

# The Impact of Natural Utilization of Traditional Chinese Cultural Elements on the User Experience in Mobile Interaction Design

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**Abstract.** This paper, by making two experiments, studies the impact of natural culture integration on the user experiences. The results of experiment I indicate that: (1) Cloud Pattern and Ink Painting are the most likely to activate “sliding” gesture, followed by “tapping” gesture; (2) Chinese Seals and Paper-cut tend to activate “pinching” gesture, followed by “sliding” and “tapping” gestures; (3) Gu Zheng and Shadow Figures have generally same tendency to activate “tapping”, “sliding” and “pinching” gestures; (4) Calligraphy tends to activate “sliding” gesture. The results of experiment II show that: (1) gesture type has very limited influence on the interaction experience; (2) task complexity affects the user experience significantly; (3) the way of integration of cultural elements has significant relationship with “Feedback Clarity”, “Easy-to-use”, “Satisfaction in Feedback”, “Satisfaction for Culture Utilization”, “Natural Degree of Culture Utilization” and “Degree of Interesting”, and has very limited correlations with “Feedback Understandability” and “Memorability”. Except for “Feedback Clarity”, other 5 evaluations are the best in the natural integration condition and the worst in no integration condition. In brief, the two experiments indicate that the natural integration of cultural elements promoted the user experience, even though it reduced the clarity.

**Keywords:** Culture representation · User experience · Mobile usability

## 1 Background

Mobility and portability of the mobile device determine the limitation of its interface, and the diversity and the personalization of the applications also can result in the complexity. The way of interaction and feedback can affect the user experience. Good user experiences require the consistency of the feedback mode triggered by a user gesture with the user’s cognitive habits, which are closely related to the user’s cultural contexts and preferences.

## 2 Literature Review

The academia started the research of the impact of the culture on the interaction design since 1990s. For example, Mushtaha et al. found that the cultural background would influence users' feeling, choice and perception of the websites, based on the data from subjects from Malaysia, Greece, United Kingdom, Nederland, United States and Japan [1]. They used the text, page layout, colors, pictures and interaction as the independent variables, and asked the subjects with various cultural backgrounds to evaluate old and new versions of 22 websites, in which some cultural markers were integrated into the new version. The results indicated that cultural background influenced the evaluation of the websites to a large extent, and the new version of the websites had higher scores than the old version. Moreover, the conclusion drawn by Mashtaha was also verified by other researchers.

For example, Marcus et al. studied the cultural differences in Social Networking Services (SNSs) through 39 seemingly well-known SNS websites from Japan, South Korea, and the USA [2]. They used the First Page, Sign-up Page, Sign-in Page and the Home as their experiment materials, and evaluated the design components of each material based on the Hofstede's Cultural Dimensions. From the usability report and streaming data, Marcus found that the differences in users' cultural context caused the differences in understanding and choice of the information. For instance, people from the countries with high uncertainty avoidance may prefer simple, clear, and consistent UI layout when compared to people from the countries with low uncertainty avoidance [2].

Based on Hall's theory of time and space [3], Honold et al. proposed that the effectiveness of the interaction on the internet was affected by cultural factors and personal factors because in HCI dialogs, interaction, and information presentation were strongly linked with time (interaction, communication) and space (layout, structure) as well as the mental aspects (relations, thoughts) [4].

Smith et al. used the Taguchi Method to study the difference between British and Chinese satisfactions and preferences of websites, based on Hofstede's study on the generic cultural differences [5]. This study indicated that the attitude towards e-financial websites was very different. For example, Chinese users preferred to browse the website in a more general way compared to British users. They believed this was because Chinese have more prominent long-term-oriented thinking, which was possibly resulted from the deeply rooted Confucian philosophy.

These studies showed that the cultural context indeed affected the users' cognitions and behaviors, but such results are often general and scattered, and it's difficult to guide the interaction design using these results. One of the reason is that researchers don't have agreement on the definition of "Culture", or "Culture" itself is indeed very vague. Then what is culture? Let's have a look at the famous "Iceberg Model of Culture" [6]. This theory compares the culture to the iceberg and divides it into 3 levels: superficial level (visualization and materials, such as architecture and fine arts), middle level (behaviors and habits, such as history and customs), and core level (philosophy and spirit, such as values and attitudes towards universe, nature and time). Generally, only a few can be seen and most of them are hidden under the water. Therefore, it may be

difficult to understand people from different cultural contexts because of the hidden part of their cultures.

Geert Hofstede proposed another point of view on culture based on the experimental research on cultural differences [7]. He believed that culture was the collective programming of the mind that distinguished the members of one group or category of people from another, where the mind stood for thinking, feeling and acting, with consequences for beliefs, attitudes and skills. Meanwhile, he suggested that culture should be defined by 5 dimensions, which were power distance, collectivism/individualism, femininity/masculinity, uncertainty avoidance, and time orientation, and all the differences of the user's cultural contexts could correspond to one or several of them.

Edward T. Hall and Mildred Reed Hall proposed their view of cultural mode from practice. They believed culture could be defined by the following dimensions: fast and slow messages, high and low context, territoriality, personal space, and monochronic and polychronic time. Edward T. Hall also suggested that culture was a "silent language" or "hidden dimension" that steered people unconsciously [8].

Alexander Thomas believed that culture "expresses the normal, typical, and valid attributes for the majority of the members of a certain culture regarding the kinds of perception, thoughts, judgments, and actions, encompasses learning basic human abilities in the social arena, control of one's own behavior and emotions, the satisfaction of basic needs, worldview, verbal and nonverbal communication, and expectations of others as well as the understanding of one's role and scales for judgment" [9].

From the above, we know that culture is a very broad concept, which involves every aspect of society. However, not all cultural elements can influence a person in a balanced and uniform way. In a certain environment, there must be a certain type of typical culture that affects people's mind, which may be the explicit part of culture (such as some patterns, architectures or arts with some typical styles), or the hidden part (such as values and formal beauty) [4]. In this case, there will be a certain framework of the interface and interaction appearing in users' minds, which includes metaphor, mental model, navigation, interaction, and presentation. For example, Marcus suggested that the users in Confucian cultural contexts would form such a framework of the interface and interaction: traditional powerful structures, feminine colors, exact, complete, detailed input and feedback, and high context dependency [10].

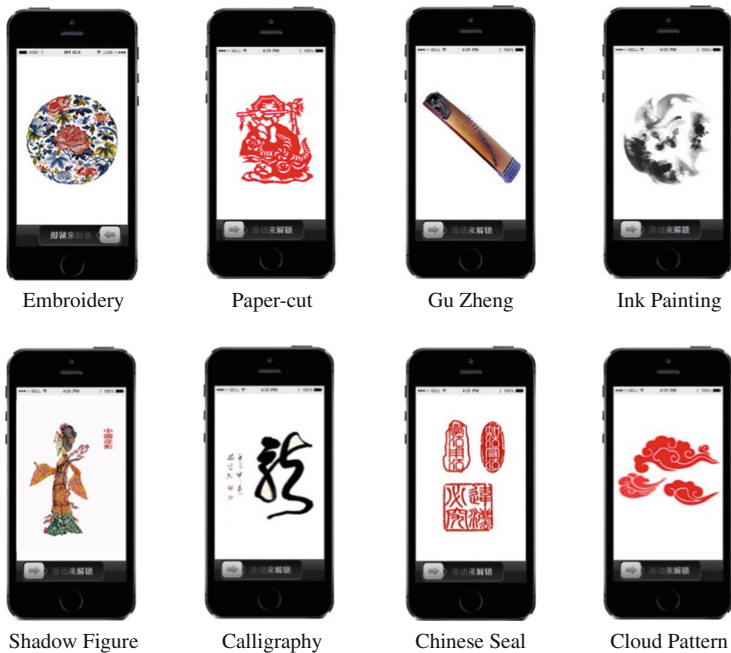
Despite Marcus' conclusion still needs to be verified, he provided a good thought: if we can integrate the local cultural element into the UI design of mobile apps in a natural way, and bring the user familiarity in such aspect as metaphor, mental model, representation and interaction process, does that mean we can design a product that matches the local cultural expectation and cognitive habits?

This paper is focused on the impact of natural integration of the culture's explicit part (i.e. the visual features) on the user experiences. This study is divided into 2 parts: Experiment 1 is the correlation test of the explicit culture and interaction, and Experiment 2 is the test of influence of the naturally integrated culture elements on the users' mental and interactive experience.

### 3 Experiment I - Correlation Test Between Typical Explicit Culture and Interaction

The goal for this part is to select typical ones from multiple Chinese cultural elements to be candidates for the integration into mobile apps.

We invited 6 experienced specialists to choose 8 typical cultural representations with various forms, based on cultural identity, semantic and symbolic meaning, and the relationship with interaction. These representations were Embroidery, Paper-cut, Gu Zheng, Ink Painting, Shadow Figure, Calligraphy, Chinese Seal and Cloud Pattern. We used these cultural representations as the samples in Experiment I (shown in Fig. 1), and asked 20 college student aged 18–26 to evaluate these samples according to the aspects of “Typicality of Chinese Culture”, “Shape-Gesture Correlation”, “Semantics”, “Identification”, “Expected Easy-to-use”, “Expected Memorability” and “Satisfaction”, using 5-point scale.



**Fig. 1.** Chinese culture representations for experiment I

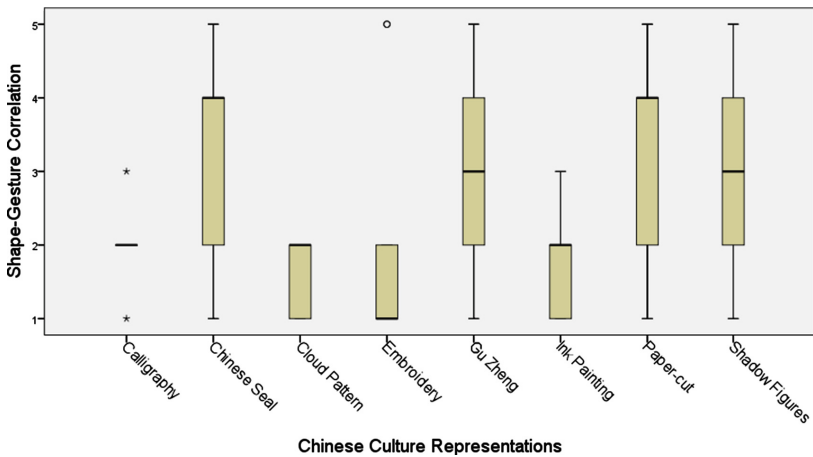
The results indicate that:

These 8 culture representations have significant differences in “Typicality of Chinese Culture”, “Identification”, “Expected Easy-to-use”, “Expected Memorability” and “Satisfaction”, with the corresponding  $\alpha$  values smaller than the threshold 0.01 (Shown in Table 1).

**Table 1.** Results of one-way ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Typicality of Chinese Culture	Between Groups	46.833	7	6.690	16.611	.000
	Within Groups	25.778	64	.403		
	Total	72.611	71			
Identification	Between Groups	78.000	7	11.143	31.774	.000
	Within Groups	22.444	64	.351		
	Total	100.444	71			
Expected Easy-to-use	Between Groups	80.167	7	11.452	42.835	.000
	Within Groups	17.111	64	.267		
	Total	97.278	71			
Expected Memorability	Between Groups	97.542	7	13.935	20.580	.000
	Within Groups	43.333	64	.677		
	Total	140.875	71			
Satisfaction	Between Groups	52.611	7	7.516	20.615	.000
	Within Groups	23.333	64	.365		
	Total	75.944	71			

Cloud patterns and ink painting are the most likely to activate “sliding” gestures, followed by “tapping”. Chinese seals and paper-cut tend to activate “pinching”, followed by “sliding” and “tapping”. Gu Zheng and Shadow Figures have generally same tendency to activate “tapping”, “sliding” and “kneading”. Besides, calligraphy tends to activate “sliding”(Shown in Fig. 2).



**Fig. 2.** Box plot of shape-gesture correlation

The cloud pattern is the most appropriate to be applied into mobile interactive design, because it has the highest scores in the “Typicality of Chinese Culture”, “Identification”, “Expected Easy-to-use”, “Expected Memorability” and “Satisfaction”. And the ink painting is in the 2nd place (shown in Fig. 3).

The possible reasons may be: (1). cloud patterns are more recognizable in life; (2). It has more features of Confucian culture; (3). similar to ink painting, the cloud patterns have the expanding tendency like ripples.

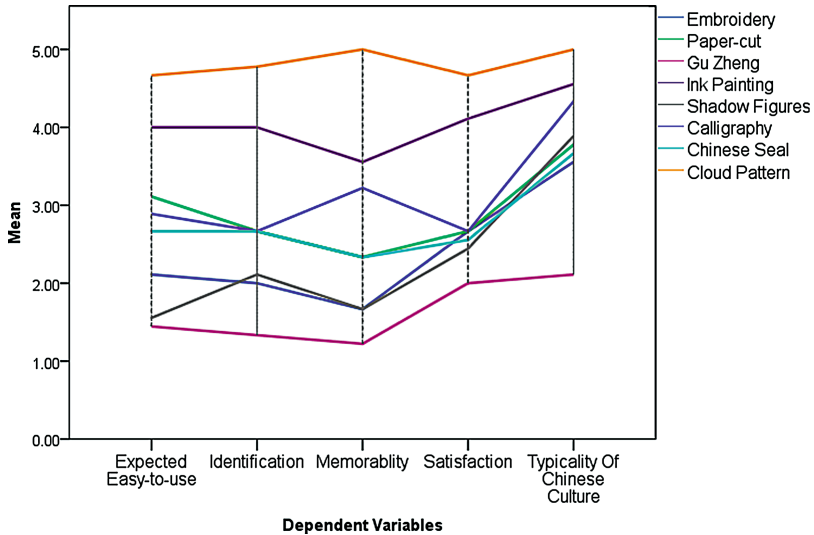


Fig. 3. Chinese culture representations' scores in dependent variables

Since the cloud pattern is significantly better according to this experiment, we used it as the elements in Experiment II.

#### 4 Experiment II – Test on the Influence of Cultural Elements on the Interactive Feedback

The goal of the part is to explore how the ways of integration of cultural elements could affect the user experience in the mobile apps. In this study, we selected the button feedback as the main scenario to understand this integration, because the button feedback is one of the basic and important way of interaction.

In terms of the way to integrate the cultural elements, the most common one nowadays is to embed these elements into the interface by direct duplication. This method may bring intimacy and familiarity to the user, however, it may also result in abruptness and conflict with existing cognitive habit and mental model. The culture should be incorporated into the mobile apps in a natural way, which refers to the

intrinsic feature, for example, the content, style, symbol and metaphor should be in accordance with the style, usage and image of the design objectives.

The independent variables in this experiment are “the Way of Integration”, “Gesture Type” and “Task Complexity”. We divided “the Way of Integration” into 3 conditions: “Natural Utilization”, “Abrupt Utilization” and “No Utilization”. “Natural Utilization” means that the cloud patterns appear on the screen gradually around the touch point, and they change from light to dark, and from vague to clear, just like a real cloud. “Abrupt Utilization” means the cloud patterns appear immediately as the finger touches the screen. “No Utilization” means there are no cloud patterns around the touch point. “Gesture Type” includes tapping and sliding, and “Task Complexity” includes simple and complex levels. The controlled variables include “Interface Layout”, “Icon Colors”, “Icon Size”, “Icon Texture” and “Icon Shape”. We designed 12 kinds of experiment materials (shown in Fig. 4) and designed the questionnaire based on the PACMAD mobile usability model with 8 questions.

The subjects are 22 college students aged 18 – 26, in which half are male and half are female, 15 are from department of industrial design, and the other 7 are from other areas. All subjects are experienced Android users.




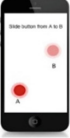
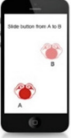
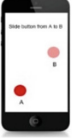






		Natural Utilization	Abrupt Utilization	No Utilization
Single Task	Tapping			
	Sliding			
Multi Task	Tapping			
	Sliding			

Fig. 4. Materials for experiment II

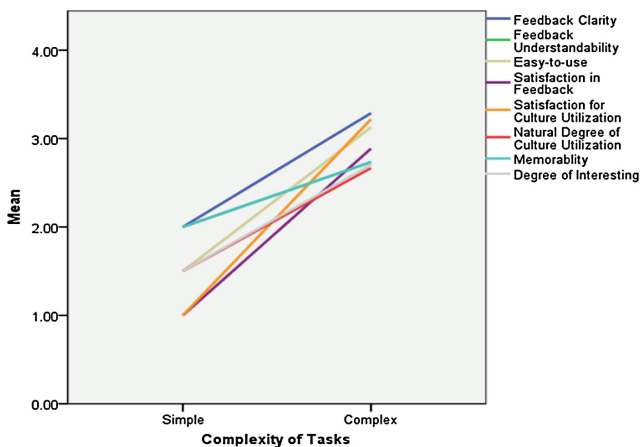
**Table 2.** Results of one-way ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Feedback Clarity	Between Groups	5.186	1	5.186	2.725	.100
	Within Groups	498.629	262	1.903		
	Total	503.814	263			
Feedback Understandability	Between Groups	2.182	1	2.182	1.604	.206
	Within Groups	356.348	262	1.360		
	Total	358.530	263			
Easy-to-use	Between Groups	41.761	1	41.761	31.338	.000
	Within Groups	349.144	262	1.333		
	Total	390.905	263			
Satisfaction in Feedback	Between Groups	4.125	1	4.125	2.921	.089
	Within Groups	370.023	262	1.412		
	Total	374.148	263			
Satisfaction for Culture Utilization	Between Groups	3.409	1	3.409	2.677	.103
	Within Groups	333.682	262	1.274		
	Total	337.091	263			
Memorability	Between Groups	1.670	1	1.670	1.660	.199
	Within Groups	263.689	262	1.006		
	Total	265.360	263			
Degree of Interesting	Between Groups	35.640	1	35.640	37.866	.000
	Within Groups	246.598	262	.941		
	Total	282.239	263			

The results indicate that:

“Gesture Type” has very limited influence on the interaction experience. Only “Easy-to-use” and “Degree of Interesting” show significant relationship (shown in Table 2). This means the gesture type doesn’t have much impact on the user experience with integration of cultural elements.

“Task Complexity” affects the user experience significantly. What’s interesting is that the more complex the task is, the better the user experience is (shown in Fig. 5). This may be related to the interaction time.

**Fig. 5.** Relationship between task complexity and dependent variables



**Table 3.** Results of one-way ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Feedback Clarity	Between Groups	17.417	2	8.708	4.673	.010
	Within Groups	486.398	261	1.864		
	Total	503.814	263			
Feedback Understandability	Between Groups	6.689	2	3.345	2.481	.086
	Within Groups	351.841	261	1.348		
	Total	358.530	263			
Easy-to-use	Between Groups	17.235	2	8.617	6.019	.003
	Within Groups	373.670	261	1.432		
	Total	390.905	263			
Satisfaction in Feedback	Between Groups	17.614	2	8.807	6.447	.002
	Within Groups	356.534	261	1.366		
	Total	374.148	263			
Satisfaction for Culture Utilization	Between Groups	26.341	2	13.170	11.062	.000
	Within Groups	310.750	261	1.191		
	Total	337.091	263			
Natural Degree of Culture Utilization	Between Groups	26.030	2	13.015	14.633	.000
	Within Groups	232.136	261	.899		
	Total	258.167	263			
Memorability	Between Groups	4.598	2	2.299	2.301	.102
	Within Groups	260.761	261	.999		
	Total	265.360	263			
Degree of Interesting	Between Groups	19.182	2	9.591	9.516	.000
	Within Groups	263.057	261	1.008		
	Total	282.239	263			

The way of integration of cultural elements has significant relationship with “Feedback Clarity”, “Easy-to-use”, “Satisfaction in Feedback”, “Satisfaction for Culture Utilization”, “Natural Degree of Culture Utilization” and “Degree of Interesting”, and has very limited correlations with “Feedback Understandability” and “Memorability” (shown in Table 3). Except for “Feedback Clarity”, other 5 evaluations are the best in the natural integration condition and the worst in no integration condition (shown in Fig. 6). This result indicates that the integration of cultural elements promoted the user experience, even though it reduced the clarity.

## 5 Conclusion

This experimental study explored the change of user experience after the explicit and visual cultural elements were incorporated into the interaction design in the mobile environment. The results indicate that: (1) the cloud patterns are one of the most popular symbol for the Chinese cultural elements in mobile interaction design; (2). The natural integration of traditional cultural elements can promote the emotional experience, such as “Easy-to-use”, “Satisfaction in Feedback” and “Degree of Interesting”, etc.

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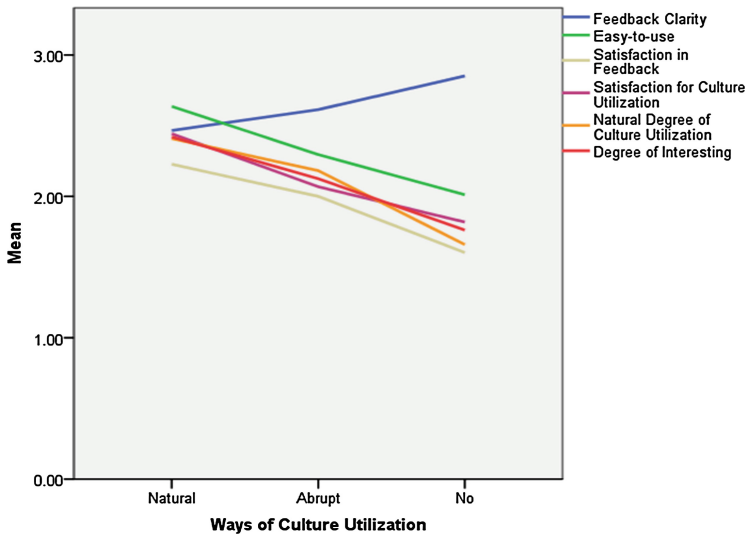


Fig. 6. Relationship between ways of culture utilization and dependent variables

## References

1. Mushtaha, A., De Troyer, O.: Cross-culture and website design: cultural movements and settled cultural variables. In: Aykin, N. (ed.) IDGD 2009. LNCS, vol. 5623, pp. 69–78. Springer, Heidelberg (2009)
2. Marcus, A., Krishnamurthi, N.: Cross-cultural analysis of social network services in Japan, Korea, and the USA. In: Aykin, N. (ed.) IDGD 2009. LNCS, vol. 5623, pp. 59–68. Springer, Heidelberg (2009)
3. Hall, E.: *The Silent Language*. Doubleday, New York (1959)
4. Honold, P.: *Interkulturelles usability engineering: Eine Untersuchung zu kulturellen Einflüssen auf die Gestaltung und Nutzung technischer Produkte [Intercultural usability engineering: An investigation of cultural influences on the design and usage of technical products]*. Als Ms. gedr. ed. vol. 647. Düsseldorf, Germany : VDI Verl. (2000)
5. Smith, A., French, T., Chang, Y., McNeill, M.: eCulture: A comparative study of eFinance web site usability for Chinese and British users. Designing for global markets. Conference (6th. 2001). In: Day, D., Duckley, L. (eds.) *Proceedings of the 3rd International Workshop on Internationalisation of Products and Systems*, pp. 87–100. The Open University, Buckinghamshire (2001)
6. Hofstede, G.: *Cultures and Organisations: Software of the Mind*. McGraw-Hill, New York (1991)
7. Hofstede, G.: *Cultures and Organisations: Software of the Mind*. McGraw-Hill, New York (1991)
8. Hall, E.T., Hall, M.R.: *Understanding Cultural Differences: [Germans, French and Americans]*. Intercultural Press, Yarmouth (2004)

9. Thomas, A.: *Psychologie Interkulturellen Handelns* [Psychology of intercultural acting]. Hogrefe, Göttingen (1996)
10. Marcus, A.: Cross-cultural user-interface design. In: Smith, M.J., Salvendy, G. (eds.) *Systems, Social and Internationalization Design Aspects of Human-Computer Interaction*, (pp. 502–505). Volume 2 of the Proceedings of HCI International 2001, pp. 5–10, August 2001, New Orleans, Louisiana, USA (2001)