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Identifying the Historical Product Recreation Design Value and Model by Preference and Similarity Evaluation: A Case of Chair Design

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Abstract: Designer stimulated by historical product can create refresh semantics appearance modern design. The aim of this article is to find out the preference relationship between modern design and its stimulation historical product by user preference and similarity evaluation to explore this design approach discipline. Fourteen famous chairs are taken as case study. Two questionnaires are carried out by 184 participants. The result shows most modern chairs win positive preference by the key preference factors of delightful, simple, beautiful, long life utilization, safe independent variable. And the armrest and backrest are significant to preserve and inherit historical chair essential main features. Based on the results, this article gives out the conclusion that historical product stimulating stimulation design is valuable and have discipline model to follow by user preference and similarity evaluation.

Keywords: *Historical product, Stimulation, Chair, Value*

1. INTRODUCTION

In many industrial designers, they develop a new product based on an existing product. Designers can focus their efforts and resources at the subsystem or component level to give the product a competitive advantage through incremental design improvement around the existing product concept. Schachinger, Johannesson in 2000 gave out design theory of reuse of a product design specification by existing product. They take the view that many product development projects take an existing product as a starting point for the development of a new version of the product. If the existing product has been successful it is worthwhile to use the existing product design specification as a basis for establishing a product design specification for the product variant to be developed [1]. Reference to existing objects are ubiquitous in design process and can be used in many different roles. Designers refer to entire objects, parts of them or even groups of objects at once [2].

The word of “historical” is “belonging to the past” in Oxford dictionary. Historical product is, therefore, a product happened in the past. Historical product is past existing product, many modern design is stimulated by and refers to historical product. Bell and Kaye thought historical awareness could also prompt ubiquitous developers to make design decisions that have more positive social and cultural ramifications [3]. Modern design is a design movement that started in Europe in the end of 19th century and at the beginning of the 20th century [4]. There is always strong connection with modern design and “historical”. As the century expires, The world are entering a new “modern”

age, an upheaval in world fuelled by new technologies, demographic changes and other historical forces [5]. The modern itself is integral to the process of becoming a twentieth-century nation, the need for continuity with the past was compelling. In describing how the past has been manipulated, updated, selected or otherwise reconfigured in order to serve national purpose, Eric Hobsbawm uses the term “the invention of tradition”. His work provides a paradigm for understanding how all invented traditions, as far as possible, using history as a legitimator of action and cement of group cohesion, designing for the purpose of creating a shared heritage. So modern motifs or forms should have historical resonance in the country’s heritage. The vernacular was embraced in the belief that essence of a culture could be encapsulated and maintained by the continuation of time-honored visual history. Such expressions were synthesized with the vocabulary of the “modern” at the turn of the century-symbolism [6].

In this more than one century development of modern design, there exists several styles and theories. In 1907, Louis Sullivan gave out “Form follow function”, after that, modern design experienced design diversified time, the main design styles and theories include the Futurism (1910-1940), Surrealism (1925-1930), Streamlining (1930-1950), Organic design (1930-present), Contemporary (1945-1960), Minimalism (1960s-1970s), Postmodernism (1978-present), Deconstructivism (1988-Present). Among these design styles and theories, some of them apply the design approach of reusing the historical product to make modern product. like Organic design, for protecting the old craft, Scandinavian country designer recreates the old furniture into modern one, many of their

furniture design is inspired by historical traditional furniture. The representative designer is Hans J. Wegner, his famous “The China chair” is the representative design work of Chinese ancient Round-backed armchair recreation [7]. Similarly, Postmodernism is famous of history context reappearing, many postmodernism design is built on history and past resource. The representative designers are Alessandro Mendini and Ettore Sottsass. Under this historical product reusing and recreation phenomenon, there comes out design theories about the modern design and historical recreation. Uri Friedlander (1981) pointed out that design should involved an extensive use of what he called “metaphors”, he thought design should have historical metaphor, which reminds us of earlier objects, designers can refer historical product to realize the historical metaphor. The design approach was designated as sensual expressionistic or metaphorical designs [8]. Krippendorff (1984) indicates that object constitutes the aggregate of all contexts, including history, manufacture process, function economic value by product semantics, the cultural model of product semantics consists of the implication of product’s historical retrospect [9]. Eventhough the value of historical product reusing is confirmed by many modern designers, But until now, how historical product can be reused and how to make historical product recreation design win user preference are not know so much yet. Based on these research background, this article launches this research to discuss historical product recreation value.

Historical product reusing design approach forms the current trend in product design of shifting from functionalism to product appearance semantics (Krippendorff, 1995). So nowadays, industrial designers attract, inform and influence consumers by appearance semantics (Baxter, 1995; Monö, 1997). Appearance became interpersonal and communication between designer and customer. The inspiration of design idea decides the product appearance expression and user preference. The key to the interplay of designers idea elements is the capacity of the stimulation to hold one’s attention and engender its consideration. Certain historical instances are useful in illustrating how these idea elements work [10]. Such as in chair design idea creating process, designers hold attention of historical chair as idea stimulation to create new chair, so there comes out many chairs who are extremely similar to each other appearance. Such as Vitra Pretzel Chair in 1957 and Thonet 14 chair in 1879, superleggera chair in 1957 and Chiavari Chair in 1807. Whether this kind of recreation chairs can get affection and preference from user need to be identify by marketing. That is means customer

preferences are primary concerns in product development within a highly competitive market [11]. A users preferences for a product can be viewed as a reflection of his or her inner world. They depend on customers’ intention. For meeting user intention in any product, Designers often intend customers to find product forms attractive, elegant or refined [12]. The visual appearance of products as one of direct connotative and denotative form in any product has a profound effect upon the way in which they are interpreted, approached and used. To improve understanding of this important subject, considerable effort has been devoted to studying how customers respond to the visual form of products and to explicit the factors that influence those responses [13]. However, not much is known about customers perception evaluation of preference between idea stimulation and its recreating product. There must be connection and divergence between them. Based on this research background, this article chose chair design as cases to exam customers viewpoint of chair preference by visual appearance comparison between modern chair and its historical stimulation chair. The reason to choose the chairs to do this research is because no other object of human daily environment has had the enduring cultural significance of the ever-present chair, unconsciously yet forcefully shaping the physical and social dimensions of human being lives [14].

There are two aims and contents of this research, one is to find out the key factors influencing user preference between modern product and its stimulation historical product by the appearance semantic evaluation of chair design cases [15]. There must some relationship between them, as the modern chairs are stimulated by their corresponding historical chairs, trying to find their relationship and fundamental reasons why modern chair can get positive preference comparing with its stimulation historical chair is the first aim and content of this research. So this research can quantify the user preference by mathematical model to provide guidance to future designer how they can apply this design approach for high preference chair design. The second aim and content is to detect the discipline of how deconstructing design elements of historical chair to recreate new chair which can maintain historical original chair main feature as culture inheriting.

The reason this article launches these two contents is because in future if designers want to apply this historical product stimulating approach. They must know both of how to design user positive preference product in the perspective of semantic perception and how to design product by figurative design element way. Based on these two research aims and contents, this article will provide a broad under-

standing by appearance semantic perception evaluation and similarity testing to formulate user preference historical product recreation design approach.

2. METHODS

There were four stages in this research. The first and second were the qualitative survey of literature review to select out chair cases and professional designer interview about extracting keywords for chair preference evaluation. The third stage was the quantitative questionnaire of chair semantic preference evaluation between modern chair and its stimulation historical chair. The fourth stage was the quantitative questionnaire of appearance similarity evaluation. The data analysis in these two questionnaire was aided by SPSS statistics software. In total, both qualitative and quantitative analysis were taken in this article. Figure 1 shows the research process.

Figure 1: Research process

3. PROCEDURES

3.1 Stage I --- Chair subjects selection

In this article, author selected out seven famous representative pairs of chairs as samples to research (total of fourteen chairs), all of which are from different era, countries and styles marked as A, B, C, D, E, F, G pair (Table1). The specific information about these seven pairs of chairs states in the following words. In A pair, the Proust chair designed in 1978 stimulated by 18th century french Louis XV period Rococo chair [16]. In B pair, the Louis Ghost Chair designed in 2002 stimulated by 18th century french Louis XVI Queen chair [17]. In C pair, the China chair designed in 1944 stimulated by 18th century Chinese round-backed armchair in Ming dynasty [18]. In D pair, the Chiavari chair designed in 1807 stimulated by Superleggera chair designed in 1957. In E pair, the Vitra Pretzel Chair designed in 1957 stimulated by classic bentwood 209 chair in 1819 [19]. In F chair, the Robert Venturi's Chippendale chair designed in 1980s stimulated by Chippendale chair in 1750s [20]. In G pair, the MUJI chair designed in 2008 stimulated by Thonet 14 chair in 1859 [21].

In the two questionnaire survey, participants were required to conduct preference subjective evaluation and similarity evaluation for these seven pairs of chairs.

Table 1: Chair subjects selections

A Pair	No.1	No.2	B Pair	No.3	No.4	C Pair	No.5	No.6
	Louis XV Rococo chair France 1750S	Proust chair Italy 1978		Louis XVI Queen chair France 1780S	Louis Ghost Chair France 2002		Ming dynasty round-backed armchair China 1500S	The China chair Denmark 1944
D Pair	No.7	No.8	E Pair	No.9	No.10	F Pair	No.11	No.12
	Chiavari chair Italy 1807	Superleggera chair Italy 1957		Thonet 209 chair Germany 1879	Vitra Pretzel Chair United States 1957		Chippendale chair United Kingdom 1754	Robert Venturi Chippendale Chair United States 1984
G Pair	No.13	No.14
	Thonet 14 Moravia 1859	MUJI chair Japan 2002						

3.2 Stage 2 --- Extracting chair evaluation key words

The second stage of extracting chair preference evaluation key words was based on literature review and professional designers interview. Literature review was mainly from high degree recognition design journalism and books, such as «How To Design a Chair» (Wilhide E, 2010), «Fifty Chairs that Changed the World» (Paula R, 2009), «Design Secrets» and so on. Based on these literature review, author designed evaluation questionnaire showing in Table 2. Meanwhile, Author interviewed six professional Japanese designers to gain their views about the evaluation criteria of chair design by this questionnaire (Figure 2). Comprehending these designers' questionnaire and interview answer, eleven keywords came out in the scale of social context, marketing, space, reference resource, physical property, user emotion of research scope. These keywords were taken as the most important factors to effect user preference judgement. These specific eleven keywords were sorted out in three groups: emotion, function and symbol (Table 3). They composed the following chair preference questionnaire content.

Designers	Interview Time	Place
A Interviewee	2017.11.16(14: 30-16: 30)	Tokyo
B Interviewee	2017.11.16(18: 00-21: 30)	Tokyo
C Interviewee	2017.11.17(13: 00-15: 30)	Tokyo
D Interviewee	2017.11.17(18: 00-20: 00)	Tokyo
E Interviewee	2017.11.18(9: 00-11: 30)	Tokyo
F Interviewee	2017.11.18(12: 00-14: 30)	Tokyo

Figure 2: The interview with designers

Table 2: Chair design evaluation questionnaire

Chair design evaluation questionnaire (Brief Content)	
Category	Main items
1. Social context	Traditional culture / Modern culture / Social value / User status / Social progress
2. Marketing	Cost / Competition / Brand / Marketing segmentation / Life cycle / Challenging
3. Space	Harmony with environment / Harmony with other furniture
4. Reference	Reference to other chairs / Reference to any other resource
5. Physical property	Morphology design / Manufacture process / Material / Ergonomics analysis / Structure and Component
6. User emotion	Warm / Masculine / Fun / Dreamly / Peaceful / Grand / New / Modern / Traditional / Close / Comfortable / Sterling / Beautiful / Soft / Delightful

Table 3: Chair evaluation key words

Sort	Evaluation items
Emotion	Delightful
	Beautiful
	Warm
	Fun
	Simple
Function	Safe
	Comfortable
	Environment friendly
	Long life utilization
Symbol	Symbol of user status
	Symbol of social progress

3.3 Stage 3 --- The first Questionnaire of chair preference evaluation

3.3.1 Questionnaire construction

The first questionnaire tested user preference of seven pair chairs selected out in the first stage by eleven keywords. The evaluation questions included both dependent variable question and independent variable questions. The dependent variable question was “How much do you like this chair to purchase it? (Y)”, the independent variable questions were the semantic perception of how participants thought about each chair's eleven attributes: delightful (x_1), beautiful (x_2), warm (x_3), fun (x_4), safe (x_5), simple (x_6), comfortable (x_7), environment friendly (x_8), long life utilization (x_9), symbol of userstatus (x_{10}), symbol of social progress (x_{11}). The questionnaire applied five-point Likert scales as evaluating scores from 1 to 5 scores (Figure 3).

This questionnaire survey samples were consisted of the 184 participants (73 males and 111 females) between 10 and 65 years of age. 38 were Japanese, 125 were Chinese, and 21 were from other countries except China and Japan. 20% of them were recruited from the University cafeteria of Kyushu University, 80% of them were recruited from internet by website questionnaire. Participants were selected based on their interest in chair attraction. They were selected in order to contribute to the discussion of what attributes can commit chair preference and purchase. All of them finished the questionnaire without interrupting. The average costing time for each questionnaire was 13 minutes.

Evaluation items		Score	1 Strongly disagree	2 Disagree	3 Neither	4 Agree	5 Strongly agree
How much do you like this chair to purchase it?							
How much do you think of this chair's attribute perception ?	1 Delightful						
	2 Beautiful						
	3 Warm						
	4 Fun						
	5 Safe						
	6 Simple						
	7 Comfortable						
	8 Ecological						
	9 Long life utilization						
	10 Symbol of user status						
	11 Symbol of social progress						

Figure 3: The content of first questionnaire

3.3.2 The first questionnaire data analysis

The data of this quantitative study was analyzed in correlation analysis, regression analysis by Statistical Product and Service Solutions (SPSS) software.

3.3.2.1 Reliability analysis

The Cronbach alpha coefficient was reported to be .983 in the first questionnaire, in a reliability analysis performed in this research. Therefore the scale used in the analysis could be considered as reliable with the sample of the research (Table 4).

3.3.2.2 The preference distribution

The preference score was an important index to reflect the extent by which a product attracts the users. Based on the first question (dependent variable). Fourteen chairs were sorted out according to the level of scores (Figure 4). It showed that the highest preference chair was No.14 MUJI chair ($M=3.98$, $SD=0.72$), second one was No.6 China chair ($M=3.78$, $SD=0.79$), both of them were from modern chair. The least preference chairs were No.2 and No.12, they also came from modern chairs. By contrast, some of historical chairs also got high popularity in this survey, such as No.3 Louis XVI Queen chair and No.5 Ming dynasty round-backed armchair, their score were a little less than the first popular chair. From this data, it can explain the user interest in.

3.3.2.3 The preference correlation

There must exist preference correlation between historical chair, which became a powerful reason for designers to reuse history chair. In each pair chairs, because modern chair designers recreated historical chair on the premise of preserving historical chair's main in

modern chair. In modern chair design process, designers preserved historical chairs' some features, meanwhile modern designers added some extra design elements freely, like the Proust chair's dotting painting on surface decoration. In this situation, the raw data for all chair samples' preference scores were analyzed to see if there existed connection of the preference in modern chair and its relative historical chair. The Table 5 presents the results of Pearson correlation by SPSS.

From Table 5, it was obvious that all the p-values were smaller than 0.05 except the B pair, which indicated that among A pair, C pair, D pair, E pair, F pair, G pair there could be correlation between modern chair preference and historical chair preference. The highest Pearson correlation coefficient (value of r) was D pair of 0.555, followed by the A pair of 0.414, C pair of 0.406, E pair of 0.399, F pair of 0.354, G pair of 0.281. This illustrated in most situation, there was strong correlation in modern chair preference and its stimulation historical chair preference.

But the p-value in B pair of Louis Ghost Chair and Louis XVI Queen chair was 0.699, which was much higher than 0.05, and the Pearson correlation coefficient was 0.029, these two parameters demonstrated that there was no preference correlation between these two chairs. In this case, author tried to find the reason from these two chairs' appearance perception, Louis Ghost Chair's designer Philippe Starck didn't alter component shape of backrest, armrest, seat, leg distinctly, just minimized the width, height, depth dimension from W25.5 cm, D25.5 cm, H39.5 cm to H37 cm, W21.25 cm, D21.75 cm slightly. But Philippe Starck totally replaced the stimulation Queen chair material from wood and fabric to transparent plastic material. Author speculated that this material change became the key reason to cause the preference discrepancy between these two chairs. Even though both of Louis Ghost Chair ($M=3.71$, $SD=0.94$) and Louis XVI

Table 4: Cronbach's alpha in reliability analysis

Reliability Statistics	
Cronbach's Alpha	N of Items
0.983	168

Figure 4: Chair preference ranking

Table 5: Each pair preference correlation

		Descriptive Statistics		Correlations	
		Mean	Std. Deviation	Pearson Correlation	Sig. (2-tailed)
A pair	Preference No.1	3.4946	1.06097	0.414**	.000
	Preference No.2	2.8533	1.03765		
B pair	Preference No.3	3.7065	0.93549	0.029	0.699
	Preference No.4	3.5652	0.92097		
C pair	Preference No.5	3.6957	1.01614	0.406**	.000
	Preference No.6	3.7772	0.7888		
D pair	Preference No.7	3.6196	0.87893	0.555**	.000
	Preference No.8	3.6739	0.8312		
E pair	Preference No.9	3.5598	0.84718	0.399**	.000
	Preference No.10	3.2717	0.98739		
F pair	Preference No.11	3.4946	0.91136	0.354**	.000
	Preference No.12	2.9891	1.05057		
G pair	Preference No.13	3.2228	1.00236	0.281**	.000
	Preference No.14	3.9783	0.71637		

Queen chair ($M=3.57$, $SD=0.93$) got relatively high score of preference, it illustrated that both chairs were in the users' favor. But according to the Pearson correlation calculation in eleven independent variable questions (x_1-x_{11}), the two chairs' preference independent variable correlation was almost uncorrelated. This illustrated the preference of these two chairs was totally different.

3.3.2.4 The preference regression analysis

A linear regression analysis was performed to examine the relationship between the preference score and the eleven evaluation independent variables. Table 6 presented the results of stepwise regression analysis of these fourteen chairs. It could be seen that all the D.W parameter were around 2, it meant the liner regression did not exist

Table 6: The preference regression analysis

	Durbin-Watson	Adjusted R Square	P value	Coefficients						Regression model
				Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
					B	Std. Error	Beta			
Preference No.1	1.908	0.107	.000	.000 (Constant)	1.774	0.367		4.839	.000	$y_{(1)} = 1.774 + 0.277x_1 + 0.207x_4$
				x_1 Delightful	0.277	0.09	0.223	3.088	0.002	
				x_4 Fun	0.207	0.072	0.209	2.896	0.004	
Preference No.2	2.02	0.238	.000	.000 (Constant)	0.757	0.307		2.467	0.015	$y_{(2)} = 0.757 + 0.334x_5 + 0.214x_1 + 0.173x_3$
				x_5 Simple	0.334	0.062	0.349	5.359	.000	
				x_1 Delightful	0.214	0.079	0.202	2.714	0.007	
				x_3 Warm	0.173	0.078	0.167	2.232	0.027	
Preference No.3	2.085	0.138	.000	.000 (Constant)	1.996	0.314		6.361	.000	$y_{(3)} = 1.996 + 0.359x_1 + 0.127x_5$
				x_1 Delightful	0.359	0.075	0.332	4.788	.000	
				x_5 Simple	0.127	0.058	0.153	2.213	0.028	
Preference No.4	2.114	0.208	.000	.000 (Constant)	1.592	0.239		6.674	.000	$y_{(4)} = 1.592 + 0.191x_1 + 0.239x_2 + 0.197x_7$
				x_1 Delightful	0.191	0.07	0.219	2.736	0.007	
				x_2 Beautiful	0.239	0.067	0.262	3.558	.000	
				x_7 Comfortable	0.197	0.066	0.21	2.978	0.003	
Preference No.5	1.956	0.225	.000	.000 (Constant)	1.411	0.332		4.251	.000	$y_{(5)} = 1.411 + 0.384x_1 + 0.231x_2$
				x_1 Delightful	0.384	0.082	0.356	4.716	.000	
				x_2 Beautiful	0.231	0.091	0.192	2.546	0.012	
Preference No.6	1.996	0.238	.000	.000 (Constant)	1.851	0.272		6.812	.000	$y_{(6)} = 1.851 + 0.153x_1 + 0.195x_2 + 0.18x_6$
				x_1 Delightful	0.153	0.073	0.192	2.102	0.037	
				x_2 Beautiful	0.195	0.069	0.236	2.827	0.005	
				x_6 Safe	0.18	0.081	0.174	2.226	0.027	
Preference No.7	1.934	0.244	.000	.000 (Constant)	1.518	0.276		5.493	.000	$y_{(7)} = 1.518 + 0.249x_1 + 0.248x_8 + 0.135x_3$
				x_1 Delightful	0.249	0.076	0.255	3.297	0.001	
				x_8 Environment friendly	0.248	0.064	0.261	3.885	.000	
				x_3 Warm	0.135	0.065	0.157	2.063	0.041	
Preference No.8	2.057	0.203	.000	.000 (Constant)	1.856	0.276		6.737	.000	$y_{(8)} = 1.856 + 0.255x_2 + 0.264x_8$
				x_2 Beautiful	0.255	0.061	0.289	4.209	.000	
				x_8 Environment friendly	0.264	0.065	0.28	4.073	.000	
Preference No.9	1.897	0.248	.000	.000 (Constant)	1.437	0.281		5.109	.000	$y_{(9)} = 1.437 + 0.219x_2 + 0.194x_8 + 0.185x_7$
				x_2 Beautiful	0.219	0.071	0.231	3.074	0.002	
				x_8 Environment friendly	0.194	0.07	0.208	2.786	0.006	
				x_7 Comfortable	0.185	0.073	0.192	2.528	0.012	
Preference No.10	2.042	0.392	.000	.000 (Constant)	0.769	0.293		2.624	0.009	$y_{(10)} = 0.769 + 0.238x_1 + 0.199x_3 + 0.250x_8 - 0.235x_4 + 0.177x_2 + 0.145x_{10}$
				x_1 Delightful	0.238	0.086	0.242	2.758	0.006	
				x_3 Warm	0.199	0.07	0.204	2.85	0.005	
				x_8 Environment friendly	0.25	0.072	0.232	3.479	0.001	
				x_4 Fun	-0.235	0.072	-0.229	-3.266	0.001	
				x_2 Beautiful	0.177	0.081	0.173	2.187	0.03	
				x_{10} Symbol of customer status	0.145	0.073	0.142	1.974	0.05	
Preference No.11	1.707	0.208	.000	.000 (Constant)	1.561	0.28		5.579	.000	$y_{(11)} = 1.561 + 0.330x_1 + 0.221x_5$
				x_1 Delightful	0.33	0.069	0.332	4.806	.000	
				x_5 Simple	0.221	0.064	0.24	3.47	0.001	
Preference No.12	2.117	0.483	.000	.000 (Constant)	0.437	0.283		1.542	0.125	$y_{(12)} = 0.437 + 0.461x_1 + 0.261x_6 - 0.255x_4 + 0.195x_8 + 0.167x_2$
				x_1 Delightful	0.426	0.077	0.417	5.534	.000	
				x_6 Safe	0.261	0.075	0.229	3.459	0.001	
				x_4 Fun	-0.255	0.069	-0.23	-3.689	.000	
				x_8 Environment friendly	0.195	0.07	0.177	2.793	0.006	
				x_2 Beautiful	0.167	0.074	0.168	2.255	0.025	
Preference No.13	1.887	0.408	.000	.000 (Constant)	0.347	0.269		1.29	0.199	$y_{(13)} = 0.347 + 0.292x_1 + 0.166x_9 + 0.210x_2 + 0.209x_7$
				x_1 Delightful	0.292	0.078	0.277	3.761	.000	
				x_9 Long life utilization	0.166	0.081	0.15	2.053	0.041	
				x_2 Beautiful	0.21	0.073	0.199	2.863	0.005	
				x_7 Comfortable	0.209	0.082	0.201	2.545	0.012	
Preference No.14	2.275	0.269	.000	.000 (Constant)	1.765	0.303		5.818	.000	$y_{(14)} = 1.765 + 0.227x_1 + 0.171x_9 + 0.184x_5$
				x_1 Delightful	0.227	0.058	0.293	3.942	.000	
				x_9 Long life utilization	0.171	0.061	0.208	2.814	0.005	
				x_5 Simple	0.184	0.074	0.174	2.479	0.014	

autocorrelation, and all the VIF were smaller than 5, it proved there was no correlation in the regression model among independent variables. So all the fourteen chairs' stepwise regression model were considered effectively.

Standardized beta coefficient was analyzed in Table 7. This table showed the difference in their beta coefficient. Such as in No.1 chair, the "delightful" beta was 0.223, following by "fun" beta of 0.209, which means independent variable was the highest strength to effect the "preference" dependent variable, then the second effect independent variable was the "fun". The standardized beta coefficients were different in No.2 chair comparing with No.1 chair. The highest beta was "simple" of 0.349, following by "delightful" beta of 0.202, the final one was "warm" beta of 0.167. These beta explaining most of the participants' preference of No.1 chair was from "delightful", then the second reason was from "fun". For interpreting in more detail, the Table 7 showed each chair standardized beta coefficient as key independent variables of effecting the strength to preference. In this table, it could be seen that there remained difference of standardized beta coefficient in each independent variable to effect the preference dependent in each pair of chairs.

(1) The standardized beta coefficient of No.1 chair in A pair was "delightful" (0.223) and "fun" (0.209), comparing with No.2 chair of "simple" (0.349), "delightful" (0.202) and "warm" (0.167). In both two chairs the independent variables of "delightful" effected participants' preference strongly.

- (2) The standardized beta coefficient of No.3 chair in B pair was "delightful" (0.332) and "simple" (0.153), comparing with No.4 chair of "beautiful" (0.262), "delightful" (0.219) and "comfortable" (0.21). In both two chairs the independent variables of "delightful" effected participants' preference strongly.
- (3) The standardized beta coefficient of No.5 chair in C pair was "delightful" (0.356) and "beautiful" (0.192), comparing with No.6 chair of "beautiful" (0.236), "delightful" (0.192), and "comfortable" (0.174). In both two chairs the independent variables of "delightful" and "beautiful" effected participants' preference strongly.
- (4) The standardized beta coefficient of No.7 chair in D pair was "environment friendly" (0.261), "delightful" (0.255), "warm" (0.157). Comparing with No.8 chair of "beautiful" (0.289), "environment friendly" (0.28). In both two chairs the independent variable of "environment friendly" effected participants' preference strongly.
- (5) The standardized beta coefficient of No.9 chair in E pair was "beautiful" (0.231), "environment friendly" (0.208) and "comfortable" (0.192) comparing with No.10 chair of "delightful" (0.242), "warm" (0.204), "environment friendly" (0.232), "beautiful" (0.173), "symbol of userstatus" (0.142). In No.10 regression analysis, the standardized beta of independent variable "fun" was negative number of -0.229, it meant the "fun" independent variable had negative effect to participants' preference dependent variable. In both two chairs the independent variables of "delightful"

Table 7: Analysis of standardized beta coefficient

Beta sequence Chair	Positive standardized beta coefficient					Negative standardized beta coefficient
	1	2	3	4	5	1
Preference 1	Delightful (0.223)	Fun(0.209)				
Preference 2	Simple (0.349)	Delightful (0.202)	Warm (0.167)			
Preference 3	Delightful (0.332)	Simple (0.153)				
Preference 4	Beautiful (0.262)	Delightful (0.219)	Comfortable (0.21)			
Preference 5	Delightful (0.356)	Pretty (0.192)				
Preference 6	Beautiful (0.236)	Delightful (0.192)	Safe (0.174)			
Preference 7	Environment friendly (0.261)	Delightful (0.255)	Warm (0.157)			
Preference 8	Beautiful (0.289)	Environment friendly (0.28)				
Preference 9	Beautiful (0.231)	Environment friendly (0.208)	Comfortable (0.192)			
Preference 10	Delightful (0.242)	Environment friendly (0.232)	Warm (0.204)	Beautiful (0.173)	Symbol of customer status (0.142)	Fun (-0.229)
Preference 11	Delightful (0.332)	Simple (0.24)				
Preference 12	Delightful (0.417)	Safe (0.229)	Environment friendly (0.177)	Beautiful (0.168)		Fun (-0.23)
Preference 13	Delightful (0.277)	Comfortable (0.201)	Beautiful (0.199)	Long life Utilization (0.15)		
Preference 14	Delightful (0.293)	Long life Utilization (0.208)	Simple (0.174)			

effected participants' preference.

- (6) The standardized beta coefficient of No.11 chair in F pair was “delightful” (0.332), “simple” (0.24), comparing with No.12 chair of “delightful” (0.417), “safe” (0.229), “environment friendly” (0.177), “beautiful” (0.168). In No.12 regression analysis, the standardized beta of independent variable “fun” was negative number of -0.23, it meant the “fun” independent variable had negative effect to participants' preference dependent variable. In both two chairs the independent variables of “delightful” effected participants' preference strongly.
- (7) The standardized beta coefficient of No.13 chair in G pair was “delightful” (0.277), “comfortable” (0.209), “beautiful” (0.199), “long life utilization” (0.15). Comparing with No.14 chair of “delightful” (0.293), “long life utilization” (0.208), “simple” (0.174). In both two chairs “delightful” and “long life utilization” these two independent variables effected participants' preference strongly.

To analyze the most typical and positive preference regression model among these fourteen chairs, author selected out the upper quartile (Q3) chairs' model as influential model by excel “QUARTILE” statistical function in preference average calculation. Finally four chairs were selected out as upper quartile. These four chairs preference regression model were:

- (1) No.14MUJI chair (modern chair):
 $Y(14) = 1.765 + 0.22x_1 (\text{delightful}) + 0.171x_9 (\text{long life utilization}) + 0.184x_5 (\text{simple})$
- (2) No.6 The China chair (modern chair)
 $Y(6) = 1.851 + 0.153x_1 (\text{delightful}) + 0.195x_2 (\text{beautiful}) + 0.186 (\text{safe})$
- (3) No.3 Louis XVI Queen chair (historical chair)
 $Y(3) = 1.996 + 0.359x_1 (\text{delightful}) + 0.127x_2 (\text{simple})$
- (4) No.5 Ming dynasty round-backed armchair (historical chair)
 $Y(5) = 1.411 + 0.384x_1 (\text{delightful}) + 0.231x_2 (\text{beautiful})$

From these four models, it can be seen that the independent variable of “delightful” had the strongest positive correlation with the preference evaluation, all the four regression models included “delightful” this independent variable. “long life utilization”, “simple”, “beautiful”, “safe” were also significant to decide perceive affection to chairs (Table 8). In this case, we may deduce that the main affecting preference factors were “delightful”, “long life utilization”, “simple”, “beautiful”, “safe”. If designers plan to recreate historical chair, they can try to change historical chair to endow new chair gets these six factors perception felling, then this new design can win users' preference.

Table 8: The factors of highest preference regression mode

Chair Independent variable	No.14 chair	No.6 chair	No.3 chair	No.5 chair	Sum
x_1 Delightful	√	√	√	√	4
x_5 Simple	√		√		2
x_2 Beautiful		√		√	2
x_9 Long life utilization	√				1
x_6 Safe		√			1

3.4 Stage 4 --- The second questionnaire

3.4.1 Constructing the questionnaire

The second questionnaire was to test the similarity between modern chair and historical chair by overall appearance and specific element comparison. The subjects in this comparison questionnaire were also from above fourteen chairs. The reason why author wanted to check the similarity between modern chair and historical chair was because if there was very less similarity between them, user can not discern where the modern chair originated from, there was no culture heritage from historical culture. Designers must know how to do the recreation from historical chair that can make user get the impression of historical chair in modern chair. So this questionnaire's purpose was to reveal the rule of how chair appearance presented similarity and dissimilarity between modern chair and its stimulation historical chair. Finally, this questionnaire can set up mathematical model to explicit the rule of historical chair stimulation design approach.

The questionnaire was consisted of dependent variable and independent variables. The dependent variable was the question of “how much the similarity of the over whole appearance (Y)”, The independent variables were the similarity of appearance elements, including backrest (x_1), armrest (x_2) (if chairs have no armrest, it will be removed), seat (x_3), leg (x_4), material (x_5), color (x_6), decoration (x_7). The answer of each question were just two types. One was “similar--1point”, the other one was “dissimilar--0 point” (Figure 5).

Similar(1)	Dissimilar(0)
How much the similarity of the over whole appearance ?			
How much the similarity of each design element?	1 Backrest		
	2 Armrest		
	3 Seat		
	4 Leg		
	5 Material		
	6 Color		
	7 Decoration		

Figure 5: The content of second questionnaire

Table 9: The second questionnaire reliability

Reliability Statistics	
Cronbach's Alpha	N of Items
0.857	53

Figure 6: The overall appearance similarity ranking

3.4.2 The second questionnaire data analysis

3.4.2.1 Reliability analysis

The Cronbach alpha coefficient was reported to be .857, the raw data in this questionnaire could be considered as reliable (Table 9).

3.4.2.2 The similarity comparison

The first question of similarity depend variable was an important index to reflect the extent to how much features the modern chair inheriting from historical chair. this questionnaire provided the similarity data in both overall similarity comparison and partial design element comparison. Figure 6 depicted these seven pair chairs' overall similarity ranking. It can be seen that the highest similarity was D pair of Chiavari chair and Superleggera chair ($M=.90$, $SD=.31$), The second high similarity was the C pair of Ming dynasty round-backed armchair and the China chair ($M=.85$, $SD=.37$). The least similarity pair was A pair of Louis XV Rococo chair and Proust chair ($M=.42$, $SD=.50$).

3.4.2.3 The similarity correlation analysis

A correlation analysis was made to see how the seven independent variables would contribute to the overall appearance similarity regression. Tables 10-16 depicted the strong correlation independent variables (marking by yellow) to appearance similarity in each pair chair, it can be seen that each pair high correlation factors were different. like the B pair, the strong similarity correlation were armrest and leg. The F pair were backrest and seat. However, in C pair, backrest, armrest, material, color, decoration contributed the overall appearance similarity. This illustrated that each modern designer chose different design element to keep and inherit the historical chair main

Table 10: The similarity correlation of A pair

		Backrest	Armrest	Seat	Leg
A Pair Similarity	Pearson Correlation	.160*	.251**	.182*	.293**
	Sig. (2-tailed)	.030	.001	.013	.000
	N	184	184	184	184

Table 11: The similarity correlation of B pair

		Backrest	Armrest	Seat	Leg	Color	Decoration
B pair Similarity	Pearson Correlation	.188*	.299**	.174*	.276**	-.042	-.032
	Sig. (2-tailed)	.011	.000	.018	.000	.571	.664
	N	184	184	184	184	184	184

Table 12: The similarity correlation of C pair

		Backrest	Armrest	Seat	Material	Color	Decoration
C Pair Similarity	Pearson Correlation	.285**	.274**	.172*	.229**	.195**	.151*
	Sig. (2-tailed)	.000	.000	.020	.002	.008	.040
	N	184	184	184	184	184	184

Table 13: The similarity correlation of D pair

		Backrest	Seat	Leg	Material	Color	Decoration
D Pair Similarity	Pearson Correlation	.221**	.179*	.312**	.161*	.307**	.212**
	Sig. (2-tailed)	.003	.015	.000	.029	.000	.004
	N	184	184	184	184	184	184

Table 14: The similarity correlation of E pair

		Backrest	Armrest	Seat	Leg	Material	Decoration
E Pair Similarity	Pearson Correlation	.423**	.459**	.321**	.258**	.160*	.246**
	Sig. (2-tailed)	.000	.000	.000	.000	.030	.001
	N	184	184	184	184	184	184

Table 15: The similarity correlation of F pair

		Backrest	Seat	Leg	Material	Color	Decoration
F Pair Similarity	Pearson Correlation	.343**	.221**	.182*	-.021	-.080	-.051
	Sig. (2-tailed)	.000	.003	.013	.778	.283	.489
	N	184	184	184	184	184	184

Table 16: The similarity correlation of G pair

		Backrest	Seat	Leg	Material	Color	Decoration
G Pair Similarity	Pearson Correlation	.295**	.225**	.328**	.226**	.164*	.298**
	Sig. (2-tailed)	.000	.002	.000	.002	.027	.000
	N	184	184	184	184	184	184

features, which design element they chose depended on designer's personal design judgement. Some designer would like to keep the original backrest as the main overall similarity factors, such as C pair of Ming round-backrest armrest chair and the China chair. While some designer would like to preserve the historical chair's leg, armrest as the primary maintaining feature, such as B pair of Louis XVI Queen Chair and Ghost chair.

3.4.2.4 The similarity regression analysis

To describe how seven independent variables deciding the overall appearance similarity intuitively. linear models of regression analysis was made to estimated the causal

Table 17: Similarity regression analysis

	Durbin-Watson	Adjusted R Square	P value	Coefficients								linear regression model	
				Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics			
					B	Std. Error	Beta			Tolerance	VIF		
A pair Similarity	2.062	0.127	.000	(Constant)	0.065	0.082		0.797	0.426			$y_{(A)}=0.065+0.321x_2+0.305x_4$	
				x_2 Armrest	0.321	0.117	0.198	2.737	0.007	0.914	1.094		
				x_4 Leg	0.305	0.088	0.248	3.486	0.001	0.945	1.058		
B pair Similarity	2.000	0.135	.000	(Constant)	0.529	0.063		8.362	.000			$y_{(B)}=0.595+0.173x_2+0.163x_4$	
				x_2 Armrest	0.173	0.061	0.21	2.853	0.005	0.873	1.146		
				x_4 Leg	0.163	0.059	0.202	2.763	0.006	0.884	1.131		
C pair Similarity	2.025	0.129	.000	(Constant)	0.343	0.095		3.612	.000			$y_{(C)}=0.343+0.221x_1$	
				x_1 Backrest	0.221	0.079	0.207	2.788	0.006	0.864	1.157		
D pair Similarity	1.935	0.150	.000	(Constant)	0.455	0.084		5.421	.000			$y_{(D)}=0.455+0.048x_1+0.159x_4+0.255x_6$	
				x_1 Backrest	0.048	0.045	0.079	1.062	0.29	0.836	1.197		
				x_4 Leg	0.159	0.057	0.212	2.789	0.006	0.807	1.239		
				x_6 Color	0.255	0.083	0.222	3.051	0.003	0.879	1.137		
E pair Similarity	2.016	0.317	.000	(Constant)	0.248	0.067		3.711	.000			$y_{(E)}=0.248+0.211x_1+0.308x_2+0.206x_3$	
				x_1 Backrest	0.211	0.078	0.199	2.72	0.007	0.697	1.436		
				x_2 Armrest	0.308	0.072	0.301	4.253	.000	0.743	1.347		
				x_3 Seat	0.206	0.052	0.249	3.945	.000	0.936	1.068		
F pair Similarity	1.979	0.141	.000	(Constant)	0.328	0.054		6.07	.000			$y_{(F)}=0.328+0.296x_1+0.15x_3$	
				x_1 Backrest	0.296	0.071	0.297	4.176	.000	0.928	1.078		
				x_3 Seat	0.15	0.075	0.142	2	0.047	0.931	1.074		
G pair Similarity	1.988	0.18	.000	(Constant)	0.204	0.076		2.685	0.008			$y_{(G)}=0.204+0.188x_1+0.18x_3+0.206x_4$	
				x_1 Backrest	0.188	0.073	0.186	2.568	0.011	0.854	1.172		
				x_3 Seat	0.18	0.077	0.163	2.342	0.02	0.924	1.083		
				x_4 Leg	0.206	0.085	0.182	2.421	0.017	0.796	1.257		

effect relationships among variables. Table 17 showed each pair linear model. The D.W in each pair was around 2, and VIF was less than 5, it illustrated there was no correlation in the regression model and the validity of each model.

Furthermore, the Table 18 showed the standardized beta coefficient comparison in each pair of chairs, it can be seen that each beta coefficient was different in regression analysis in each pair chairs. The higher of beta, the stronger effect on independent variable to “Similarity” dependent variable. The standardized beta coefficient analysis was concluded in following:

Table 18: Standardized beta coefficient

Beta		Standardized beta coefficient		
		1	2	3
Similarity A pair		Leg (0.228)	Armrest (0.198)	
Similarity B pair		Armrest (0.21)	Leg (0.202)	
Similarity C pair		Backrest (0.207)		
Similarity D pair		Color (0.222)	Leg (0.212)	Backrest (0.079)
Similarity E pair		Armrest (0.301)	Seat (0.249)	Backrest (0.199)
Similarity F pair		Armrest (0.302)	Seat (0.250)	Backrest (0.200)
Similarity G pair		Backrest (0.186)	Leg (0.182)	Seat (0.163)

- (1) The standardized beta coefficient of A pair was “leg” (0.228), “armrest” (0.198), it meant the first key factor to effect this pair’s appearance similarity was “leg”, the second one was “armrest”.
- (2) The standardized beta coefficient of B pair was “armrest” (0.21), “leg” (0.202), it meant the first key factor to effect this pair’s appearance similarity was “armrest”, following by “armrest”.
- (3) The standardized beta coefficient of C pair was just “armrest” (0.207). It meant the two chairs’ similarity in C pair was just “armrest”.
- (4) The standardized beta coefficient of D pair was “color” (0.222), “leg” (0.212), “backrest” (0.079). It meant the first key factor to effect this pair’s appearance similarity was “color”, the second one was “leg”, the final one was “backrest”.
- (5) The standardized beta coefficient of E pair was “armrest” (0.301), “seat” (0.249), “backrest” (0.199). It meant the first key factor to effect E pair’s appearance similarity was “color”, the second one was “leg”, the final one was “backrest”.
- (6) The standardized beta coefficient of F pair was “backrest” (0.297), “seat” (0.142). It means the first key factor to effect this pair’s appearance similarity was “backrest”, following by “seat” factor.
- (7) The standardized beta coefficient of G pair was “backrest” (0.297), “seat” (0.142). It meant the first key factor to effect G pair’s appearance similarity was “backrest”, following by “seat” factor.

To calculate the frequency of each independent variable appearing in each regression model. This article divided these seven pair chairs into two categories, The first category was pairs with armrest, including A, B, C, E pairs. The second category was pair without armrest, including D, F, G pairs. In each pair of chair regression model, each independent variable frequency was different. As this similarity regression analysis purpose was to find out the key independent variable to effect the overall appearance similarity. The low similarity of A pair chair (Mean=0.42) was excluded from discussion. In this case, this article selected B, C, E pair and D, F, G pair as regression analysis subjects. Table 19 and Table 20 showed the frequency of independent variable appearing in two type groups regression model.

From Table 19, it could be seen that in the first category chair regression analysis, both “backrest” and “armrest” were the highest frequency of twice, following by “leg”, “seat” of once. The other three independent variables of “material”, “color”, “decoration” appeared zero times in regression model. In this situation, it can infer that “backrest” and “armrest” were the most significant independent variable in similarity regression analysis. “leg” and “seat” were the second significant independent variables. “material”, “color”, “decoration” these three independent variables had no effect to the overall appearance similarity. So in future, If designers want to persevere the main feature of historical chair, they mustn’t modify the backrest and armrest appearance seriously, or users can’t identify where the recreation chair referring from. Meanwhile, designers can modify and change leg and

seat moderately, finally they can modify material, color, decoration these three design factors markedly, even completely change these three factors, as these three factors will not influence the identification of similarity between recreating new chair and historical chair.

The Table 20 presented the regression analysis in category which chairs had no armrest situation, it showed that “backrest” was the highest frequency, following by “seat”, “leg”, “color”. The independent variables of “material” and “decoration” didn’t appear in regression models. So from this result it can be said that, “backrest” was the most significant independent variable in similarity regression model. Designers should preserve historical chair’s “backrest” as main feature to inherit the main feature of historical chair. The other parts of “material” and “decoration”, designers can alter them freely, as these two independent variables have no effect to similarity dependent variable.

4. RESULTS

Based on the above two investigation studies, there comes out five results of this research:

- (1) The modern chairs stimulated by historical chair gains positive user preference in most situation, such as No.14 MUJI chair, and No.6 the China chair get the highest preference score. Meanwhile some historical chairs are also very popular, like No.3 Louis XVI Queen chair and No. 5 Chinese Ming dynasty armchair. This phenomenon illustrates the value of the recreating design of historical chairs. In sum, by historical chair stimulation design approach, modern chair designers can obtain progressive marketing value.
- (2) The preference correlation between modern chair and its stimulation historical chair shows that user can perceive the similar preference feeling between them. No matter how different the appearance of them, the user’ preference getting from modern chair and historical chair has strong connection in most cases, except the B pair of Louis XVI Queen chair and Louis Ghost Chair. There is no correlation in preference between them, the reason may come out because of the completely different materials in these two chairs.
- (3) The preference regression models in all chairs indicate that “delightful” is the most significant independent variable that effects the chair preference evaluation, following by the influence factor of “simple”, “beautiful”, “long life utilization”, “safe”. These five factors become the main influential factors of chair preference and popularity.

Table 19: Frequency of independent variables in pairs with armrest

Chair Independent variable	B pair	C pair	E pair	Sum
x_1 Backrest		√	√	2
x_2 Armrest	√		√	2
x_3 Seat			√	1
x_4 Leg	√			1
x_5 Material				0
x_6 Color				0
x_7 Decoration				0

Table 20: Frequency of independent variables in pairs without armrest

Chair Independent variable	D pair	F pair	G pair	Sum
x_1 Backrest	√	√	√	3
x_3 Seat		√	√	2
x_4 Leg	√		√	2
x_5 Material				0
x_6 Color	√			1
x_7 Decoration				0

- (4) The high overall appearance similarity is important in the historical chair stimulation design process. Appropriate appearance similarity between modern chair and historical chair can promote the perception of where the modern chair originates from to inherit historical culture. To some extent, designers should maintain the key features of historical chair, if there is no continuity in the appearance between modern chair and historical chair, this historical culture inheritance design approach lose the value and meaning.
- (5) Each pair chair similarity regression model illustrates that “backrest” and “armrest” is the most significant independent variable of high appearance similarity in chairs which have armrest. The “backrest” is the most significant independent variable of high appearance similarity in chairs which have no armrest. Designers inherit the historical chair essential feature by tiny modification of these two independent variables. Other similarity independent variables of “leg”, “seat”, “color”, “material”, “decoration” are less important, designers can recreate them freely, the modification of these five elements will not effect the appearance similarity seriously.

5. DISCUSSION

This article researches the value of historical chair stimulation design approach by user preference and similarity evaluation, eventhough in most situation, the stimulating modern chair gains higher preference comparing with its historical chair, but also there existing some exceptions, like the A pair, Proust chair preference is much more lower than its stimulation Louis XV Rococo chair, also in F pair, Robert Venturi's Chippendale Chair preference is much lower than historical Chippendale Chair. In this article, the negative aspects this approach isn't mentioned. In fact, in the above two cases, the declining preference in A and F pair modern chairs occurs in the user's point of view evaluation. But people cannot judge their success or not only from user perspective, as these two modern chairs are essentially a kind of art works representing postmodernism. They have strong progressive value in design aesthetic field. So the criteria of value judging in historical chair stimulation approach should be from several aspects, user preference evaluation is just one aspect.

The other one this article needs to discuss is how much modification of historical chair is appropriate which can both inherit the features from historical chair and win the high preference. That is to say, the research of relationship between modification and preference should also be carried

out. If they can be quantified in some model, people can predict this historical product stimulation approach is valid or ineffective in advance. In the future research, author will focus on this matter to explore deeply to promote the successful historical product stimulating design approach.

6. CONCLUSIONS

This article researches the designerly thinking way of the existing product stimulation design approach by preference and similarity evaluation from user perspective. Two quantitative questionnaires of chair cases are carried out. The questionnaires data shows that the existing historical chair stimulating new chair design approach can win positive user preference, and the key factors in preference by linear regression model analysis are “delightful”, “simple”, “beautiful”, “long life utilization”, “safe”. Meanwhile, the high overall appearance similarity to persevere historical chair features are the elements of “backrest” and “armrest” (if the chairs have armrest) and “backrest” (if the chairs have no armrest) by linear regression analysis. Based on the above research, this research gives out the conclusion that there is positive marketing value of historical product stimulation design approach. This design approach can be implemented in the directions of preference thinking and appearance similarity thinking. However, there still has some limitation in this article, the extent of the similarity for inheriting historical chair main features is not quantified, in further research, author will focus on the appearance similarity level testing to visualize the extent of historical product features maintaining research.

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