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**Abstract:** There is a difference in how Danish and Chinese people group object, method and concepts into categories. Difference in these points affect the information structure in applications, which involve menus, links and directories. This study involves groups from Chinese and Danish cultures and investigates how these two cultures group cards into different categories and how their cultural backgrounds affect the structure of their categories.

**Keywords:** Card Sort, Information Structure, Cultural Difference and Usability.

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# 1. Introduction

In this global world, different applications must be equally usable across different countries. The usability of a product is affected not only by the features of the product itself, but also by the characteristics of the users (Thomas and Bevan, 1996). Culture is one of the factors that affect a user's way of categorizing objects. Different users have a different approach of categorizing the same object according to their cultural background. Cultural factors significantly affect information structure of applications worldwide because these applications are more used outside of countries and cultures where they have been developed and designed (Shen, Wolley and Prior, 2006). Their formation is primarily based on metaphors of the specific country or culture where this application is made and it ignores the facts of cultural based ethics. For example, color association is different in different cultures (Dmitrieva, 2002).

Paying attention to how the target audience groups object, functions and concepts is the most important part of designing an application. Cultural background of a user plays an important part in grouping of these objects. Therefore, the cultural aspect of the target audience should be considered a very important part in grouping of objects in the designing application. The information structure of objects in applications covers organization of menu structure, interfaces, and links in websites and file directories.

As Thomas Plocher and Torkil Clemmensen (2006) point out in a recent study, the category forms the basis for information architecture (Clemmensen and Plocher, 2006). Eastern and Western cultures differ in how they group objects, functions and concepts into categories. Western cultures group objects together on the base of their features and attributes, whereas Eastern cultures group objects together on the base of their relationship with each other. Generally eastern cultures are not interested in organizing things into categories as compared to western cultures. If an application is made for the Danish or Swedish users and the software company hires designers from India to accomplish this task, the designer, who has an Indian cultural background, makes the information structure of the application in the best possible way, but the structural approach is inspired by his cultural background. Therefore the difference in cultural background will affect the usability of the application.

The results have shown that different cultures group objects, functions and concepts differently. Difference in grouping has an effect on the usability of the software. As Nisbett (2003) stated in his study, there are indeed dramatic differences in the nature of Asian and European thought process (Richard E. Nisbett, 2003; p.80). Designing software for a global audience will increase the global acceptance of the software. Del Galdo and Nielsen (1996) also spoke about cultural reflection in the software by stating that truly intuitive cross-cultural softwares should reflect the cultural orientation of its users and accommodate the user's cultural differences (Del Galdo and Nielsen, 1996).

## 1.1. Goal

The purpose of this research is to investigate:

- how different cultural groups differ or are similar in grouping of objects, functions and concepts during a task
- user and software information structure for cross cultural compatibility by using repeated single criterion
- how it would help in building better information structure in applications.

## **2. Research question**

Investigate people's information structure in Denmark and China and measure the difference in the information structure of categories in Chinese and Danish cultural groups.

### 3. Background

The beginning of work on cross-culture aspects of design was seen in 1970. Publications on culture and product design reached at peak in 1975 (Honold, 2000). After 1990, another aspect of cultural usability was in the headlines - designers started to emphasize on interface for global audience. They started to seek help from the domain experts and human interface professionals to make terminologies for universal audience so that they could be universally used for global internet and application users. Russo and Boor suggested translation of text into local language as a first step in preparing a product for international users (Russo P and Boor S, 1993). So Experts started to work on translations of products to make it internationally recognizable. But there was a contradiction of image acceptability to different cultures because some images acceptable in one culture were non-comprehensible to another culture. As Russo and Boor described, the American "OK" hand gesture is considered vulgar in Brazil and Germany (Russo and Boor). There are many interpretations of symbols in different cultures when companies would make their products for international users.

Computer is slowly but surely becoming ubiquitous (Fernades, 1995). Main human computer conferences started to talk about the study for international users and differences in users in the mid nineties. Initially, large companies took initiatives to make applications and translated in different languages as initial step towards globalization and internationalization of applications, but Fernades (1995) describes that for financial and strategic reasons, companies tried to make their product globally acceptable with minimum amount of modification (Fernades, 1995). Evers and Day (1997) discussed the research proposition of cultural differences and expressed that users' culturally specific design preference influence their perception about system ease of use and concluded the result that Chinese find usefulness a more discernible variable, while Indonesians find ease of use more importuned. They suggested that the Chinese try to work with a useful interface even when it is hard to use. Indonesians, however will tend to give up more easy when an interface is hard to understand (Evers and Day, 1997).

Asian and Western cultures organize and group objects with different approach. Western people tend to group objects by categories where as Asian people tend to group objects on the base of their relationship. Studies of Li-jun Ji, Zhiyong Zhanda and Nisbett RE (2002) showed same kind of result. Students were provided with different sets of words (e.g., panda, monkey and banana) and they were asked to indicate which two of the three words were most closely related. The American participants made groups on the base of common categories. They put panda and monkey into the animal category. The Chinese participants made grouping on the base of their thematic relationship and put monkey and banana in one category. They justified their answer by saying that monkeys eat bananas (Nisbett RE, 2003; p.141).The difference in grouping of objects in different cultures pores a lot of questions to answer.

The primary goal of information systems should be to provide uncomplicated information structure to the users keeping their cultural background in mind and localizing application in a way that not only includes language transformation but also keeps the cultural and intellectual level of the people for which it is going to be made.

# 4. Research methodology

This research is based on the belief that different cultures have different judgments about the usability of information structure according to their cultural background. Culture is a very important factor of usability from technology perceptive.

## 4.1. Research design

In order to understand the difference in grouping of objects in both cultures, card sorting experiment is performed. Card sorting is a usability method used in software and product design to discover the user’s mental model about information architectures (Nielsen, 1995; p. 179-88). Card sorting is a useful way of finding the commonality and difference in grouping and categorization of respondents and experts of systems (Rugg G and McGeorge, 2005). Card sorting is also a useful way of finding commonality and difference in grouping and categorization of people in China and Denmark. Card sorts are primarily used for this experiment because it can be easily understood by the people in both cultures. There are different techniques which can be used in card sorts. In this research, repeated single criterion sort (Rugg G and McGeorge, 2005) will be used as a sorting technique to gather data from subjects of both cultures. Repeated single criterion sort will be used because they are more flexible and easier for most elicitors to handle and respondents sort the same entities repeatedly, categorizing in terms of a different single criteria each time (Rugg G and McGeorge, 2005).

Card sorting experiments are primarily performed in Denmark and China. These experiments help us understand the variation in formulating categories in Danish and Chinese cultural groups. These experiments will also help us understand the variation within cultural group. The important terminologies for experiments described by Rugg are defined here:

**Criterion:** A criterion is the attribute used as the basis for sort when using the sorting technique. For example the criterion may be the ‘place of manufacture’ or ‘cost’. The criterion provides the base of sorting things into categories.

**Category:** A category is a group into which things may be classified using criteria. For example, the categories under criterion of ‘place of manufacture’ may be ‘USA’, ‘Japan’ or ‘Europe’.

Edit distance will be used as a method for analyzing card sorts. Basic ideology for edit distance is that minimum number of steps is required to convert one sort into another sort where one step comprises of moving one item of card from one group to another group. Edit distance is used to measure the similarity of categories in different sorts.

Sort A	Sort B
$A_1 = \{1, 2, 3, 4\}$	$B_1 = \{1, 2, 3\}$
$A_2 = \{5, 6, 7\}$	$B_2 = \{4, 5, 6\}$
$A_3 = \{8, 9, 10\}$	$B_3 = \{7, 8, 9\}$
$A_4 = \{\}$	$B_4 = \{10\}$

**Table 1:** Measuring edit distance by using cards in Sort A and Sort B

Table 1 shows the example of two sorts A and B, where ten cards are used. These cards are sorted in four groups:  $A = \{A_1, A_2, A_3, A_4\}$  and  $B = \{B_1, B_2, B_3, B_4\}$ . These cards use the numbers to be identified from each other. In Sort A, empty group  $A_4$  is included so that both sorts have the same number of groups. Sort A can be converted into Sort B by moving cards in the same sort from one group to another group. Minimum sets of move are shown in Table 1. By moving 4 from  $A_1$  to  $A_2$ , 7 from  $A_2$  to  $A_3$  and 10 from  $A_3$  to  $A_4$ , edit distance analysis will help examine the difference in two sorts.

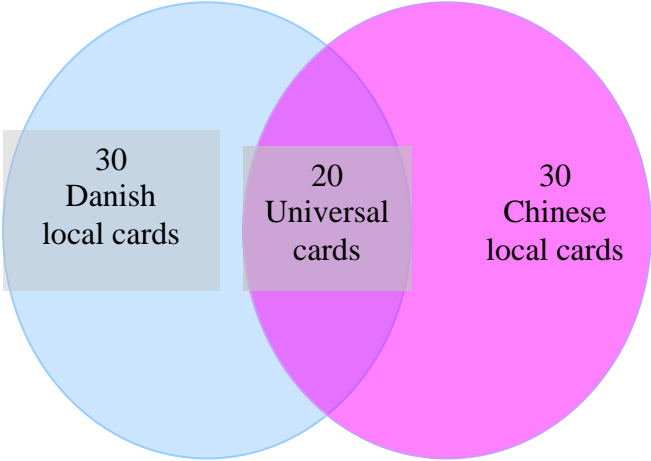
### 4.2. Material

The purpose of this study is to analyze people’s information structures for compatibility cross culturally using repeated single criterion sort .The participants in this study are one group of Chinese and one group of Danish users with 10 participants each. These participants are called ‘subjects’ in these experiments. This study comprises of 10 sessions from 10 subjects in each culture.

Wedding pictures for designing wedding invitation cards are used as cards for this study. The basic principle in choice of pictures of card sorts is that all pictures of cards are related to wedding invitation and all these pictures can be used in designing wedding invitation cards. This experiment is initially divided into two types of cards that are used in these experiments.

- Universal cards
- Local cards

Universal cards consist of wedding pictures that can be used to design wedding invitation cards in Danish and Chinese cultures. These pictures are common in both cultures. Universal wedding cards are selected and chosen with the help of subjects from both cultures. Researchers of these cultures finalize these cards. In this study 20 universal cards are used for Danish and Chinese subjects.



**Figure 1:** Chinese and Danish sample space for wedding invitation cards used for experiment.

Local cards consist of wedding pictures that can be used to design wedding invitation card for local people according to their cultural background. These local cards are different for both cultures according to their cultural backgrounds. In this study, 30 local cards are used for Chinese subjects and same number of cards is used for Danish subjects.



### **4.3. Procedure**

In the experimental session a participant will perform three sorts for both local and universal cards separately. A criterion for Sort 1 is wedding. The subject defines and names his own categories for Sort 1 and sorts cards into his own defined categories. After completing the sorting, the subject writes down the name of each category which he created. Purpose of Sort 1 is to identify people's defined categories and compare it with other people in the same culture and cross culturally.

A criterion for Sort 2 is also wedding. In this sort, the subject is provided with predefined categories and asked to place these cards accordingly. The Researcher provides the following categories for the subject to use: Flowers, Rings, Hearts, Light, (object-oriented categories) and "Two people together" and "Love" (wedding theme categories). The experimenter writes each category name on separate pieces of paper and places them in front of the subject with the cards to be sorted. The experimenter tells the subject that he can make more categories if he wishes to do so.

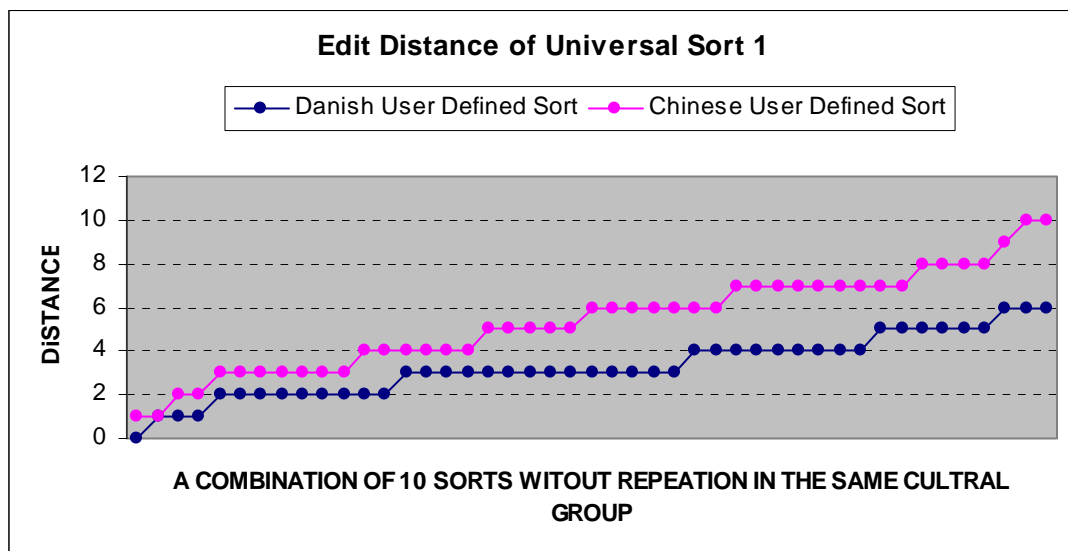
A criterion for Sort 3 is wedding colors. In this sort the subject is also provided with predefined categories related to colors. The experimenter provides the following categories for the subject to use: Red, Pink, Gold, Blue, Violet, and Silver. The experimenter repeats the same procedure and writes each category name on separate pieces of paper and places them in front of the subject together with the cards to be sorted. The experimenter tells the subject that he can make more categories if he wishes to do so, but only categories related to colors.

These three sorts will be used for both universal and local card sorts. Universal card sorts will help to identify cultural difference cross culturally. Local card sorts will help to identify variation within a cultural group.

## 5. Results

The results of 10 Danish and 10 Chinese participants were analyzed by using the UW Card<sup>1</sup> sort application. Results of data are presented in the following structure:

- 1) Edit distance of Universal sort 1-3 in Danish and Chinese cultural group. It highlights the difference and distances, in grouping and categories of universal card sorts, of people from each other.
- 2) Edit distance of Universal sort 1-3 in Danish and Chinese cultural group from their perspective probe sorts (Appendix C1 and C2). It highlights the difference and distance of categories in the grouping of people in these cultures, from researchers sort.
- 3) Compare the distances of all universal and local sorts of Danish and Chinese people with each other.



**Figure 2:** Difference and distance in grouping of Danish and Chinese universal sort 1.

Figure 2 shows the edit distance of Danish and Chinese universal Sort 1 which is taken from 10 Danish and 10 Chinese subjects. Sort 1 is a people defined sort and subjects can choose their own categories under the criteria of wedding, for this sort. X axis shows the combination of 10 sorts without repetition. Y axis shows the distance of combination of sorts within the cultural group and cross culturally. A single pink dot represents the distance of two Chinese subjects from each other. Trend of pink line shows the combination of Chinese subjects with each other without any repetition. The order of 10 subjects on X axis is sequenced from ascending to descending order. This figure shows that Danish people have less distance within their sorts as compared to the Chinese people. In this user defined sort, only one Danish subject puts all cards in three categories whereas two Chinese subjects distributed cards into three categories. When all sorts are taken into consideration, Danish people made more categories than Chinese people. This result also reveals that five Chinese subjects used the

<sup>1</sup> <http://www.cs.washington.edu/research/edtech/CardSorts/>

*other* category whereas only two Danish subjects used *other* category. This result specifies that there is more use of other categories in Chinese group as compared to the Danish group. Maximum distance within Danish people defined sorts is 6; whereas the maximum distance within Chinese people defined sorts is 10.

The result from figure 2 shows that Danish subjects are good if they are asked to make categories and define names of categories. The object oriented thinking of Danish subjects is close to each other in their cultural group. Whereas many Chinese subjects are unable to decide about placing the cards into categories and defining categories which are related to wedding criteria.

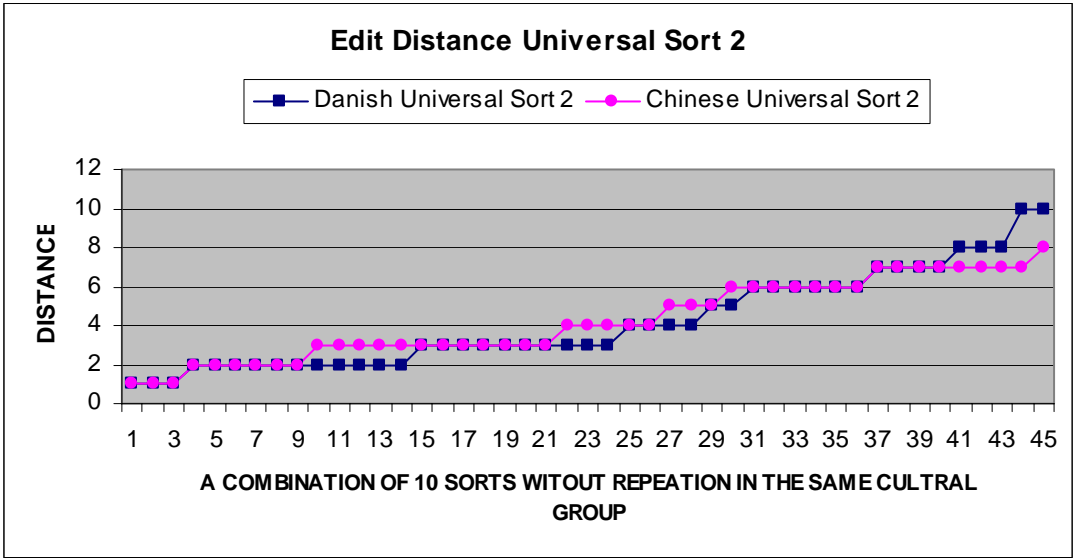


Figure 3: Edit distance of Danish and Chinese universal sort 2.

Figure 3 shows the edit distance of Danish and Chinese universal sort 2 which is taken from 10 Danish and 10 Chinese subjects. Subjects are provided with predefined categories in sort 2. They also have options of making their own categories. X-axis shows the combination of 10 sorts without repetition and Y-axis shows the distance of a combination of sorts within the cultural group and cross culturally.

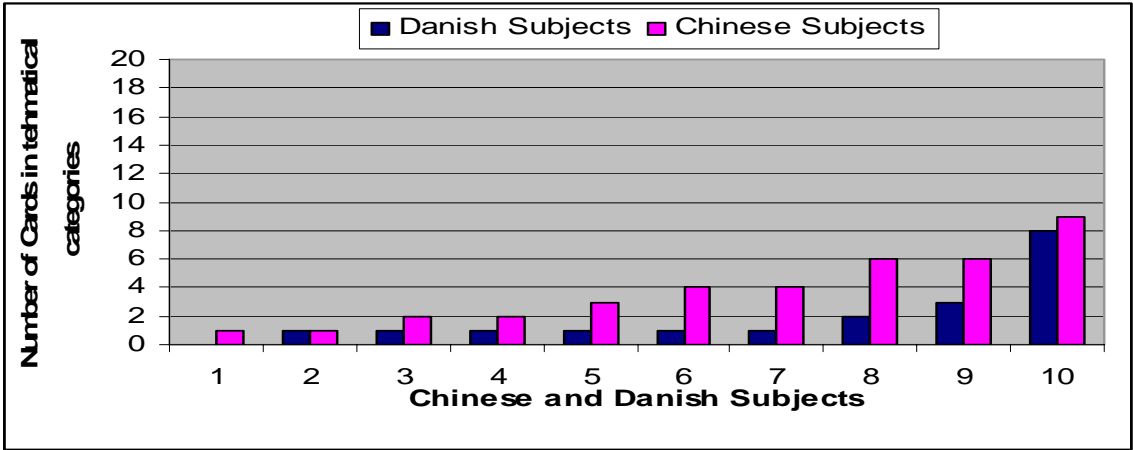


Figure 4: Use of Thematical based categories between Chinese and Danish people.

In Sort 2, there were two categories related to wedding theme namely *Love* and *Two people together*. Figure 4 shows the number of cards in thematic categories of universal sort 2. On an average Chinese subjects put 3.8 cards out of 20 cards into these two thematic categories. Danish subjects put 1.9 cards out of 20 cards into these thematic categories. Out of 10 Danish subjects, 6 subjects chose one card and one subject chose no cards for one of these thematic categories. On the contrary 6 Chinese subjects chose four or more cards for thematic categories and only two Chinese subjects chose one card for one of these two thematic categories. These statistics show that there is more use of thematic categories in Chinese people and the Danish people use thematic categories less than Chinese people.

Comparison of universal sort 2 in Chinese and Danish subjects indicates that physical attribute of items and concepts should be dominant in Danish information and data manipulation of applications because Danish people prefer to highlight category name by its physical attributes which are present in the data. Analysis of the data for Danish population indicated that the structure of information in applications should be organized and grouped by keeping relations of entities and tags with each other. Chinese people highlight the category name by identifying the relation between different entities.

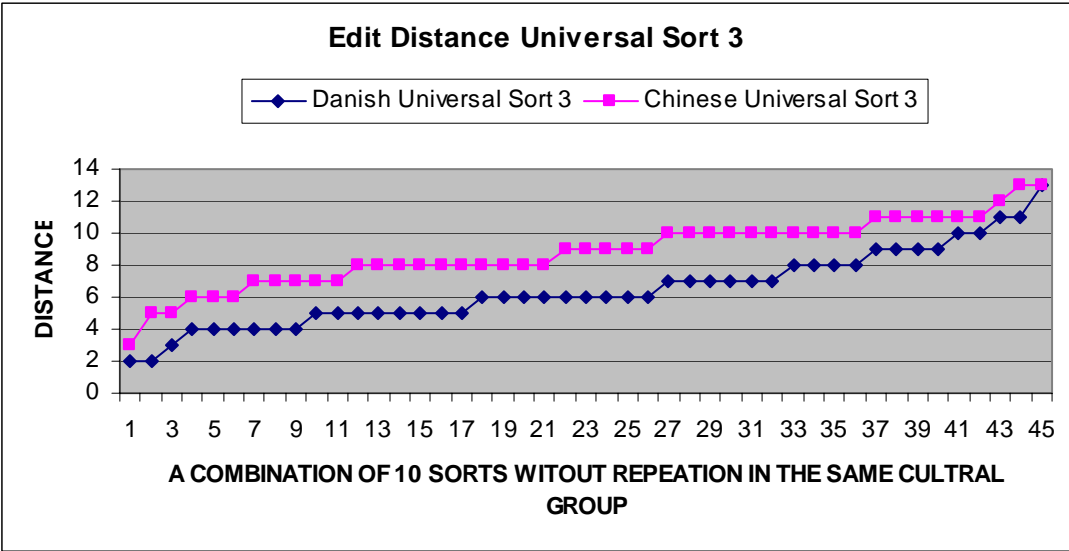




Figure 5: Edit distance of Danish and Chinese universal sort 3.

Figure 5 shows the edit distance of Danish and Chinese universal sort 3 which is taken from 10 Danish and 10 Chinese subjects. Sort 3 is also a predefined sort with the criteria of *Colors*. In edit distance universal sort 3, distance of Chinese and Danish subjects is higher than the pervious sorts. Distance of Chinese subjects is bigger than Danish subjects. There are several reasons for greater distance under the criteria of color. Distribution of colors in the selected cards was not equally divided. Subjects have more options of placing a card into different categories.

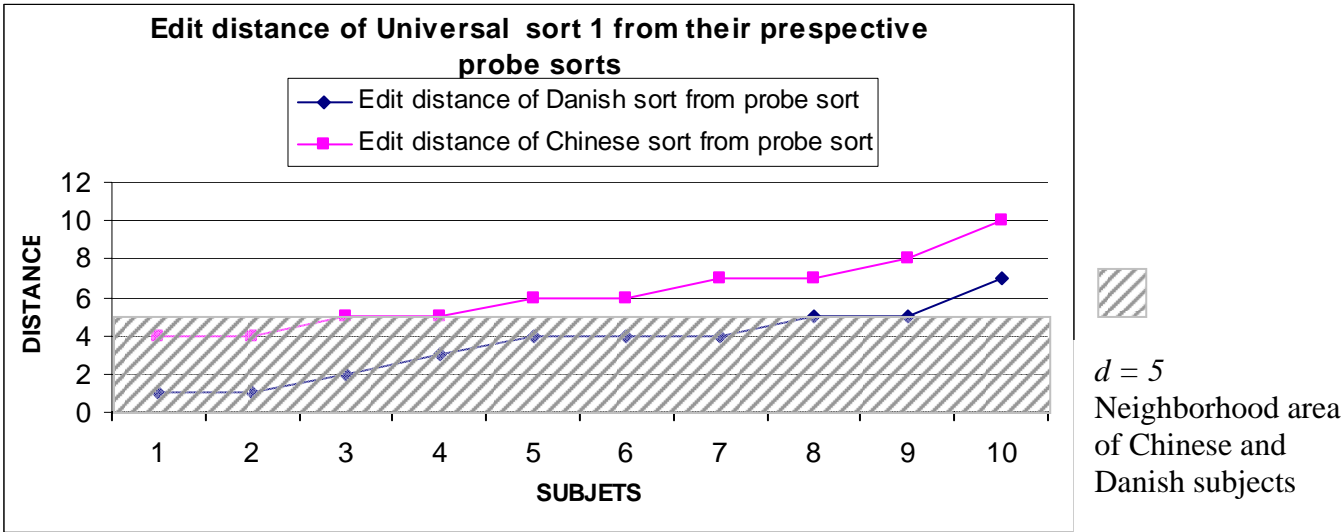
Color is also an important factor in usability of applications and it affects different cultures differently. Red color dominates as preference of choice in both cultures, but Red color dominates the focus of subjects in Chinese culture more as compared to Danish culture. Foreground color of data and information is important for Danish subjects whereas Chinese subjects observe and judge by keeping background color of information as well in their mind.

In the previous analysis, sorts of subjects were compared by sorts of other subjects in the same culture to see their approach to group cards. Now sorts of subjects will be compared with a single specific sort which is called probe sort. Probe sort is a model sort which researchers think that subjects are going to make accordingly (Appendix B.2). It will help to see the difference and distance of all sorts from that specific sort. This process of comparing one sort with different sorts is called Neighborhood (Appendix B.1).

Pictures	Criterion for probe sort		Description
	Danish subjects	Chinese subjects	
	<b>User-defined categories</b>		
	Ring	Flowers	According to Nisbett’s theory, Danish subjects place card into the Ring category because the foreground object is ring. Chinese subjects place card into Flower category because major area of card is covered by flowers.
	<b>Colors categories</b>		
	Pink	White	According to Nisbett’s theory, Danish Subject will place it in Red color category because foreground object color is red. Chinese subject will place it in Pink.

**Table 2:** Description of probe criterion for Chinese and Danish subjects.

Table 2 shows the criterion for probe sort which is followed to construct probes. After creating probe sorts, the next step is to notice the difference between probe sorts and subject’s sorts. This difference between probe sort and subject’s sort can be measured in the form of distance of subject’s sort from their perspective probe sort. It allows us to see how far the subjects lie from the probe sort.



**Figure 6:** Edit distance of user-defined universal sort from their perspective probe sort.

Figure 6 shows the distance of universal sort 1 of Chinese and Danish subjects from their perspective probe sorts. Here the point is to be noted that the sorts of Chinese and Danish subject are compared and evaluated from their own probe sorts. Figure 9 shows that Chinese subjects have greater distance as compared to Danish subjects from their perspective probe sorts. According to the hypothesis, Chinese and Danish subjects should have the same distance because separate probes were used for both cultures. A general reason for bigger distance in Chinese sort could be that universal cards are not related to Chinese wedding theme and they are more apparent to Danish subjects.

In these experiments neighborhood is used to identify the similarity in same cultural group. The value of distance depends on the number of cards and the number of categories in the sorts. As 75% of Chinese and Danish universal sorts contain five or fewer categories in universal sort 1, therefore sorts with maximum distance of 5 can be related to universal probe sort 1. Value of distance is determined by the number of categories and the number of items in sorts. Nine out of ten Danish subjects lie in the neighborhood area of probe sorts. On the other hand, only 4 Chinese subjects lie in neighborhood area of probe sort. Most of the Chinese subjects do not sort cards according to the theoretical fundamentals of Chinese population that is presented by Nisbett.

The result of universal probe sort 1 from perspective probe sort suggests that Chinese subjects do not have the same thought process as it is discussed in theory. It suggest that any method of usability testing, which involve less number of subjects, can be used to test usability of information, categories and menu structure in Danish culture because results of Danish subjects are closer to the theoretical structure of categories. In Chinese cultural group, it is helpful to involve such kind of usability methods, which involve more subjects to see the difference of subjects from theoretical foundation.

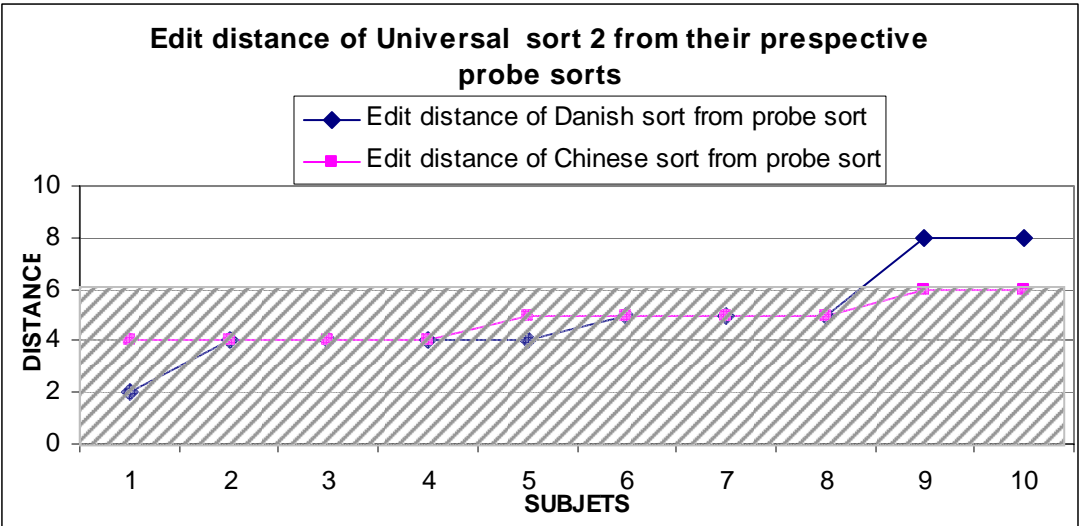


Figure 7: Edit distance of pre-defined universal sort 2 from their perspective probe sorts.

Figure 7 shows the distance of Chinese and Danish universal sort 2 from their perspective probe sorts. Danish and Chinese subjects have the same amount of variation in distances from their perspective probes. 80% of Chinese and Danish universal sorts contain six or fewer categories in universal sort 2. Therefore sorts with maximum distance of 6 can be related to

universal probe sort 2. Value of distance is determined by the number of categories and number of items in sorts. All the Chinese subjects lie inside neighborhood area and two Danish subjects lie outside neighborhood area. It indicates that Chinese subjects place the cards equally in all categories where as Danish subjects places the cards according to the attribute that are visible in the cards.

Focus of universal sort 2 with their perspective universal sorts is to identify the usage of pre-defined categories in both cultures and identify the difference in theoretical sorts and subject's placement of cards in pre-defined categories. A result of this sort shows that there is not significant difference in the usage of predefined categories in both cultures. It suggests that it is easy to understand the use of categories of Chinese subjects by providing the Chinese with a pre-defined theoretically derived structure (category names) and gather feedback on this structure.

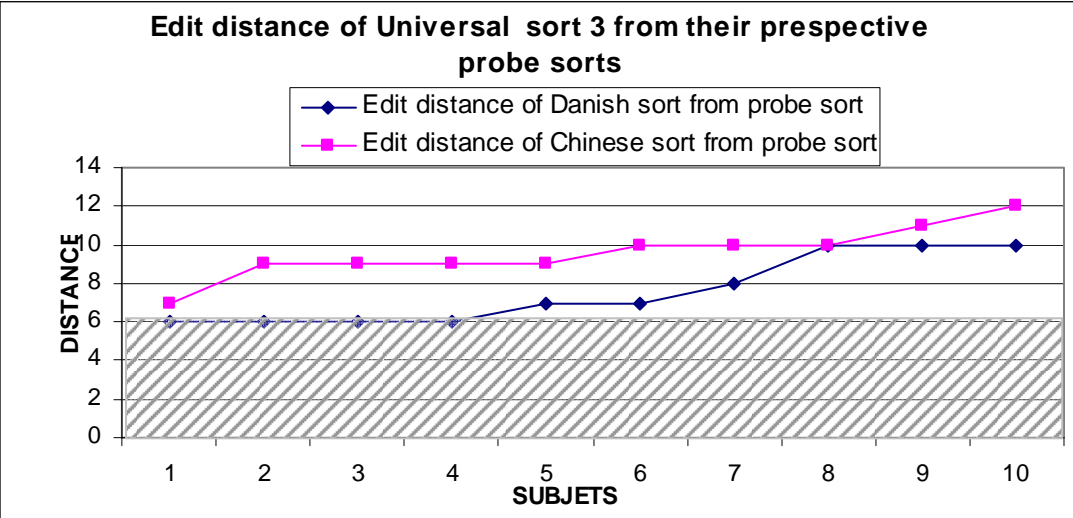


Figure 8: Edit distance of pre-defined universal sort 3 from their prespective probe sorts.

Figure 8 shows the distance of Chinese and Danish universal sort 3 from their perspective probe sorts. The Chinese have bigger distance from their perspective probe sorts as compared to Danish subjects. 80% of Chinese and Danish universal sorts contain six or fewer categories in universal sort 3. Therefore sorts with maximum distance of 6 can be related to universal probe sort 3. The value of distance is determined by the number of categories and the number of items in sorts. As we can see from the graph that both Danish and Chinese subjects constructed their sorts far away from probe sorts. There are number of reasons for bigger distance in universal sort 3. The criteria for placing cards was *Wedding color*, so subjects have a lot of options of placing a card into different categories. It is always difficult to determine the color selection of subjects as users' precision differs from one subject to another.

Results of universal sort 3 with its perspective probe sorts suggest that usability of colors in information structure largely depends on target audience choice because Chinese subjects identified red color more than the Danish subjects. On the contrary, Danish subjects identified white and off white color more as compare to the Chinese subjects. Therefore theoretical structure and stereotype of colors do not assist in usability of information. Metaphor of color and association of color also changes within culture.

The distance of both cultures has been measured with universal and local sorts respectively. Table 3 and 4 shows the descriptive results of these distances in experiments. The distance of these sorts is also shown in percentage because universal and local cards use different number of cards, so percentage of distance gives a better understanding between these sorts. There is a big difference in the distances of universal and local sorts.

Criteria	User-defined sorts		Wedding		Wedding colors	
	Danish sort 1	Chinese sort 1	Danish sort 2	Chinese sort 2	Danish sort 3	Chinese sort 3
Average	3.27	5.38	4.2	4.27	6.44	8.78
Maximum	6	10	10	8	13	13
Minimum	0	1	1	1	2	3
<b>Distance</b>	<b>16%</b>	<b>27%</b>	<b>21%</b>	<b>21%</b>	<b>32%</b>	<b>44%</b>

**Table 3:** Edit distance of universal sorts.

Comparing universal and local sort 1 in both tables reveals that there is a considerable difference in the distances in user-defined criterion. The percentage of distance shows the differences not only cross culturally but it also indicated that there is a difference in distance within the same groups if different cards are selected using the same categories.

Distance in user-defined sort between local and universal sort is almost double. The distance of sort 2 and 3 is also big in local sorts as compared to universal sorts. It expresses that both cultures are good in their categorization for modern cards because universal cards are acceptable worldwide. In Chinese local cards, most of the cards were old fashioned and related to typical culture.

Criteria	User-defined sorts		Wedding		Wedding colors	
	Danish sort 1	Chinese sort 1	Danish sort 2	Chinese sort 2	Danish sort 3	Chinese sort 3
Average	12.4	12.42	9.87	14.33	11.84	12.07
Maximum	20	19	15	21	17	18
Minimum	4	6	4	8	9	5
<b>Distance</b>	<b>41%</b>	<b>41%</b>	<b>33%</b>	<b>48%</b>	<b>39%</b>	<b>40%</b>

**Table 4:** Edit distance of local sorts.

Results of universal and local sorts reveal that the structure of data and information is affected by difference in cultural background.



## 6. Discussion and conclusion

The results showed that the Chinese subjects have more variation in their sorts as compare to Danish subjects. While comparing distances of Chinese and Danish subjects in universal sort 1; 37 combinations of 10 subjects have distance of 4 or less than 4 and only 17 combinations of 10 Chinese subjects have 4 or less than 4 distance where a single combination represents distance of two subjects from each other in same cultural group. This variation can also be notified if we compare probe sorts of Chinese and Danish universal sorts with their perspective probes; 7 Danish subjects have 4 or less than 4 distance from their probes where as only 3 Chinese subjects have 4 or less than 4 distance. This difference in structure of categories in both cultures enables us to identify the variation in formation of structure in both cultures.

In the universal sorts, there was greater use of *other* category in Chinese subjects as compared to the Danish subjects. It reveals that the Danish subjects defines the categories by looking at the objects and simply makes new categories with different objects. Therefore the use of the *other* category is not used frequently in Danish subjects. The Chinese subjects make categories by taking a holistic view of the card (Richard E. Nisbett, 2003; p.80-110) and it is difficult to do so. Therefore they cannot change their way of thinking and make other category.

There was an apparent difference in choice of colors in the selection process of cards for both cultures. Red was the dominant color for Chinese local cards. On the contrary red color is more associated to Christmas and the subject tried to avoid red color cards during the selection process of Danish cards for experiments.

There was one extreme object oriented user on the Danish side (S10) and one on the Chinese side (S2). Similarly there is an extreme background/holistic user on the Chinese side (S8) and one on the Danish side (S3). This study also educates us that Chinese subjects are more inclined to using thematic categories as compare to Danish subjects. The Chinese subjects put 19% cards into these two thematic categories and Danish subjects put 9% in thematic categories.

Describing the criterion for probes also plays an important role in the results of distances. Judgment and study of both cultures is important before defining the criterion for different sorts. Therefore the experts, with the same cultural background in this context, are a vital part in the selection of appropriate sets of cards for certain criterions. Criterion of probe can help experts and designers to construct information and categories of applications in ways that are associated with cultural aspects of users.

The object oriented thinking of Danish subjects is close to each other in their cultural group, whereas many Chinese subjects are unable to decide about placing the cards into categories and defining categories which are related to wedding criteria. Physical attribute of items and concepts should be dominant in Danish information and data manipulation of applications. On the contrary, structure of information in Chinese applications should be organized and grouped by keeping relations of entities and tags with each other.

Initial results of experiments provide us guidelines that any method of usability testing, which involves less number of subjects, can be used to test usability of information, categories and menu structure in Danish culture because results of Danish subjects are closer to theoretical structure of categories. In Chinese cultural group, it is helpful to involve this kind of usability method which involves more subjects to see the difference of subjects from theoretical foundation.

Initial results of experiments also provide us guidelines that color is also an important factor in the usability of applications. Different colors have different meaning for cultures (Barber and Badre, 1998). Foreground color of data and information is important for Danish subjects where as Chinese subjects observe and judge keeping the background color of information in their mind as well. Usability of colors in information structure largely depends on target audience choice because Chinese subjects identified red color more than Danish subjects. On the contrary, Danish subjects identified white and off white color more as compare to the Chinese subjects. Metaphor of color and association of color also changes within culture.

Metaphor of color can help designers imply such colors that are associated to specific culture for which that application or game is designed. While comparing Chinese and Danish subjects, Chinese subjects considered background color as a part of their observation more than Danish subjects. These approximations can help designers in the structure of graphic designing in games and assist that the Chinese subjects will consider the background color of application in their study.

## **7. Future research**

The current study is a pilot for larger projects of cultural usability. In this study, pictures of wedding cards were used to investigate the cultural difference in the structure of categories. Future research will include cards for real application. It will also include alternate data collection modes such as interviews, direct observation of user behavior and focus groups, to minimize potential cultural problems of the current study.

## **Acknowledgement**

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# Appendix

Steps for Card sorting experiments:

## A.1. Selection of entities

The basic principal of selection of entities consists of coverage of appropriate hierarchy of the required field. These cards should be covering an important part of the required field of the research area. The lowest number of entities for experiments should be around eight. Maximum number of entities for the experiments could vary from twenty to thirty.

## A.2. Preparation of cards

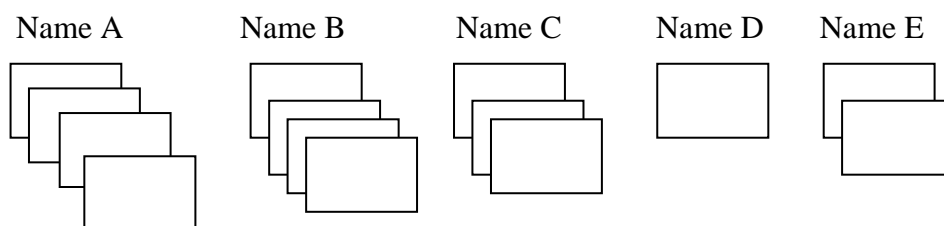
While preparing the cards for experiments, their size should be same, so that during the study the size of the card may not consider a standard for selection of category for a specific picture. All the cards should be given random numbers. Providing a sequential numbering system with the attributes and features of cards can influence the subject in grouping the cards.

## A.3. Availability of instructions

In most cases during the card sorting experiments, subjects of the experiments are novice users for this kind of experiment. Availability of instruction will help them in getting the understanding and intention of experiment. Availability of instruction will also results in carrying out of smooth experimental session. Instructor of experiment can also describe these instructions in the beginning of the experiment and inform the subjects what they can or cannot do. For example, single criteria sort will be used as sorting technique for experiments. Therefore, subjects should be clear after reading the instruction and description of experimental session that they can put only one card in one category.

## A.4. Conducting the session

Once cards and instructions are available to the subject, they are asked to sort them into groups. When the subjects finish sorting the cards, they are asked to give names to different groups of cards.



**Figure 9:** Example: Sample of cards after sorting.

## A.5. Analyzing session

After completing all sessions, these sessions are analyzed for gathering productizing information from these sessions. Analyses of experimental sessions vary for different card sorting experiments. It depends on research purpose and goal.

## B.1. Formulation of criteria and categories in universal and local sorts

	Sort 1	Sort 2	Sort 3
<b>Criteria</b>	Wedding	Wedding	Colors
<b>Categories</b>	User-defined categories related to wedding criteria	Pre-defined categories + User-defined categories related to wedding criteria	Pre-defined categories + User-defined categories related to criteria of colors
<b>Categories detail</b>	User-defined categories	Flowers, Rings, Hearts, Light, (object-oriented categories) and “Two people together” and ” Love” (wedding theme categories) + Categories related to wedding theme	Red, Pink, Gold, Blue, Violet, Silver + categories related to criteria of colors

**Table 4:** Formulation of criteria and categories in universal and local sorts.

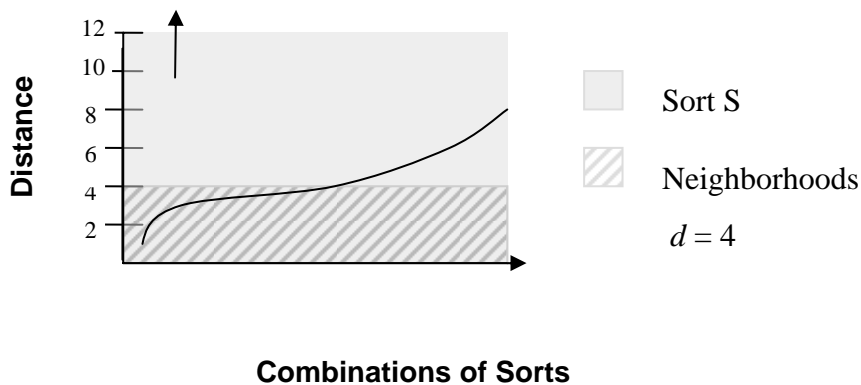
## B.2. Application for analysis

In order to support analysis study, different tools are designed and can be used to analyze data. Analysis for this study is conducted by single application, the University of Washington Card Sort Analyzer (UW Card)<sup>2</sup>. This analyzer provides different features to study card sorts. It allows us to measure the similarity between two sorts. It also allows us to measure the minimum, maximum and average edit distance in sets of sorts which share the same attributes. It also allows us to analyze a set of sorts for similarity to a researcher’s theoretical sort or probe sort.

<sup>2</sup> <http://www.cs.washington.edu/research/edtech/CardSorts/>

### B.3. Neighborhoods

After specifying a sort, there is a simple approach to list all sorts which are near to specified sort. Listing of these sorts can be accomplished by arranging them in order of increasing distance. The  $d$ -neighborhood of sort  $S$  is defined to be the set of all sorts with distance of at most  $d$  of  $S$  (Deibel et al, 2005).



**Figure 10:** Neighborhoods of card sorts.

Researchers of the study identify the value of  $d$  for neighborhoods. They consider a number of factors to specify the value of  $d$  which includes number of cards and groups in a sort. It is not possible that all experimenters sort cards in exactly the same manner. Value of  $d$  expresses the tolerance level for same theme in the experiment of card sorting.

### C.1. Probe sort

A probe sort is a sort specifically constructed by the researchers to represent a sort criterion of interest (Diebel *et al.*, 2005). Probe sort is a model sort of researchers which they make according to the theory. After making probe sort, one can see the presence of probe sort in different data sets, which are exercised during the experiment. It is easy to investigate data after making probe sort because the analyzer has predefined sorts of researchers (probe sorts) for comparing different data that is gathered from experiments.

### C.2. Criterion of probe sort

Researchers must have their own criterion of probes for their respective experiments. In these experiments different probe sorts are crafted by keeping Nisbett's theory criterion in mind. According to this theory, the Western people tend to group objects by categories where as the Asian people tend to group objects on the base of their relationship. All probe sorts are constructed by keeping this criterion in mind.

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