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Analyzing automotive interior images and their perceived-value with Kansei Engineering

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Abstract: Automotive interior design plays a very important determinant when people purchase a car. Therefore, an automotive with interior design satisfying drivers emotional needs will outshine the others without one. This study applying Kansei engineering approach, tried to find key elements of car interior that influence the drivers emotion most. The study consists of four stages:

(1) Interviews with marketing experts: divided cars into high-class, middle-class and entry-class three categories under European, American and Asian three regions using car pictures available on the market.
(2) Design elements extracting by design experts: disassembled car interior into 17 design items and 55 categories.
(3) Kansei evaluation experiments: eight most meaningful vocabularies to drivers were extracted to evaluate the image of car interiors. They were: luxury, interesting, stylish, casual, dynamic, precise, technological and lively.
(4) Perceived value constructing with questionnaire survey: using the four dimensions proposed by Sweeney and Soutar as the basis to measure and construct the perceived value for the eight adjectives extracted previously.

The study explored the weights for design elements of car interiors using Kansei Engineering technique and quantification type I, and further measured the perceived value for the eight adjectives. It was hoped to provide effective guidelines for car interior designers in the future.

Keywords: Kansei Engineering, Kansei Image, Auto Interior Design, Perceived Value

1. INTRODUCTION

In addition to the pursuit of power performance, how to enhance the qualia of auto interior and

meet consumers' desire has become an important issue for auto development. As the majority of auto buyers already have been familiar with auto exterior in the purchase stage, an executive form auto company has pointed out that "consumers usually spend 5 minutes for viewing auto exterior, but fifteen minutes for checking its interior." Which also revealed the importance of automotive interior design. Therefore, designers must understand consumers emerging emotional needs about auto interior in order to create core value of the car culture

Japanese scholar, Mitsuo Nagamachi, had proposed in 1995 a consumer-oriented product development technology - Kansei Engineering, which has grown rapidly in recent years. The approach of Kansei Engineering can help clarify people emotional preferences and hence, can be applied to design practice. That this new research area not only injected new life to the engineering fields but also brought precise interpretation of the emotional preferences, has been confirmed by the studies of Kansei Engineering globally (Chen et al., 2000; Chen et al., 2001). Consumer perception, on the other hand, is a complementary study to Kansei research from the marketing perspective. Being one of the important factors influencing consumer behavior, "perception" is formed through human senses, including vision, hearing, tactile, taste, and sense of equilibrium etc. Therefore, "sense" is the basis of perception, and also a subjective conscious activity with one's own personal expectations, values and experiences of environmental awareness. Considering the complexity and diversity of the composing components of auto interior, which makes it more difficult to evaluate, in addition to emotional preferences, perceived value of auto interior are also analyzed with Kansei engineering approach in this study.

2. RELATED RESEARCHES

2.1. Applications of Kansei engineering

Kansei engineering was proposed by Professor Mitsuo Nagamachi from Hiroshima University in 1970s aiming at fulfilling human needs and trying to convert consumers' feeling and preferences to the design elements in new product development (Nagamachi, 1995). Employing Kansei engineering methods to assess the image of auto interior space, especially the feeling of spacious and oppression, Tanoue et al. (1997) developed a comfort diagnostic system for auto interior space. Muneo (1998) also proposed a product design process satisfying consumers' cognition model to provide designers an integrated design environment. Meanwhile, Hirohiko (1999) developed a technique for visualizing consumers' cognition construct with Kansei Engineering technique, using a series of charts to illustrate the relationships between product attributes and consumers' subjective value.

Literature indicates that human contact with things and images frequently and considerably on a daily basis, and the eye in the visual system plays an important role receiving visual information. In order to watch and detect properly, human has to blink 15,000 times a day. In this study, we evaluate Kansei preferences and perceived value of auto interior based on the sense of "vision" only.

2.2. Perceived values

Value is the ratio of the overall benefits consumers received over the total cost paid for. Woodruff (1997) believed that "the perception of value occurs at every stage of the purchase process, including pre-purchase stage." Zeithaml (1988) argued that "the perception of value is at a rather individual level than that of quality, and belongs to a higher level of abstraction" in addition, "the perceived value is the exchange between what a customer got and paid, but the quality is just part

of he/she got.” Parasuraman and Grewal (2000) proposed a measure of perceived value with four dimensions, including acquisition value, transaction value, in-use value and redemption value. "Acquisition value" means that consumers believe they can obtain more benefits by purchasing a product or service, this benefit mostly relates to monetary one, which indicates whether there is a feeling of "earn"; "transaction value" is the feeling of euphoria, consumers think they got a good deal and feel joy; "in-use value" refers to the utility benefits consumers got from the use of products or services; while "redemption value" is the residual benefits or value available for other purposes when the product comes to the end of its life.

Sweeney and Soutar (2001) divided perceived value into four categories: (1) Quality value: measured by the quality of services or products obtained; (2) Emotional value: measured by customers’ emotion affected during purchasing or consuming a product or service; (3) Price value: measured by the comparison between the price and function of a product or service obtained; (4) Social value: measured by the social image after consumers buy or use the product. McCain (2005) considered the "perceived value" of services can be measured by five dimensions, such as: convenience, reliability, response, assurance and concern. In short, perceived value is the overall assessment of paid and got for a consumer.

3. RESEARCH METHODS AND PROCEDURES

The study is divided into four stages: (1) samples screening and adjectives selection, (2) design elements extraction, (3) Kansei evaluation experiments and (4) perceived value surveys.

3.1. Samples screening and adjectives selection

First, a large number of existing auto interior designs on the market was collected. Then, 5 car experts were invited to screen the sample pictures and select most appropriate adjectives for later use in experiments. Picture samples selected include interior space, driver's seat, interior texture and color tone, and spatial variations. Adjectives selected include: luxury, interesting, stylish, casual, dynamic, precise, technological and lively.

3.2. Design elements extracting

In this stage, design experts were invited to break down auto interior designs into functions (items in KE) and solutions (categories in KE).

3.3. Kansei evaluation experiments

Followed by the first stage, 30 subjects with more than 5 years driving experience were invited to evaluate picture samples against each adjective. In the first round, samples were sorted into strong, medium and weak three groups. Then, each group was further divided into strong, medium and weak three sub-groups. Total was nine levels. Quantification Type I (Hayashi, 1950) was employed in the study for establishing the relationships between design elements and adjectives.

3.4. Perceived value surveys

Integrated with Kansei engineering approach, the four dimensions of perceived value (quality, emotional, price and social) proposed by Sweeney and Soutar (2001) were adopted to measure the eight adjectives (luxury, interesting, stylish, casual, dynamic, precise, technological and lively) chosen by experts at the first stage. Internet questionnaires were employed at this stage of the study, and only those who have driving experience qualified for the test. Total of 48 questionnaires were collected and al of them were valid ones.

4. RESULTS AND ANALYSES

4.1. Samples screening and adjectives selection

Only those available on Taiwan market were collected. Sample pictures covered interior space, driver's seat, interior texture and color tone, and spatial variations and grouped into Asian, American and European three regions. Each was further divided into three classes. (Figure 1) Adjectives selected include: luxury, interesting, stylish, casual, dynamic, precise, technological and lively.

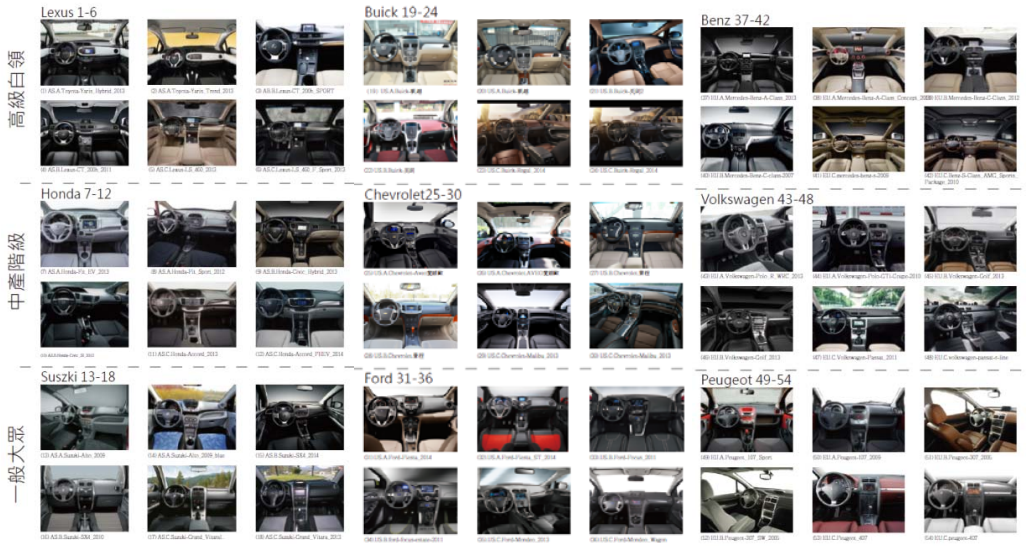

Figure 1: Sample pictures of Asian, American and European from left respectively

4.2. Design elements extracting

17 design items (functions) and 55 categories (solutions) were resulted from the interview with design experts.

4.3. Kansei evaluation experiments

With Quantification Type I analysis, partial correlation coefficients of each items (x1 ~ x17) and scores of each categories were calculated. The higher the partial correlation coefficient, the higher the weight of the item is, and means that item has greater influence to the Kansei adjective. The value of each category represents the impact to the adjective, the higher the stronger, and plus sign before the value indicates positive effect while minus sign negative. R^2 is the coefficient of determination, indicating how well data points fit a statistical model, and hence the forecasting explanatory power to each Kansei adjective. The results of statistical analysis for each Kansei adjective follow.

4.3.1. Luxury

Item "console style" has the highest partial correlation coefficient 0.562 to “luxurious", and category "touch screen" has the positive highest point; R (multiple correlation coefficient) is 0.727, strongly correlated. (Table 1)

4.3.2. Interesting

Item "console style" has the highest partial correlation coefficient 0.561 and category "touch screen" has the highest point; R= 0.512, highly correlated. (Table 2)

Table 1: Results of statistical analysis for “luxury”

Items	Categories	Scores	Partial correlation coefficient	Items	Categories	Scores	Partial correlation coefficient
X1-dashboard display color	white on black	-2.440	0.407	X8-shift lever material (continued)	leather + teak head	-45.660	0.413
	red on black	-10.290			leather + plastic head	-6.168	
	yellow on black	21.300		X9-shift lever & cup holders style	straight bar	-2.782	0.042
X2-dashboard display style	digital - digital	-18.208	0.248		coated leather style	0.712	
	digital - pointer	4.122		X10-color of central armrest	harmony /door panel	0.083	0.004
	analog - pointer	-14.368			contrast /door panel	-0.198	
X3-dashboard display backlight design	cold (G, B)	9.607	0.363	X1- glove box & trim material	plastic	-7.250	0.457
	warm (Y, O, R)	-18.295			metal	31.444	
	gradients	-22.428			plastic teak	2.073	
X4-steering wheel material	rough leather	0.462	0.497		leather	14.511	
	smooth leather	-1.885		X12-seat color	two colors	-8.776	0.177
	rough plastic	-18.431			monochrome	4.575	
	two-tone leather	37.777			2 – 3 colors	-0.201	
	plastic wood	25.375		X13-seat material	leather + fabric	-5.514	0.303
X5-steering wheel shape	round /dashboard	2.689	0.299		leather	11.613	
	polygonal	8.241			fabric	-13.666	
	traditional	-24.550		X14-air-vent color	silver frame + black blades	22.275	0.548
X6-console material	metal	1.800	0.390		silver frame + silver blades	23.110	
	plastic teak	41.758			black frame + black blades	-22.368	
	plastics metal	17.267		X15-air-vent style	square /R corner	21.803	0.476
	plastics - rough	-10.654			round	-14.538	
	plastic /metal trim	4.360			round + square	-24.944	
X7-console style	no screen /buttons	-26.097	0.562		rectangular	-17.715	
	screen /button	-1.059		X16-door panels color	brown, khaki, cream	9.588	0.192
	screen /knob	-23.471			black, gray, silver	-6.102	
	touch screen	30.835		X17-color of reading lights + glasses case + sunroof switch	same as auto interior	-2.021	0.065
X8-shift lever material	leather /metal head	8.052			different from car interior	3.176	
	embossed leather head	-11.523					

Constant: 143.444; R=0.727; R^2=0.528

4.3.3. Stylish

"Air-vent color" has the highest partial correlation coefficient 0.616 to “stylish", and category "silver frame + silver blades" has the highest point; R= 0.681, strongly correlated. (Table 3)

Table 2: Results of statistical analysis for “interesting”

Items	Categories	Scores	Partial correlation coefficient	Items	Categories	Scores	Partial correlation coefficient
X1-dashboard display color	white on black	-2.449	0.220	X8-shift lever material (continued)	leather + teak head	-29.668	0.207
	red on black	33.216			leather + plastic head	-9.459	
	yellow on black	28.018		X9-shift lever & cup holders style	straight bar	-23.623	0.311
X2-dashboard display style	digital - digital	-10.741	0.100		coated leather style	6.043	
	digital - pointer	0.509		X10-color of central armrest	harmony /door panel	1.059	0.039
	analog - pointer	5.306			contrast /door panel	-2.514	
X3-dashboard display backlight design	cold (G, B)	-0.387	0.131	X1- glove box & trim material	plastic	-0.624	0.313
	warm (Y, O, R)	-3.854			metal	29.404	
	gradients	16.973			plastic teak	-12.041	
X4-steering wheel material	rough leather	15.695	0.299		leather	-12.488	
	smooth leather	-2.583		X12-seat color	two colors	2.086	0.035
	rough plastic	-14.256			monochrome	-0.736	
	two-tone leather	32.185			2 – 3 colors	-1.510	
	plastic wood	-2.455		X13-seat material	leather + fabric	-11.724	0.163
X5-steering wheel shape	round /dashboard	2.192	0.381		leather	3.280	
	polygonal	12.995			fabric	4.401	
	traditional	-32.564		X14-air-vent color	silver frame + black blades	15.838	0.357
X6-console material	metal	-4.626	0.304		silver frame + silver blades	20.116	
	plastic teak	-24.012			black frame + black blades	-16.314	
	plastics metal	-29.475		X15-air-vent style	square /R corner	13.374	0.456
	plastics - rough	9.894			round	24.003	
	plastic /metal trim	-4.661			round + square	-9.218	
X7-console style	no screen /buttons	-40.228	0.561		rectangular	-32.466	
	screen /button	9.592		X16-door panels color	brown, khaki, cream	6.169	0.130
	screen /knob	-0.757			black, gray, silver	-3.926	
	touch screen	23.804		X17-color of reading lights + glasses case + sunroof switch	same as auto interior	1.555	0.052
X8-shift lever material	leather /metal head	3.691			different from car interior	-2.444	
	embossed leather head	6.282					

Constant: 136.148; R=0.512; R^2=0.262

4.3.4. Casual

"Glove box & trim material" has the highest partial correlation coefficient 0.426 to “casual", and category "plastic teak" the highest point; R= 0.559, highly correlated. (Table 4)

Table 3: Results of statistical analysis for “stylish”

Items	Categories	Scores	Partial correlation coefficient	Items	Categories	Scores	Partial correlation coefficient
X1-dashboard display color	white on black	-2.830	0.347	X8-shift lever material (continued)	leather + teak head	-91.347	0.357
	red on black	0.377			leather + plastic head	-8.412	
	yellow on black	10.384		X9-shift lever & cup holders style	straight bar	-14.755	0.183
X2-dashboard display style	digital - digital	-15.925	0.238		coated leather style	3.775	
	digital - pointer	4.749		X10-color of central armrest	harmony /door panel	7.305	0.265
	analog - pointer	-20.766			contrast /door panel	-17.349	
X3-dashboard display backlight design	cold (G, B)	11.040	0.358	X1- glove box & trim material	plastic	-4.228	0.605
	warm (Y, O, R)	-22.126			metal	29.163	
	gradients	-21.915			plastic teak	-20.081	
X4-steering wheel material	rough leather	-1.006	0.376		leather	-10.747	
	smooth leather	1.277		X12-seat color	two colors	-5.941	0.233
	rough plastic	-20.563			monochrome	6.589	
	two-tone leather	35.694			2 – 3 colors	-15.600	
	plastic wood	17.994		X13-seat material	leather + fabric	-1.872	0.213
X5-steering wheel shape	round /dashboard	6.608	0.288		leather	7.467	
	polygonal	4.640			fabric	-10.147	
	traditional	-29.104		X14-air-vent color	silver frame + black blades	26.912	0.616
X6-console material	metal	0.214	0.246		silver frame + silver blades	27.518	
	plastic teak	0.314			black frame + black blades	-26.979	
	plastics metal	-19.851		X15-air-vent style	square /R corner	25.555	0.517
	plastics - rough	-7.277			round	-9.334	
	plastic /metal trim	16.139			round + square	-18.693	
X7-console style	no screen /buttons	-27.828	0.553		rectangular	-35.769	
	screen /button	-0.430		X16-door panels color	brown, khaki, cream	-0.005	0.001
	screen /knob	-32.013			black, gray, silver	0.003	
	touch screen	34.646		X17-color of reading lights + glasses case + sunroof switch	same as auto interior	-2.290	0.067
X8-shift lever material	leather /metal head	8.535			different from car interior	3.598	
	embossed leather head	-9.145					

Constant: 143.667; R=0.681; R^2=0.464

4.3.5. Dynamic

"Console style" has the highest partial correlation coefficient 0.561 to “dynamic", and category "touch screen" the highest point; R= 0.650, strongly correlated. (Table 5)

Table 4: Results of statistical analysis for “casual”

Items	Categories	Scores	Partial correlation coefficient	Items	Categories	Scores	Partial correlation coefficient
X1-dashboard display color	white on black	-0.736	0.237	X8-shift lever material (continued)	leather + teak head	-51.404	0.315
	red on black	-12.853			leather + plastic head	0.306	
	yellow on black	31.252		X9-shift lever & cup holders style	straight bar	-15.610	0.290
X2-dashboard display style	digital - digital	5.771	0.258		coated leather style	3.993	
	digital - pointer	2.059		X10-color of central armrest	harmony /door panel	3.322	0.191
	analog - pointer	-19.563			contrast /door panel	-7.890	
X3-dashboard display backlight design	cold (G, B)	-0.915	0.194	X1- glove box & trim material	plastic	0.684	0.426
	warm (Y, O, R)	2.386			metal	-27.229	
	gradients	-18.270			plastic teak	36.076	
X4-steering wheel material	rough leather	9.065	0.266		leather	-0.025	
	smooth leather	-1.600		X12-seat color	two colors	1.027	0.158
	rough plastic	3.648			monochrome	2.234	
	two-tone leather	-25.928			2 – 3 colors	-10.453	
	plastic wood	-21.289		X13-seat material	leather + fabric	0.544	0.119
X5-steering wheel shape	round /dashboard	1.221	0.076		leather	-2.941	
	polygonal	0.638			fabric	4.153	
	traditional	-4.939		X14-air-vent color	silver frame + black blades	4.832	0.369
X6-console material	metal	4.525	0.369		silver frame + silver blades	-40.478	
	plastic teak	-30.393			black frame + black blades	0.202	
	plastics metal	-22.075		X15-air-vent style	square /R corner	1.156	0.352
	plastics - rough	1.159			round	-18.115	
	plastic /metal trim	7.100			round + square	15.080	
X7-console style	no screen /buttons	-9.350	0.217		rectangular	-10.950	
	screen /button	1.794		X16-door panels color	brown, khaki, cream	-7.420	0.216
	screen /knob	5.805			black, gray, silver	4.722	
	touch screen	0.289		X17-color of reading lights + glasses case + sunroof switch	same as auto interior	-0.758	0.035
X8-shift lever material	leather /metal head	3.466			different from car interior	1.192	
	embossed leather head	-9.114					

Constant: 142.000; R=0.559; R^2=0.313

4.3.6. Precise

“Console style" has the highest partial correlation coefficient 0.650 to “precise", and category "touch screen" the highest point; R= 0.723, strongly correlated. (Table 6)

Table 5: Results of statistical analysis for “dynamic”

Items	Categories	Scores	Partial correlation coefficient	Items	Categories	Scores	Partial correlation coefficient
X1-dashboard display color	white on black	-2.794	0.273	X8-shift lever material (continued)	leather + teak head	-55.195	0.290
	red on black	29.555			leather + plastic head	-13.751	
	yellow on black	10.292		X9-shift lever & cup holders style	straight bar	-34.050	0.377
X2-dashboard display style	digital - digital	-1.316	0.056		coated leather style	8.710	
	digital - pointer	1.069		X10-color of central armrest	harmony /door panel	-18.021	0.279
	analog - pointer	-6.567			contrast /door panel	7.954	
X3-dashboard display backlight design	cold (G, B)	6.756	0.244	X1- glove box & trim material	plastic	-0.862	0.531
	warm (Y, O, R)	-18.889			metal	26.827	
	gradients	5.306			plastic teak	-28.871	
X4-steering wheel material	rough leather	16.714	0.365		leather	-22.161	
	smooth leather	-3.137		X12-seat color	two colors	-2.056	0.101
	rough plastic	-22.255			monochrome	3.077	
	two-tone leather	36.233			2 – 3 colors	-8.927	
	plastic wood	17.812		X13-seat material	leather + fabric	-7.852	0.125
X5-steering wheel shape	round /dashboard	4.528	0.355		leather	4.949	
	polygonal	11.643			fabric	-1.353	
	traditional	-36.870		X14-air-vent color	silver frame + black blades	28.765	0.560
X6-console material	metal	1.716	0.327		silver frame + silver blades	14.646	
	plastic teak	-13.883			black frame + black blades	-27.196	
	plastics metal	-23.990		X15-air-vent style	square /R corner	12.998	0.530
	plastics - rough	6.202			round	21.911	
	plastic /metal trim	4.896			round + square	-7.194	
X7-console style	no screen /buttons	-39.756	0.561		rectangular	-49.841	
	screen /button	16.195		X16-door panels color	brown, khaki, cream	1.402	0.025
	screen /knob	-32.035			black, gray, silver	-0.892	
	touch screen	27.851		X17-color of reading lights + glasses case + sunroof switch	same as auto interior	-2.263	0.064
X8-shift lever material	leather /metal head	8.742			different from car interior	3.556	
	embossed leather head	-4.577					

Constant: 137.389; R=0.650; R^2=0.423

4.3.7. Technological

"Console style" has the highest partial correlation coefficient 0.641 to “technological", and category "touch screen" the highest point; R= 0.705, strongly correlated. (Table 7)

Table 6: Results of statistical analysis for “precise”

Items	Categories	Scores	Partial correlation coefficient	Items	Categories	Scores	Partial correlation coefficient
X1-dashboard display color	white on black	-2.635	0.339	X8-shift lever material (continued)	leather + teak head	-96.162	0.394
	red on black	1.204			leather + plastic head	-2.927	
	yellow on black	24.661		X9-shift lever & cup holders style	straight bar	5.760	0.078
X2-dashboard display style	digital - digital	4.953	0.274		coated leather style	-1.473	
	digital - pointer	-13.021		X10-color of central armrest	harmony /door panel	6.608	0.270
	analog - pointer	-24.144			contrast /door panel	-15.693	
X3-dashboard display backlight design	cold (G, B)	11.326	0.390	X1- glove box & trim material	plastic	-4.653	0.530
	warm (Y, O, R)	-25.116			metal	31.564	
	gradients	-14.032			plastic teak	-10.795	
X4-steering wheel material	rough leather	-4.860	0.307		leather	-5.993	
	smooth leather	2.900		X12-seat color	two colors	-3.082	0.115
	rough plastic	-14.050			monochrome	3.216	
	two-tone leather	-6.979			2 – 3 colors	-7.197	
	plastic wood	18.941		X13-seat material	leather + fabric	0.028	0.190
X5-steering wheel shape	round /dashboard	4.650	0.369		leather	6.142	
	polygonal	10.327			fabric	-9.620	
	traditional	-34.603		X14-air-vent color	silver frame + black blades	12.303	0.321
X6-console material	metal	11.177	0.376		silver frame + silver blades	-0.757	
	plastic teak	2.930			black frame + black blades	-28.630	
	plastics metal	23.209		X15-air-vent style	square /R corner	28.623	0.571
	plastics - rough	-14.733			round	-32.681	
	plastic /metal trim	16.822			round + square	-25.533	
X7-console style	no screen /buttons	-19.222	0.650		rectangular	-24.944	
	screen /button	4.414		X16-door panels color	brown, khaki, cream	-7.436	0.148
	screen /knob	-51.697			black, gray, silver	4.732	
	touch screen	29.662		X17-color of reading lights + glasses case + sunroof switch	same as auto interior	0.988	0.031
X8-shift lever material	leather /metal head	7.632					
	embossed leather head	-15.299			different from car interior	-1.553	

Constant: 139.611; R=0.723; R^2=0.523

4.3.8. Lively

“Console style" has the highest partial correlation coefficient 0.515 to “lively", and category "touch screen" the highest point; R= 0.632, strongly correlated. (Table 8)

Table 7: Results of statistical analysis for "technological"

Items	Categories	Scores	Partial correlation coefficient	Items	Categories	Scores	Partial correlation coefficient
X1-dashboard display color	white on black	10.113	0.275	X8-shift lever material (continued)	leather + teak head	-91.356	0.388
	red on black	5.156			leather + plastic head	-5.585	
	yellow on black	-2.982		X9-shift lever & cup holders style	straight bar	-17.608	0.198
X2-dashboard display style	digital - digital	-6.239	0.088		coated leather style	4.504	
	digital - pointer	2.144		X10-color of central armrest	harmony /door panel	5.711	0.198
	analog - pointer	-10.163			contrast /door panel	-13.564	
X3-dashboard display backlight design	cold (G, B)	11.345	0.292	X1- glove box & trim material	plastic	-3.101	0.524
	warm (Y, O, R)	-23.921			metal	29.151	
	gradients	-18.380			plastic teak	-28.999	
X4-steering wheel material	rough leather	5.906	0.241		leather	-11.059	
	smooth leather	2.074		X12-seat color	two colors	3.695	0.100
	rough plastic	-22.454			monochrome	0.545	
	two-tone leather	31.150			2 – 3 colors	-10.858	
	plastic wood	22.764		X13-seat material	leather + fabric	-3.561	0.233
X5-steering wheel shape	round /dashboard	2.458	0.308		leather	10.522	
	polygonal	14.674			fabric	-13.547	
	traditional	-36.721		X14-air-vent color	silver frame + black blades	35.353	0.586
X6-console material	metal	14.153	0.302		silver frame + silver blades	-19.456	
	plastic teak	-32.960			black frame + black blades	-29.263	
	plastics metal	-12.439		X15-air-vent style	square /R corner	30.791	0.515
	plastics - rough	-6.385			round	-25.645	
	plastic /metal trim	14.965			round + square	-20.985	
X7-console style	no screen /buttons	-44.594	0.641		rectangular	-38.230	
	screen /button	14.711		X16-door panels color	brown, khaki, cream	-7.072	0.112
	screen /knob	-50.299			black, gray, silver	4.500	
	touch screen	39.766		X17-color of reading lights + glasses case + sunroof switch	same as auto interior	-2.190	0.055
X8-shift lever material	leather /metal head	10.717			different from car interior	3.442	
	embossed leather head	-24.770					

Constant: 141.796; R=0.705; R^2=0.497

In summary, the statistical analysis results from Quantification Type I against the eight adjectives are summarized in Table 9 to show the highest partial correlation coefficients and multiple correlation coefficients.

Table 8: Results of statistical analysis for “lively”

Items	Categories	Scores	Partial correlation coefficient	Items	Categories	Scores	Partial correlation coefficient
X1-dashboard display color	white on black	-0.865	0.237	X8-shift lever material (continued)	leather + teak head	-55.195	0.290
	red on black	-15.146			leather + plastic head	-13.751	
	yellow on black	16.770		X9-shift lever & cup holders style	straight bar	-34.050	0.377
X2-dashboard display style	digital - digital	5.057	0.258		coated leather style	8.710	
	digital - pointer	-1.482		X10-color of central armrest	harmony /door panel	-18.021	0.279
	analog - pointer	6.408			contrast /door panel	7.954	
X3-dashboard display backlight design	cold (G, B)	-1.081	0.194	X1- glove box & trim material	plastic	-0.862	0.531
	warm (Y, O, R)	-10.580			metal	26.827	
	gradients	4.235			plastic teak	-28.871	
X4-steering wheel material	rough leather	14.849	0.266		leather	-22.161	
	smooth leather	-6.410		X12-seat color	two colors	-2.056	0.101
	rough plastic	-7.427			monochrome	3.077	
	two-tone leather	41.050			2 – 3 colors	-8.927	
	plastic wood	-4.745		X13-seat material	leather + fabric	-7.852	0.125
X5-steering wheel shape	round /dashboard	0.750	0.076		leather	4.949	
	polygonal	4.757			fabric	-1.353	
	traditional	-15.772		X14-air-vent color	silver frame + black blades	28.765	0.560
X6-console material	metal	-10.382	0.369		silver frame + silver blades	14.646	
	plastic teak	-47.478			black frame + black blades	-27.196	
	plastics metal	-65.135		X15-air-vent style	square /R corner	12.998	0.530
	plastics - rough	8.922			round	21.911	
	plastic /metal trim	12.232			round + square	-7.194	
X7-console style	no screen /buttons	-37.818	0.217		rectangular	-49.841	
	screen /button	13.863		X16-door panels color	brown, khaki, cream	1.402	0.025
	screen /knob	-11.302			black, gray, silver	-0.892	
	touch screen	21.271		X17-color of reading lights + glasses case + sunroof switch	same as auto interior	-2.263	0.064
X8-shift lever material	leather /metal head	7.315			different from car interior	3.556	
	embossed leather head	8.559					

Constant: 141.407; R=0.632; R^2=0.399

4.4. Perceived value surveys

The section will divide into two parts one is Descriptive statistics and reliability analysis, the other Validity analysis and factor analysis.

Table 9: The highest partial correlation coefficients and multiple correlation coefficients

Adjectives	Items w/highest partial correlation coefficients	Partial correlation coefficients	Categories w/highest point	Multiple correlation coefficients
Luxury	Console style	0.562	Touch screen	0.727
Interesting	Console style	0.561	Touch screen	0.512
Stylish	Air-vent color	0.616	Silver frame + silver blades	0.681
Casual	Glove box & trim material	0.426	Plastic teak	0.559
Dynamic	Console style	0.561	Touch screen	0.650
Precise	Console style	0.650	Touch screen	0.723
Technological	Console style	0.641	Touch screen	0.705
Lively	Console style	0.515	Touch screen	0.632

4.4.1. Descriptive statistics and reliability analysis

Total of 48 valid questionnaires was collected, men 54% and women 46%. The majority of subjects were 21-30 and 31-40 years old, most of them afford buying a car. In terms of driving experience, 21% of them were less than three years, 19% 3-5 years, and 60% more than 5 years, which indicated that most of the respondents have years of driving experience. As for education level, 58% of them have university degrees and 42% have master degrees and up. Reliability analysis wise, the α value for "price value" was 0.838, "emotional value" 0.870, "quality value" 0.836, and "social value" 0.820. Therefore, we can say that the reliability of each variable in this study has reached high reliability standards.

4.4.2. Validity analysis and factor analysis

In this study, the questionnaire was revised by experts to meet the criteria of content validity. Two main factors were extracted for "Quality value" (Table 10), 57.7% and 24.0% (totaling 81.7%) of the variance could be explained respectively. Consisted of four questions, namely: interesting, dynamic, lively and casual, factor one was entitled as: “Encouraging”. Factor two made up of technological and luxury questions was entitled "Utility." As the factor loadings of "stylish" and "precise" did not reach 0.5, they were deleted.

Table 10: Exploratory factor analysis for “Quality value” dimensions

Variables	Questions	Factor loadings		Eigenvalues and Percentages of Explained variance (%)	
		Factor 1	Factor 2	Factor 1	Factor 2
Quality value	Interesting	0.904		3.223	1.443
	Dynamic	0.868		(57.720)	(24.045)
	Lively	0.859			
	Casual	0.836			
	Technological		0.829		
	Luxury		0.778		
Factor named		Encouraging	Utility		

Three main factors were extracted for "Emotional value" (Table 11), 38.1%, 24.7% and 19.6% (totaling 82.4%) of the variance could be explained respectively. Consisted of four questions, namely: precise, stylish, dynamic and interesting factor one was entitled as: “Fashionable”. Factor two made up of casual and lively questions was entitled "Ease." Formed by technological and luxury questions, factor three was named as "Extravagant."

Two main factors were extracted for "Price value" (Table 12), 48.5% and 18.2% (totaling 66.7%) of the variance could be explained respectively. Consisted of four questions, namely: technological, luxury, precise and dynamic, factor one was entitled as: “Practical”. Factor two made up of four questions, namely: casual, stylish, lively and interesting, was entitled "Hedonic."

Table 11: Exploratory factor analysis for “Emotional value” dimensions

Variables	**Questions**	**Factor loadings**			**Eigenvalues and Percentages of Explained variance (%)**		
		Factor 1	Factor 2	Factor 3	Factor 1	Factor 2	Factor 3
Emotional value	Precise	0.908			3.050	1.979	1.571
	Stylish	0.903			(38.129)	(24.738)	(19.634)
	Dynamic	0.728					
	Interesting	0.724					
	Casual		0.943				
	Lively		0.6978				
	Technological			0.860			
	Luxury			0.845			
Factor named		Fashionable	Ease	Extravagant			

Table 12: Exploratory factor analysis for “Price value” dimensions

Variables	**Questions**	**Factor loadings**		**Eigenvalues and Percentages of Explained variance (%)**	
		Factor 1	Factor 2	Factor 1	Factor 2
Price value	Technological	0.886		3.882	1.460
	Luxury	0.807		(48.527)	(18.249)
	Precise	0.804			
	Dynamic	0.696			
	Casual		0.797		
	Stylish		0.784		
	Lively		0.756		
	Interesting		0.749		
Factor named		Practical	Hedonic		

Two main factors were extracted for "Social value" (Table 13), 47.7% and 22.3% (totaling 70.0%) of the variance could be explained respectively. Consisted of six questions, namely: dynamic, interesting, casual, precise, lively and stylish, factor one was entitled as: “Youthful”. Factor two made up of technological and luxury questions, was entitled "Honorable."

Table 13: Exploratory factor analysis for “Social value” dimensions

Variables	Questions	Factor loadings		Eigenvalues and Percentages of Explained variance (%)	
		Factor 1	Factor 2	Factor 1	Factor 2
Social value	Dynamic	0.898		3.813	1.783
	Interesting	0.831		(47.667)	(22.289)
	Casual	0.779			
	Precise	0.769			
	Lively	0.756			
	Stylish	0.713			
	Luxury		0.855		
	Technological		0.838		
Factor named		Youthful	Honorable		

5. CONCLUSSIONS AND SUGGESTIONS

Along with Kansei engineering approach, in-depth interviews and experiments were employed to explore consumers’ Kansei evaluation about automotive interior design. The results showed that the “style of central consol” was considered as the most influential factor for adjectives "luxury", "interesting", “dynamic", “precise”, “lively” and “technological”, and “touch screen” had the highest point for that item. That the operation of touch-screen is similar to that of contemporary IT devices explains that the Hi-tech IT equipments play a key role to the sense of "precise” and “technological”. As “touch” operation is funnier than traditional knobs or mechanical buttons, it also contributes to the feeling of “dynamic” and “interesting”. Item "glove box & trim material" has the most weight to the feeling of "casual" and “plastic teak” can make auto interior the most casual feel.

As for the perceived value, total of 48 valid questionnaires were collected. Through exploratory factor analysis, two factors were extracted for dimension “quality value” named "Encouraging" and "Utility". Three were extracted for “emotional value” and named as "Fashionable", "Ease" and "Extravagant". Two for "price value" named "Practical" and "Hedonic” and two extracted for "social value" and named as "Youthful" and "Honorable". The results of this study can provide auto interior designers a handy reference for future development of new design.

As this study has focused on the visual Kansei evaluation of automotive interior design, some other sensory (such as hearing, touch, smell, etc.) need to be further explored for better comprehend the overall Kansei feelings of auto interior.

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REFERENCES

Chen, K. H., Guan, S. S., Deng, Y. S., Chang, Y. M. (2001). [Techniques for rationalizing sensibility]. 29(1) 2-16. 北

Chen, K. H., Guan, S. S., Deng, Y. S., Chang, Y. M. (2000). [Teaching methods for Kansei Engineering]. 28(2) 160-165. 北

Hirohiko, A. (1999), A Hierarchical Representation of the Consumer Value Structure Using Qualitative Data, Report of Modeling the Evaluation Structure of Kansei, pp. 223-231.

Iwabuchi, C. et al. (2001), Data Management and Analysis by Yourself, Japan: Humura publishing, pp. 180-185.

McKain, S. (2005).What Customers Really Want, Thomas Nelson Inc, 210-220.

Muneo, K., Kim, Don-Han. (1998), Communicating Kansei Design Concept via Artifacts- A Cognitive Scientific Approach, Report of Modeling the Evaluation Structure of Kansei, pp. 337-343.

Nagamachi, M. (1989), [Kansei Engineering in Japanese]

Nagamachi, M. (1995), “Kansei Engineering: A new ergonomic consumer-oriented technology for product development”, International Journal of Industrial Ergonomics, 15, pp. 3-11.

Parasuraman, A. and Grewal, Dhruv, The impact of technology on the quality-value-loyalty chain: A research agenda, Academy of Marketing Science Journal, Greenvale, Winter, vol. 28, No. 1, 20.

Sweeney, J. C. and Soutar, G. N. (2001), “Consumer-Perceived Value: The Development of a Multiple Item Scale,” Journal of Retailing, 77(2), 203-220.

Tanoue, C., Ishizaka, K., Nagamachi, M. (1997), “Kansei Engineering: A study on perception of vehicle interior image ” , International Journal of Industrial Ergonomics Vol.19, pp.115-128.

Woodruff R. B. (1997), Customer value: The next source of competitive advantage. Journal of the Academy of Marketing Science, Vol. 25, No. 2, pp.139-153.

Zeithaml, V. A. (1998), Consumer perceptions of price, quality, and value: A Means-End Model and Synthesis of Evidence. Journal of Marketing, Vol.52, pp.2-22.

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