The Difference of User Perception between Similarity and Dissimilarity Judgments

Ming-Xian Sun[1], Chi-Hsien Hsu[2], and Ming-Chuen Chuang[3]

[1,3] Institute of Applied Arts, National Chiao Tung University
Hsinchu City 30010, Taiwan
[2] Graduate School of Creative Industry Design, National Taiwan University of Arts
New Taipei City 22058, Taiwan
buddasfox@gmail.com, assah16@gmail.com, cming@faculty.nctu.edu.tw

Abstract. The similarity and dissimilarity is a corresponding relationship which is the base of cognitive judgments. The main purpose of this paper is to study the user perception by using similarity judgments. In this study, fifteen innovative products are used as the stimuli which divided into three groups: global, creative and local products. A total of 139 student volunteers participated in the various phases of the study. The feature measures are used to collect data under three different experiments: similarity judgment by random, similarity judgment by order, and dissimilarity judgment by random. In addition, the paper proposed an approach to confirm the effectiveness of collecting data. Then, MDS analysis was used to explore the difference of user perception between similarity and dissimilarity judgments. The results provide designers with a valuable reference for designing innovative products.

Keywords: multidimensional scaling, INDSCAL, similarity, dissimilarity, product design.

1 Introduction

Similarity judgment plays a critical role in cognitive capabilities such as memory, reasoning and decision making, especially, user preference and user experience in innovative product design [4, 15, 16, 32]. Traditionally, marketing researchers apply a variety of similarity judgment techniques, including MDS (multidimensional scaling) and its related programs (e.g. KYST, INDSCAL) to help them understand consumer perceptions of products or service alternatives [1, 3, 13, 20, 37, 38]. According to Norman's mental model [36], innovative products must be appreciated and recognized by the users. Several researchers have proposed different classifications for categories of innovative products based on the market insight and technological innovation [15, 16]. Recently, the design trend came from user-centered to user value and experience [2, 7, 36], and researchers of design field apply MDS analysis to explore the user perception in innovative product design [24, 25]. User emotional responses are derived from their perception expressed by products playing a significant role in their visual appearance [4, 15, 16]. Hence, the use of conventional multidimensional distance

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model of similarity judgment is to understand users' perception and preference increasingly [18, 19, 20, 38].

However, marketing researchers have recognized that there is a limit to the amount of "effective" information that can be collected from respondents [20]. This has led to the development of procedures for reducing the number of required judgments, including the use of sorting tasks or categorization [14, 34, 37, 44]. The importance of studying user perception has been shown repeatedly in several studies in various areas of the design field [2, 4, 7, 15, 16, 26-28, 36]. Despite the recognized importance of user perception in innovative product design and creative design industries, industries lack a systematic approach to study user perception. Therefore, this study proposes an approach for illustrating how to transform "user perception" into "innovative products design." The approach integrates the difference between innovative products and user perception of global market into the design strategy of current service design practice.

2 Literature Reviews

When performing MDS analysis, for example, INDSCAL input data is generally of some type of similarity or dissimilarity data [1, 3, 5, 6, 24, 25]. For collecting similarity data, the researcher needs to determine which of the objects (products) are most similar to each other and which are the most dissimilar. The uncertainty in similarity measurement is the fundamental to compare all pairs of objects, then, what is the difference between similarity and dissimilarity data remains [8, 9, 10, 12]. In addition, when performing the comparison of paired objects, the researcher could choice the paired objects to compare randomly or to compare one by one orderly [1, 3, 13, 38, 39]. There is also a question about which one is better for collecting this type of data. Thus, several problems remain to be solved [6, 9, 12, 21, 35, 43].

The problems of identify the product features in cognitive science is determining the mental representations that underline human inductions [2, 4, 7, 18-20]. Solutions to this problem often rely on the analysis of subjective similarity judgments [10-12, 43-46]. Based on the assumption of recognizing "resemblance" between users, objects and events is crucial to everyday inference [33-35]. The question of what makes two objects psychologically similar has considerable significance for much of cognitive psychology. A variety of Models (i.e. categorization, memory, and learning theorists) have claimed to explore the questions [10-12, 32-35]. The models are related to factor analysis, multidimensional scaling and latent class models. The researches of similar theory and related models were widespread in many fields, For examples, Geometric model [1, 3, 13, 24-28, 39, 40], Feature Contrast Model [10, 12, 20, 41, 44, 45, 46], Alignment-Based Model [9, 11, 14, 34], Transformational Model [8, 35, 37], and so on [17, 29-31].

Spatial configuration approaches and feature-set approaches are the two of most influential approaches to deal with similarity judgments. Spatial configuration approaches define similarity as inversely related to the distance between stimuli in a dimensionally perceptual metric space, as exemplified by multidimensional scaling [39-42]. Feature-set approaches assume similarity increase as a function of the

common features and decreases as a function of the distinctive features of compared items [23], as exemplified by Tversky's Contrast Model [43, 44]. The contrast model of Tversky is a classic feature-set model of similarity that is applied to explore a range of fields in category-based [14, 18]. What makes category-based inductive reasoning on especially powerful is our capacity to project information from one category to another [14]. Multidimensional scaling provides a method of assigning a set of hidden features to a collection of objects, according to the observable similarities between those objects [34, 35].

Therefore, the purpose of this study is to propose an approach to study the differences of user perception between similarity and dissimilarity data of similarity judgments, and to explore the effect of randomly and orderly paired comparison. These results were discussed in terms of user perception and the likely psychological processes underlying similarity judgment [16, 17, 18]. Furthermore, results presented herein provide an interface for looking at how users recognize the innovative products, as well as illustrating the interwoven effect of user experience and perception in similarity judgments.

3 Research Method

This study involved using interviews, similarity ratings and MDS analysis [1, 3, 4, 24-27] to study the difference between similarity and dissimilarity judgments [8, 10, 18, 30, 43]. The study can be divided into three sessions. In session I, a literature review was used as a way to understand how the difference approaches influence the similarity judgment, and how to select stimulus products. In session II, three experiments, which are random similarity compared, random dissimilarity compared and sequence similarity compared, are performed to collect the similarity data. In session III, an MDS approach was used to study the difference between similarity and dissimilarity. The data were analyzed using descriptive statistics, MDS analysis and SPSS analysis. The framework of this study is shown in Figure 1 [15, 16].

3.1 Selecting Stimulus Products

Based on the previous studies [15, 16, 24-28], four professional designers and four design professors who are the experts from the fields of culture, creativity and industry served as the subjects for interviewing to select stimulus products for similarity ratings. The stimulus products came from three categories: cultural products, Alessi (global) products, and innovative products as shown in Table 1. P08 was chosen from "The Chin Family" [15,16] as the stimulus product representing the group of cultural products, and P01, 06, 10 &15 were chosen from different cultural product design competitions.

The innovative products stimuli were chosen from the 2011 iF gold award products because the German iF product design award is globally recognized and well known as the Oscar Award in the design industry. The iF design competition awards were awarded to encourage products with creative design elements to enter the global market. In Table 1, P09 was chosen from 2011 iF gold award products as the stimulus product representing the group of innovative products, while P02, 04, 11 &13 were chosen from different categories in the 2011 iF product design award competition.

For the global market, Alessi products were chosen as the stimulus products because the product is "glocal" and well-developed in the global market. Hence, in order to explore the concept of glocalization in Alessi's design strategy, P14 known as Mandarin was chosen as the representing Alessi's products because the Mandarin was designed by Stefano Giovannoni, and the idea also came from the portrait of Emperor Chien-Lung in the Chin Dynasty. In addition, P03, 05, 07 &12 were chosen from Alessi's best selling global products as the stimulus products [15, 16].

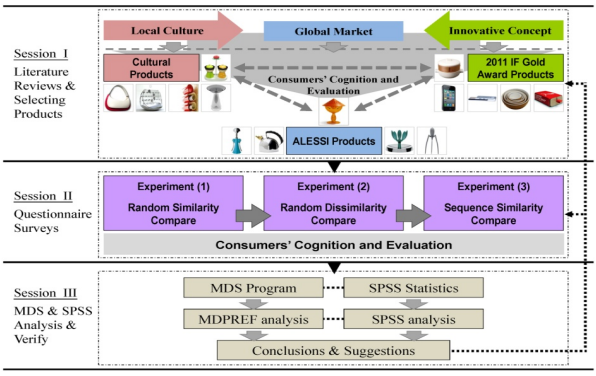

Fig. 1. The research framework

3.2 Procedures

The 15 stimulus products as shown in table 1 were used as the stimulus materials to collect the data. The stimulus materials of pairwise comparison are arranged by three different ways. Experiment 1 is to rate the similarity that arranged by the randomly paired compared (SR); experiment 2 is to rate the dissimilarity by the randomly arranged (DR); experiment 3 is to rate the similarity by the orderly paired compared (SO). The three experiments are conducted by every other week sequentially. After the experiments, the similarity rating data were applied to the analysis using linear regression to study the relationship among SR, DR, and SO.

The INDSCAL solution produced various multidimensional configurations which can be used to study the cognition of similarity judgments. Finally, the results were discussed to explore the difference between the similarity and dissimilarity judgments as well as the random and order pairwise comparison. The experimental procedures are

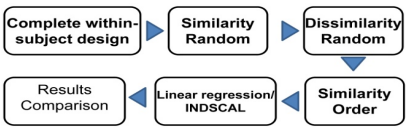

Fig. 2. Experimental Procedure

shown as figure 2. A test book was given to the participants that contained a total 112 paired comparison for the similarity judgments. In general, the 15 stimulus products produce only 105 pairs for comparison. 7 pairs which include 14 stimulus products were selected from 105 pairs to confirm the "effectiveness" of the similarity judgment. Before the experiment, subjects were briefed on the purpose and procedure of the study. In a laboratory, a PC was used to project the stimulus materials on a screen. The subjects were first asked to compare the similarity of each product pair, and then they were asked to rate the extra 7 pairs to confirm their ratings. A 9-point Likert scale was used to rating the degree of similarity from 1 (Not similarity) to 9 (completely similar), and the subjects indicated their responses by circling the numbers according to their judgments.

Table 1. Three different categories of product samples

Cultural Products – From Taiwan e-Learning and Digital Archives Commercial Application Competitions				
P01	P06	P08	P10	P15
				
"Ripple" martini cup	**"Pinban Boat" handbag**	**"Mr. & Mrs. Chin" salt and pepper set**	**"Pearls Dropping on the Jade Plate" piggy bank**	**"Tile" magazine rack**
Innovative Products – From 2011 IF Gold Awards				
P02	P04	P09	P11	P13
				
"iPhone 4" smartphone	**"Family Bowls" tableware**	**"Clever Little Bag" shoe packaging system**	**"Steamer Set" steamer pot**	**"USB-Clip" USB flash drive**
ALESSI Products – From Italian fashion brand Alessi				
P03	P05	P07	P12	P14
				
"Anna G." corkscrew	**"Fruit Mama" fruit bowl**	**"9091" kettle**	**"Juicy Salif" citrus squeezer**	**"Mandarin" Squeezer with goblet**

3.3 Subjects and Data Validation

A total of 139 student volunteers participated in the various phases of the study. The subjects comprised four groups with different backgrounds: 42 subjects with design-related background, 33 subjects with humanity related background, and 64 subjects with communication management related background. The subjects were between the ages of 20 and 40. As mentioned before, the extra 7 pair's comparison was used to check the effectiveness of judgments. Based on the ratings of 7 pairs comparison, how to confirm the effectiveness of judgments are followings: (1) Using Likert scale 5 as the standard point, the extra 7 pairs with the same pair in 105 pairs must be in the same side as 1~4or 6~9. (2) The deviation allows ±2, thus, if the one answer is 5, the other must be 3,4 or 6,7. (3) The combination of 4 and 6 also regard as

qualified. (4) There must be at least 5 qualified in the extra 7 pairs for regard as valid data. According to the confirmation of the data, 52 had to be excluded because their answers were not ineffective and 87 subjects were verified for the judgments consisting of 24 male and 63 female participants. Subjects were undergraduate and graduate students with an educational background in Arts and Humanities related (19 participants), Design related (32 participants) and Communication and Management related (36 participants) as shown in Table 2.

Table 2. The validation of subjects' judgments

Background	Subjects			Excluded
	Male	Female	Sub-total	
Arts and Humanities Related	5	14	19	14
Design Related	7	25	32	10
Communication Management Related	12	24	36	28
Total	24	63	87	52

4 Results and Discussions

The data were collected by three approaches including similarity judgments by randomly arranged (A-RS) and orderly arranged (B-OS), and dissimilarity judgments by randomly arranged (D-RD). Based on the previous researches, we got another three estimated data from three experiment data by: (1) estimated similarity data (C-EDS) = 10 – D-RD, (2) estimate dissimilarity data (E-ERS) = 10 – RS, (3) estimated dissimilarity (F-EOS) = 10 – OS. Then, the similarity data including A-RS, B-OS, and C-EDS and the dissimilarity data including D-RD, E-ERS, and F-EOS were applied to INDSCAL analysis. The MDS solution produced various multidimensional configurations for use in studying the difference between similarity and dissimilarity judgments.

INDSCAL analysis was used to transfer the similarity judgments data into a multidimensional configuration that can be used to study the cognitive space, to interpret the dimensions, and to analyze the individual difference of approaches. Figure 3 shows a two-dimensional perceptual space and the plot of three different approaches with the average correlation coefficient of .882. The correlation between computed scores and original data are .881, .873, and .892 for similarity judgments by randomly arranged (A-RS), orderly arranged (B-OS) and estimated similarity data (C-EDS), respectively. The stimulus products came from three categories: cultural products, Alessi (global) products, and innovative products. P08 was chosen from "The Chin Family" as the stimulus product representing the group of cultural products. P09 was chosen from 2011 iF gold award products as the stimulus product representing the group of innovative products, and P14 known as Mandarin design by Stefano Giovannoni was chosen as the representing global products. In figure 3, P11, P12 and P14 are separately away from the groups of P2,P3 and P13, P4, P6, P7 and P10, P1 and P5. Figure 4 shows a two-dimensional space of randomly arranged (A-RS) and orderly arranged (B-OS). Figure 5 shows a two-dimensional space of randomly arranged (A-RS) and estimated similarity data (C-EDS). Figure 6 shows a two-dimensional space of orderly arranged (B-OS) and estimated similarity data (C-EDS).

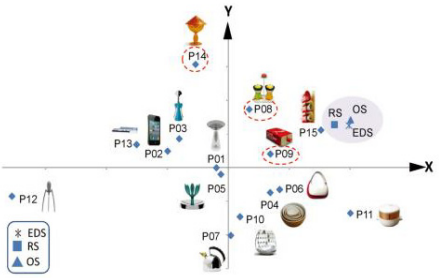

Fig. 3. Two-dimensional space of group stimulus of similarity judgments

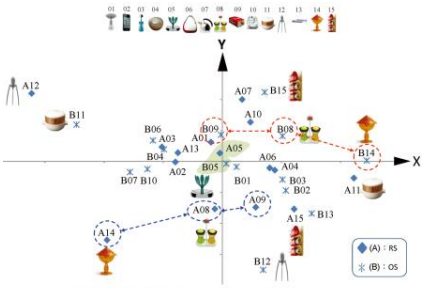

Fig. 4. The comparison of two-dimensional space of RS (Random Similarity) and OS (Order Similarity)

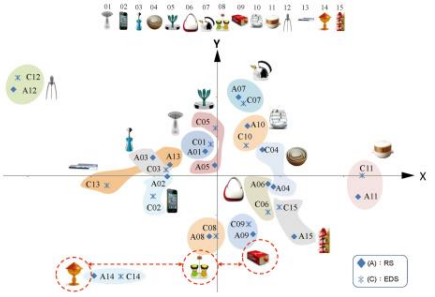

Fig. 5. The comparison of two-dimensional space of RS (Random Similarity) and EDS (Estimated Similarity)

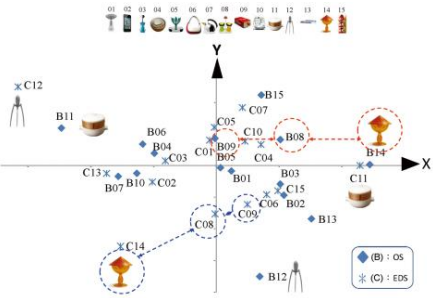

Fig. 6. The comparison of two-dimensional space of OS (Order Similarity) and EDS (Estimated Similarity)

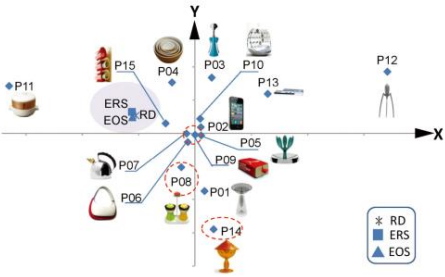

Fig. 7. Two-dimensional space of group stimulus of dissimilarity judgments

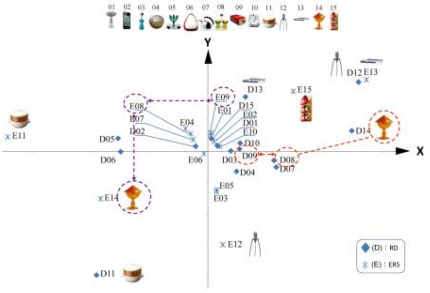

Fig. 8. The comparison of two-dimensional space of RD (Random Dissimilarity) and ERS (Estimated Random Dissimilarity)

Using the same way, the dissimilarity judgment data of different approaches including the dissimilarity data including D-RD, E-ERS, and F-EOS were subjected to INDSCAL analysis. Figure 7 shows a two-dimensional space of group stimulus of

dissimilarity judgments. In Figure 7, P2, P5, P6, and P7 grouped together with the P09 which represented the group of innovative products, while P11, P12 and P14 are separately away from the groups of P09 and other products. Figure 8 shows a two-dimensional space of dissimilarity judgment randomly arranged (D-RD) and estimated dissimilarity data (E-ERS). Figure 9 shows a two-dimensional space of randomly arranged (D-RD) and estimated dissimilarity data (F-EOS). Figure 10 shows a two-dimensional space of estimated dissimilarity data (E-ERS) and estimated dissimilarity data (F-EOS).

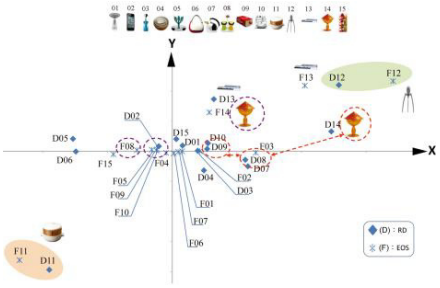

Fig. 9. The comparison of two-dimensional space of RD (Random Dissimilarity) and EOS (Estimated Order Dissimilarity)

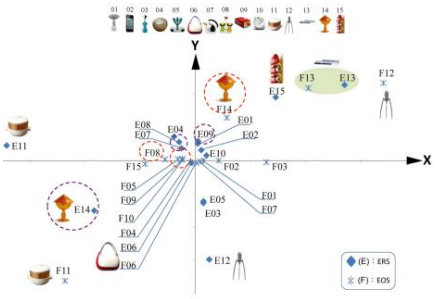

Fig. 10. The comparison of two-dimensional space of ERS (Estimated Random Dissimilarity) and EOS (Estimated Order Dissimilarity)

5 Conclusions and Suggestions

In this study, three groups of stimulus products including local cultural products, global market products, and innovative products are used to explore the user perception by similarity judgments. The similarity is one of the key factors to identify the user experience and value. The MDS analysis used in this study is a test of its utility as an approach to understanding the user perception in local design and global market. This study establishes a conceptual framework to provide designers with a valuable reference for studying user experience in cross-cultural product. The results of this study can be used as future reference for designers in the design strategy of the application of local culture for the global market. There are some tendencies for subjective interpretation in the foregoing context, so it is expected that more specific and rigid methodology will be conducted to verify these results in the future. Furthermore, while cross-cultural factors become important issues for product design in the global economy, the intersection of service innovation design and culture becomes a key issue making both local design and the global market worthy of further in-depth study.

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