CONSUMER NEUROSCIENCE AS A TOOL FOR FINDING AN EFFECTIVE CULTURAL MARKERS FOR VISUAL DESIGN

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Abstract

By determining icon image attributes that correspond with Hofstede's five cultural dimension index of the state of Slovakia, and by harnessing both neuroimaging and biometric sensor on the participants, whether the app's icon design choice has any impact value over the consumer's purchasing decision can be determined. This in turn can give an insight to the best strategy on utilizing digital visual merchandising over Android apps. The experiment showed support on Hofstede's model on cultural distinction which tells that every culture has biased preferences on design and usability. The experiment suggested that it is possible to induce iconography with the elements from Hofstede's cultural index with proper adjustments to reproduce a better design and overall a better usability.

Key words: *Android; biometric; cultural dimension; Google Play Store, neuroimaging, visual merchandising.*

JEL Classification: *M31, M39, M81*

1 Introduction

Year 2008 witnessed a new era that changed everything when Apple introduced a new medium called App Store where it opened its door to all developers to create new, fresh, exciting apps for the iPhone users. Since then, every innovative idea that came in the form of an app changes the way people use their smartphone. From simple photo sharing media like Instagram to complex infrastructure service like Dropbox, have attracted millions of users and in return, creates an immeasurable source of income for both Apple and the developers. This huge potential presumably attracts others to attempt with a similar business model. One of them being the software giant, Google, with their then Android Market, now Google Play Store.

Years later, Android has grown stronger and now poses as the largest install base of any mobile operating system with 1.6 billion active units globally as of 2014 thanks to its open nature as an ecosystem. This openness, contrary to the Apple's own walled garden ecosystem, creates more chances of expanding their multitude of user base backed by dozens of OEM adopting Android as their choice of operating system. While Apple imposes a fairly strict evaluation and tight rules over every proposed app that is trying to get published, contrastingly, Google applies a rather unrestricted policy, believing that the decision will attract more developers to develop apps for Android, thus attract more users.

While the decision to embrace a rather unrestricted and open policy has proven to be successful to bringing more and more people joining to develop apps for Android, On the other hand, Google Play Store, backed by the lack of quality control over Google's end has also attracted lots of unoriginal, unpolished, low quality apps that scatter all over the already densely populated application store. Not to mention a lot of malware trying to harm the users by disguising themselves as normal apps. Due to this problem, customers are given a hard time to choose genuinely useful apps while the developers' creations cannot get the full presence they deserve.

One of the solution is to make sure the icon design, which is one of the key factor of customer's app purchasing decision, to comfortably concur with the Material Design, a complete set of design guidelines arranged by Google subsequent to the release of the Android 5.0 Lollipop, which widely believed has been successfully boost the download rate as well as the sales, but there is currently no scientific reason behind this.

The paper suggests that there is a broader meaning beyond this simple answer. Hofstede (1980) identified that every culture can be distinguished by five cultural dimensions. This model focused on the thinking, feeling, and acting patterns that

occurs in every culture that shapes its mentality structure. Each of the five Hofstede's cultural dimension is a dichotomy and is divided by two opposing sides representing each index.

Barber & Badre (1998) also suggested that by applying culturally-specifics design elements for website design to drive more traffic. Merging culture and usability, dubbed "culturability" has been a common practice among big companies in developing the proper user interface (UI) and user experience (UX) for each different kind of countries that they invested in. Another research argued that applying specific design interfaces that accommodate only one side of the index will result an increase in web usability for all users (Ford & Kotze, 2005).

With this knowledge, there is a possible connection between the icon design presentation and the culturability factor behind it. By determining icon image attributes that correspond with Hofstede's five cultural dimension index of a certain country, one can find the perfect formula of the icon design for different culture. Hence there is a specific need to further investigate the situation. One of the related research fields is neuromarketing. Albeit controversial at its first emergence, neuromarketing is an area of study that bridges the study of consumer behaviour with neuroscience that is gaining rapid credibility and adoption among advertising and marketing professionals (Morin, 2011).

Thus the research is done by harnessing consumer's brain activity using EEG device upon seeing several icon samples induced with each of the Hofstede's cultural dimension index. This research further looking at the matter on whether the application's icon design choice has any impact value over the consumer's behaviour and perception. This in turn can give an insight of the best strategy, e.g. design attributes choice on utilizing digital visual merchandising over Android apps. This idea backed up by the paper proposed by Cole et al (2000) that believed design elements are capable of altering consumer's purchasing decision and behaviour.

1.1 Design, Usability and Culturability

Since the wake of internet era in 1980s, the World Wide Web has been dubbed as a bridge to globalization of all aspects. Mainly contributed as a powerful tool for international communication, this relatively new and fast developing medium is often developed and designed to maintain its multicultural nature. Several companies are also starting to realize the importance of designing the interface towards internationalization. This movement is viewed as a way towards global convergence, which aims for an easier way to communicate in a neutral, unbiased environment.

Despite the effort for interface globalization, It is often believed the cause of several cultures tend to have different preferences over what is considered user-friendly (Rovný, 2016). It is somewhat parallel to the fact that there are several cultural and design constraints in localized websites. Although cultural biases and preferences are part of the users' characteristics, Barber & Badre (1998) believed that there should be a focused study on these cultural biases and characteristics to find out the determining factors of usability design for international audiences. This joint study of cultural and usability is known as "culturability".

There are several researches tried to overcome the problem of missing "culturability" by designing adaptive user interface suitable for one specific cultural frame (Reinecke & Bernstein, 2007; Fraternali & Tisi, 2008; Nasrul, 2012; George et al., 2012). Fraternali and Tisi (2008) believed that the understanding of the different cultural backgrounds of users plays a prominent role in industrial product development, where requirements analysis and product design are influenced by cultural variables. While George et al. (2012) suggested a focused research towards localization rather than globalization, and it requires designers to adapt the interface to specifically targets the culture of the specific group.

Culture itself is an abstract object with layers of social values associated with ethnicity, religion, language, generation, gender, or workplace Šugrová et al. (2017). Cultural dynamics as such the case above has been an attraction for researchers in multiple fields to understand the mystery behind it, with many also tries to measure it. To do such things, one obvious course of action would be to dissect the definition of culture itself, while at the same time finding out the meta-model that create such structures, or dimension (Tayeb, 2001).

1.2 Hofstede's Cultural Dimension

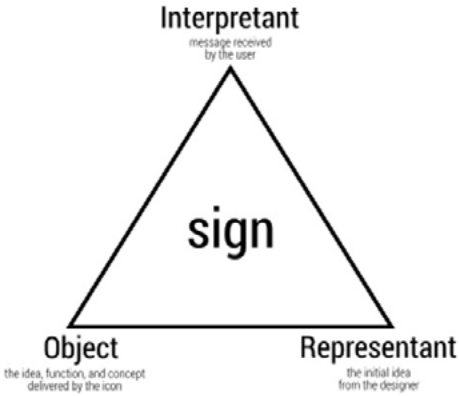
Cultural usability research in the past three decades has been mainly revolt on the cultural dimension theory that was proposed by the cultural anthropologist Geert Hofstede. Hofstede (1980) revealed his model on a publication, which is a by-product of two in-house attitude questionnaire surveys of an American multinational company. Even though Hofstede's research has been considered a groundbreaking by many fellow scholars, there were a lot of cynical and criticism surrounding the model for being vague and for lacking basic theory (Fougère & Moulettes, 2007; Orr & Hauser, 2008). However, Hofstede's cultural dimensions still remain relevant and widely accepted among respected researchers despite several claims that stated otherwise. Cultural implementation on website usability and design is still one of the area that relies a lot of the Hofstede's cultural dimension theory (Paluchová & Horská, 2012). The Hofstede model is a classification of culture predicates the differences in cultural values which divided these classifications

into four different indexes, each representing a dichotomy in a continuum of two opposite values. These dimensions are known as: power distance, uncertainty avoidance, individualism vs. collectivism, and masculinity vs. femininity (Horská, 2007). Not until 1984 the fifth dimension is discovered as a result of two questionnaires among a sample of 10 and 23 international students respectively. This dimension, dubbed time orientation, is intended to embrace the two contrasting value and to distinguish between a short-term oriented countries with long-oriented ones. The five cultural dimension indexes are Power Distance Index (PDI); Uncertainty Avoidance Index (UAI); Masculinity vs. Femininity (MAS); Individualism vs. Collectivism (IDV); and Time Orientation Index (TOI).

1.2.1 Cultural Marker

Visual icons can be considered as a mean for designers to deliver messages to end-users via the interface of a computer system (Isherwood, 2009). It also plays its part as one of the ways to conveys company brandings via shapes and colours (see Figure 1). As important as it seems, icon design in application structure is often considered as the least important part of development and developers tend to deliver the least amount of effort on this particular subject. Icons are first and foremost designed to deliver the clear message, intention, and meanings of each of the interface components for greater usability. However, icon design process usually time-consuming and costly due to its dependency on usability evaluation after a set of alternative icons are developed (Goonetilleke, 2001). The issue of what should an icon depicted in each of the function it supposed to represent, and whether training affected usability performance of novice users when accessing the interface. Result shows generally shorter response times for the trained users. Icons have evolved from the concept of a sign which defined as "something that stands to someone for something in some respect or capacity" (Peirce, 1932), a sign is comprised of three interconnected elements, depicted in Figure 1; 1) the interpretant (the user that received the message); 2) the object (objects, function, or concept represented by the icon); and 3) the representant (the icon itself). This is inherently dependent on the user's knowledge, familiarity with the sign or its depicted function, usage frequency, et cetera, since each person is unique and possesses a certain cultural and social bias (Goonetilleke, 2001; Isherwood, 2009).

Figure 1 **Object, Representing, Interpreting Relationship Diagram**



Source: Peirce, 1932.

Icons are meant to correspond with real objects with which the users are familiar with. Isherwood (2009) also stated that designer should aim for the choice of icons that correctly represent the information and accurately activate mental models in the end-user, since how the user interprets the sign will depend on the user's mental models, likewise how the designer chooses to represent the object may also depend on their own set of mental models. An established and generally accepted way to design icons is based on unifying individual icons into a collective metaphor. However, there is an apparent problem since there is a limited possibility of direct mappings between real object with system objects. Figure 1 shows the different usage of concrete icons, which the idea comes from everyday real objects. On the contrary, abstract icons are likely to represent information using graphical features such as arrows and lines and consequently have less obvious connections with their real world counterparts. Research has shown that users are more inclined to concrete icons than to abstract icons, thus prove that visually obvious symbol will be most easily understood by a user (Stotts, 1998; McDougall & Isherwood, 2009). Users' responses to icon sets in which the icon characteristics of semantic distance and concreteness were also varied. McDougall et al. (2001) found that user does not rely on visual metaphor as much as semantic distance.

2 Data and Methods

All of 14 participants were the Slovak residents with a variety of age and gender group (See Table 1). From all 14, two of them were not in a good quality therefore

only 12 of them will be used for the evaluation. All of the participants were able to understand the instruction clearly and were able to participate in a correct manner.

Table 1 **Participant Data**

Age Group	Male	Female
18-24	1	1
25-49	7	2
50-64	**0**	**1**

Source: Own research, 2017.

The experiment was divided into two parts, each of them representing different scenario. The first part was to test users' preferences on four different cultural markers. There were four set of icons induced with specific markers; 1) to test straight/ curve line preferences; 2) to test cool/warm colours preferences; 3) to test depth preferences; and 4) to test abstract/ concrete symbol preferences. Each cultural markers scenario was presented for a period of 20 seconds, while the opposite sets were presented together accordingly.

The second part was to test users' preferences on icons induced with four different cultural indexes by Hofstede. Each of the indexes was presented using four different icons which represent both opposing indexes. 1) the PDI index used different set of colours representing Slovak flag and the generic ones; 2) MAS index used a set of similar icons with different colours; 3) IDV index used a globe metaphor for browser icon each representing different continent image; and finally 4) TOI index used four different symbol for dialler icon with specific time-constraint. Each scenario was presented for a period of 15 seconds. In total there were eight different set of scenario and an average experiment time span of 140 seconds.

The experiment conducted using two different sensory devices to produce both of the neuroimaging and biometric output. The devices used for the experiment are EEG device EPOC from Emotiv for collecting participant's brain waves thus creating a heat map for the brain activity. Gazepoint eye tracker was also utilized for creating a heat map of the participant's eye movement. The data from both of the device would be used to determine user's preferences and emotions while being presented with the stimuli.

3 Results and Discussion

From the result we gather from the eye tracker motion sensor to gather user's preference on conscience level, the results were varying on the participants. From the average of participant's visual attention seen on Table 2, we can see that while the majority of participant responded faster to the left (A) stimuli, the right (B) stimuli got more view treatment.

Table 2 **Eye Tracker Result (A) and (B)**

Stimuli (A)	*Viewers*	*1st Viewers (s)*	*Viewed Times (s)*	*Viewed Times (%)*	*Stimuli (B)*	*Viewers*	*1st Viewers (s)*	*Viewed Times (s)*	*Viewed Times (%)*
1	12/12	**0,95**	3,60	17,99	1	12/12	2,07	4,35	**21,74**
2	11/12	1,11	4,25	21,23	2	11/12	**0,90**	4,67	**23,33**
3	12/12	**1,82**	3,88	19,38	3	12/12	2,12	4,36	**21,82**
4	12/12	**0,65**	4,13	20,64	4	12/12	1,37	4,88	**24,39**

Source: Own research, 2017.

The majority of users prefer icons induced with straight lines markers, with the circular and curved icons get less attention. It also appears that the participants were more inclined to icons with concrete structures rather than abstract symbols, and it is parallel with the findings from Stotts (1998) as well as McDougall & Isherwood (2009). The colour and depth markers comparison suggested that both of the factors were equally accepted with slight inclines towards warm colours and flat/shadow-less icons.

The four Hofstede's index test results were also good. Based on the pin-point of the fixation map for each of the index, we witness some high concentration in attention on particular icons, suggesting a high power level, a high masculinity level, a low individuality level, with no clear preference on the time orientation index. Although we cannot get a rather quantitative result for each of the level, it has a clear resemblance towards the Hofstede cultural index for the state of Slovakia which we get from the official website, suggesting a correlation between the model and the experiment which is suggested by Table 3 below.

Table 3 **Brief Comparison on Hofstede Model and Experiment Result**

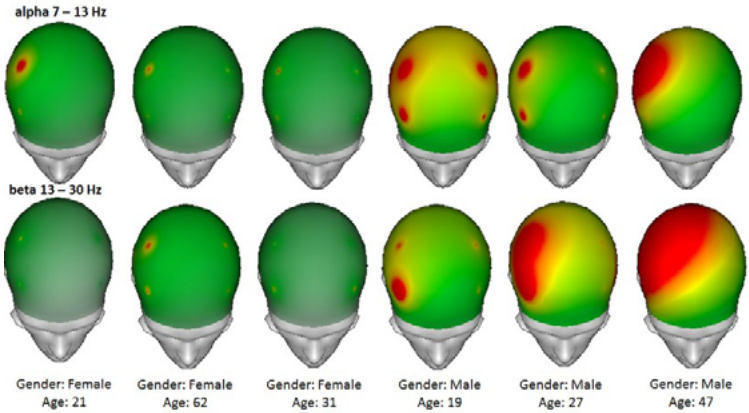
Hofstede Index	Level from site	Experiment result
Power Distance Index	100 (high)	high
Uncertainty Avoidance Index	51 (medium)	-

Hofstede Index	Level from site	Experiment result
Masculinity vs. Femininity	100 (high)	high
Individualism vs. Collectivism	52 (medium)	medium
Time Orientation Index	77 (high)	medium

Source: Own research, 2017.

Based on the research from Önal-Hartmann et al. (2012) which suggested that activity in right brain hemisphere lead to negative response, while activity in both hemispheres suggests positive reactions, we believed that the brain activity heat map as shown by Figure 2 produced by Emotiv software is also capable of capturing the general emotions of the participants.

Figure 2 **Male and Female Brain Activity Comparison**



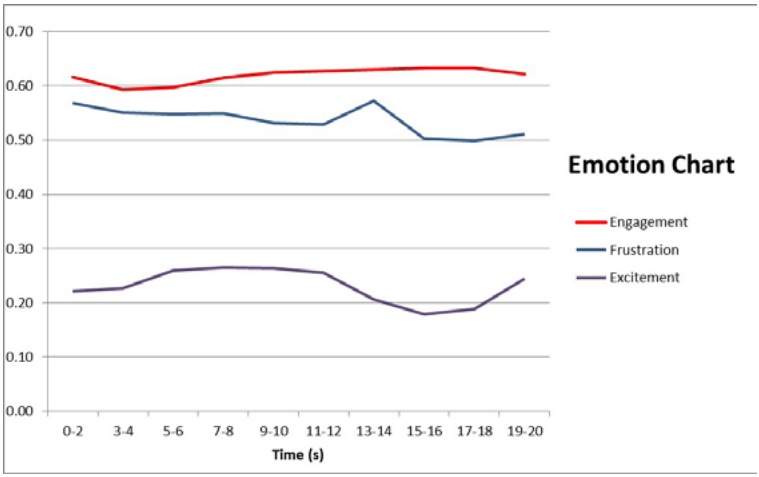
Source: Own research, 2017.

What we can see in the Figure 2 is rather interesting issue since we can see a major brain activity in both alpha and beta wavelengths on the male participant which shown otherwise by its gender counterparts. In the male participant, we can see a generally positive reaction because of the activity on both brain hemispheres on all the age range with a lot of activity happened with the older participant (age 47). While in contrast, a very low brain activity happened on all of the female subjects of the experiments. Only the younger participant (age 21) showed some negative emotion in alpha wavelength. We assume that this finding is still in its infancy age since it shows a contradictory result from the research of Collignon et al. (2010) which suggested that men have less multisensory emotional response

on particular subjects compared to women subjects. In the meantime, it is mainly believed that male and female have a distinct psychology, mental state, emotional state which plays a huge role on human history from evolutional perspective.

The stimuli used for the experiment is not really suitable for a more thorough result of the activity therefore it only showed a little change. Nevertheless, the experiment showed that the generality of the participant has a slight higher level of emotional engagement and frustration with a rather lower excitement level (Figure 3).

Figure 3 **Emotion Chart**



Source: Own research, 2017.

4 Conclusion

The experiment showed support on Hofstede's model on cultural distinction which tells that every culture has biased preferences on design and usability. The experiment suggested that it is possible to induce iconography with the elements from Hofstede's cultural index with proper adjustments to reproduce a better design and overall a better usability. Even so, a similar value on qualitative perspective means that there should be a way to calculate the effectiveness on quantitative scale for a statistical comparison. We also believe that there is an indication on whether a specific culture also has a biased preference towards general cultural markers such as shape, colour, depth, and symbolic preferences. This issue needs further research for a better answer. Another issue to further explore is coming from EEG result, although it is shown that the majority of the participants were

giving the positive reactions, we still see a slightly lower excitement level in general. This also needs further research to determine whether the cause of the problem was the design choice. The result in the brain activity heat map in which we found some interesting assumption also needs a further research treatment. In future, it would be necessary to include participants from different cultural environments as a control group so that we could compare results and measure the statistical significance of measured differences in cultural markers perception.

Albeit with the result of the experiment is arguably acceptable, there are still a lot of factors that need an improvement for the sake of better results. We believe that in order to have a thorough and complete statistical result, the amount of participant should be sufficient. With the amount of respondents that involved in the experiment, we could only manage to gather such small amount of data. We also found some obstacle which have various impact that implicated the findings, such as two of the 14 participant data that did not turned as desired. Another mistake happened during the preparation of the stimuli in which we missed to include one index (UAI) for the scenario, thus only four of five Hofstede index was tested. However, the data is enough to get a conclusion of the experiment. Also, this research is only applied and specified for those of Slovak residence in which we encourage other researchers to contribute on the same field of research involving other countries.

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