

An Extended Study of Search User Interface Design Focused on Hofstede's Cultural Dimensions

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Abstract. Geert Hofstede's classic cultural model has been studied and applied to website design for a number of years. In this paper we examine if Geert Hofstede's six cultural dimensions can also be applied to search user interface design. Two user studies have been conducted to evaluate the culturally designed search user interfaces, and the findings are reported in this paper. Our first study comprised of 148 participants from different cultural backgrounds. The second study was smaller with 25 participants, also from different cultural backgrounds. The results from these studies have been analyzed to ascertain if Hofstede's cultural dimensions are suitable for understanding users' preferences for search user interface design. Whilst the key findings from these studies suggest Hofstede cross-cultural dimensions can be used to model users' preferences on search interface design, further work is still needed for particular cultural dimensions to reinforce the conclusions.

Keywords: Cross-Cultural Information Retrieval, Cross-Cultural Theory, Website Design, Human-Computer Information Retrieval (HCIR), Hofstede's Cultural Dimensions, Human-Computer Interaction (HCI).

1 Introduction

A form of 'localisation' is offered by search engines (SE). This is achieved by displaying the search results related to a particular country and location within that country. Geographical location only offers a basic or a surface pointer of the user's culture or ethnic identity.

Considerable research has been undertaken regarding the necessity for the localisation of websites and software applications to meet cross cultural requirements. This paper refers to the term localisation as tailoring the user experience (UX), both affective and cognitively. Examples are given in Smith et al., [1] Singh [2] Alcántara-Pilar et al., [3] and Benaïda [4] to name but a few. However, research is limited with regards to cross cultural search engine user interface (UI) design, such as Taksa and Muro Flomenbaum [5] and Hover [6]

This research paper looks at the gap that exists between cross cultural website design and search engine user interface design. The chief idea and motivation behind this research is to incorporate an extant cultural model into search engine user interface design. This paper is an extension to our first paper by Chessum et al., [7] that examines different cultural models and how they can be utilised to enhance the user experience. This paper reports the additional findings of the second experiment and compares them to the findings of the first experiment.

Several cultural models are talked about in the field of Human Computer Interaction (HCI) for example, Hall [8], Nisbett [9], Trompenaars & Hampden-Turner [10] and Hofstede et al., [11]. These cultural models are described in more details below.

1.1 Edward Hall

The anthropologist, Edward Hall, became a pioneering person for cross-cultural business communication. Hall [8] gave a definition of culture as, ‘high context’ (HC) and ‘low context’ (LC).

The high-low framework relates to how information is stored and flows. Smith et al., [1] describe a high context communication as being when ‘little has to be said or written because most of the information is either in the physical environment or within the person, while very little is in the coded, explicit part of the message’. Liu [12] describes ‘people from high-context cultures prefer face-to-face communication’ and continues by saying high-context cultures, ‘look for both less-direct verbal and subtler nonverbal cues during the communication’

Conversely, with a low context culture, little is hidden and the information in the message is explicit. Oshlyansky [13] notes examples of low context cultures are: USA, Germany and Switzerland, and examples of high context cultures would be Japan and China.

Hall was also responsible for creating ‘elements of units of culture’. This allowed projects to be measured against each other. Oshlyansky [13] notes Hall also encouraged others to identify universal measures of culture. One of the responses to this call from Hall, was from Trompenaars & Hampden-Turner [14], their contribution is described later in section 1.2

Hall created the Primary Message Systems (PMS), this is non-lingual communication made by humans to one another. Hall advocates, that to understand a culture, the individual needs to understand how the culture relates to the PMS system. Hall recognized 10 PMS, each one he related to a facet of human activities [15].

Hall’s 10 PMS are; Interaction, Association, Subsistence, Bisexuality, Territoriality, Learning, Play, Defence and Exploitation. Despite Hall’s work on PMS, it is his work on ‘high- context’ and ‘low-context’ that is utilised the most from a perspective of Human Computer Interaction (HCI)

1.2 Trompenaars and Hampden-Turner

Trompenaars & Hampden-Turner viewed culture at a dimensional level, where the dimensions can be considered as units, and like Hall’s PMS, can be used for comparison. Trompenaars & Hampden-Turner defined seven dimensions. As noted by Ches-

sum et al., [7] they took Parson's five relational orientations [16] as a starting point. These seven dimension are; Universalism vs Particularism, Individualism vs Communitarianism, Specific vs Diffuse, Neutral vs Emotional, Achievement vs Ascription, Sequential time vs Synchronous time and Internal direction vs Outer direction.

1.3 Richard Nisbett

Social psychologist Richard E. Nisbett, looks at the culture differences from Eastern and Western cultures.

Oshlyansky [13] notes, Nisbett examines the 'processes of thought, perception, attention, organisation of knowledge, understanding' along with and other mental processes. Oshlyansky [13] continues to say, Nisbett uses what he refers to as, 'holistic' and 'analytic' thought patterns or mental processes, to make a distinction between Eastern and Western cultures. This is where Western cultures would be on the analytics side and East/Asian cultures would be on the holistic side.

As noted by Nisbett and Miyamoto [17] with regards to differences in attention and perception, "the evidence indicates that people in Western cultures focus on salient objects and use rules and categorization for purposes of organizing the environment. By contrast, people in East Asian cultures, focus more holistically on relationships and similarities among objects when organizing the environment."

Regarding East Asian cultures, Oshlyansky [13] continues to say, 'there is a continuity and a relationship among objects and events that cannot be broken down into constituent parts, for it is meaningless to do so', conversely for western cultures, it is seemingly 'important to categorise and find rules that govern the world so that predictions and control can be established'.

1.4 Geert Hofstede

Geert Hofstede, a Dutch anthropologist, conducted in-depth surveys/questionnaires from 117,000 IBM employees spanning over 50 countries, as noted in [18]. Hofstede analysed the responses and identified four cultural dimensions initially, with an additional fifth dimension for Long Term Time Orientation, identified from work conducted by Michael Harris Bond with the support of Hofstede. This dimension was added in 1991 [19].

Later a new sixth dimension, Indulgence versus Restraint (IND), was added and published by Hofstede et al., [11]. This followed the analysis by Michael Minkov of the World Value Survey (WVS) data, obtained from the World Values Survey Organisation; this data was from 93 countries. Details of all six dimensions can be found in Hofstede et al., [11]. Hofstede's dimensions are as follows: Power Distance (PD), Individualism vs. Collectivism (IDV), Masculinity vs. Femininity (MAS), Uncertainty Avoidance (UA), Long-term Time Orientation (LTO) and Indulgence versus Restraint (IND). These dimensions are described further from section 2.1 to 2.6 inclusive.

1.5 Why choose Hofstede’s cultural model?

Hofstede’s cultural research has been selected for this research due to it being, as observed by Chessum et al., [7] likely the most well-known of the cultural models and the most widely accepted and acknowledged metric set for cross cultural studies, as described by Ghemawat & Reiche [20] and also the most widely used.

Hofstede’s work also has its critics. One of the more well-known being Mc Sweeney, [21, 22]. However, notwithstanding this, as noted by Chessum [23] Hofstede’s research provides us with a set of recognizable metrics, that can be used to quantify and objectively reason.

Dimitrov [24] looked areas where Hofstede’s cultural model has been applied and notes it ‘has attracted the attention of different social actors – scientists, managers, politicians, administrators, opinion leaders, and other agents’ [24].

Geert Hofstede’s eldest son, Gert Jan, says his father has written 244 journal publications [25]. As noted by Chessum [23] a number of books have been published by Hofstede, among the publications are ‘Culture’s consequences: Comparing values, behaviors, institutions, and organizations across nations’, Hofstede [26] ‘Cultures and Organizations: Software of the Mind’ [11,19] and ‘Cross-Cultural Analysis: The Science and Art of Comparing the World’s Modern Societies and Their Cultures’ Minkov and Hofstede [27].

As noted by Chessum [23], Hofstede’s work has been widely used in a number of areas, including global branding and advertising, Mooij and Hofstede [28]. Oshlyansky [13] notes with regards to cross cultural models used in Human Computer Interaction (HCI), ‘By far the most popular of these models is Hofstede’s’, Pogosyan [29] describes Hofstede’s work as being used in international management, marketing, inter cultural communications, cross cultural psychology and negotiation. Pogosyan [29] continues to say, ‘he is among the most widely cited social scientists in the world’

To conclude, Hofstede created six dimensions by which cultures can be compared, Reid [30] and as noted by Chessum [23] fulfils the requirement for scientific research, ‘to be able to quantify and objectively reason a set of recognisable metrics’. [23].

2 User Interface Design

Using Hofstede’s six cultural dimensions described below in section 1.4, twelve prototype user interfaces have been designed. These prototypes consist of two user interfaces designed for each dimension, with one interface representing the lower end and one representing the higher end of each dimension, making twelve user interfaces in total, as described in Chessum et al., [7]¹.

The design of the user interfaces, has been based upon the following attributes of Hofstede’s dimensions and have been applied to user interfaces as shown below. These attributes have also been published in Chessum et al., [7].

¹ Examples of UI 1 to UI 12 can be seen at <https://github.com/ifromm/cross-cultural-ui-designs/>

2.1 Power Distance (PD)

Power Distance within a culture refers to the extent members of that culture are willing accept or expect an unequal distribution of power, [31]. It is noted by Hofstede, that high Power Distance governments are generally more centralised, with substantial pay differences for people with higher and lower positions, and have taller hierarchical company structure, [31]. High Power Distance culture and country members would expect, and could even have a preference for inequality [11]. As noted by Traquandi [32] the inequality is defined from the bottom and not from the top. This suggests, that within a society, the amount of inequality can be approved by the countries members, as well as the country's leaders. The following user interface design features are shown in Chessum et al., [7].

User Interface 1 High (PD) exemplar site population features, are as follows:

- Images of Experts, official buildings, official logos, prominence given to security and restrictions [31].
- Structured website design [33].
- “Older people are both respected and feared” use images of older people for wisdom and credibility [34].

User Interface 2 Low (PD) exemplar site population features, are as follows:

- Status is displayed to leaders rather than the population, staff or consumers. Information hierarchy is shallow [31].
- Use a looser structure to allow users to explore your site for themselves [31, 35].
- Use earned evaluations e.g., ratings, testimonials, likes, to promote your goods or services [35].
- “Older people are neither respected nor feared” Show images of younger or youthful people [34].

2.2 Individualism (IDV)

With this dimension, Hofstede looked at the Individualism and Collectivism within cultures, that is to say how much individuals are integrated into groups [32]. Within Individualism cultures, an individual person is only expected to care for ‘one’s self or immediate family’ [31]. As opposed to a collectivism culture, where the members from birth are ‘integrated into strong, cohesive in-groups, often extended families’ [32]. The following user interface design features are shown in Chessum et al., [7].

User Interface 3 High (IDV) exemplar site population features, are as follows:

- “High text-to-image ratio”. Avoid cluttered graphics. Show positive images of goal achievement [36].

- “Create competitions and challenges to engage your customers”. “Give visitors a sense of personal achievement to motivate actions”. Have content that has ‘novelty’ and ‘difference’ in order to ‘attract attention’ [37].
- Have their own personal goals. Follow their likes and dislikes [38].
- “Speaking one's mind is healthy” [34].

User Interface 4 Low (IDV) exemplar site population features, are as follows:

- “High image-to-text ratio” [36].
- Transparency, give users full disclosure, for example how their data would be used. “Show that you respect privacy and security of personal info”. “Engage the community – ‘we’ not ‘me’” [37].
- Emphasis on social and organisational goals. An individual’s goals are less important [36].
- Members of a collective society, aspire to achieve their in-groups’ goals [38].
- “Harmony should always be maintained’ [34].

2.3 Masculinity (MAS)

As noted by Chessum et al., [7], this dimension does not refer to physical gender but to gender roles. Traquandi [32] describes Hofstede’s analysis of the IBM questionnaires showed women’s (feminine) values are more consistent across countries than male values. The male (masculine) values can vary from assertive and competitive, to being modest and caring. Traquandi [32] continues to say within feminine cultures both women and men have the same caring values. Whereas in masculine cultures, women also show assertive and competitive values, however, this is less than males show. Traquandi [32] concludes, there is a gap shown between male and female values. The following user interface design features are shown in Chessum et al., [7].

User Interface 5 High (MAS) exemplar site population features, are as follows:

- User attention obtained by games and competitions. Work tasks, roles, and skills, quick results obtained for limited actions. Navigation focused on exploring but also on control [31].
- Masculine societies are competitive. Motivated by achievement, heroism, assertiveness, and materialism [39].
- “Admiration for the strong” [34].
- Bright contrasting colours [40, 41].

User Interface 6 Low (MAS) exemplar site population features, are as follows:

- User attention is obtained by the use of poetry, aesthetics, and appealing to uniting values [31].
- Provide contact information and be prepared for feedback and questions. “This group is very cooperative and if they want to give feedback, they don’t hesitate to get in contact with you”. [39].

- “Feminine societies are consensus-oriented”. With a preference for values, corresponding to cooperation, modesty, care for the weak, and quality of life [39].
- “Sympathy for the weak” [34].
- Pastel colours, low saturation [40, 41].

2.4 Uncertainty Avoidance (UA)

Hofstede’s Uncertainty Avoidance dimension, is related to what extent members of a culture tolerate unknown situations or uncertainty [31]. Members from an uncertainty avoidance culture tend to reduce uncertainty, in unknown, or novel situations, by having ‘strict laws’ within the country and formal rules in business [32]. The following user interface design features are shown in Chessum et al., [7].

User Interface 7 High (UA) exemplar site population features, are as follows:

- Tries to show/predict the results or effects of actions before the user acts. Navigation structures are designed to help prevent users from becoming lost. Any ambiguity can be decreased by the use of “Redundant cues”, e.g., design, sound visual aids [33].
- Simplicity, with clear metaphors, restricted options, and limited volume of data [31].
- “The uncertainty inherent in life is felt as a continuous threat that must be fought”. “Need for clarity and structure” [34].

User Interface 8 Low (UA) exemplar site population features, are as follows:

- Information is maximised by the use of colour coding, typeface, font, and sound. Use multiple links but not redundant cueing. Limited control over navigation e.g. Links could open content in new windows that lead away from the original webpage(s). Complexity with maximum content and options. Acceptance of exploring and risk (can even be encouraged), with a stigma on “over- protection.” [31].
- “The uncertainty inherent in life is accepted and each day is taken as it comes”, “Comfortable with ambiguity and chaos” [34].

2.5 Long-term Time Orientation (LTO)

Long-term Time Orientation, is also known as Long Term Orientation versus Short Term Normative Orientation (LTO).

This fifth dimension was recognized later and described in [42] Hofstede & Bond (1984), when Michael Bond and Hofstede conducted a study using a re-designed questionnaire Bond called the Chinese Value Survey, (CVS). This survey was conducted in 23 countries. A Long Term Time Orientation culture member values long term gain over short-term gain, [31]. As observed by Traquandi [32] Long-term Time Orientation values, both negative and positive, are found in the teachings of Confu-

cius who lived in about 500 B.C. The following user interface design features are shown in Chessum et al., [7].

User Interface 9 High (LTO) exemplar site population features, are as follows:

- Offer ways for the user to save browsing history, e.g., wish lists. Together with means of sharing on social media. Persons with long-term orientation decisions are comprehensive and grounded “for the future” [39].
- Patience shown in attaining results and reaching goals. “Relationships as a source of information and credibility” [31].
- “Perseverance in achieving results” [43].
- “Thrift and perseverance are important goals”. “Large savings quota, funds available for Investment” [34].

User Interface 10 Low (LTO) exemplar site population features, are as follows:

- Users require quick results that are consistent with known values and traditions. Persons with a short-term orientation would appear “to live more in the past and in the present than in the future” [39].
- Persons from a very short-term oriented culture e.g., Spain have a tendency “to live in the moment” [44].
- A wish for instant results and achieving goals. “Rules as a source of information and credibility” [31].
- “Focus on achieving quick results” [43].
- “Service to others is an important goal”. “Social spending and consumption” [34].

2.6 Indulgence vs Restraint (IND)

This last sixth dimension, refers how happy a societies members are, how much they feel in control of their own life, and how much they value freedom of speech. [33].

As noted by MacLachlan [45] the indulgence dimension is partly based on the work carried by Bulgarian sociologist Michael Minkov, who created the World Values Survey.

Nickerson [46] observes, the indulgent vs restraint dimension, looks at what degree and inclination a particular culture has to satisfy their desires or to control them. Nickerson [46] continues to say, a high indulgence culture has comparative freedom with regards to satisfy their desires and enjoy the ‘good life’. Whereas restraint within a culture, is where its members have a tendency to control the fulfilment of its needs and desires, and these are regulated ‘through social norms’.

High indulgent societies have a ‘higher importance of leisure’, and restraint societies have a ‘lower importance of leisure’, as described in [34]. The following user interface design features are shown in Chessum et al., [7].

User Interface 11 High (IND) exemplar site population features, are as follows:

- Use and encourage user-generated content. “Make interactions fun”. “Reflect loose gender roles by using a range of models” [47].
- People from an Indulgent culture have a tendency to put an emphasis on individual happiness and wellbeing. Their leisure time is more significant and people experience more freedom and “personal control” [45].
- Maintaining order in the nation is not given a high priority. A perception of personal life control. Freedom of speech is seen as important [34].

User Interface 12 Low (IND) exemplar site population features, are as follows:

- Frugal, show how they can save money. “Emphasise how you serve the community”. “Strict, cultured gender roles” [47].
- People from a restrained culture do not display positive emotions as easily, with freedom, happiness and leisure time not assigned the same significance [45].
- Higher number of police officers per 100,000 population. A perception of helplessness: what happens to me is not my own doing. Freedom of speech is not a primary concern [34].

3 Experiment One Set-up

An on-line survey was conducted asking participants to select one from each of the six pairs of user interfaces, i.e., one from each dimension. This allowed the participant to select six user interfaces in total. As discussed in Chessum et al., [7] this survey was completed by 148 participants. The number consisted of 101 participants currently residing in the UK and 47 who reside overseas. The survey attracted 97 participants who identified as male, and 51 who identified as female. The 148 participants are from 33 countries, however, a number of countries only had 1 to 2 participants and it was decided not to include these results. The countries without a Hofstede index score have also been excluded.

A set of hypotheses for experiment one have been created using all six Hofstede’s cultural dimensions. There are six hypotheses in total, with one relating to each dimension, as shown below in table 1. These hypotheses have also been used for experiment two.

Table 1. Hypotheses for experiments one and two [7, 23].

Hofstede’s Cultural Dimensions	UI Design Number	Hypothesis
Power Distance (PD)	PD High UI 1 PD Low UI 2	H1: Higher PD Countries will show a preference for UI design number 1 and Lower PD Countries will show a preference for UI design number 2

Hofstede's Cultural Dimensions	UI Design Number	Hypothesis
Individualism (IDV)	IND High UI 3 IND Low UI 4	H2: Higher IDV Countries will show a preference for UI design number 3 and Lower IDV Countries will show a preference for UI design number 4
Masculinity (MAS)	MAS High UI 5 MAS Low UI 6	H3: Higher MAS Countries will show a preference for UI design number 5 and Lower MAS Countries will show a preference for UI design number 6
Uncertainty Avoidance (UA)	UA High UI 7 UA Low UI 8	H4: Higher UA Countries will show a preference for UI design number 7 and Lower UA Countries will show a preference for UI design number 8
Long-term Time Orientation (LTO)	UA High UI 9 UA Low UI 10	H5: Higher LTO Countries will show a preference for UI design number 9 and Lower LTO Countries will show a preference for UI design number 10
Indulgence (IND)	IND High UI 11 IND Low UI 12	H6: Higher IND Countries will show a preference for UI design number 11 and Lower IND Countries will show a preference for UI design number 12

The findings from the data have been analysed using standard statistical software, Microsoft Excel. The data has been analysed according to the participant preferences for each user interface selected from a pair, then grouped into nationality.

These findings are then measured against Hofstede's index scores and rankings tables, available in Hofstede et al., [11] and lastly compared to the six hypotheses, in order to ascertain if the hypotheses have been supported. This work has been published in Chessum et al., [7] where the results show potential to inform search user interfaces, although further research was found to be required to understand why several of the results showed some inconclusive findings.

4 Experiment One Results

Table 2. Experiment one results [7, 23].

Hypotheses	H1	H2	H3	H4	H5	H6
Dimension	Power Distance (PD)	Individualism (IDV)	Masculinity (MAS)	Uncertainty Avoidance	Long-term Time Orientation (LTO)	Indulgence (IND)
Country						

				(UA)		
U.K.	<u>Not Con</u>	<u>Not Con</u>	Con	<u>Not Con</u>	<u>Not Con</u>	Con
Germany	<u>Not Con</u>	<u>Not Con</u>	Con	Con	<u>Not Con</u>	<u>Not Con</u>
Poland	Con	<u>Not Con</u>	Con	Con	Con	Con
Pakistan	Con	Con	<i>Partial</i>	Con	<i>Partial</i>	Con
Nigeria	Con	Con	<u>Not Con</u>	<u>Not Con</u>	<u>Not Con</u>	Con
Bangladesh	<u>Not Con</u>	<u>Not Con</u>	<i>Partial</i>	Con	Con	<u>Not Con</u>
Ethiopia	Con	<u>Not Con</u>	Con	Con	N/A	N/A
China	Con	Con	<u>Not Con</u>	<u>Not Con</u>	<u>Not Con</u>	<u>Not Con</u>
Nepal	Con	Con	Con	Con	N/A	N/A
Sri Lanka	Con	Con	Con	<u>Not Con</u>	<u>Not Con</u>	N/A
India	Con	<u>Not Con</u>	Con	<u>Not Con</u>	<i>Partial</i>	<u>Not Con</u>

Key: **Con** = Confirmed Not Con = Not Confirmed
Partial = Partially Confirmed N/A = Not Applicable

4.1 Hypothesis 1 (H1) Power Distance (PD)

The UK and Germany both have a Hofstede index score of 35, and would be considered as low Power Distance countries. This index score indicates a culture supporting any inequalities within society to be kept to a minimum. Consequently, the expected result for Hypothesis1 would be for these countries to show a preference for user interface 2. This was not found to be case, with 12% for the UK and 14% for Germany showing a preference for user interface 2.

With a Hofstede index score of 55, Pakistan would be just above the centre point for Power Distance. This would indicate just over half of the survey participants would show a preference for user interface 1. We would consider this to be partially supported with 80% of users showing a preference for user interface 1.

Other countries with a high Power Distance index scores, such as Poland, Nigeria, Ethiopia, China, Nepal, Sri Lanka and India, showed a preference for user interface 1 as would be expected. Unexpectedly, participants from Bangladesh, showed a preference for user interface 2. It should be noted these countries were only represented by a few participants.

4.2 Hypothesis 2 (H2) Individualism (IDV)

The UK, Germany, and Poland, with a high Individualism score, would be considered as high Individualism countries. This would indicate they would show a preference for user interface 3.

This prediction for Poland was supported, however, it was not supported for the UK and Germany.

India would be just below the centre point with a Hofstede index score of 48. This would indicate just over half of the survey participants would show a preference for user interface 4, however, this is not the case with 86% of users showing a preference for user interface 4, and only 14% for user interface 3.

From Hofstede index scores, Pakistan, Nigeria, Bangladesh, Ethiopia, China, Nepal, and Sri Lanka would be considered to be low Individualism countries. As such the expectation would be for participants to show a preference for user interface 4. Our survey data has confirmed this for Pakistan, Nigeria, China, Nepal, and Sri Lanka, however not for Bangladesh and Ethiopia.

4.3 Hypothesis 3 (H3) Masculinity (MAS)

Hofstede's Index scores, for the UK, Germany, Poland, Nigeria, Ethiopia and China would indicate they are high masculine countries, and as such would show a preference for user interface 5. This expectation has been confirmed for the UK, Germany and Ethiopia, with mixed preferences shown for China and India. Nigeria preference for user interface 5 has not been confirmed.

Pakistan, Bangladesh and India would be considered to be close to the centre point for Masculinity. As such we would expect no clear preference to be shown for this pair of user interfaces.

A low Hofstede index score is reported for Nepal and Sri Lanka, and as such would indicate a preference for user interface 6. Our survey data, although not conclusive for this hypothesis, does show a slight preference for user interface 6.

4.4 Hypothesis 4 (H4) Uncertainty Avoidance (UA)

This hypothesis (H4), indicates higher Uncertainty Avoidance countries will show a preference for user interface 7, and lower Uncertainty Avoidance countries will show a preference for user interface 8.

Poland, Pakistan, Germany and Bangladesh, with a higher Hofstede index score would be considered to be high uncertainty avoidance countries. This has been confirmed with the participants indicating a preference for user interface 7.

Middle range countries with regards to the Uncertainty Avoidance index score, such as Sri Lanka, Nigeria and Ethiopia, would be expected to show no clear preference for either user interface from this pair. This has not been confirmed for Nigeria or Sri Lanka. With a Hofstede index score of 55, Ethiopia did show a preference for user interface 7.

In the case of the UK, China, Nepal and India, all countries with a low Uncertainty Avoidance index score, with the exception of Nepal, our results do not agree with anticipated user interface 8 preference.

4.5 Hypothesis 5 (H5) Long-term Time Orientation (LTO)

As noted by Chessum et al., [7] virtuous behaviour, perseverance and having patience for achieving goals and results, are qualities valued by Long-term time orientation cultures. Our hypothesis 5 (H5), indicates higher Long-term time orientation countries would show a preference for user interface 9, whilst lower Long-term time orientation countries would show a preference user interface 10.

Hofstede index score would show Germany and China are high Long-term orientation countries and as such, would show a preference for user interface 9, however this was not the case.

The UK, Pakistan, Bangladesh, India and Sri Lanka would be considered to be middle range countries regarding Long-term time orientation. As expected, there is no clear preference shown for either user interface, although Pakistan did show a slight preference for user interface 9.

Poland and Nigeria would be considered as low Long-term time orientation countries. Their preference for user interface 10 has been confirmed. Hofstede does not report an index score for Ethiopia and Nepal.

4.6 Hypothesis 6 (H6) Indulgence (IND)

With regards to this final dimension and hypothesis, we expect higher Indulgence countries to show a preference for user interface 11 and lower Indulgence countries to show a preference for user interface 12.

The UK and Nigeria would be considered as high Indulgence countries, this has been confirmed with both countries showing a preference for user interface 11.

Hofstede's index score show Germany, Bangladesh, India and China, to be low Indulgence countries. Our data shows mixed results for these countries, and as such, would not be considered to be confirmed.

However, our final hypothesis for Poland, a low Indulgence country, would be considered to be a confirmed country. Hofstede had not reported an Indulgence index score for Ethiopia, Nepal and Sri Lanka.

5 Experiment Two Set-up

The six hypotheses developed for experiment one, have also been used in experiment two, and are shown with their corresponding user interface number in Table 2.

The user interface designs have been updated², based upon feedback collected from a subsection of the survey conducted for experiment one, this is reported in [23]. The updated prototype web based search user interfaces, as with experiment one, comprise

² Updated UIs <https://github.com/ifromm/cross-cultural-ui-designs/tree/main/UIDesignImages>

six pairs of user interfaces, one pair for each of Hofstede's six dimensions. One user interface designed for the low end and one for high end of each dimension, making twelve in total. The participants can only choose one user interface from each pair as the responses are mutually exclusive.

As noted in Chessum [23] the survey for the second experiment was conducted over a shorter time span, and as a consequence, attracted fewer participants, with 25 in total from eleven countries. Many of the eleven countries had fewer than four respondents. Therefore, the respondents have been grouped with respondents from another country in the same region as defined by Hofstede et al., [11]. However, it was decided in the case of Germany and Greece, categorised by Hofstede et al., [11] as 'Europe N/NW Anglo World' (Europe North and North West, and Anglo World) and 'Europe S/SE' (Europe South and South East) respectively, would be re-classified as 'European' for the purpose of the results of this experiment. As such for analysis, the arithmetic mean average of both countries Hofstede indices have been used.

5.1 Regional Grouping

The countries are given below with the number of participants shown in brackets.

UK (11), Germany (1), Nigeria (1), Greece (1), Russia (1), Venezuela (1), Zimbabwe (2), Congo (1), China (4), Romania (1), and Uzbekistan (1).

The following countries have been grouped together using Hofstede's region 'Europe C/E Ex-Soviet'. (Europe, Central and East, and Ex-Soviet), Romania, Russia, and Uzbekistan. (Hofstede does not report an index for Uzbekistan, consequently, the index for Russia has been used.)

Hofstede's region 'Muslim World M.E. & Africa' (Muslim World, Middle East and Africa) for Nigeria, Zimbabwe and the Congo (DRC). (Hofstede does not report an index for Zimbabwe and Congo, DRC (Democratic Republic of the Congo), consequently the index for Nigeria has been used).

As explained above, Germany and Greece have been grouped together, and are referred to as 'Europe'. The index scores for all six of Hofstede's dimensions, [11] (Hofstede, 2010) for both countries have been averaged, thus creating an arithmetic mean average index score. The index scores used are shown in table 3 below.

Table 3. Regional grouping [23].

Region or Nationality	PD Index	IDV Index	MAS Index	UA Index	LTO Index	IND Index
China	80	20	66	30	87	24
Europe	47	51	61	82	64	45
Europe C/E Ex-Soviet	91	34	39	92	66	20
Muslim World M.E. & Africa	80	30	60	55	13	84

United Kingdom	35	89	66	35	51	69
Venezuela	81	12	73	76	16	100

6 Experiment Two Results

As with experiment one, the findings from the data have been analysed using standard statistical software, Microsoft Excel. The data has been analysed according to the participant preferences for each user interface selected from a pair, then grouped into nationality or regional grouping.

Hofstede's countries index scores Hofstede et al., [11] have been compared to the experiment two results for analysis. The results, as displayed in table 4, showed mixed outcomes, with some hypotheses being confirmed and partially confirmed, whilst others being unconfirmed.

Table 4. Experiment two results [23].

Hypotheses	H1	H2	H3	H4	H5	H6
Region or Nationality	Power Distance (PD)	Individualism (IDV)	Masculinity (MAS)	Uncertainty Avoidance (UA)	Long-term Time Orientation (LTO)	Indulgence (IND)
China	Con	Con	Con	<u>Not Con</u>	Con	Partial
Europe	<u>Not Con</u>	<u>Not Con</u>	Partial	Partial	Partial	Partial
Europe C/E Ex-Soviet	Con	Con	<u>Not Con</u>	Con	<u>Not Con</u>	<u>Not Con</u>
Muslim World M.E.& Africa	Con	Con	<u>Not Con</u>	<u>Not Con</u>	Con	<u>Not Con</u>
United Kingdom	<u>Not Con</u>	<u>Not Con</u>	Con	<u>Not Con</u>	Partial	Con
Venezuela	<u>Not Con</u>	Con	<u>Not Con</u>	<u>Not Con</u>	Con	Con

Key: Con = Confirmed Not Con = Not Confirmed *Partial* = Partially Confirmed

6.1 Hypothesis 1 (H1) Power Distance (PD)

With a Hofstede index score of 80, China would be considered to be a high Power Distance country, therefore, the results for H1 would expect to show that participants

show preference for user interface 1. This is the case, with 75 per cent (3), participants indicating this preference.

The author generated 'Europe' combined index scores for Germany and Greece, as described in section 4 above, and table 3 have been calculated as 47 for Power Distance [23]. The expected result would be for Europe to show a preference for user interface 2. However, this is not the case, with both participants showing a preference for user interface 1.

Hofstede's region of 'Europe C/E Ex-Soviet', has a Power Distance index score of 91. With this score it would be expected a preference to be shown to user interface 1, this indeed the case.

The Hofstede region of 'Muslim World M.E. & Africa', has a Power Distance index of 80; this would indicate that a preference for user interface 1 would be expected. This was confirmed.

The UK is placed in the lower part of Power Distance index with a score of 35. This would suggest the UK participants would show a preference for user interface 2. However, the result showed a preference for user interface 1.

For completeness we are reporting the results for our one Venezuelan participant. We also fully acknowledge once participant cannot be representative of any culture. However, this one participant, as expected, showed a preference for user interface 1.

6.2 Hypothesis 2 (H2) Individualism (IDV)

China has a low Hofstede Individualism index score of 20. Consequently, it would be expected the participants show a preference for user interface 4. This was confirmed with 75 per cent (3), of participants showing a preference for user interface 4.

The author created 'Europe' grouping for Germany and Greece, have a mean averaged Hofstede index score of 51 as shown in table 3. It would be expected to see the result to be showing a 50/50 split preference, alternatively, a possible marginal preference for user interface 3 to be shown. This is not the case with a preference being shown for user interface 4.

Regarding Hofstede's region for 'Europe C/E Ex-Soviet', which has an Individualism index score of 34, user interface 4 is the expected participant preference. This outcome has been confirmed.

Similarly, the Hofstede region for the 'Muslim World M.E. & Africa', which has an index score of 30, has also been confirmed, with participants showing a preference for user interface set 4.

The UK has a high Hofstede Individualism score of 89. This would indicate the participants would show a preference for user interface 3. However, the UK is reporting only one participant (9%), is reported as showing a preference for user interface 3. Subsequently, this hypothesis 2 for the UK has not been confirmed.

Likewise for Venezuela in Hypothesis 1, the results for Hypothesis 2 are also reported for completeness. With a low Hofstede index score of 12, it would be expected a preference for user interface 4 to be shown, for this one individual and this was indeed the case.

6.3 Hypothesis 3 (H3) Masculinity (MAS)

China has a Hofstede index score of 66 for the Masculinity. This would suggest participants would show a preference for user interface 5. This has been confirmed for China with 75 per cent (3), of the participants selecting their preference as user interface 5.

The author created 'Europe' with a mean average index score of 61, as shown in table 3, show a split preference of 50 per cent, for user interface 5 and 50 per cent for user interface 6. Consequently, this Hypothesis is being considered as partially supported.

The region grouping by Hofstede for the 'Muslim World M.E. & Africa', showing an index score of 60, participants would be expected to show a preference for user interface 5. All four participants reported a preference for user interface 6, therefore this Hypothesis 3 has not been supported.

The UK's Hofstede index score for Masculinity is 66, and as such the expected preference is for user interface 5 to be shown. With 55 (6) per cent of participants identifying user interface 5 as their preference, Hypothesis 3, has been confirmed.

Similarly, as with the hypotheses 1 and 2, the results for Venezuela are being reported for completeness. Conversely, our one participant did not show a preference for user interface 5, as we expected.

6.4 Hypothesis 4 (H4) Uncertainty Avoidance (UA)

Hofstede reports an index score of 30 for China with regards to Uncertainly Avoidance. As such it would be expected the participants would show a preference for user interface 8. However, 75 per cent (3), participants indicated a preference for user interface 7, consequently, Hypothesis 4, for China has not been confirmed.

The results for 'Europe' as shown in table 3, with 50% of participants showing a preference for user interface 7, would be considered to be partially supported.

Hofstede's region of 'Europe C/E Ex-Soviet', has an index score of 92, this would indicate a preference for user interface 7 to be shown. This has been confirmed.

Hofstede's 'Muslim World M.E. & Africa' region has an index score of 55, this would suggest participants would show a preference for user interface set 7. This hypothesis is unconfirmed with 75 per cent (3), of the participants showing a preference for user interface 8.

The UK has a Hofstede index score of 35 and would be considered to be low, a preference for user interface 8 would be expected. This was not shown to be the case, with 55 per cent (6) participants showing a preference for user interface 7.

As with previous hypothesis, the results for Venezuela are being reported for completeness. A preference for user interface 7 would be expected, however this was not the case, with our one participant preferring user interface 8.

6.5 Hypothesis 5 (H5) Long-term Time Orientation (LTO)

The Long-term Time Orientation index score for China is 87, and is considered as high. Consequently, the anticipated result for China would be to show a preference for user interface 9. This was indeed the case for hypothesis 5, with 75 per cent (3), participants showing a preference for user interface set 9.

The results for the region of 'Europe' for Hypothesis 5, are considered to be partially supported, with a result of a 50/50 split. With one participant showing a preference for each of the two user interfaces.

The Long-term Time Orientation Hofstede index score for the region of 'Europe C/E Ex-Soviet' is 65, and therefore would indicate participants would show a preference for user interface 9. This is not confirmed with 66 per cent or (2), participants showing a preference for user interface set 10.

Hofstede's grouping region of the 'Muslim World M.E. & Africa', has an index score of 13. This would be considered to be low Long-term Time Orientation, therefore, it would be anticipated results for this region would show a preference for user interface 10. Our results support this with 75 per cent (3), participants indicating this preference.

The UK, with a Long-term Time Orientation Hofstede index score of 51, would be considered to be the central point. A 50/ 50 split result would be expected to be returned. Due to the odd number of participants being 11, this would be mathematically impossible, therefore the result the result of 45 per cent (5), has considered as partially supported.

As with the other previous hypotheses, the results for Venezuela are being reported for completeness. The Venezuelan Hofstede index score is 13, and would be considered to be low. This preference has been echoed with our one participant showing a preference for user interface 10.

6.6 Hypothesis 6 (H6) Indulgence (IND)

China has a low Hofstede index score of 24 for Indulgence, and as such the expected participant user interface preference would be for 12. This has been partially supported with the 50 per cent (2), participants, showing a preference for user interface 12.

Likewise, the 'Europe' region has an index score of 45, as shown in table 3. This result would also be considered to be partially supported, with 50 per cent (1), participant showing a preference for user interface 12.

The 'Europe C/E Ex-Soviet' Hofstede region has an index score of 20. This score would be considered to be low, therefore, the participants for the region would be anticipated to show a preference for user interface 12. However, the results do not support this, with only 1 participant showing a preference for user interface 12.

The Hofstede region for 'Muslim World M.E. & Africa' with an index score of 84, would be considered to be high Indulgence. Consequently, an expected preference for user interface 11 would be given. However, this is not the case with 1 participant showing a preference for user interface 11.

The UK with an Indulgence Hofstede index score of 69, would be expected to show results indicating a preference for user interface 11. Our results for this hypothesis would be considered to be supported by the UK with 64 per cent (7), participants showing a preference for user interface 11.

As a final point, as previously, the results for Venezuela are being reported for completeness. The Hofstede index score of 100 for Venezuela would be considered to be very high, hence a preference for user interface 11 would be shown. This has been supported by our one participant.

Thirty six results have been recorded, this consists of the number of Hofstede's dimensions, being six, multiplied by the number of nations and regions also, and being six in this instance. As shown in table 4 above, fifteen results are confirmed, six results are considered to be partially confirmed and fifteen results not confirmed.

7 Discussion and Conclusion

7.1 Experiment One

The results shown for experiment one, show support for four of Hofstede's cultural dimensions. There are a possible 11 confirmations, (one for each country) for each of the six dimensions with the exception of Long-term Time Orientation (LTO) where there are 9 possible confirmations, and Indulgence, where there are 10. This is due to Hofstede not reporting an index score for Ethiopia and Nepal for both of these dimensions and with Sri Lanka being reported for Indulgence.

These are as follows:

- Power Distance (PD) 8/11 confirmed
- Masculinity (MAS) 7/11 confirmed and 2/11 partial confirmations
- Uncertainty Avoidance (UA) 6/11 confirmed
- Indulgence (IND) 4/8 confirmed

The least supported dimension in this experiment, is Long term time orientation with 2/9 confirmed and 2/9 partial confirmations.

We offer the following observations for experiment 1. As noted in Chessum et al., [7] the findings for this experiment show 33 of a possible 61 results support the Index scores from Hofstede et al., [11] and our hypotheses. We found 12 results difficult to categorise fully, and as such, these are considered to be partially confirmed. We also found 16 results that do not correspond with their anticipated hypothesis.

First, we would like to say Hofstede's dimensions and index scores original use, was not for web design or search user interface design. However, we consider this to be our contribution to ascertain the degree to which these dimensions and index scores can be applied to search user interfaces. The data collected from this experiment, indicates there is potential for Hofstede's dimensions and index scores to be used to inform the design of search user interfaces. These results also show further research is needed to understand why some of our results did not match our hypothe-

ses, and how cultural awareness can better inform search user interfaces. As observed in Chessum et al., [7] ‘we consider our study as an important contribution to triggering this discussion.’

Our second observation is we have a limited number of participants for some of the countries within our study. Our study involved numerous participants with UK (51), Germany (21) and Pakistan (10).

Our data shows the dimension with the most confirmations is Power Distance, with 8 from 11. Masculinity having 7 confirmations, and 2 partial confirmations, and Uncertainty Avoidance, with 6 from 11 confirmations.

7.2 Experiment Two

The results given for experiment two also show the support for four of Hofstede’s cultural dimensions. There are a possible 6 confirmations, being one for each regional grouping or country, for each of the six dimensions.

As follows:

- Power Distance (PD) 3/6 confirmed
- Individualism (IDV) 4/6 confirmed
- Long Term Time Orientation (LTO) 3/6 confirmed, 2/6 partial confirmations
- Indulgence (IND) 2/6 confirmed and 2/6 partial confirmations

The least supported dimension in this experiment is Uncertainty Avoidance, with 1/6 confirmed and 1/6 partial confirmations.

We offer the following observations for experiment 2. As noted by Chessum [23] the sample size for experiment two being twenty five, would be considered as small, particularly for a cross cultural study. The twenty five participants are made up from eleven different countries and identify with a number of cultural backgrounds.

An attempt has been made to overcome some of the challenges of the small sample size and those countries having under four participants, by grouping these respondents with respondents from another country but from the same region as defined by Hofstede et al., [11].

Every care has been taken to ensure the grouping of the countries are as closely linked as possible, this has been achieved by using Hofstede’s own regional groupings, [11]. However, in the case of Germany and Greece, this was not possible, and they have been grouped together as ‘Europe’. This author created grouping, may well explain the unexpected results of four partially confirmed and two non-confirmed results, and is the only result to contain no confirmations.

The sample size for this experiment could be considered as being small, particularly when compared to experiment one, which attracted 215 participants. In view of this, every effort has been made to use all 25 participant’s results. One of the 25 participants identified as Venezuelan. We acknowledge one participant cannot be considered to represent Venezuelan culture; however, for completeness, this individual’s results are also reported.

Our findings indicate the results from Chinese participants show the most confirmations. The results in table 4 show four confirmations, one partial confirmation and only one non-confirmation. All four of the participants identify as Chinese, comprising one participant who identified as male, and three identifying as female.

Three of the four participants self-classify as living for less than one year in the UK, therefore, these respondents, due to their limited length of stay in the UK, may not have assimilated much British culture, as a result their answers maybe Chinese in nature.

In conclusion it would seem we have varying results from the two experiments. However, it would seem the Power Distance dimension has performed well in the first experiment, and fairly well in the second experiment. Hofstede's last identified Indulgence dimension coming in fourth out of a possible six in both experiments. One explanation for this could be there has been considerably fewer research studies undertaken that include this last dimension, therefore the design features for this user interface design, shown in section 2.6 have been taken from a somewhat limited number of studies. This indicates further research needs to be carried out with this dimension from a cross cultural HCI prospective.

With our first experiment the results indicated the most support shown was for three of Hofstede's original four dimensions. However, the second experiment indicates support for two of Hofstede's original four dimensions, along with his fifth dimension, Long Term Time Orientation.

Although these results are a little mixed, we believe, there is potential for Hofstede's dimensions to inform search user interface design and to enhance the user experience. We consider further research is required to ascertain how best this can be achieved.

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