A Study on Oral Language Expressions and Communication Effects for Car Shape

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Abstract: The competition of car market is becoming more and more intense. Car's shape is an important factor for catching consumers' favor, and "how to collect consumers' opinions effectively to further the product development of cars" is an essential design topic. Structural investigations are used to do the works popularly, but they are difficult to present consumers' receptions completely. This paper tried to analyze opened nature languages into different types while people expressed shapes by they, and to compare using tend and recognition effect of people who have different shaping ability on various expressing types. The result could be referred on obtaining consumers' desire on product shapes using natural language. The car side shapes was chosen as an instance, and 8 typical samples were extracted from 120 original samples by Cluster analysis method. 500 participators were assigned into general and professional groups according to shaping ability, and performed Shape Expressing experiment and Shape Recognition experiment, and Language Analysis Method and χ^2 Test were adopted to analyze the data. As results, 5 expression types had been found out, they are: Local Feature, Whole Shape, Object Analogy, Group Classification and Sense Stating. "Local Feature" has the highest recognition rate (86.41%), and "Sense Stating" has the lowest (13.24%). Participators' expression tendencies were significant difference (χ^2=601.665, P<.01), General participators tend to indirect expression with specific concepts, and Professional participators tend to direct expression by shaped vocabulary. As a whole, Professional group's recognition ability was better than General group's, Object Analogy and Group Classification have well recognition effects to both 2 participator groups.

Key words: *Oral Expressing, Consumer-oriented design, Natural Language Processing, Kansei Engineering, Car Shape*

1. Introduction

Traditionally, product shapes tended to depend upon prevailing market trends or upon the individual designer's originality and creativity. The designers could never be guaranteed of the market success of a particular design, and the consumers were in the position of only being able to choose a preferred design from a restricted range of shapes, which generally did not totally match their desires anyway. This situation existed because the designers failed to fully incorporate the consumer's feelings and preferences for particular car shapes into the design process. A further major factor for the failure to satisfy consumer needs satisfactorily was the existence of a cognitive gap between the designer and consumer groups [1]. In recent years, following the trend of user-oriented design, consumers' opinion have become the guide for shape design gradually, such as Kansei Engineering, in Nagamachi's method, consumers' feeling was regard as engineering targets to inference product shape that could satisfied consumer's desire [2][3]. Neilson advocated the concept of "User Participation" should be entered into

design procedure to satisfy consumers' needs [4].

However, let consumer design the shape that they real like is the best way to satisfy their own desire. But general consumers aren't skilled to represent shape (such as drawing or molding), and they can't design by themselves. Even so, they still can express the shape that they want, ordinary people usually use oral language to express various shape concepts, this communication of shape not only simple but also advantage to use by ordinary people. Anyhow, though oral language has a lot of indeterminacy of cognitional difference [5], but it is very valuable to communication [6]. Some researchers had obtained results about the relationship between shape and oral language, for example Harada connected shape of car's front-view and various countenance and animal words successfully [7], Inoue built a system that could match words and shapes to help designers know the connection between consumers' wording and shape [8]. Development and research of oral language expression will obtain more applied values in product shape design. The purpose of this study is to know: How do people express car-shape with oral language? How many types do oral expression can be divided into? How are communication efficacies of various oral expression types? In addition, difference between consumers and designers on expression and recognition is an important point in this study.

2. Case Study: Analysis for Oral Language Expressing on Car Shape

The current investigation was separated into three distinct stages:

(1) Pre-experiment

Representative car profile samples were extracted from original samples for the two major experimental studies outlined below in Steps 2 and 3. This step included image processing, subjective grouping and cluster analysis.

(2) Oral Language Expression Experiment

The participants were invited to express their intuitive reactions to a series of car profiles by means of oral language. This step included a linguistic analysis of the sentence patterns and vocabulary items used by the participants in expressing their reactions, and adopted a cluster analysis technique to categorize the responses. This step also analyzed the differences between the responses given by the general participants and those given by their professional counterparts.

(3) Shape Recognition Experiment:

The participants were requested to identify the correct car profile sample when supplied with the corresponding oral description. This step included the analysis of the relative efficiency of each identified expression type, and explored the differences between the recognition ability characteristics of the two participant groups.

2.1 Pre-experiment

2.1.1 Subject Grouping

Firstly, 120 authentic car profile samples were collected from magazines. In order to avoid any potential influence, these samples were processed to form gray images of each car's profile (Fig.1). 30 Industrial Design students (15 male and 15 female) were invited to participate in a subjective grouping process, in which they were asked to browse the total sample of 120 images and to then group them by similar shape characteristics.

Fig. 1 Gray Image Processing of Car Profile Samples

2.1.2 Extraction of Typical Samples

The procedure adopted to extract typical samples may be summarized as follows:

a. The subjective grouping data were represented in a dissimilar distance matrix form.

b. Using Ward's Method [9], Hierarchical Cluster Analysis was performed to obtain a tree-shape grouping result with an optimum number of 8 groups.

c. Using the K-Means Method [10], Non-Hierarchical Cluster Analysis was employed to distribute the total sample of 120 car profiles amongst the 8 groups.

d. The center of each group was determined, and the sample which most closely resembled each group center was identified as a "typical sample". The 8 typical samples are presented in Fig. 2 below.

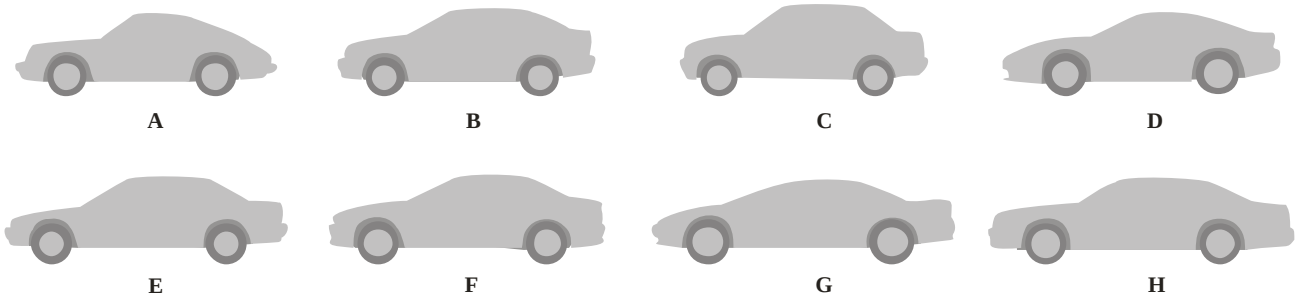

Fig. 2 Typical Car-Profile Samples

2.2 Participants in Experimental Studies

500 students were invited to participate in the current experimental study. They were divided evenly into two broad groups, namely a "professional group", containing only individuals from a design-related department who had completed a product shape design course, and a "general group", containing students from non-design-related departments. Each group contained 250 participants, who were then further divided into experimental units containing 50 individuals. Accordingly, the present study involved a total of ten experimental units.

2.3 Oral Language Expression Experiment

The purpose of this experiment was to obtain a series of oral language expressions describing car profiles. The experimental procedure is described as follows:

a. Each individual experiment involved a single experimental unit only. The experimental procedure was first described to all of the participants within that experimental unit.

b. Each participant looked at the 8 typical car profile samples for 1 minute.

c. Each participant chose one car profile sample at random and re-examined it. He or she then orally described that profile and their feelings about it in Chinese. Note that when expressing their feelings about the profile, the participants were requested to conform to the following guideline:

Guideline: "Please provide an intuitive oral description of the following car profile such that others will be able to *identify this profile based upon your descriptions"*

d. Step c) above was repeated for each of the 8 typical samples.

Steps a)-d) were repeated for each of the 10 experimental units.

2.4 Oral Language Expression Analysis

In order to determine the optimum means of expressing a car's profile, each oral description was analyzed in terms of its "Sentence Pattern" and "Vocabulary Items". Since the original expressions were supplied in Chinese, the services of Chinese language experts were engaged to analyze the linguistic structure of the supplied oral descriptions.

2.4.1 Sentence Pattern Analysis

Sentence Pattern Analysis enables the identification of the mechanisms employed in oral expressions of description and feelings. According to the grammar reference "Introduction to Chinese Grammar" [11], any Chinese sentence adheres to one of four basic patterns, namely "Narration", "Indication", "Judgment" or "Possession". Furthermore, as shown in Table 1, each of these patterns comprises two or more of the following sentence elements: "Subject", "Linking", and "Predicate".

2.4.2 Vocabulary Analysis

Three Chinese linguistics experts analyzed the expression sentences in order to determine the grammatical parts of speech most commonly used by the "expressers" within each of the structural elements of the four basic sentence patterns identified in Table 1. It was established that the Subject elements were usually a noun or a pronoun, and that the three types of Predicate element (i.e. object, representation or diagnosis) were generally a noun or an adjective. Regarding the three types of Linking element, the copulative form was usually a noun, while the determiner copulative form of the Judgment pattern was generally "is" or "isn't", and the determiner copulative of the Possession pattern was "have" or "non".

Table 1. Basic Chinese Sentence Pattern Structure

Sentence Pattern	Structure			Description
	Subject+	Linking+	Predicate	
Narration	Subject	Copulative	Object	P: To describe behavior or event. S: Noun, pronoun, ellipsis, the originator of behavior or event. C: Verb, represent the subject's action. O: 1.Noun, object of verb. 2.Ellipsis, if Linking was an intransitive verb.
Indication	Subject	--	Representation	P: To describe thing's property or situation. S: Noun, the object be described. R: Noun or adjective, contents of description.
Judgment	Subject	Determiner Copulative	Diagnosis	P: To explain thing's meaning or to judge things' dissimilarity. S: Noun, the object be explained or judged. DC: Limited to "is" or "not". D: Noun, adjective, contents of explanation or judgment.
Possession	Subject	Determiner Copulative	Object	P: To explain things' possession relation existing or not. S: Noun, the object be explained. DC: Limited to "have" or "non". O: Noun, adjective, the thing be had or not.

(P=Purpose, S=Subject, C=Copulative, R=Representation, DC=Determiner Copulative, D=Diagnosis, O=Object)

2.5 Shape Recognition Experiment

The purpose of this experiment was to explore the effectiveness of the "typical expression sentences". The experimental procedure may be summarized as follows:

a. The linguistics experts eliminated the repetitive or very similar sentences, and integrated the remaining expressions to form a series of "typical expression sentences".
b. 50 general participants and 50 professional were invited to take part in the recognition experiment.
c. The researchers outlined the experimental procedure and then asked each participant to look at the 8 typical car profile samples for one minute.
d. The researchers then read out a typical expression sentence and asked each participant to choose the corresponding profile from the 8 typical samples.
e. This procedure was repeated for each of the typical expression sentences.

3. Results Analysis

3.1 Results of Sentence Pattern Analysis

The oral expression experiment has total 4000 expressions, and obtained 3914 effective sentences (1973 from general group, 1941from professional group). Table 2 shows frequencies and percentages of 4 basic sentence patterns, Indication is 1648, Narration is 28.42%, Judgment is 16.56%, Possession is 11.68%, and 86 sentences couldn't be categorized. Table 3 shows the result of χ^2 test for participators' trends on sentence patterns, and the deference of 2 groups' tendencies were significant (χ^2=512.39, df=3, p<.01). The most deference appeared on Indication sentence (30.94%), and the least deference appeared on Possession Sentence (17.44%).

Table 2 Frequencies and percentage of sentence patterns

	Narration	Indication	Judgment	Possession	Total
Whole	1137 (28.42%)	1648 (41.19%)	662 (16.56%)	467 (11.68%)	3914 (100%)
General group	643 (32.59%)	528 (26.76%)	396 (20.07%)	406 (20.58%)	1973 (100%)
Professional group	494 (25.45%)	1120 (57.70%)	266 (13.70%)	61 (3.14%)	1941 (100%)
Difference between 2 groups	7.14%	30.94%	6.37%	17.44%	

Table 3 Test of participators' trends on sentence patterns

	N	Pearson Chi-Square	DF	Asymp. Sig. (2-sided)
Participator Group	3914	512.359	3	.000

3.2 Results of vocabulary analysis

Table 4 shows the result of vocabulary analysis, Subject has 2 obvious types of diction, the first type indicates "whole car" (68.43%), the second type indicates clear "some region of car" (30.65%), and it includes "noun of car part" (such as windscreen glass, front bumper) and "noun of personification region" (such as head, back). Linking has 4 obvious types, 43.25% of Linking is ellipsis (usage of Indication sentence), 16.56% of Linking are determiner copulative of Judgment sentence, 11.68% of Linking are determiner copulative of Possession sentence, and negative determiner copulatives had never occurred. 26.59% of Linking are verb, and they are almost "like". Predicate has 6 types: noun of car category, noun of concrete object, noun of abstract concept, adjective of shape, adjective of feeling, adjective of values.

Table 4 Result of vocabulary analysis

Attribute	Parts of speech	Category	(%)	Instance
Subject	Noun, Pronoun, Ellipsis	(1) Whole Car	68.43	The car, whole, this, it, etc.
	Noun	(2) Region of Car	30.65	1. Proper noun: Windscreen glass, Bumper 2. Personification noun: Head, Back
	--	(3) Other	0.92	--
Linking	--	(1) Non	43.52	--
	Determiner (Judgment)	(2) Judgment Relationship	16.56	Is
	Determiner (Possession)	(3) Possession Relationship	11.68	Has
	Verb	(4) Similar Relationship	26.59	Like
	--	(5) Other	2.77	--
Predicate	Noun	(1) Car category	13.97	Sport car, Passenger car
	Noun	(2) Concrete	19.62	Spaceship, Frog
	Noun	(3) Abstract Concept	14.81	Chairman, Youngster, 1980 Age
	Adjective	(4) Shape Adjective	39.55	Sharp, Round, Heavy
	Adjective	(5) Feeling Adjective	7.71	Lovely, Fleetingly, Stiff
	Adjective	(6) Values Adjective	3.75	Good, Bad, Expensive, Cheap
	--	(7) Other	0.58	--

3.3 Cluster Analysis of Expression Sentence

The procedure of analysis as below:

(a) Coding of expression sentence: Table 5 shows the attributes and levels of sentences, any expression sentence can be composed with S (1~2) + L (1~4) + P (1~6).

(b) Distance measure: According the coding, 12 variables (M1~2, L1~4, D1~6) could be obtained, and every expected value of variable were calculated (Table 6), Chi-Square Measure was adopted to measure the difference between 2 expression sentences (*X*, *Y*) with occurred frequency, the calculation as Eq.1。

$$Distance(X,Y) = \sqrt{\sum \frac{X_i - E_i}{E_i} + \sum \frac{Y_i - E_i}{E_i}} \quad \text{(Eq.1)}$$

where, X_i = frequency of *X* on variable *I*, Y_i = frequency of *Y* on variable *i,*, E_i = the expected value of variable *i*

(c) Cluster method: "K-means Cluster" was adopted to cluster all expression sentences. We compared 6 cluster situations (group number: 3, 4, 5, 6, 7, 8) and found out the optimum group number (5 groups, has maximum difference).

(d) Name for groups: we given 5 groups names according to their characteristics, they are: Local Feature, Object Analogy, Group Classification and Sense Stating (as Table 7).

Table 5 Coding of expression sentence

Attribute	Level					
	1	2	3	4	5	6
(S) Subject	Whole Car	Region of Car	--	--	--	--
(L) Linking	Non	Judgment Relationship	Possession Relationship	Similar Relationship	--	--
(P) Predicate	Car category	Concrete	Abstract Concept	Shape Adjective	Feeling Adjective	Values Adjective

Table 6 Expected value *(E)*

variable	M1	M2	L1	L2	L3	L4	D1	D2	D3	D4	D5	D6
expected value	2678	1200	1703	648	457	1041	547	768	580	1548	302	147

Table 7 Grouping result of expression sentence

Group	Typical Structure	Pattern	Example Sentence	Name of Group
1	S (2) + L (1) + P (4)	Indication	The rear very oblique (car A)	Local Feature
	S (2) + L (3) + P (4)	Possession	Bumper has a hollow (car D)	
2	S (1) + L (2) + P (3)	Judgment	It is a chairman car (car H)	Group Classification
	S (1) + L (2) + P (1)	Judgment	This is a sports car (car D)	
3	S (1) + L (1) + P (4)	Indication	Round (car C)	Whole Shape
	S (1) + L (2) + P (4)	Judgment	This is a flat car (car G)	
4	S (1) + L (2) + P (2)	Judgment	It is a spaceship (car G)	Object Analogy
	S (1) + L (4) + P (2)	Narration	It like a shoe (car A)	
5	S (1) + L (1) + P (5)	Indication	The car lovable (car C)	Sense Stating
	S (1) + L (1) + P (6)	Indication	The car cheap (car E)	

Table 8 shows frequencies and percentages of 5 expression types in oral expression experiment. On the whole, Local Feature was the commonest expression (30.18%), and Sense Stating has least utility rate (6.92%). According participators' group to arrange 5 expressions in order, the sequences as below:

general group: Group Classification > Object Analogy > Local Feature > Whole shape > Sense Stating

professional group: Local Feature > Whole shape > Group Classification > Object Analogy > Sense Stating.

In the general group, Group Classification and Object Analogy had higher utility rate than average (20%), they are idiomatic expressions to general participators. In other hand, Local Feature and Whole shape had higher utility rate than average in professional group, and professional participators tend to use them.

Table 8 Result of Oral Expression Experiment (frequency of occurrence)

Car-Shape Sample		Types of Expression					Total
		Local Feature	Group Classification	Whole Shape	Object Analogy	Sense Stating	
A 	G	32	76	28	89	16	241
	P	105	34	63	28	12	242
	st.	137	110	91	117	28	483
B 	G	34	93	37	61	22	247
	P	88	41	75	24	15	243
	st.	122	134	112	85	37	490
C 	G	43	94	28	63	20	248
	P	101	35	57	22	13	228
	st.	144	129	85	85	33	476
D 	G	46	110	27	48	18	249
	P	112	47	42	29	12	242
	st.	158	157	69	77	30	491
E 	G	44	112	30	41	23	250
	P	87	38	74	34	14	247
	st.	131	150	104	75	37	497
F 	G	71	67	36	53	21	248
	P	102	20	68	40	10	240
	st.	173	87	104	93	31	488
G 	G	60	49	32	82	23	246
	P	122	23	74	15	15	249
	st.	182	72	106	97	38	495
H 	G	30	80	29	82	23	244
	P	104	32	78	22	14	250
	st.	134	112	107	104	37	494
Total	G	360 (18.25%)	681 (34.52%)	247 (12.52%)	519 (26.31%)	166 (8.41%)	1973 (100%)
	F	821 (42.30%)	270 (13.91%)	531 (27.36%)	214 (11.03%)	105 (5.41%)	1941 (100%)
	T	1181 (30.18%)	952 (24.31%)	777 (19.85%)	733 (18.73%)	271 (6.92%)	3914 (100%)

(G= general group, P= professional group, T =total, st= subtotal)

3.4 Difference of expression Tendency between General and Professional Participators

Using shaping ability and car shape as the grouping variables, the Chi-square Test was employed to understand: "Did participators' expressing tendencies relate to their shaping ability and car shape?"

3.4.1 The relationship between shaping ability and tendency of expression types

The results are presented in Table 9, below. Overall, the Pearson Chi-Square value is given by χ^2=601.665 (df=4, p<.01), which indicates that there is a significant difference in the expression type selection tendencies of the two participant groups. Regarding each of the eight typical car shapes ((A~H), the results show: A: χ^2=100.769, B: χ^2 74.376, C: χ^2=80.803, D: χ^2=61.912, E: χ^2=72.064, F: χ^2=46.394, G: χ^2=95.099 and H: χ^2=120.626.These results are all statistically significant (df=4, p<.01), and therefore confirm that the shaping ability of an individual is an important factor in determining the choice of expression type when he or she wishes to express their feelings about a particular car shape.

Table 9 Results of Chi-square Test using "car shape" as grouping variable

Car shape	Shaping ability * Expression Types			
	N	Pearson Chi-Square	df	Asymp. Sig. (2-sided)
Whole	3914	601.665	4	.000
A	483	100.769	4	.000
B	490	74.376	4	.000
C	476	80.803	4	.000
D	491	61.912	4	.000
E	497	72.064	4	.000
F	488	46.394	4	.000
G	495	95.099	4	.000
H	494	120.626	4	.000

3.4.2 The relationship between car shape and tendency of expression types

Table 10 shows the results. Overall, the Pearson Chi-Square value is given by χ^2=105.178 (df=28, p<.01), which indicates that there is a significant difference in the expression type selection tendencies about the 8 car shapes. Regarding each of the 2 participator groups, the results show: General group: χ^2=108.474, the result is statistically significant (df=28, p<.01), and Professional group: χ^2=56.785, the result isn't statistically significant (df=28, p<.01). Therefore confirm that general participators' tendency of expression types were related to the car shape which they expressed, and professional participators' tendency of expression types were not related to car shape.

Table 10 Results of Chi-square Test using "shaping ability" as grouping variable

Shaping Ability	Car Shape * Expression Type			
	N	Pearson Chi-Square	df	Asymp. Sig. (2-sided)
Whole	3914	105.178	28	.000
General Group	1973	108.474	28	.000
Professional Group	1941	56.785	28	.012

3.5 Difference in Shape Recognition between General and Professional Participants

In the shape recognition experiment, 386 expression sentence samples categorized by 5 expression types, 50 general and 50 professional participants recognized and selected the associated one from the 8 car shapes according to every expression sentence sample individually, there is a total of 38600 recognition events. Table 11 presents the results of the shape recognition experiment. Overall, there are 24281 correct recognitions, the total Correct Recognition Rate (CRR) was 62.92%, Object Analogy had top CRR (86.41%), Sense Stating had least CRR (13.64%), professional group have higher (73.66%) CRR than General group (52.15%). According to CRRs arrange 5 expressions in order by individual group, the sequences as below:

general group: Object Analogy > Group Classification > Local Feature > Whole shape > Sense Stating

professional group: Object Analogy > Local Feature > Group Classification > Whole shape > Sense Stating.

Based on the total CRR (62.92%) as a criterion, general participators have better recognition ability on Object Analogy and Group Classification, professional participators have better recognition ability on Object Analogy, Local Feature and Group Classification.

Table 11 Frequency of Correct Recognitions and CRR

Shaping Ability	Expression Types					Total
	Local Feature 116*	Whole Shape 77*	Object Analogy 72*	Group Classification 94*	Sense Stating 27*	
Whole	7526 (64.88%)	3347 (43.47%)	6222 (86.41%)	6818 (72.53%)	368 (13.64%)	24281 (62.92%)
General	2507 (43.23%)	1145 (29.73%)	3025 (84.04%)	3226 (68.63%)	161 (11.95%)	10064 (52.15%)
Professional	5019 (86.53%)	2203 (57.21%)	3196 (88.78%)	3592 (76.43%)	207 (15.33%)	14217 (73.66%)

*number of expression sentence samples

Table 12 shows the results of the χ^2 Test between CRRs of 5 expression types. The overall result of χ^2=6354.442 is statistically significant (df=4, p<.01) and implies that Recognition effects of every expression type were different.

Table 12 Test of deference among CRRs of expression types

	N	Pearson Chi-Square	DF	Asymp. Sig. (2-sided)
Whole	38600	6354.442	4	.000

Table 13 shows the result of the χ^2 Test that using expression type as group variable, on the whole, the Pearson Chi-Square value is given by χ^2=1783.451, that is a significant difference (df=1, p<.01), which indicates participators' shaping ability relate to recognition ability. Regarding each of expression types, Local Feature (χ^2=2387.328), Whole shape (χ^2=591.545), Group Classification (χ^2=71.528) have significant difference (df=1, p<.01), and therefore confirm that participators' shaping ability relate to recognition ability on the 3 expression types. Object Analogy (χ^2=2.137) and Sense Stating (χ^2=1.582) have not significant difference (df=1, p<.01), and that means participators' shaping ability don't relate to recognition ability on the 2 expression types

Table 13 Test of recognition ability using "expression type" as grouping variable

Expression Type	N	Pearson Chi-Square	DF	Asymp. Sig. (2-sided)
Whole	38600	1783.451	1	.000
Local Feature	11600	2387.328	1	.000
Whole Shape	7700	591.545	1	.000
Object Analogy	7200	2.139	1	.144
Group Classification	9400	71.528	1	.000
Sense Stating	2700	1.582	1	.208

4. Discussion

Participators' expression language to express car shape is diversification

According to linguistics theory, people express their feeling for shape by oral language is a descriptive behavior of linguistics. So, it seems reasonable to use direct shape-described language. However, this study found 5 expressing types (Local Feature, Whole Shape, Object Analogy, Group Classification, Sense Stating) form experimental result, Object Analogy and Group Classification belong to indirect expressions that associate car shape by irrelevant objects or concepts, Local Feature and Whole Shape belong to direct expressions that present car shape by shape-described vocabularies, and Sense Stating belong to subject expressions that using abstract feelings or evaluations. This result represented that participator's expressing was diversified.

Shaping ability is related to participators' tendencies of expression type, general participators tend to adopt indirect expressions, and professional participators tend to adopt direct expressions.

Object Analogy and Group Classification were preferred by general participators, Local Feature and Whole Shape were preferred by professional participators, and both 2 participant groups have lower utility rate on Sense Stating. It confirmed that general consumers' expressing manners are different to designers'. General consumers are not skilled in direct expressions, so they analogize or associate shapes by means of medium (other objects or common concepts).

The expression type which general participators adopt was related to the car shape what they seen, participators' expression are not influenced relatively by shapes.

In the General group, frequencies of 5 expression types in different car shape are distinct different. However, the phenomenon was not obvious in Professional group. For example, General group's expression to describe D car shape focus on Group Classification (44.17%), the CRRs of Local Feature in Professional group were highest, without respect to car shape samples.

Different expression types have different efficacies of recognition, and indirect expression types better than direct expression types.

Differences of CRRs among 5 expression types have large intervals (SD=28.41%). Object Analogy and Group Classification have satisfying CRRs (86.41%, 72.53%), and they used common mediums that easy to associate shape for general participators. CCRs of Local Feature and Whole Shape were acceptable (64.88%, 43.47%), it resulted largely from they include many professional shape-described vocabularies that difficult to understand for general participators. Besides, Sense Stating had lower CRR (13.64%), subjectivity and abstraction

of Sense Stating may be the resulted in lower utility rate.

General participators have better recognition ability on Object Analogy and Group Classification, Professional participators have better recognition ability on Object Analogy, Local Feature and Group Classification.

On the whole, as a result of professional participators possess better sensitivity of shaping, so it is conform expectation that Professional participators' Recognition ability higher General participators'. However, there is interesting discussion: General group have well CRR in Object Analogy (84.04%), and less only 2.74% than Professional group's, in Group Classification General group's CRR was 68.63%, and less only 8.80% than Professional group's. The result presented that Object Analogy and Group Classification were easy to understand for General Participators.

5. Conclusion

On the trend of consumer-oriented design, understanding consumers' real desire is the most important work on product shape design, using NLP technique could support shape developer to obtain consumers' information that closest their original desire. This paper found 5 expressing types of participators' natural language that expressed car shape according to sentence structures and vocabularies, and found the deference between general and professional on expressing tend and recognition effects. General participators not only tend to "analogy" or "association" (Object Analogy, Group Classification) for expressing but also have well recognition on such, and they are simple and effective approach. Direct shape expressing types (Local Feature, Whole Shape) were not favorable ways to general participators, but they could connect thinking with visual information. Sense Stating expressed subject evaluation of car shape, and it had lower utility rate in shape communication. For product shape development, we propose that integrate the 5 expressing types into a hierarchical process to bring shape information of consumers' desire form their mind. For instance, in the first using Object Analogy and Group Classification to induce a roughly outline of consumers' desire, then apply Local Feature and Whole Shape to regulate detail of shape, finally consumers could use Sense Stating to estimate the satisfied degree for the shape. Through this natural investigation, the completeness of consumers' desire information will be ensure to reduce the probability of information misunderstand, and to develop more satisfied product shape foe consumers. In follow-up studied, based on this paper we will integrate Natural Language Processing and visual information to develop a translation method between consumers' desire and product shapes for supporting consumer-oriented design.

Reference

[1] Hsu SH, Chuang MC, Chang CC. A semantic differential study of designers' and users' Product form perception. International Journal of Industrial Ergonomics, 25, 375-391(2000).

[2] Nagamachi M. Kansei Engineering: Anew ergonomic consumer-oriented technology for product development. International Journal of Industrial Ergonomics, 15, 3-11(1995).

[3] Jindo T; Hirasago K; Nagamachi M. Development of a design support system for office chairs using 3-D graphics. International Journal of Industrial Ergonomics, 15, 49-62(1995).

[4] Nielson J. Usability Engineering. Academic Press, (1993)

[5] Nisbett RE, Wilson TD. Telling more than we can Know: Verbal reports o mental Processes. Psychological Review, 84(3), 231-259(1977).

[6] Ericsson KA, Simon HA. Verbal reports as data. Psychological Review, 87(3), 215-252(1980).

[7] Harada, Mori, “Analysis of Recognition of Car’s Front View Design” Bulletin of JSSD, Vol.45, No.2, pp79~86(1998)

[8] Inoue K, Mochizuki S, Futatugi Y, Tsuchiya M. A trial Study on Systematizing Shape Expression Terminology. Bulletin of JSSD. 48(3), 49~58(2001).

[9] Ward JE. Hierarchical Grouping to Optimize an Objective Function. Journal of American Statistical Assoc. 59 (March), 236-244(1963).

[10] Afifi AA, Virginia C. Computer-Aided Multivariate Analysis, Second ed. Chapman & Hall, 447(1990).

[11] Wen-Si-Jer press. Introduction to Chinese Grammar, Wen-Si-Jer press, Taipei, 20-45(1985)