) observed higher task success on culturally specific website designs. In their study, Chinese users' effectiveness was higher on Chinese website designs that incorporated high information parallelism and density, as well as interaction parallelism. The effectiveness of Western users was higher on Western website designs incorporating low information parallelism and density, as well as low interaction parallelism. Thus, it was hypothesized that:

H1: Cultural factors, HCI factors, and website design interact to affect effectiveness.

Two more specific sub-hypotheses were proposed to enable testing of H1:

H1a: Users from Australia have higher effectiveness on Australian culturally specific website designs as opposed to Chinese culturally specific website designs.

H1b: Users from China have higher effectiveness on Chinese culturally specific website designs as opposed to Australian culturally

specific website designs.

3.2. Errors

In an experimental HCI context, errors are defined as the number of incorrect web pages viewed by a user during a task (Nielsen, 1993). Cross-cultural research in HCI has found that culturally specific navigation structures minimize such errors (Cui et al., 2015; Reinecke and Bernstein, 2011). Reinecke and Bernstein (2011) found that users from high-uncertainty avoidance countries, such as Australia, prefer a deeper navigation structure with a linear navigation pattern to minimize errors. However, users from low-uncertainty avoidance countries, such as China, prefer less structured design (Sang-Hun, 2007) that places content more freely on the web page (Calabrese et al., 2012), to provide navigation freedom (Reinecke and Bernstein, 2013) and to reduce the number of page views to complete tasks (Reinecke and Bernstein, 2011). Given this cultural difference, it was proposed that:

H2: Cultural factors, HCI factors, and website design interact to affect errors.

Two more specific sub-hypotheses were proposed to enable testing of H2:

H2a: Users from Australia make fewer errors on Australian culturally specific website designs than do users from China.

H2b: Users from China make fewer errors on Chinese culturally specific website designs than do users from Australia.

3.3. Efficiency

The time required to successfully finish a task is used to measure user efficiency in cross-cultural website designs. Fraternali and Tisi (2008) and found that Chinese users' efficiency was high in website designs with high information density. Higher information density allows users from long-term orientation and low-uncertainty cultures, such as China, the use of many pieces of information (Reinecke and Bernstein, 2011), to accomplish tasks quickly on web pages (Heimgärtner, 2013). However, Western users' efficiency is higher in Western website designs that minimize the information presented in web pages (Cui et al., 2015; Fraternali and Tisi, 2008). The deeper hierarchical structure reduces the visible items and display density, which helps users with short-term orientation, such as those from the US, to accomplish tasks quickly (Hsieh, 2015; Reinecke and Bernstein, 2011). Given this cultural difference in efficiency, it was proposed that:

H3: Cultural factors, HCI factors, and website design interact to affect efficiency.

Two more specific sub-hypotheses were proposed to enable testing of H3:

H3a: Users from Australia have higher efficiency on Australian culturally specific website designs than do users from China.

H3b: Users from China have higher efficiency on Chinese culturally specific website designs than do users from Australia.

3.4. Satisfaction

Satisfaction refers to a user's subjective comfort with a system and the acceptability of its use (Nielsen, 1993), which is an important indicator for website success (Cui et al., 2015). User satisfaction incorporates perceptions of both usability and aesthetics (Reinecke and Bernstein, 2011). In this study, satisfaction is defined as the overall satisfaction of a user with a website. Users have long exhibited high levels of user performance and satisfaction with culturally specific website designs (Cui et al., 2015; Hsieh, 2014; Reinecke and Bernstein, 2011). For example, studies have shown that Chinese users have higher levels of satisfaction with Chinese website designs than with Western designs (Cui et al., 2015; Fraternali and Tisi, 2008), and users from Saudi Arabia are more satisfied with web pages that incorporate Saudi Arabian cultural preferences (Alyahyan et al., 2016). The impact of culturally specific website design on trust, satisfaction, and ultimately loyalty has been studied by Cyr (2008), who found that design characteristics should be a central consideration in website design across cultures. It is therefore hypothesized that users are likely to experience a higher level of satisfaction with culturally adapted web pages than with non-adapted web pages.

H4: Cultural factors, HCI factors, and website design interact to affect satisfaction.

Two more specific sub-hypotheses were proposed to enable testing of H4:

H4a: Users from Australia have higher satisfaction when using Australian culturally specific website designs as opposed to Chinese culturally specific website designs.

H4b: Users from China have higher satisfaction when using Chinese culturally specific website designs as opposed to Australian culturally specific website designs.

4. Research methodology

To test the hypotheses, two unmoderated, remote usability experiments (Winckler et al., 2000) were conducted. This made it possible to collect large-scale quantitative data from participants in different countries. Two existing websites were adapted for user testing: English and translated Chinese versions of an Australian website, and Chinese and translated English versions of a Chinese website. The complexity of the resulting four web pages, and the associated translations that needed to be done, limited the study to two cultures. The reason that Australia and China were chosen is because they have quite different contrasting cultural characteristics as well as being roughly representative cultures for other similar countries (Hofstede et al., 2010). Furthermore, this choice of countries allowed our research to build upon a prior large-scale study of website design elements which provided a strong foundation in the form of insights into the design preferences and norms of both Australia and China (Alexander et al., 2016). This study involved 100 Australian and 100 Chinese participants. A between-subjects approach was used where each participant undertook tasks on either the Australian or Chinese designed web pages and behavioral and satisfaction data were collected. The behavioral data included effectiveness, efficiency, and errors.

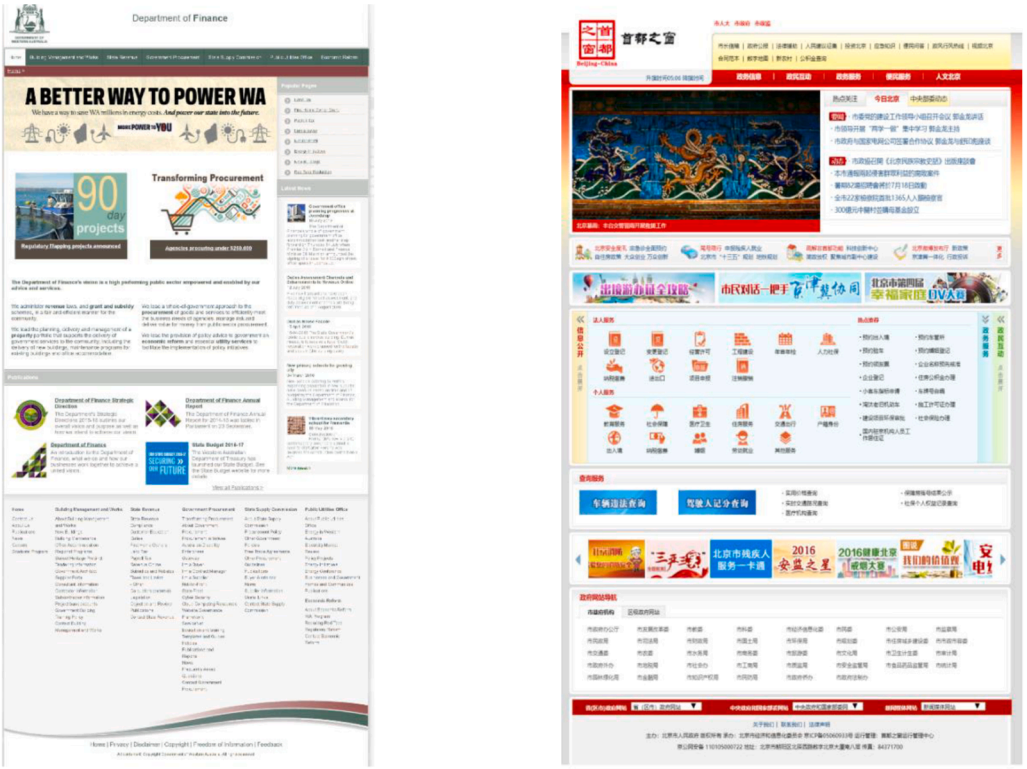
4.1. Participants

All Australian participants were native English speakers living in Australia. Similarly, the Chinese participants were native Mandarin speakers living in China. A survey recruitment company, Cint (2018), was used to recruit 100 Australian and 100 Chinese participants, from Australia and China, respectively. Potential participants, who were required to have desktop computers to participate, were recruited by emails to the relevant Cint survey panels. The email contained a survey link with the survey instructions as well as a consent form.

4.2. Materials and measures

Design elements described by Alexander et al. (2016), and cross-cultural design guidelines developed by Alexander, Thompson and Murray (Alexander et al., 2017a, b), were consulted to find Australian and Chinese websites that display Hofstede et al.'s (2010) and Hall and Hall's (1990) cultural factors and HCI factors. The Department of Finance - Western Australia (2016) website (see Figure 1(a)), originally designed in English, and the Beijing Municipal Government Portal (2016) website (see Figure 1(b)), originally designed in Simplified Chinese, were selected to represent Chinese and Australian cultures, respectively. These websites provide government services, policies, and programs for a local audience and were considered to be representative of the target cultures.

Each website was professionally translated so that English speaking



(a) Australian version of website design in English **(b) Chinese version of website design in Mandarin**

Fig. 1. Examples of the Websites used in the experiments
(a) Australian version of website design in English (b) Chinese version of website design in Mandarin

Australian participants could complete tasks on both Australian and Chinese designed web pages. Similarly, Chinese participants were able to complete their tasks in Mandarin (Simplified Chinese). The translator advised on any culturally sensitive wording as well as comparability and equivalence in meaning. The websites used in each experiment are as follows:

1 Experiment 1 (H1a, H2a, H3a, and H4a):
- Australian website in English, for Australian participants (AU-AUWeb).
- Chinese website in English, for Australian participants (AU-CNWeb).

2 Experiment 2 (H1b, H2b, H3b, and H4b):
- Australian website in Mandarin, for Chinese participants (CN-AUWeb).
- Chinese website design in Mandarin, for Chinese participants (CN-CNWeb).

Contextual inquiry is a research technique where users are asked a set of standard questions before being observed while they work in their own environment. Using the principles of contextual inquiry (Beyer and Holtzblatt, 1997), four information-seeking tasks were created for the Australian website design and four for the Chinese website design. The tasks were designed to allow identification of potential performance differences resulting from cross-cultural differences in website design, such as differences in navigation designs, with Australian websites tending to have "deep" navigation, and in display density, with Chinese websites tending to have higher display density (Alexander et al., 2016). To complete an information-seeking task, participants needed to successfully navigate to a web page that contained the required information. The tasks were designed to be consistent across the Australian and Chinese websites. For example, '…find the electricity prices/charges per unit for the Tariff A1 – residential electricity' (Task 3 for the Australian website design) and '…find the electricity prices in Yuan/kWh for Tier 1 of the Stepped Tariff Trial (Task 3 for the Chinese website design). The task information was translated by professional translators to ensure consistency between the English and Mandarin versions. Details of all tasks are provided in the Appendix (Table 10).

User performance on these tasks was measured in terms of effectiveness, efficiency, and errors. Effectiveness was measured using task completion rate (where each task attempt was classified as successfully completed, incorrectly completed, or abandoned); errors as the number of web pages that were clicked to successfully complete a task, and efficiency as the time taken to successfully complete a task.

A questionnaire was used to collect demographic details as well as responses for the user satisfaction items. Demographic details included gender, age, education and Internet experience. Satisfaction was measured using a six-item scale using items adapted from McKinney et al. (2002) and Cui et al. (2015) (see Table 1). The items were measured on a 7-point Likert scale, with 1 labelled "Strongly Disagree" and 7 labelled "Strongly Agree". Reliability testing showed the scale to be reliable with a Cronbach's alpha of 0.94 (Nunnally and Bernstein,

Table 1
Items used to measure satisfaction

Item	Source
SA1: In general, I am satisfied with the design of the website. SA2: In general, the browsing experience that I have had with the website was satisfactory.	Cui et al. (2015)
SA3: Using the website made me frustrated. (Reverse coding) SA4: I feel terrible when using the website. (Reverse coding) SA5: After using the design, I will never recommend it to my friends. (Reverse coding) SA6: After using this website, I will never use it again. (Reverse coding)	McKinney et al. (2002)

1994). A composite measure of satisfaction was calculated for each participant as the mean of the six items.

4.3. Experimental procedures

This study used two unmoderated, remote usability experiments to test the hypotheses. Winckler et al. (2000) proposed the unmoderated, remote usability experiment approach as a fast, effective and low-cost approach that provides good quality data for analysis, and it is used extensively because of its benefits (Alharbi and Mayhew, 2015). Remote usability testing allows large scale recruitment of participants, simultaneously, in their natural environment, thereby reducing travel time and cost. It also allows for testing in a setting familiar to the user (Alharbi and Mayhew, 2015). It was, therefore, appropriate for the testing of website usability by different cultures. This technique is now a well-established approach to conducting usability testing (Alghamdi et al., 2013; Valencia et al., 2015). Participants of unmoderated remote testing are required to have a computer with Internet connectivity and a web browser. To ensure that participants viewed consistent interfaces, all participants were required to use desktop computers and the Firefox browser. This information on participants' platform and browser, was also captured during our web-based data collection and separately verified by the researchers.

The study used a between-subjects design. This required a shorter amount of the participants time compared to a within-subjects design, thus reducing participant fatigue and dropout rate. After undertaking training, participants were randomly assigned to web pages that were either Australian designed or Chinese designed.

Pilot testing with three participants per website was conducted to identify any procedural issues and to refine the experimental procedure and instructions. These pilot participants were recruited via Cint using the same procedure as for the main experiments.

In Experiment 1, 50 Australian participants used AU-AUWeb (Australian website in English) and 50 Australian participants used AU-CNWeb (Chinese website in English) to test hypotheses H1a, H2a, H3a, and H4a.

In Experiment 2, 50 Chinese participants used CN-AUWeb (Australian website in Mandarin) and 50 Chinese participants used CN-CNWeb (Chinese website design in Mandarin) to test hypotheses H1b, H2b, H3b, and H4b.

In each experiment, task-based user testing was used to evaluate whether the culturally specific websites affected user performance on tasks and perceptions of overall satisfaction. Task-based user testing is a direct testing technique designed to assess website usability (Fraternali and Tisi, 2008), and measures the actual user performance when accomplishing a task in a certain context (Cui et al., 2015). Four information-seeking tasks were used in each experiment and the participants in each experiment were asked to perform these activities without distraction including viewing web pages unrelated to the study.

A web-based remote usability tool, Loop11 (2018), was used to record the interaction of each participant with the website they were assigned to. The Loop11 software runs as a frame around the website, allowing the user to interact freely, completing tasks or questions on the website. The software records data about each user's interactions, such as the number of clicks and page views as well as the time spent on each task. Interactions are captured, processed, and made available in real-time clickstream and heatmaps reports. These clickstream reports were used to graphically analyze participants' journeys through the website, as well as the path they took before abandoning or failing a task. Heatmaps were analyzed task by task to identify attempts to click on elements such as links, images, text, or dead space on the homepage.

Each participant was initially asked to perform a 3-minute training exercise. This training was designed to familiarize participants with the Loop11 environment. At the start of the training, participants were provided instructions then asked to navigate the website for a specific piece of information to achieve the task goal; they then selected "Task Complete". If they could not find the page or were having difficulty, they could select "Task Abandon".

After completing the training, participants were directed to the main experiment and randomly assigned to one of the two website designs. The four information-seeking tasks for that website were then presented in sequence to participants. Following the information-seeking tasks, participants were asked to complete the online questionnaire which obtained demographic data and measured user satisfaction.

5. Results

A total of 200 valid responses, 100 from Australia and 100 from China, were obtained. The demographic profile of the respondent pool is presented in Table 2. As can be seen, the Chinese participants were relatively young compared to the Australians (21% 35years and over versus 69%), and there was a higher percentage of Chinese males (59% versus 35%). The Chinese participants were also more likely to hold a degree (90% versus 35%), which was roughly consistent with the Chinese Internet user population reported by China Internet Network Information Center (2017).

Statistical tests were conducted to identify whether the hypotheses were supported. All statistical analysis was conducted using SPSS Version 22, and an alpha level of 0.05 was used for all statistical tests. Table 3 below summarizes the results of the hypothesis testing such that if all the outcomes for each task are as stated in the hypothesis the result is reported as 'Supported'; if the outcomes for some tasks are as stated in the hypothesis the result is reported as 'Partially supported'; and if none of the outcomes are as predicted, the result for the hypothesis is shown as 'Not supported'. This approach is consistent with other HCI studies such as Gayler et al. (2019) and Pan et al. (2014). The detailed results of each of the hypothesis tests are presented in the subsections below.

5.1. Performance attributes

5.1.1. Effectiveness

As shown in Figure 2, the task completion rate was higher in the culturally specific website designs. The successful completion rate of Australian participants was higher with the Australian website design (AU-AUWeb, 53%) than with the Chinese website design (CN-AUWeb, 47%). Similarly, the successful completion rate of Chinese participants was higher in the Chinese website (CN-CNWeb, 57%) than the Australian website (CN-AUWeb, 31%).

As the participant country and task completions are categorical variables, chi-square tests were employed to test whether users from Australia have higher effectiveness on Australian culturally specific websites than Chinese culturally specific websites (H1a) and whether users from China have higher effectiveness on Chinese culturally specific websites than on Australian culturally specific websites (H1b). Table 4 provides a summary of this analysis.

With the Australian website design, Australian users had higher levels of successful completion for each task, but the differences were only significant for Tasks 1 to 3. For Task 1, 62% of Australian users successfully completed the task as compared to 38% of the Chinese users ($\chi 2(1) = 5.76$, $p = .016$). The success rates for Task 2 were 80% versus 50% ($\chi 2(1) = 9.89$, $p = .002$), and for Task 3 were 54% versus 32% ($\chi 2(1) = 4.94$, $p = .026$). The success rates were much lower for both groups for Task 4 (18% versus 6%, ($\chi 2(1) = 3.41$, $p = .065$). H1a was, therefore, partially supported.

With the Chinese website design, Chinese users had significantly higher levels of successful completion for two of the four tasks. With Task 1, only 44% of Chinese users successfully completed the task as compared to 68% of Australian users; that is, the difference was in the opposite direction to that proposed ($\chi 2(1) = 5.844$, $p = .016$). Whilst 50% of Chinese users successfully completed Task 2 (compared to 34% of Australian users), the proportions were not significantly different ($\chi 2(1) = 2.627$, $p = .105$). However, Chinese users had significantly higher

Table 2
Demographic profile of survey respondents

		Australian participants		Chinese participants	
		Australian website design	Chinese website design	Australian website design	Chinese website design
Gender	Male	15	20	31	28
	Female	35	30	19	22
Age	18-24	5	7	11	6
	25-34	9	10	26	33
	35-44	6	6	8	9
	45-54	13	10	4	2
	55+	17	17	1	0
Internet experience	1-5 years	1	1	3	1
	5-10 years	4	6	17	14
	10 years or more	45	43	30	35
Level of education	Less than high school completion	3	2	0	0
	High school graduate	12	16	1	1
	Trade/ technical/ vocational training	16	17	7	1
	Bachelor's degree	15	10	37	38
	Master's degree or higher	4	5	5	10

Table 3
Summary of hypothesis testing

Usability attribute	Hypotheses	Result
Effectiveness	H1a: Users from Australia have higher effectiveness on Australian culturally specific website designs as opposed to Chinese culturally specific website designs	Partially supported (Tasks 1, 2, 3)
	H1b: Users from China have higher effectiveness on Chinese culturally specific website designs as opposed to Australian culturally specific website designs	Partially supported (Tasks 1, 3, 4)
Errors	H2a: Users from Australia make fewer errors on Australian culturally specific website designs than do users from China	Not supported
	H2b: Users from China make fewer errors on Chinese culturally specific website designs than do users from Australia	Not supported
Efficiency	H3a: Users from Australia have higher efficiency on Australian culturally specific website designs than do users from China	Partially supported (Tasks 1, 2)
	H3b: Users from China have higher efficiency on Chinese culturally specific website designs than do users from Australia	Not supported
Satisfaction	H4a: Users from Australia have higher satisfaction when using Australian culturally specific website designs as opposed to Chinese culturally specific website designs	Supported
	H4b: Users from China have a higher satisfaction when using Chinese culturally specific website designs as opposed to Australian culturally specific website designs	Not supported

levels of successful completion for both Task 3 (46% versus 24%. $\chi 2(1) = 5.319$, $p = .021$) and Task 4 (88% versus 62%, $\chi 2(1) = 9.013$, $p = .003$). H1b was, therefore, partially supported.

A detailed posthoc analysis of task completion using clickstream reports and heatmaps was employed to understand why certain tasks may have had higher or lower success rates than others. Through this analysis, the differences identified were found to be associated with the level at which the required information was available. As discussed earlier, the Australian and Chinese websites were designed with "deep" and "broad" navigation designs respectively and the tasks were designed to assess users' ability to find information placed in different levels of the hierarchical structure of the websites. The task completion information is summarized below in Figures 3 and 4.

An example of this analysis is provided by Task 4, which for the

Table 4
Task Completion rates across cultures

Task	Successful task completion (N=50)	Chi-square	p-value	
	Australian participants	Chinese participants		
Australian website design				
Task 1	31	19	5.76	.016
Task 2	40	25	9.89	.002
Task 3	27	16	4.94	.026
Task 4	9	3	3.41	.065
Chinese website design				
Task 1	34	22	5.84	.016
Task 2	17	25	2.63	.105
Task 3	12	23	5.32	.021
Task 4	31	44	9.01	.003

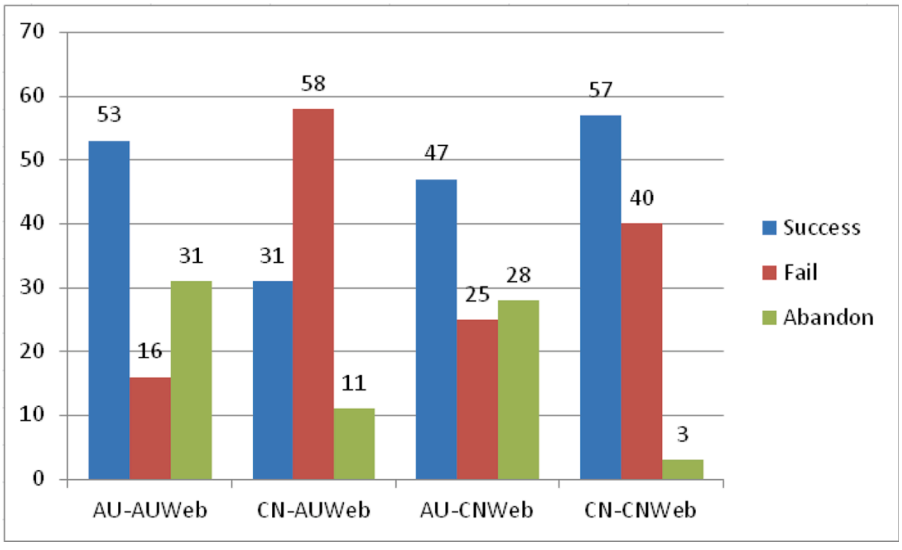


Fig. 2. Task completion rates (%)

Chinese website asked participants to find an external website. This type of task was found to be easier for Chinese participants than Australian participants as they could anticipate, find and click the external link given on the homepage. Clickstream reports were analyzed for the Chinese and Australian participants' success and abandon task rates. This revealed that 66% and 42% of Chinese and Australian participants, respectively, went directly to the required page from the homepage. As shown in Figure 4, Australian participants had a 16% abandon task rate, while Chinese participants had a 0% abandon task rate. The results suggest that displaying hyperlinks on the homepage provides a clear direction to finish a task with fewer clicks. This navigation freedom helps Chinese users not to get confused when completing a task (Heimgärtner, 2013).

On the other hand, the deep hierarchies of Australian websites may be less intuitive for Chinese participants. The information required for Task 3 in the Australian website was located in the third level of the hierarchical structure, and tasks that involve finding information deep in the hierarchical structure were found to be difficult for Chinese users. As shown in Figure 3, 54% of Australian and only 32% of Chinese participants successfully completed the task. Clickstream reports revealed that 40% of Australian participants and only 10% of Chinese participants successfully completed Task 3 by viewing 5 or fewer pages.

Similar observations were made for Task 4 on the Australian website, which also involved navigating a deep hierarchical structure. The average success rate across these two tasks was only 19% for Chinese participants. Furthermore, across these tasks, an average of 67% of the Chinese participants thought they had successfully completed a task when they had in fact failed. This can be contrasted with the 36% average successful completion and 19% average fail rate of Australian users on the same tasks. These results indicate that during deep navigation tasks, Chinese participants were more likely to abandon the task.

Interestingly, three of the tasks were never abandoned by Chinese participants (Task 2 on the Australian web design, and Tasks 1 and 4 when using the Chinese web design). Clickstream reporting showed that in these tasks, participants used a direct shortcut from the homepage to the target page. This navigation preference is explained by the finding that Chinese websites typically have a much flatter structure and higher link density than those of other cultures (Alexander et al., 2017b). This use of direct shortcuts proved to have positive effects on both Australian and Chinese participants using the Australian web design. These intermediary links between the homepage and the target page are commonly presented as a "Fat Footer" or a "Popular Pages" shortcut. These were used in Task 2 and the high success rates in both cultures suggest that this design feature may be a useful cross-cultural feature.

5.1.2. Errors

H2 hypothesized that users have fewer errors when interacting with their culturally specific website design. For the evaluation of H2, only data on successfully completed tasks was considered. Failed or abandoned tasks were screened out as the associated number of page views may be misleadingly lower than in tasks that are successfully completed (Darem, 2013). Error rate is, therefore, considered in terms of the number of pages that were clicked leading up to a successful task completion. Fewer clicks is an indicator of lower errors. As the data did not meet the assumption of normality, the non-parametric Mann-Whitney *U* test was used to test H2.

For those that successfully completed the tasks, the number of pages clicked on for Task 1, 3, and 4 in the Australian website did not differ between Australian and Chinese participants (U =364, z = 1.432, p = .152; U = 246, z = 0.765, p = .444; and U =16.5, z = 0.571, p = .568). The number of errors Australian participants made during successful completion of Task 2 was significantly higher than that of Chinese participants (U = 331, z = -2.390, p = .017). This data is summarized in Table 5. Since Australian users did not have significantly lower levels of errors than Chinese users when using the Australian website design, H2a, which hypothesized that Australian users make fewer errors on Australian culturally specific website designs than users from China do, was not supported.

As can be seen from Table 5, the number of errors for Tasks 1 to 4 when using the Chinese design website were not significantly different between Australian and Chinese participants (U =381, z = 0.148, p = .883; U = 209.5, z = -0.080, p = .936; U = 139, z = 0.035, p = .972; and U =644, z = -0.512, p = .609), respectively. Therefore, H2b, which proposed that Chinese participants have fewer errors on the Chinese website, was not supported.

A more detailed analysis of the number of pages viewed was undertaken to understand these results better. Australian participants viewed an average of 3.5 pages to complete a task in the Chinese website design, increasing slightly to 3.9 pages per task in the Australian website. The Chinese website design's flatter hierarchy led to Australian participants viewing slightly fewer pages to complete tasks. Chinese participants viewed an average of 4.3 pages per task when using the Australian website design; this dropped to 4.1 pages per task with the Chinese website design. As expected, maximizing the amount of information on the home page reduces the number of additional page views to complete tasks.

Analysis of page heatmaps provided another insight into web users' behavior. As shown in Figure 5, when using the Australian website design, most Australian user clicks were on text hyperlinks located in the main menu or the Fat Footer, where major categories are located. However, the Chinese participants' clicks were more dispersed around

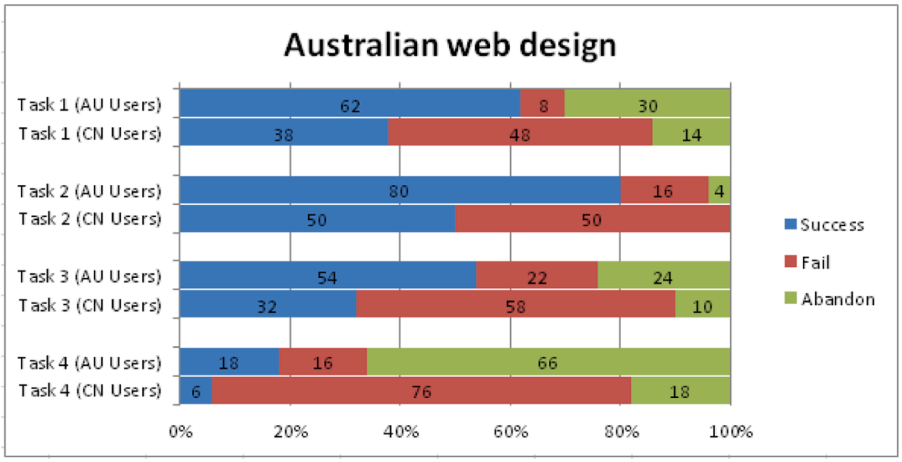


Fig. 3. Task completion comparison for Australian website design

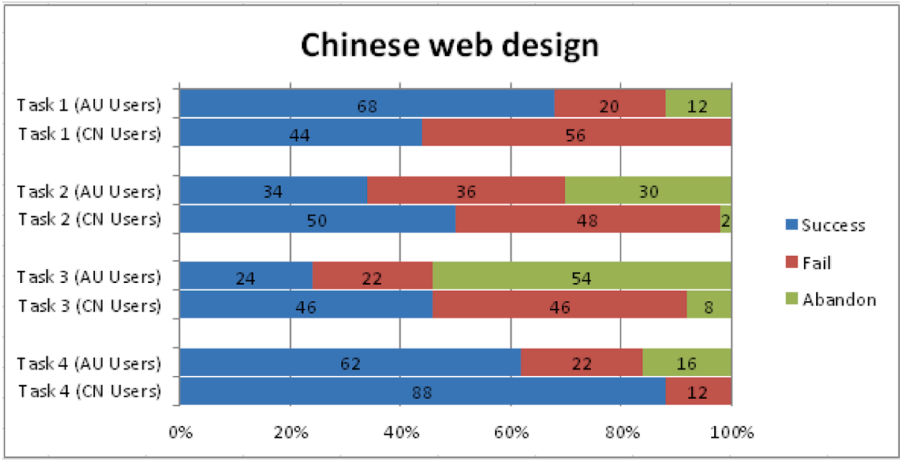


Fig. 4. Task completion comparison for Chinese website design

Table 5
Comparison of errors across cultures

Task	Australian participants		Chinese participants		Mann-Whitney *U*	*z*-score	*p*-value
	Median	Mean rank	Median	Mean rank			
In Australian website							
Task 1	3.00	23.26	4.00	29.16	364.00	1.432	.152
Task 2	3.00	37.22	3.00	26.24	331.00	−2.390	.017
Task 3	5.00	20.89	5.50	23.88	246.00	0.765	.444
Task 4	4.00	6.17	4.00	7.50	16.50	0.571	.568
In Chinese website							
Task 1	2.00	28.29	2.00	28.82	381.00	0.148	.883
Task 2	4.00	21.68	4.00	21.38	209.50	−0.080	.936
Task 3	6.50	17.92	6.00	18.04	139.00	0.035	.972
Task 4	2.00	39.23	2.00	37.14	644.00	−0.512	.609

the homepages and included clicks on different elements including blank space, images, text, as well as links. Since mouse and eye movement follow very similar rhythms and focus on the same page content (Chen et al., 2001; Clicktale, 2010), this suggests that Chinese participants scan the whole page to gain an overall picture of the website and process information by partially thinking in images. However, Australian participants' attention may be directed to the main menu to gain an overall picture of the website (Dong and Lee, 2008) and to process information by thinking in words.

5.1.3. Efficiency

Efficiency refers to time on task (Tullis and Albert, 2008), which is the time elapsed between the start and end of a task; less time spent to succeed in a task indicates increased efficiency. H3 predicts that participants have higher efficiency when using their culturally specific website design. To evaluate this hypothesis, only data on successful tasks was considered, as the time taken for failed or abandoned tasks may be lower than that for tasks that are successfully completed and therefore misleading (Darem, 2013).

Mann-Whitney *U* tests were used to determine if any differences in the time it took to successfully complete tasks were significant (see Table 6). This non-parametric statistical test was used as the data did not meet the assumption of normality. Australian participants were significantly more efficient than Chinese participants when carrying out Task 1 and 2 using the Australian website designs ($U = 403$, $z = 2.169$, $p = .030$; $U = 658$, $z = 2.131$, $p = .033$). However, no significant differences in efficiency were found between Australian and Chinese participants for Task 3 and Task 4 when using the Australian website design ($U = 254$, $z = 0.955$, $p = .340$; $U = 16$, $z = -0.462$, $p = .644$). H3a was therefore partially supported.

When using the Chinese website design, efficiency when carrying out Task 1, Task 2 and Task 3 did not significantly differ between Australian and Chinese participants ($U = 410$, $z = 0.612$, $p = .540$; $U = 234$, $z = 0.564$, $p = .573$, and $U = 135$, $z = -0.104$, $p = .917$). Only the time taken to (successfully) complete Task 4 using the Chinese website was significantly lower for Chinese participants than Australians participants ($U = 429.5$, $z = -2.718$, $p = .007$). These results suggest that Chinese participants were no more efficient in the Chinese website design than were Australian users. H3b was therefore not supported.

5.2. Satisfaction

H4 hypothesized that participants have higher satisfaction when using their culturally specific web design. Satisfaction was measured using six items and Table 7 provides descriptive information for each of these items for the different websites. Australian participants had higher mean responses for each item when rating the Australian website design, however, the patterns for Chinese participants were more mixed.

As described in Section 4.2, a composite satisfaction variable was calculated for each participant as the mean of the six satisfaction items. As this did not meet the assumption of normality, the non-parametric Mann-Whitney *U* test was used to test H4. Table 8 confirms that Australian participants had significantly higher levels of satisfaction with the Australian website design than with the Chinese website design (Median 3.33 vs 2.50; $U = 894$, $Z = -2.457$, $p < .014$). H4a was therefore supported. H4b hypothesized that Chinese participants have higher satisfaction with Chinese website design, as opposed to Australian website design. Contrary to expectations, there was no significant difference in satisfaction for Chinese participants between Australian and Chinese website designs (Median 4.42 vs 4.42; $U = 1267$, $Z = 0.117$, $p = .907$), and H4b was therefore not supported.

6. Discussion

This research has investigated the importance of considering cultural factors and HCI factors to improve user performance and satisfaction in cross-cultural websites that carry different information presentation and interaction styles. Website user performance and satisfaction were empirically evaluated with participants from two culturally distinct countries, to evaluate effectiveness, errors, efficiency and satisfaction in a realistic setting. Eight hypotheses were tested, and the results highlight that the cultural differences in the implementation of the web attributes discussed in prior literature, such as navigation structure and information density (Reinecke and Bernstein, 2011), do influence performance and satisfaction, but that these relationships are more complex than originally hypothesized and than suggested by some previous literature (see Table 3 for a summary of the results of the hypothesis testing). Possible reasons for these additional complexities are discussed below.

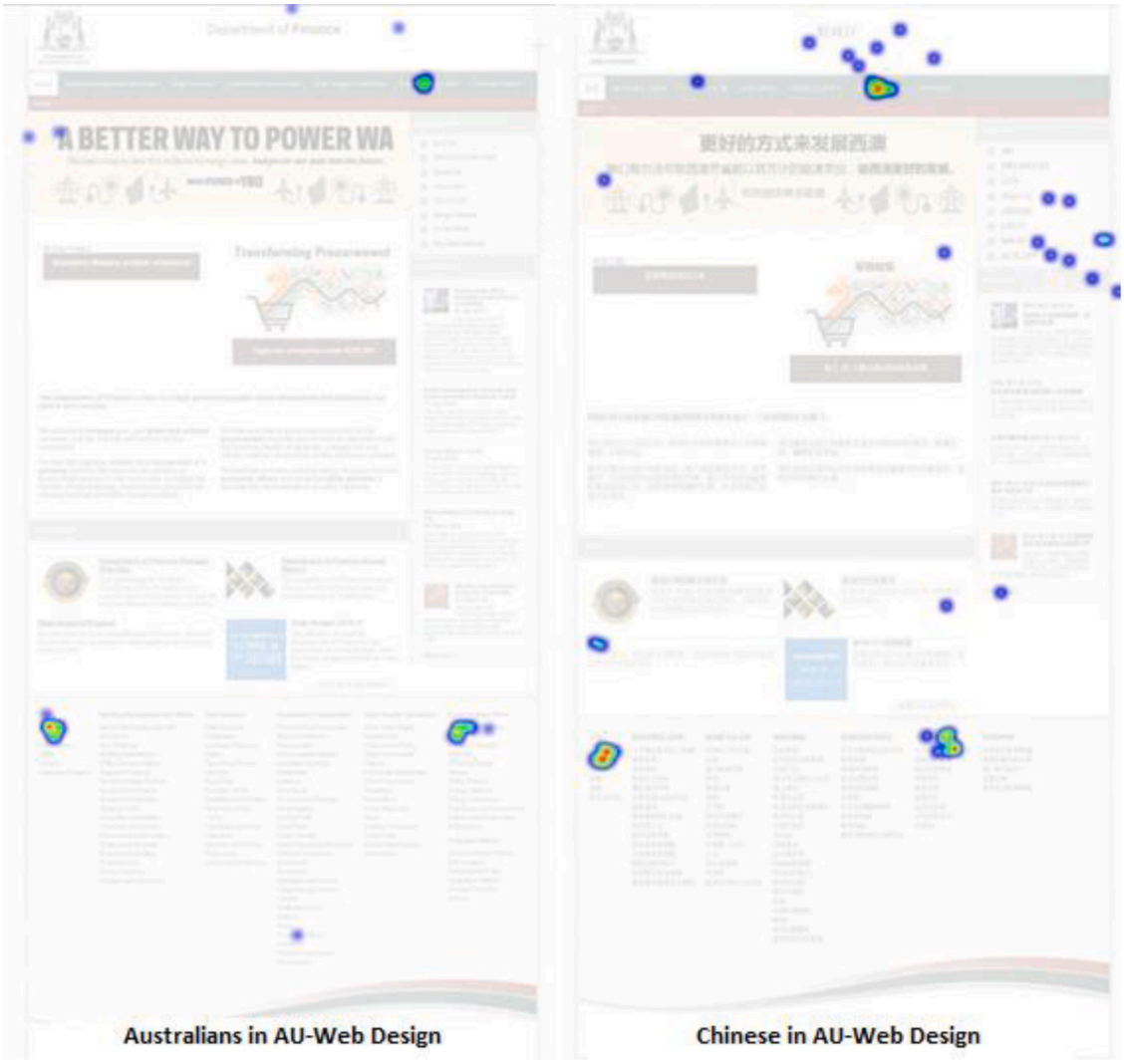


Fig. 5. Heatmap of Task 1

Table 6
Comparison of efficiency across cultures

Task	Australian participants		Chinese participants		Mann-Whitney's	*z*-score	*p*-value
	Median	Mean rank	Median	Mean rank	*U*		
In Australian website design							
Task 1	3.00	22.00	4.00	31.21	403.00	2.169	.030
Task 2	3.00	29.05	4.00	39.32	658.00	2.131	.033
Task 3	5.00	20.59	5.50	24.38	254.00	0.955	.340
Task 4	4.00	6.22	4.00	7.33	16.00	0.462	.644
In Chinese website design							
Task 1	2.00	27.43	2.00	30.16	410.50	0.612	.540
Task 2	4.00	20.21	3.00	22.38	234.50	0.564	.573
Task 3	6.50	18.25	6.00	17.87	135.00	−0.104	.917
Task 4	2.00	46.15	2.00	32.26	429.50	−2.718	.007

Table 7
Descriptive satisfaction information

Satisfaction Item	AU-AU Web Mean (SD)	AU-CN Web Mean (SD)	CN-AU Web Mean (SD)	CN-CN Web Mean (SD)
In general, I am satisfied with the design of the website.	3.52 (1.78)	2.68 (1.67)	4.48 (1.25)	4.24 (1.32)
In general, the browsing experience that I have had with the website was satisfactory	3.42 (1.91)	2.74 (1.65)	4.30 (1.50)	4.24 (1.53)
Using the website made me frustrated	3.16 (1.95)	2.60 (1.62)	4.38 (1.66)	4.58 (1.53)
I feel terrible when using the website.	4.30 (1.68)	3.34 (1.72)	4.32 (1.68)	4.60 (1.52)
After using the design, I will never recommend it to my friends	3.82 (1.88)	2.86 (1.79)	4.36 (1.68)	4.62 (1.65)
After using this website, I will never use it again	3.82 (1.94))	2.86 (1.95)	4.90 (1.76)	4.80 (1.62)

H1 suggested that cultural factors, HCI factors and website design interact to affect user effectiveness when using websites. This was partially supported in both the Australian and Chinese user groups. Australian users had significantly more successful task completions than Chinese users on the Australian website design for three of the four tasks tested. Chinese users had significantly more successful task completions than Australian users on the Chinese website design for two of the four tasks.

This improved effectiveness in successfully undertaking some tasks on websites that are culturally specific is consistent with work by Fraternali and Tisi (2008) who found that Chinese users are less effective or slower to complete tasks in Western designed website designs than in flatter navigation structures. Therefore, for Chinese users, less structured designs and placing contents more freely on web pages is important. This provides navigation freedom for users from low uncertainty avoidance countries, such as China, to tolerate less control in navigation

Table 8
Comparison of satisfaction with website designs

Australian website design		Chinese website design		Mann-Whitney's *U*	*z*-score	*p*-value
Median satisfaction	Mean rank	Median satisfaction	Mean rank			
Australian participants						
3.33	57.62	2.50	43.38	894.00	−2.457	.014
Chinese participants						
4.42	50.16	4.42	50.84	1267.00	0.117	.907

to reduce the number of page views to complete tasks (Reinecke & Bernstein, 2011). This finding is also consistent with Reinecke and Bernstein (2013) and Sang-Hun (2007), who found that users in many Asian countries prefer less structured web pages and that this preference translates to improved performance (Cui et al., 2015; Reinecke and Bernstein, 2011) as well as satisfaction (Cui et al., 2015; Fraternali and Tisi, 2008).

Given that there were differences at the task level, future work is necessary to understand what types of tasks are subject to stronger cultural influences. A possible explanation for these observed differences at the task level could lie in the amount of exposure and experience users have with different website design elements. Due to the dominance of a handful of technological platforms and software, general users may have received training and experience with particular user interface elements regardless of cultural background. For instance, design choices made in a prominent operating system such as Microsoft Windows are often applied to a wide cross-cultural base, over time blurring the cultural distinctions.

Contrary to expectations, H2 was not supported and Australian and Chinese users made similar numbers of errors regardless of whether the website they used was culturally specific or not. This result is consistent with the findings of Fraternali and Tisi (2008) and it seems that lack of cultural specificity does not have a direct detrimental effect on this aspect of performance. As users of many software or web packages will attest, it is still usually possible to accomplish stated goals even with a non-ideal interface. However, a site designed to support the user's natural ways of processing and handling information is more likely to produce positive outcomes in terms of efficiency and satisfaction, it will be perceived as more usable and aesthetically pleasing. This is consistent with our findings in those dimensions.

H3 proposes that cultural factors, HCI factors and website design interact to affect user efficiency on tasks. Though this hypothesis was partially supported in the Australian website design, Chinese users did not appear to be more efficient than Australian users when using a Chinese web design. Australian user efficiency was higher in the Australian website design, which minimized the amount of information presented on a web page. The deeper hierarchical structure used in Australian websites reduces the number of visible items and display density, which helps users from countries with short-term orientation cultures, such as Australia, to accomplish tasks quickly (Hsieh, 2014; Reinecke and Bernstein, 2011).

Though users from long-term orientation and low-uncertainty cultures, such as China, will use many pieces of information to accomplish tasks quickly (Heimgärtner, 2013), this did not translate into improved efficiency in this aspect of the study. More research is needed to understand why the Chinese users performed similarly in both the Australian designed and Chinese designed pages. One explanation is that Chinese users tend to have more exposure to English language sites than English speakers do to Chinese websites (Li and Kirkup, 2007). As English language Internet sites are designed with a Western audience in mind, Chinese users are relatively accustomed to websites designed for other cultures and this might explain why Western designs were not detrimental to their efficiency in performing tasks. Australian users, however, would rarely see an Asian website, and therefore experience a greater impact on task performance.

It has been suggested that users will be more satisfied with their culturally specific website design (Hsieh, 2014; Reinecke and Bernstein, 2011), and this was proposed in H4. Consistent with expectations, Australian users had higher satisfaction with the Australian website design as opposed to the Chinese website design. However, there was no significant difference for Chinese users, no matter which website design they used. This pattern is consistent with the differences in prior exposure to websites designed for other cultures discussed above (Li and Kirkup, 2007).

6.1. Implications

Overall, the results show that there are cultural differences associated with effectiveness, efficiency, errors and satisfaction when doing web-based tasks, though these differences are more complex than previously thought. One common theme that emerged through these results, is that Chinese users show less difference in performance when using non-culturally specific designs than Australian users. A likely cause for this is that the Internet is a Western creation, and though China has a booming tech industry, the major Internet sites are often designed with a Western audience in mind. Thus, Chinese users are accustomed to Western designs and likely have experience interacting with such layouts and designs. Consequently, they do not find it so detrimental to performance when asked to perform an information-seeking task using a website designed for a Western audience. Australian Internet users, however, generally see far fewer Asian designed websites and, therefore, the difficulty faced is greater when they are asked to interact with a non-familiar culturally specific website.

This possible link between user familiarity and performance on culturally specific websites has strong organizational implications for the marketing or launching of technology or designs into new markets, especially where potential users may have little experience with the culture for which the website was initially designed. For instance, developing nations or areas where there may be a below average level of technology use could require special consideration. As users from these areas will have had spent less time interacting with Western designs, the influence of cultural preferences may be expressed more strongly.

Though our findings illustrate the possible effect of development being conducted in a Western environment and then marketed elsewhere, it is important to acknowledge that the converse situation may also arise. That is, as users from Western cultures have had lower exposure to, for example, Asian or Chinese designs, developers from these areas must take care to tailor their products accordingly or face the potential for rejection from Western markets. This is especially relevant today due to the expanding and competitive Asian based Internet commerce sites. A possible future direction may be that culturally specific designs may converge and normalize toward a single "tech-culture", which may be closer to a Western design. Another is that alternatives to Google and eBay, for example, Baidu and Taobao, will continue to develop to meet the expectations of their user bases and convergence will not occur.

Finally, this study and the foundational literature is based around computers with a large screen, mouse and keyboard. However, in current mobile-enabled platforms, it is well known that websites will quite drastically re-arrange the page, navigation structure and images to fit in with the technical constraints of the device. Little is known about the cultural design aspects that might exist for mobile apps targeting different cultural groups. With a small visual field and a touchscreen-based input, do the previously known cultural dimensions diminish? Future research is needed to address this question.

6.2. Limitations

There are several limitations of this study that should be addressed by future work. Prior research has shown that unsupervised online participants are less likely to pay attention to instructions (Oppenheimer et al., 2009) and hence are more likely to respond in unexpected

ways (Goodman et al., 2013). Future research could conduct participant pre-screening to determine participant language competencies and cultural exposure in addition to the instructional manipulation check (Oppenheimer et al., 2009), to gauge attention and comprehension.

Second, cross-cultural research has shown that participants from different cultures may differ in their interpretation of survey questions (Cui et al., 2015; Schneider and De Meyer, 1991). Although this study included objective measurements of user performance to reduce this limitation, future research could try other methods to eliminate this potential issue. Furthermore, demographic differences, such as age and gender between Australian and Chinese users may partially account for their varying performance and perception on cross-cultural websites. To address these limitations, future research could adopt the psychological priming method (Oyserman and Lee, 2007), by manipulating the cognitive style of users from the same culture and then studying user performance and perception on cross-cultural websites. It is expected that this approach may help to eliminate the effect of language or other unrelated cultural distinctions.

7. Conclusion

The internationalization of websites requires web designers to provide effective website design to enhance usability for those from diverse cultural backgrounds. The research described in this paper uses a set of translated Australian and Chinese websites to evaluate how cultural factors and website design influence user task performance and satisfaction. This research shows that preferences for Website usability attributes differ between cultures and that culturally specific websites and the use of some web attributes can increase user performance and satisfaction with websites. These relationships are more complex than traditional HCI research may have originally hypothesized, with some web elements, such as the fat footer, being truly multicultural. The findings highlight the importance of considering cultural factors and HCI factors to improve user performance and satisfaction in cross-cultural websites that utilize different information presentation and interaction styles.

8. Creadit author statements

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Declaration of Competing Interest

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or nonfinancial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Signed by all authors as follows:

Appendix

Task	Australian website design	Chinese website design
Task 1	Suppose you want to obtain information regarding your day to day public utilities from the Public Utilities Office, but you are not aware of the weekday opening times of the office. Using the given website, find the web page that contains information regarding weekday (Monday to Friday) opening hours of the Public Utilities Office.	Suppose you want to obtain information regarding your day to day public utilities from the Operation Management Centre, but you are not aware of the office's postal address. Using the given website, find the web page that contains information regarding postal address of the Operation Management Centre.
Task 2	Suppose you have purchased land in the city and need to obtain land tax payment options. Using the given website, find out the number of available payment options to pay your private land tax.	Suppose, as a legal and single person, you have to obtain approval for deferred tax payment. Using the given website, find the guideline information including the "application conditions" and 'commitment period' for the taxpayer's deferred tax payment approval.
Task 3	Suppose you want to obtain information regarding your residential electricity. Using the given website, find the electricity prices/charges per unit for the Tariff A1 – residential electricity.	Suppose you want to obtain information regarding Beijing's residential electricity tariff. Using the given website, find the electricity prices in Yuan/kWh for the Tier 1 of the Stepped Tariff Trial.
Task 4	Suppose you want to obtain some information from the Department of Housing website. While browsing the current website, get the external web page of the Department of Housing website.	Suppose you want to obtain some information from the "Fengtai District" website. While browsing the current website, get the external web page of the Fengtai District.

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