User Interface Characteristics of Mobile Applications Across Cross-Cultures

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Abstract. This paper will clarify the relationship between the background of each country's lifestyle and UI (User-Interface) design based on Hofstede's *6 Dimensional Model*. Lately, it become more ICT-based, so called interface has built its position in a global environment where anyone can easily operate and view a variety of information at hand. Accordingly, Culture-Based User-Interface has become a new field of interest, and many people have studied the relationship between cultural differences and UI design. Therefore, it was found that there were differences in UI elements on the score of Hofstede's Cross-Cultural Model. Also, it's considered that UI design is not only changing as UI trend, but also as a result of changes in our lifestyles that have significant impact to our live. Consequently, in this research we will focus food culture which has seen a change in lifestyle, and examine the differences in UI design in food delivery app in different countries from the background of User's lifestyle.

Keywords: User-Interface · Cross-cultures · UI design · Mobile app · Lifestyle

1 Introduction

Lately, With the spread of the internet technology on society, many people own mobile devices such as Smart Device and have more ICT-based, so anyone can easily obtain information at hand [1]. This has accelerated globalization and the influence of different cultures in our lives. Accordingly, it becomes popular to target not only local users but also overseas users from the planning stage of developing products and services. However, while there is no problem in translating the text information, other User-Interface such as process and operations can be confusing. This is caused by a difference in perception about UI metaphor [2]. It's said that this metaphor reflects the culture and way of thinking of each country where the information is generated. In other words, it's very important for expressing cultural and regional characteristics, but it can also be exotic, fresh and difficult to understand for users from other culture. So, there is a significant relationship between UI design and cultural differences, and many people have conducted research on this topic. Hofstede's Cross-Cultural Model consists of 6

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Dimensions: Power Distance (PDI), Individualism vs. Collectivism (IDV) Masculinity vs. Femininity (MAS), Uncertainty Avoidance (UAI), Long-term Time Orientation (LTO) and Indulgence vs. Restraint (IVR) [3, 4]. Among them, 5 Dimension excluding Indulgence, were focus on, and their characteristics were identified according to their respective scores [5]. In order to clarify the differences in UI design on the Web depending on the score of each dimension, previous studies compared the five aspects of UI elements: metaphor, mental model, navigation, interaction, and appearance, and found that UI design differs greatly depending on the score. As a result, we suggest that it is not enough to make something designed for one country compatible with foreign languages so that it can be used in other countries [6]. In the field of web design, there are other studies that show the similarities and differences between the websites of universities in different countries, as well as comparisons of web pages focusing on cognitive style, which can be said to have a great deal to do with different cultures [7, 8]. In addition, research has been conducted on the recognition of mobile phone interface design icons due to cultural differences, and the fact that different cultures have different ways of presenting the required information [9]. Therefore, as more and more people have mobile devices, we can expect to see differences in mobile apps from country to country. The changing UI design isn't a trend towards *Skeuomorphism, Flat Design*, or even *Neumorphism*, but rather a change in our lifestyle. In particular, food culture is thought to differ greatly depending on cultural differences, and it is assumed that the background of food culture also influences UI design.

From the above, this research clarifies the differences in the UI design of delivery apps in each country, focusing on food culture among lifestyles. The purpose of this research is to clarify how the UI design of delivery apps is affected by the lifestyle of each country and how it relates to the *6 Dimensional Model*, and to propose a future UI design.

2 About Hofstede's Culture Dimensions

In 1978–1983, Geert Hofstede, the Dutch cultural anthropologist, interviewed employees of IBM in 53 countries, and the results were used as the basis for the model [4]. Each dimension is defined as follows, and Table 1 shows the scores of the *6 Dimensional Model* for 5 countries, which were used for comparison. In each dimension, the higher the score, the more Individualism, Masculine, long-term oriented, and Indulgence is.

PDI: The degree to which less powerful members anticipate and accept the unequal distribution of power in the organizations and institutions of their respective countries.
IDV: Strong ties among members or loose ties among individuals.
MAS: The contrast between the desirability of assertive attitudes and the desirability of humble attitudes.
UAI: The degree to which members of a culture feel threatened by uncertain or unknown situations.
LTO: Whether to invest in the future and look ahead, or to seek results now.
IVR: Is it a negative or positive society.

Table 1. *6 Dimension Model* score for each country.

Country	PDI	IDV	MAS	UAI	LTO	IVR
Japan	54	46	95	92	88	42
The U.S.	40	91	62	46	26	68
The U.K.	35	89	66	35	51	69
Korea	60	18	39	85	100	29
China	80	20	66	30	87	24

3 Research Method

This research aimed to investigate and analyze the characteristics of UI in each country, focusing on delivery applications with a focus on lifestyle, and clarify the differences in UI that occur in different cultures.

The Aim of the research are as follows:

1) We understand Hofstede's 6 Dimensional Model and select 5 countries that belong to both the top and bottom of the model based on their scores in each dimension. Also, we understand the differences in UI design caused by the 5 Dimensional Model from previous studies and investigate whether these differences can be applied to mobile apps.
2) We compare delivery apps related to food culture as the target apps for comparison. We select 3–5 top-ranked apps on Google Play as services used by many users in each country, and create a transition diagram of the apps to identify UI features such as operating procedures, visuals, and priority of information.
3) We analyze the UI elements of delivery apps in each country based on sensory adjectives: metaphor, interaction, navigation, and mental model. Cluster analysis conduct to identify trends in UI elements in each country, and principal component analysis conduct to identify which elements are emphasized in each UI element.
4) Based on the results of the above survey and analysis, the background of lifestyles in each country, and the relationship between the 6 Dimensional Model. We discuss how UI elements differ in each country and present the future of UI in each country.

4 Research Content and Results

4.1 Research

In the survey, apps by Android devices were installed and the apps compared are shown in Fig. 1. As a result, there were no major differences between the different cultures in terms of operating procedures. However, the internal details of some of the processes, such as the layout, and the input of information, were found to differ depending on cultural differences. Figure 2 summarizes the differences in UI features, and the results are summarized for the main features.

Fig. 1. List of food delivery applications

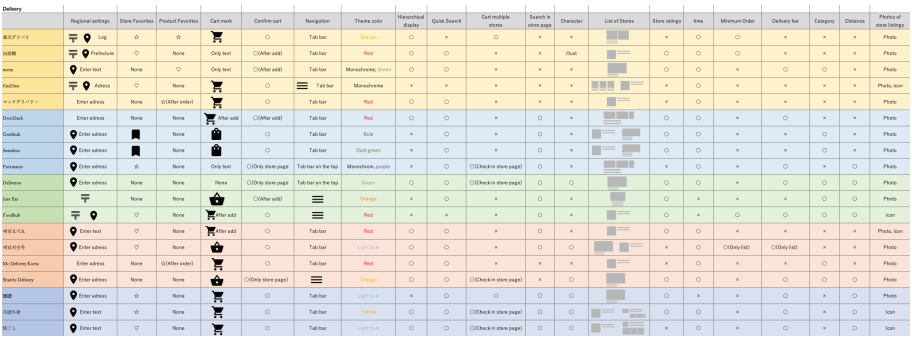

Fig. 2. On the characteristics of UI design in delivery applications

1) **Search in Store Page**
   Search in store page is a function that allows users to search the menu from the search icon in the upper right corner of the screen when selecting products after deciding on a store. We found that this function is used in all four countries except Japan. In Japan, there is no search function, only categorization, and you have to search for what you want to eat from a list of menus. Presumably, if it is a favorite restaurant, people tend to prefer to choose which menu item they want to eat based on their mood of the day.
2) **List of Stores**
   They can be divided into two patterns. The first is to display more than half of the product photos and minimize the description. The other pattern is to show half photos and half details, or to show only a small range of photos. In the Asian, the priority is relatively given to the products with explanations, while in the west, the products are mainly presented. This showed the difference between emphasizing the appearance of the product and appealing to the user's taste buds, and giving a sense of security to the user by providing proper explanations. It was also found that the amount of information presented when displaying a list of stores varied depending on cultural differences.

4.2 Analysis

Investigation of Features by Cluster Analysis

Based on previous research [10], we selected 10–15 UI elements and sensibility terms for them, and conducted a cluster analysis to investigate whether there is a specific UI trend for each culture. The four UI elements are defined as follows.

Metaphor: A basic concept such as a letter, image, or sound.
Interaction: Feedback with movement and change in response to user input and output.
Navigation: Movement through a mental model, that is, through content and tools.
Mental Model: It is the organization and structure of data, functions, and tasks Table 2.

By comparing the principal components obtained in conducting the analysis, we were able to understand what UI characteristics were present in each cluster. For example, in the mental model, Japan had a simple structure with not a lot of information. Therefore, the process is done unconsciously to the goal and can be done efficiently to the purchase. The other had a complex structure with a lot of information. However, even though the clusters were rich in information, they were able to reach the goal relatively smoothly, which may lead to the unification of perceptions Table 3.

Table 2. List of UI elements and sensitivity terms

UI elements	Terms
Metaphor	Intuitive, simple, realistic, cute, rounded, fresh, flat, complex, concrete, flashy, easy to understand, interesting, unified, stylish, modern, graphic
Interaction	Intuitive, straightforward, complex, familiar, simple, and smooth, unique, fancy, easy, simple, easy to operate
Navigation	Pleasant, smart, quick, fresh, flashy, fun, easy to understand, pleasant, animated, unique, friendly
Mental model	Rich, understandable, quick, natural, complex, efficient Unconscious, cognitive agreement, fine, gaping

Table 3. Countries in which clusters were found and their characteristics

Delivery service	
Japan	Navigation: familiar and easy to navigate Mental model: simple structure, smooth to the purpose
The U.S.	Metaphor: simple, flat, and unified Mental model: rich and complex, relatively smooth in reaching objectives
The U.K.	Mental model: rich and complex, Relatively smooth to achieve objectives

Characteristics of UI in Each Country by Principal Component Analysis
Next, we conducted a principal component analysis to clarify what components were important for each UI element. The principal components consisted of 3–4 components, and created radar chart to clarify which components were important in each country.

Thus, the influence of culture and lifestyle was found to be very strong in all UI elements. Therefore, it's necessary to take cultural influences into account when designing UI elements Fig. 3.

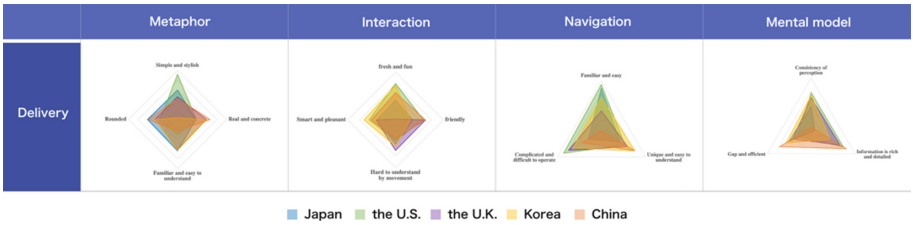

Fig. 3. Radar chart for each UI element obtained by principal component analysis

4.3 Consideration

In this section, we will discuss the relationship between UI design in each country and the radar chart, *6 Dimensional Model*, and lifestyle background obtained from these surveys and analyses.

1) **Japan**
   Metaphor: Most of the designs were tended to be familiar and easy to understand. This suggests that familiarity is preferred over freshness. Since Japan has a high-UAI, we believe that people don't try anything unique and prefer metaphors that are simple, easy for many people to understand and intuitive.
   Interaction: There are no unique or flashy. As a result, there is no challenging sprit, and people tend to prefer designs that are relatively familiar to them.
   Navigation: The emphasis is on familiarity and easy operation. This could also be due to the fact that this is a country where high-UAI. By using simple navigation, it's possible to operate the system without losing sight of the objective, ensuring that the desired results are obtained.
   Mental Model: There is not a lot of information, and from the simple appearance of the product, the user is able to efficiently select the desired product and purchase it. Therefore, they are able to reach their goal without getting lost, which means that they are in agreement with each other.
2) **The U.S.**
   Metaphor: Many of the designs have graphic elements and a stylish look. This suggests that the emphasis is on appearance. Belonging to the Indulgence, we think that enjoying the flavor of life may lead to enjoying food, and as long as we reach the goal, we may not have much trouble even if we lack intuition.
   Interaction: They tended to prefer to be able to have fun with the controls rather than to understand that pressing this button would give them this feedback. The U.S. is located in a country where people tend to enjoy life in a rough and free manner, and we think that there may be a relationship between this and the ability to operate freely and enjoyably.
   Navigation: There is no uniqueness or original design in all of them, and general operation is required. Since the U.S. is a multi-ethnic country, it's expected that everyone will require easy to understand operations.
   Mental Model: The information is detailed, but even with a large amount of information, it is possible to reach the goal smoothly. As for the amount of information,

the abundance of option selection falls under this category. As the U.S. is low-LTO, it is believed that the structure of the site is such that it can be operated smoothly and crisply to reach the goal.

3) **The U.K.**
Metaphor: It had the characteristics of being familiar and easy to understand. As the U.K. is the birthplace of design, metaphors that are easy for everyone to understand are favored, and we believe that this design will lead to standards in other countries.
Interaction: Overall, there was a tendency not to like flashy operability, but rather interaction that is relatively smart and leads to understanding.
Navigation: It's a simple operation, but a unique navigator. It is a one-way operation, so there is not much need for navigation elements. For this reason, it doesn't use a tab bar, but instead uses a menu bar and navigation at the top.
Mental Model: It able to reach the goal smoothly even with a large amount of information and detailed information. With regard to the amount of information, the abundance of options was relevant, and in the U.K., the structure was such that you could see what option you had just selected by switching between pages. Since the U.K. is a low-LTO, so it is thought that the structure is designed to allow users to operate smoothly and crisply to reach their goals.

4) **Korea**
Metaphor: Icons related to food tended to be realistic illustrations or photographs rather. Since high-UAI, the use of realistic designs is thought to reduce ambiguity.
Interaction: There is a tendency to seek quick and smart operability, and smooth feedback leads to understanding. Being high-UAI, there is a tendency to demand accuracy.
Navigation: Looking at the overall picture, there is a preference for general design and simplicity. We think that the tendency to want to get results immediately may lead to complicated operability, which may not be user-friendly.
Mental Model: Although the amount of information, the structure is not complicated and allows the user to reach the goal efficiently. In addition, Korea has always had a high demand for delivery services, and it is thought that many people use these services due to the influence of this, so even if the amount of information is increased, it will not be too difficult to operate smoothly.

5) **China**
Metaphor: They tended to be flashy designs, using a variety of colors. In terms of metaphors, some designs are simple and flat, while others include detailed, three-dimensional elements. This is thought to be a result of the Chinese culture of clutter and bustle, and the fact that there is a lot of information, which may lead to a sense of security.
Interaction: There is no need to have fun. There are some flashy interactions, but most people may want familiarity and ease of use. The preference for flashy interactions may be related to the preference for flashy colors such as red.
Navigation: Unique navigation is a feature. The tab bar is easy to understand, but the rest of the search and other navigation is complicated. We believe this is due to China's low-UAI, which tends to favor an all-round approach.
Mental Model: The home and search pages are packed with a lot of content. This may be due to the fact that they are high-LTO and don't seek immediate results, but

rather want to deliver a lot of information to the user, even if it takes some time to achieve the desired product purchase in the end.

5 Conclusion

In this research, we focused on the influence of lifestyle on mobile app UI design due to cultural differences. In order to clarify the causes of the effects of these differences, we focused on food delivery, in various countries, and examined the comparison of mobile app UI design based on research and analysis. As with web UI design, we found that UI design for mobile apps differs depending on cultural differences, and we believe that it can be adapted to any device, regardless of content. As a result, we found that UI design does not change as a trend, but changes daily in accordance with the social background of each country. It can be said that the relationship with culture is very close. From this point of view, when developing services for countries around the world, it is possible to develop services that are familiar to many people by not only translating the language but also designing the UI that is required in each country.

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