



Methodology Article

Comparison of Aesthetic Evaluation Analyses Based on Information Entropy and Multidimensional Scaling Approaches: Taking Interior Design Works as Example

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Abstract: Beautiful objects and things are welcome by everyone; beautiful view and scenes are attractive. How can interior design works be attractive? This is one of the most important issues of the field. What aesthetic attributes or features of an interior design work should possess to arouse aesthetic response? What visual components compose these aesthetic features? How to decide the order of each visual component and the composition of all visual components in the design process to reach the best effect? All of these are important key issues, and they have not yet been deeply and systematically studied in the world. Information entropy and Multidimensional scaling are two research approaches usually applied by other fields. The information entropy approach applies the “entropy” concept in Thermodynamics to explore the casual link and the best decision order of those compositional elements of an object. The multidimensional scaling approach can find out the most ideal composition of elements by analyzing the relational position of each element in the stimuli space. These two approaches are very suitable to explore the aesthetic evaluation related issues, but the literatures are quite few. By using color photos of designed interiors as measuring instrument, conducting an investigation to the domestic college students, collecting data of aesthetic evaluation of these subjects to the color photos, this study intends to respectively explore and compare the results of aesthetic evaluation analysis of these two approaches. The result of this study will be meaningful and valuable to the fields of interior design and empirical aesthetics.

Keywords: Aesthetic Evaluation, Information Entropy, Multidimensional Scaling, Interior Design

1. Introduction

Beautiful things are appealing, pleasant scenery inspire the joy of good sensation. One of the most fundamental purposes of interior design is to create a pleasing man-made environment; therefore, how to give a pleasant impression is essential to interior design. On this aspect, visual components that compose the “aesthetic” features of interior design work are important. However, what aesthetic attributes or features of an interior design work should possess to arouse aesthetic response? What visual components compose these aesthetic features? How to decide the order of each visual component and the composition of all visual components in the design process to reach the best effect? All of these are important key issues,

and they have not yet been deeply and systematically studied in the world.

As for aesthetics research, discourses and arguments vary considerably due to different researches aptitudes. Researches of environmental aesthetics are mainly innate empirical aesthetics, formal aesthetics research is one of them. Also known as structural aesthetics research, formal aesthetics targets at physical features of the environment, explores relationship between aesthetic experience and form or structure that entirely focus on form or structure of objects. Descriptive questionnaires are its major tool to collect data with correlational analysis which is commonly seen in sociology on aesthetic factor and aesthetic response. This study attempts to explore empirical aesthetics research further with information entropy and multidimensional

scaling using pictures as its tool.

Specifically, the purposes of this study include:

1. Using information entropy to analyze aesthetic evaluation to understand the ideal order of aesthetic compositional elements.
2. Using multidimensional scaling to analyze aesthetic evaluation to know the best composition of aesthetic compositional elements.
3. Comparing analysis results from information entropy and multidimensional scaling towards aesthetic evaluation.

2. Literature Reviews

The important issues in this study are related aesthetic perception, information entropy and multidimensional scaling. Related literature reviews are as followed.

2.1. Related Aesthetic Perception

Aesthetic perception is generally human perception of beautiful things, the ability within every one. Kant's Critique of Aesthetic Judgment explained that it contains three elements: 1. The feeling of pleasure or pain: sensation is an instinct aesthetic, not entirely equals to aesthetic, but a necessity to foster aesthetics. 2. Free fusion of understanding and imagination: concept's understanding during aesthetic process helps imagination wander around freely, understanding ability is not an instinct, which develops after sensation that increases with human growth. 3. Universal rules: individual's perception of aesthetics is affected by one's own comprehension and imagination. However, when everyone feels identically or has the same perception of the same things, the "common perception" is the universal rules.

As for empirical aesthetics research to environment, the sweet physical, mental and behavior responses caused by hidden aesthetic factors in environment/ object is the so-called aesthetic response, which is one of the responses interacts with all sort of environmental cues. Environment provides all kinds of cues, people react on these cues physically, mentally or behaviorally that bring back the good feelings are called aesthetic response or preference. Formal aesthetics research aims for specific physical feature of environment, in other words, it focuses entirely on form or structure of objects to explore relation between aesthetic experience and form or structure. Aesthetic evaluation means measurement of human perception of "beauty." Current aesthetic evaluation of environment uses photos or pictures as its research tool to assess and analyze respondents' preferences towards physical feature of certain environment. That is to say, aesthetic evaluation is based on how "eye-catching" the physical feature of certain environment can be.

2.2. Information Entropy

Information entropy is basically a combination of information and entropy. Originated from Wiener's Cybernetics and Shannon's Mathematical Theory of

Communication, information entropy combines Probability Theory and System Theory to explain situation when information transfers and exchanges, mainly targets at hidden volume during its process, information coding and decoding and transfer capacity of information exchange. Entropy is the terminology of Thermodynamics. Two principles of Thermodynamics are: 1. The law of conservation of energy, in other words, energy can neither be created nor be destroyed, it can only be transformed from one state to another. 2. When energy transfers from one state to another, some becomes useless and unrecyclable wasted energy. Entropy is a measure of the useless wasted energy. In short, entropy is an index used to measure disorder, chaos or uncertainty in a system, (Pong, 2005) while uncertainty means probability in statistics.

Claude Shannon from Bell Laboratories was the one who introduced entropy into sociology in 1948. Entropy is used to measure uncertainty associated with random events or a series of events. In other words, entropy stands for level of chaos, disorder or uncertainty in a system. The entropy is higher when a system is more disordered, chaotic and uncertain, on the contrary; due to its reversibility, negative entropy helps to lower uncertainty or chaos caused by entropy. In short, increasing negative entropy means increasing information volume as well. Transferring unidentified uncertainty status (disorder) to defined certainty (order).

For art and design, the final presentation of a work is the summary of all information output. Information input by each element has its own uncertain probability, each compositional element is the input information, in short, the entire work piece can be seen as the sum of probability of each compositional element. When it comes to three dimensional interior design work, visual information can be extremely complex and various, along with subjective viewpoints and personal preference; it is indeed a difficult challenge to lower information entropy and raise information negative entropy at the same time.

2.3. Multidimensional Scaling

Multidimensional Scaling (MDS) is a set of effective scientific method of condensed data, mainly used to extract hidden structure from perceivers' perception of stimulus and draw out message from the so-called stimulus space onto a map. (Yang, 1996) The ultimate goal is to set up a stimulus space with minimum dimension to reflect the observed fundamental relation between stimuli. Basically, there are two procedures in conducting MDS analysis: transforming input data into vector and developing stimulus form based on transformed vector. (Wen, 1993) Specifically speaking, MDS tries to find out configuration of perception hidden inside respondents' heads based on their judgments of similarities or dissimilarities of stimuli then present the hidden fundamental structure in space. Test objects determined to be similar are shown as close dots in the diagram; while dissimilar objects are shown in distant dots in the diagram.

MDS and the conventional Factor Analysis (FA) both have

its ultimate goal of simplifying “scattered and hidden data” into “systematic and clear information.” Still, basic differences remain. MDS is suitable for some not yet fully discovered research topics than FA. An ideal multidimensional experiment requires collection of four data: 1. Similarities judgment of all paired stimuli. 2. Stimuli’s rating based on descriptors, such as adjective. 3. Related objective quantities of stimuli perceptual attributes. 4. Respondents’ bio data. (Yang, 1996:21) In order to gather these data as basis of multidimensional analysis, the following three steps are required: similarities judgment, preferences and adaptive analysis and ideal-point analysis.

3. Research Method

This research aims to explore and compare information entropy and multidimensional scaling on aesthetic evaluation analysis respectively. To minimize possible influence from certain individual variables, (eg. age, education, job, etc.) respondents in this research are limited to college students with high similarities. In addition, current literatures have indicated obvious differences of aesthetics evaluation and preferences between professional designers, such as architects and ordinary people. (Devlin & Nasar, 1989; Duffy, 1986; Gifford, et al., 2000; Groat, 1982; Nasar, 1989, 1997; Nasar & Kang, 1989) To better understand the possible differences caused by professional education, respondents are divided into interior design majors and non interior design majors, gather research data via self-developed questionnaires, then proceed analysis and comparison.

Research tool is a set of colored photography of real interior design case selected by experts. Aesthetics merely means respondents’ visual and mental perception from its “appearance and form” in this research, functional evaluation such as practicability is not included. Likert scale is used to measure aesthetics level, from extremely attractive (5 points) to extremely unattractive (1 point). Higher scores indicate more attractive interior design shown in photography. Since information entropy and multidimensional scaling have some similarities, this

research hopes to sort out analysis results on the same ground and it adopts the same list of questions, (pictures of real interior design work) work classification and mental-oriented adjectives aesthetics feature.

Research work in this study is divided into two parts. First, outlining the research tool. 5 graduate students with interior design major select 350 color photos of real interior design work based on six different design styles. 60 pieces with significant feature are screened out by ten experts. A power point file of these 60 pictures is displayed in class to college students to collect their answers. These answers are analyzed as tool for the second part of the research work. Finally, analysis results are compared and analyzed via information entropy and multidimensional scaling.

4. Results and Discussions

4.1. Stage One Research

The research proceeds aesthetic evaluation in a power point file with 60 color pictures of real interior design work to four college interior design major students willing to participate in this research. 292 valid questionnaires are collected then analyzed them via Exploratory Factor Analysis. Standard factor loading is set at .5 with principle component analysis to eliminate pictures fall behind .5 factor loading. To repeat this analysis for consecutive 4 times, 22 pictures are eliminated with the remaining 38 pictures to run Factor Analysis. KMO=.815 shows its superb suitability, chi-square distribution is 4025.633 (df =703) from Bartlett Sphericity test, P=.000 with significance level. 10 factors result from analysis of these 38 questions with its accumulated explanatory power to 62.61%. (Table 1) Due to the limitation of numbers of test objects and stimuli by multidimensional analysis software PD-MDS, not all 38 questions can be listed as the measure tool for the next stage. Therefore, picture with the highest factor loading in each factor is chosen to be the representative. Among all these 10 pictures, factor loadings are all above .72, only picture no. 33 in factor 8 is .652; in other words, these 10 pictures can be seen as representative for each style.

Table 1. Factor Transformation Matrix of 38 pictured questions.

Factor picture no	factor and loading									
	1	2	3	4	5	6	7	8	9	10
39	.780	.101	.088	.045	.068	-.010	-.124	.070	.036	.093
42	.758	-.038	-.069	.094	.027	.061	.058	.171	-.155	.029
52	.673	.088	-.082	.182	.000	.093	.176	-.121	-.023	.093
17	.669	-.012	.363	-.094	.083	-.029	-.007	-.065	-.013	.071
12	.649	-.010	.024	.017	-.009	.074	.012	.038	.090	.006
27	.619	.246	.084	.124	.009	-.081	-.118	-.101	-.047	.147
48	.589	-.007	.111	.396	-.072	.135	.208	.106	.015	-.039
14	.565	.197	0.03	.106	.005	-.086	-.315	-.039	.248	.188
37	.054	.789	-.003	.052	-.008	.128	.150	.146	-.046	.077
25	.206	.761	.126	-.048	.077	.018	.102	.058	.026	.002
32	-.022	.744	.083	-.099	.294	-.076	-.003	.125	.052	-.052
47	.085	.680	-.003	.031	.239	.221	.232	.153	-.045	.110
03	-.075	.581	-.077	.303	.020	.113	-.050	-.105	.223	.166

Factor picture no	factor and loading									
	1	2	3	4	5	6	7	8	9	10
31	.239	.566	.151	-.039	.315	-.057	.027	-.132	.228	-.120
22	.151	-.049	.777	.162	-.003	-.042	.130	.098	.158	-.002
21	.051	.042	.718	.052	.053	.201	.001	.132	.074	.077
56	.013	.122	.663	.059	.006	.235	.069	.153	-.057	.090
53	.078	.078	.599	.259	.013	.155	.010	-.124	.094	.107
07	.062	-.074	.085	.779	.131	.108	.048	-.046	.003	.219
55	.301	-.010	.178	.648	.082	-.060	.116	.155	.033	-.045
35	.193	.128	.158	.605	-.175	.046	.301	.165	.205	-.112
28	.121	.118	.332	.594	.313	.203	-.107	.029	.107	-.046
51	.066	.175	-.066	.048	.726	-.050	-.034	.162	.185	.058
40	.036	.210	.135	.089	.690	.035	.184	.053	.076	-.052
46	-.023	.186	-.008	.086	.657	.104	.290	.109	.085	-.019
59	.050	-.022	.256	.101	-.019	.752	.163	.055	-.085	.112
60	.161	.237	.136	.065	.056	.727	-.005	-.005	.115	.038
38	-.116	.055	.297	.104	.008	.516	-.096	.454	.213	-.119
57	-.044	.236	.136	.063	.162	-.028	.780	-.023	.128	.027
58	.005	.122	.035	.180	.309	.115	.759	.060	.165	.072
33	.167	.081	.134	.162	.130	-.063	-.044	.652	-.169	.183
26	-.045	.108	.013	-.048	.194	.132	.096	.627	-.029	.217
43	-.061	.036	.228	.026	.156	.496	-.061	.515	.313	-.094
34	.055	.223	.082	0.21	-.119	.050	.414	.511	.382	-.158
16	.076	0.16	.109	.083	.133	.026	.107	-.002	.768	-.007
09	-.067	-.033	.119	.084	.280	.131	.192	-.022	.682	.149
08	.163	.032	.129	.020	.103	-.027	-.004	.161	.050	.747
06	.291	.110	.125	.070	.190	.139	.061	.087	.044	.609

Extraction: Principle component analysis. Rotation: Kaiser's varimax rotation criterion.

a. Maximum iterations for convergence of 10

Later, 10 experts are invited to give verbal description of these 10 pictures for its visual feature and mental image. Followings are the 10 verbal descriptions: 1. Visual feature: mix and match, nature-oriented, simple and order, colorful format, clean and bright, quality and elegance, unique and stylish, nostalgia, attractive hue, and innovative. 2. Mental image: noble and extravagance, modern and classic, exotic and leisure, warm and cozy, fashion and graceful, unadorned and moderate, yuppie and concise, newly retro, classical grandeur, and natural leisure. The following stage uses the 10 pictures with its visual feature and mental image description as tool for further research.

4.2. Stage Two Research

108 respondents, including 50 interior design major students and 58 students with other majors participate in this research. They are asked to evaluate the 10 pictures with 10 verbal descriptions of visual feature and mental image respectively. Scale from 1 to 10, the more hidden description it contains, the higher number it gets. Results are as followed:

4.2.1. Information Entropy

The followings are results from weighted value analysis on visual feature and mental image from all students respectively. Top three of visual feature from interior design students are nostalgia (.2139), colorful format (.1798) and nature-oriented (.1508), from non interior design students are nostalgia (.2490), nature-oriented (.2129) and colorful format (.1458). Students agree on the top one ideal feature, while

the 2nd and the 3rd switch places. (Table 2 and 3) Top three of mental image from interior design students are yuppie and concise (.1700), unadorned and moderate (.1564) and natural leisure (.1150), from non interior design students are yuppie and concise (.1418), classical grandeur (.1379) and unadorned and moderate (.1222). Again, the ideal number one is the same. (Table 4 and 5) Results from information entropy clearly show that no major differences exist on the relative ideal ranking.

4.2.2. Multidimensional Scaling

1. According to the result of information entropy analysis, in "visual feature" (Table 2, 3), the first three factors with high score weight for interior design majors are: (8) nostalgic (weight. 2139) > (4) colorful format (.1798) > (2) nature-oriented (.1508); while for other majors are: (8) nostalgic (weight .2490) > (2) nature-oriented (.2129) > (4) colorful format (.1458). In "mental image" (Table 4, 5), the first three factors with high score weight for interior design majors are: (7) yuppie and concise (weight .1700) > (6) unadorned and moderate (.1564) > (10) natural leisure (.1150); while for other majors are: (7) yuppie and concise (weight .1418) > (9) classical grandeur (.1379) > (6) unadorned and moderate (.1222). It shows that there is only some minor difference between interior design majors and other majors in their aesthetic response. They all share the highest appreciation for the same factor.

Table 2. Weighted visual feature index value of interior design students.

calculation of weighted value	M=10												
Index	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	e j	1- e j	W
Mix and match	-.2702	-.2102	-.1933	-.2796	-.2571	-.1250	-.2155	-.2393	-.1842	-.2702	.9748	.0252	.1009
Nature-oriented	-.2843	-.1461	-.2902	-.2069	-.1740	-.2483	-.1283	-.2397	-.2138	-.2843	.9624	.0376	.1508
Simple and order	-.1873	-.2639	-.2464	-.1554	-.2523	-.2676	-.2568	-.2619	-.1768	-.1873	.9797	.0203	.0813
Colorful format	-.2855	-.1679	-.1907	-.3161	-.1993	-.1359	-.1784	-.1923	-.2477	-.2855	.9552	.0448	.1798
Clean and bright	-.2346	-.2644	-.2218	-.2001	-.2680	-.2120	-.2665	-.2105	-.1602	-.2346	.9870	.0130	.0520
Quality and elegance	-.2289	-.2540	-.2157	-.1813	-.2689	-.2217	-.2274	-.2787	-.1642	-.2289	.9857	.0143	.0573
Unique and stylish	-.2254	-.2061	-.2368	-.2360	-.2427	-.2240	-.1962	-.2659	-.2342	-.2254	.9957	.0043	.0173
Nostalgia	-.2090	-.1622	-.2499	-.1918	-.1391	-.2989	-.1203	-.2935	-.3061	-.2090	.9467	.0533	.2139
Attractive hue	-.2581	-.2262	-.2347	-.2179	-.2466	-.2032	-.1891	-.2795	-.1536	-.2581	.9846	.0154	.0619
Innovative	-.2458	-.2155	-.2133	-.2579	-.2691	-.1496	-.2236	-.2794	-.1538	-.2458	.9788	.0212	.0849

Table 3. Weighted visual feature index value of non interior design students.

calculation of weighted value	M=10												
Index	1	2	3	4	5	6	7	8	9	10	e j	1- e j	W
Mix and match	-.2776	-.2031	-.2057	-.2627	-.2496	-.1558	-.2109	-.2153	-.1990	-.2801	.9814	.0186	.0663
Nature-oriented	-.1328	-.1502	-.3168	-.1898	-.1694	-.2571	-.1466	-.2557	-.2302	-.3166	.9403	.0597	.2129
Simple and order	-.1437	-.2789	-.2510	-.1564	-.2550	-.2708	-.2619	-.2539	-.1701	-.1954	.9716	.0284	.1013
Colorful format	-.2453	-.1690	-.2213	-.3248	-.1873	-.1583	-.1912	-.1776	-.2447	-.2889	.9591	.0409	.1458
Clean and bright	-.2022	-.2676	-.2391	-.2120	-.2689	-.2012	-.2789	-.1927	-.1606	-.2398	.9828	.0172	.0613
Quality and elegance	-.2652	-.2460	-.2261	-.1948	-.2655	-.1850	-.2556	-.2569	-.1555	-.2158	.9843	.0157	.0559
Unique and stylish	-.2221	-.2177	-.2554	-.2292	-.2354	-.2068	-.2123	-.2443	-.2253	-.2472	.9971	.0029	.0104
Nostalgia	-.2104	-.1516	-.2698	-.1805	-.1148	-.3019	-.1148	-.2959	-.3156	-.1865	.9302	.0698	.2490
Attractive hue	-.2302	-.2209	-.2623	-.2342	-.2377	-.1932	-.2096	-.2525	-.1653	-.2705	.9886	.0114	.0405
Innovative	-.2138	-.2093	-.2419	-.2497	-.2469	-.1667	-.2341	-.2579	-.1653	-.2806	.9842	.0158	.0564

Table 4. Weighted mental image index value of interior design students.

calculation of weighted value	M=10												
Index	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	e j	1- e j	W
Noble and extravagance	-.3231	-.2146	-.1728	-.2120	-.2563	-.1419	-.2248	-.2736	-.1967	-.2052	.9646	.0354	.0627
Modern and classic	-.2563	-.2861	-.1616	-.1957	-.3058	-.1377	-.2839	-.2429	-.1002	-.2125	.9479	.0521	.0922
Exotic and leisure	-.2471	-.2074	-.3195	-.2437	-.1828	-.2335	-.1429	-.2116	-.1389	-.2824	.9597	.0403	.0712
Warm and cozy	-.2330	-.1961	-.2793	-.2984	-.1953	-.1918	-.1764	-.1901	-.1459	-.3066	.9611	.0389	.0689
Fashion and graceful	-.2706	-.2769	-.1673	-.1946	-.3006	-.1488	-.2669	-.2541	-.1115	-.2113	.9565	.0435	.0770
Unadorned and moderate	-.1297	-.2004	-.2501	-.1394	-.1944	-.3549	-.1599	-.3085	-.1623	-.1995	.9116	.0884	.1564
Yuppie and concise	-.1164	-.3190	-.1762	-.1435	-.3322	-.1652	-.3172	-.2141	-.1137	-.1839	.9039	.0961	.1700
Newly retro	-.2596	-.1849	-.2626	-.2016	-.1431	-.2472	-.1203	-.3280	-.2485	-.1973	.9524	.0476	.0842
Classical grandeur	-.3037	-.1650	-.1944	-.1952	-.1474	-.2515	-.1157	-.3084	-.2978	-.1901	.9421	.0579	.1025
Natural leisure	-.1196	-.2138	-.3260	-.1877	-.1926	-.2515	-.1547	-.2215	-.1604	-.3251	.9350	.0650	.1150

Table 5. Weighted mental image index value of non interior design students.

calculation of weighted value	M=10												
Index	1	2	3	4	5	6	7	8	9	10	e j	1- e j	W
Noble and extravagance	-.3238	-.2189	-.2307	-.2184	-.2520	-.1257	-.2441	-.2451	-.1469	-.2104	.9625	.0375	.0677
Modern and classic	-.2512	-.2896	-.1848	-.1969	-.3114	-.1209	-.3047	-.1918	-.1002	-.2093	.9384	.0616	.1112
Exotic and leisure	-.2576	-.2020	-.3145	-.2353	-.1768	-.2488	-.1548	-.2231	-.1471	-.2646	.9661	.0339	.0611
Warm and cozy	-.2196	-.2039	-.2905	-.2934	-.1816	-.2196	-.1838	-.1809	-.1761	-.2852	.9705	.0295	.0532
Fashion and graceful	-.2703	-.2809	-.1897	-.1988	-.2951	-.1367	-.2872	-.2209	-.1117	-.2087	.9554	.0446	.0804
Unadorned and moderate	-.1170	-.2089	-.2579	-.1729	-.2048	-.3404	-.1695	-.3092	-.1670	-.1991	.9323	.0677	.1222
Yuppie and concise	-.1142	-.3126	-.1838	-.1637	-.3171	-.2033	-.3162	-.2266	-.1221	-.1622	.9215	.0785	.1418
Newly retro	-.2203	-.1408	-.2827	-.1897	-.1173	-.2598	-.1120	-.3244	-.2931	-.2096	.9336	.0664	.1198
Classical grandeur	-.2533	-.1293	-.2576	-.1831	-.1085	-.2787	-.1000	-.3119	-.3162	-.1881	.9236	.0764	.1379
Natural leisure	-.1069	-.2229	-.3151	-.1940	-.1874	-.2524	-.1712	-.2184	-.1756	-.3251	.9420	.0580	.1047

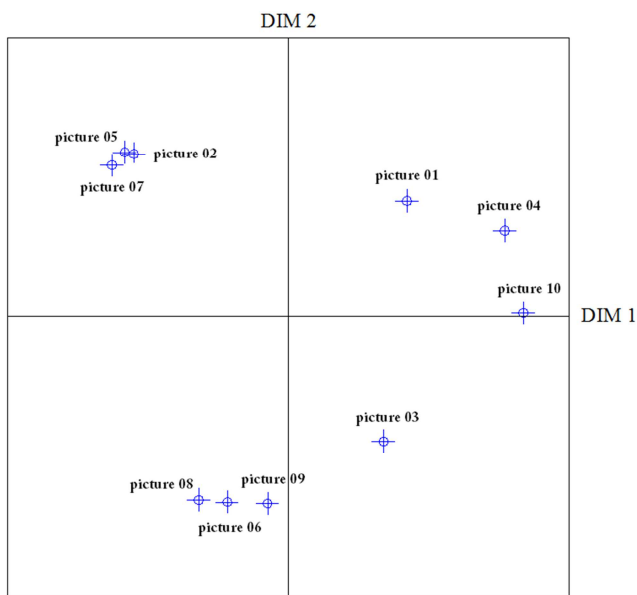


Figure 1. Distribution of 10 pictures in four quadrants.

2. According to the results of multidimensional scaling analysis, in “visual feature”, pictures which most match their verbal description in 10 factors are: (1) mix and match: picture 04 (attribute weight .5269), (2) nature-oriented: picture 09 (.5383), (3) simple and order: picture 02 (.3785), (4) colorful format: picture 04 (.5724), (5) clean and bright: picture (.4650), (6) quality and elegance: picture 07 (.4602), (7) unique and stylish: picture 09 (.4633), (8) nostalgia: picture 09 (.5106), (9) attractive hue: picture 04 (.4105) and (10) innovative: picture 04 (.3910). Among all pictures, picture 04 takes

the lead in 4 factors.

3. In “mental image”, pictures which most match their verbal description in 10 factors are: (1) noble and extravagance: picture 07 (attribute weight.3412), (2) modern and classic: picture 05 (.5047), (3) exotic and leisure: picture 03 (.5607), (4) warm and cozy: picture 03 (.5555), (5) fashion and graceful: picture 05 (.5018), (6) unadorned and moderate: picture 03 (.3785), (7) yuppie and concise: picture 05 (.5016), (8) newly retro: picture 09 (.4704), (9) classical grandeur: picture 09 (.5285) and (10) natural leisure: picture 03 (.5598). Among all pictures, picture 03 takes the lead in 4 factors.
4. Judging from similarity perception space, 10 pictures are distributed on all four quadrants with picture 06, 08 and 09 fall on the lower left quadrant.
5. According to PREFMAP analysis, the overall ideal coordinates and the ideal coordinates for both interior design majors and other majors all fall on the lower left quadrant (Figure 2), not entirely identical though (Figure in right shows an enlarged more detailed lower left quadrant, GROUP A and GROUP B represent interior design majors and other majors respectively, ALL stands for the overall coordinates.) It indicates that the common characteristics or qualities of picture 06, 08 and 09 are mostly preferred by both interior design majors and other majors. Inspecting these three pictures, we can find they all contain nostalgic elements in visual feature, and tend to arouse mental images such as moderately unadorned or classical grandeur.

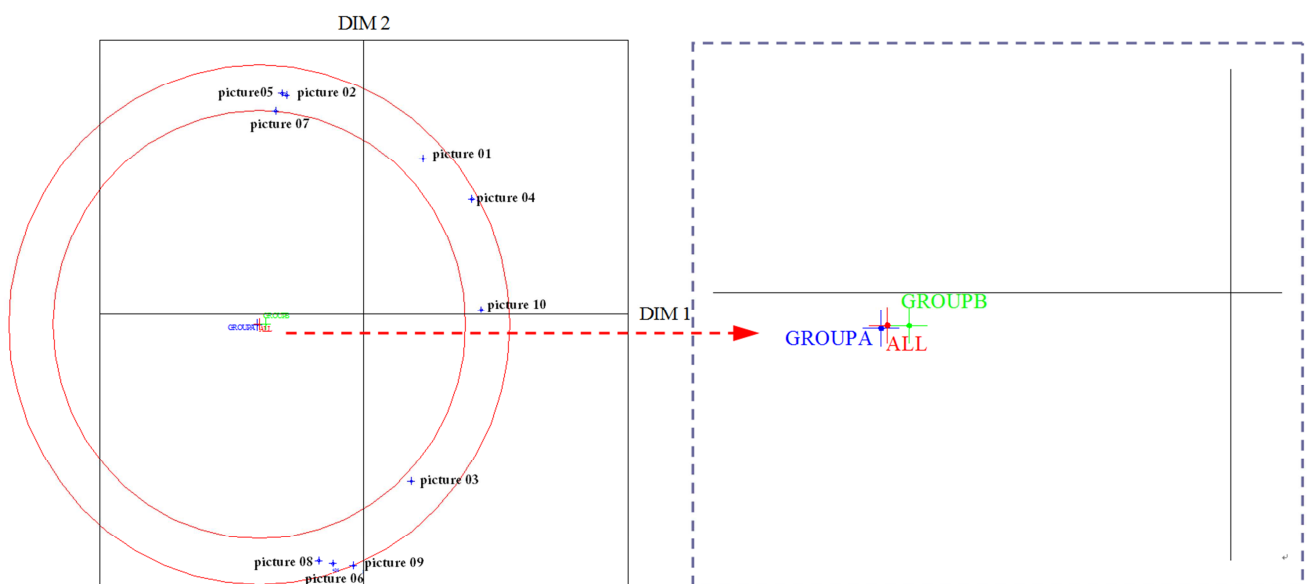


Figure 2. PREFMAP analysis.

5. Conclusions and Suggestions

Spatial components and elements that comprise interior design can be complex and diverse. Not only it is rare to see research regarding aesthetic evaluation on miscellaneous and variable interior design works, but it is inadequate and limited to interpret visual diagram and feature via verbal approach. Therefore, no suitable research method has been set up yet. This research tries to conduct its analysis and comparison based on information entropy and multidimensional scaling. However, the principle and nature of these two analysis methods are quite different. The results can be considered as complementary or cross-examined to each other.

Results from this research offer a new research analysis method to aesthetic evaluation of interior design work.

Appendix

picture 01-10



picture 01



picture 02



picture 03



picture 04



picture 05



picture 06



picture 07



picture 08



picture 09



picture 10

Followings are suggestions from this study. (a) This study uses spatial pictures of interior design as its objects that do not include participants' mental perception and preferences, which may result in inaccuracy. It is suggested that future research on this regard should offer more options of objects, i.e., spatial model, 3D space, and computer animation, which could bring out diverse results. (b) It is rare for spatial image study to apply questionnaire survey. As suggested in literature reviews, multidimensional scaling, factor analysis, and cluster analysis all have its steps and measures. Detailed in-depth discussion could be made in further research. However, "information entropy" and "multidimensional scaling" still have huge differences in its principles and natures. Though its result can be seen as complementary and cross-examining, more advanced comparison and discussion shall continue for further research.

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