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EFFECT OF INFORMATION ASSIMILATION ON PRODUCT EVALUATION

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Keywords: intuition, subjective preference, product evaluation

1. Introduction

"Design is a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole life cycles. Therefore, design is the central factor of innovative humanization of technologies and the crucial factor of cultural and economic exchange. Design seeks to discover and assess structural, organizational, functional, expressive, and economic relationships [International Council of Societis of Industrial Design]." In other words, design is comprehensive creative activity between individual and the surrounding factors. One of the curious aspects of design of product is how designers know 'the product is well designed' in multi-faceted qualities of object. Why do individuals want to choose 'the product'? This question has fascinated researchers in design field, and continues to motivate them today. This study addressed one of evaluative factors in individuals; preference. Preference has been addressed as an important theme in design whereas preference mechanism has not been well explained. This study shows preference mechanism in product evaluation using automotive image by an approach considering *Subjective Preference (like-dislike)* thereby answering of the question with experimental procedure. The reason why automotive images were used as stimuli in the experiments due to the complexity of partial attributes, such as body, headlights, fender, radiator grille, wheels, bumper, and so on. These various attributes can offer natural reconciled-stimuli, even though they are partial changes.

2. Method

The experiment of the present study aims to investigate if information assimilation affects product evaluation. The authors hypothesized that user's preferences of product are influenced by (1) attributes of product, and (2) the assimilability of information.

The authors hypothesized that *Subjective Preference* affects user's preference of product. It is reasonable to assume that stimuli that consist of subjectively preferred parts to be evaluated affirmatively. On the contrary, it assumed that stimuli that consist of subjectively non-preferred parts to be evaluated negatively. Then, what about a stimulus involves both parts came from a subjectively preferred product image and a subjectively non-preferred product image [Figure 1]? The stimulus will be evaluated affirmatively? Or negatively? Difference from a car image consist of completely like or dislike attribute, what if a car-front-face image consists of preferred car body and non-preferred headlights? What if a car-front-face image consists of non-preferred car body and preferred headlights? It is the first scope of this study.

Then, the consequences will be expected in any situation, e.g. non-separated image and separated image in two? Non-separated image which stands for a piece of product image is named *Uninominal Reality Sets*, and separated-image which stands for two pieces of product image is named *Binominal Reality Sets* in this study [Figure 2]. Comparison of the results between *Uninominal Reality Sets* and *Binominal Reality Sets* shows that if Reality Sets make a difference in product evaluation.

Factor 1	Factor 2	Factor 1&2	Expected result
Like	Like	L+L	Affirmative
Like	Dislike	L+D	?
Dislike	Dislike	D+D	Negative

Figure 1. The scope of the present study (1)

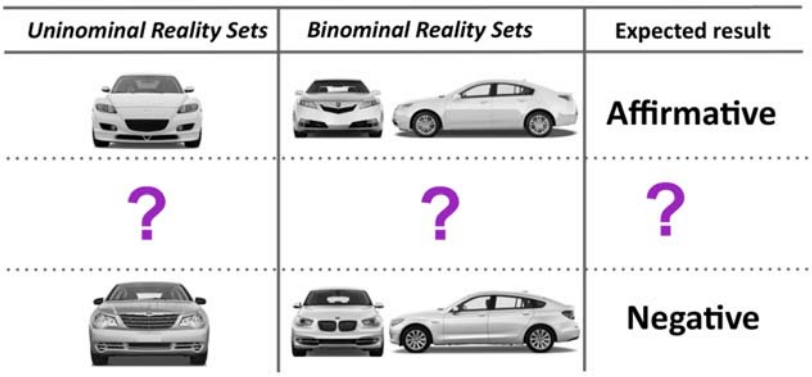


Figure 2. The scope of the present study (2)

Furthermore, this study addressed if various aspects and lightness of products influence product evaluation [Figure 3]. To investigate if various aspects influence product evaluation, not only car-front-face images but also car-side images were used as stimuli. To investigate if lightness of products (i.e. white-black) influence product evaluation, car-multi-aspect images applied to the experiment. Different to other stimuli, car-multi-aspect images in white/black.

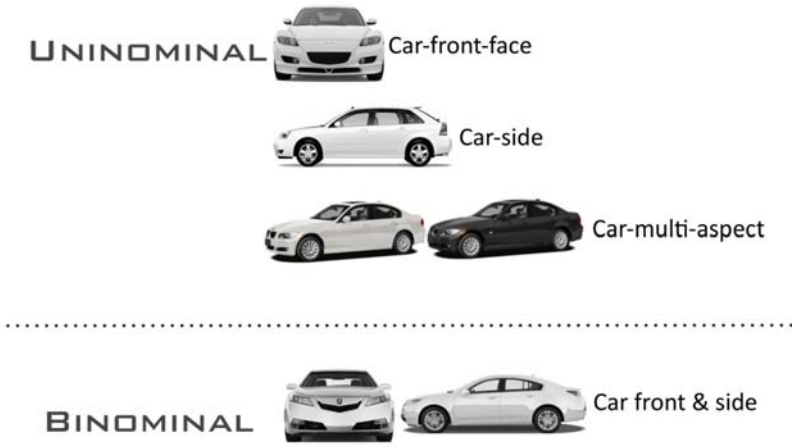


Figure 3. The types of used stimuli

2.1 Subjects

Thirty university students (15 females) participated in this experiment. No subjects have taken part in any kind of similar experiment before. None of them majored in design.

2.2 Evaluation values in semantic differential method: preference, aesthetic and pleasure

The three very intuitive product evaluation values (i.e. aesthetic, preference, and pleasure) applied to the experiment: one is the preference, which indicates whether images are directly related to

preference or not. The other is aesthetic, indicating whether the design attributes of an image are well balanced or not, and other is pleasure, which indicates whether images evoked good or bad feelings.

2.3 Item screening

As aforementioned in advance with Figure 3, stimuli in gray were used in the experiment to prevent color effects except car-multi-aspect images. Since the purpose of the car front and side multi-aspects stimulus was to investigate if lightness affect product evaluation. For the car front and side multi-aspect stimulus, black and white in same designed automotive images were used. The subjects, who will participate in the experiment, conducted pre-task (item screening) one week before the experiment. Pre-task was conducted to prepare experimental stimuli. In pre-task, four groups of images were used as stimuli, and there was no same photo among the stimuli groups.

- Seventy car-front-face images as *Uninominal Reality Sets* that stands for **F**
- Seventy car-side images as *Uninominal Reality Sets* that stands for **S**
- Seventy car front and side multi-aspects images as *Uninominal Reality Sets* that stands for **FS**. This stimulus was prepared to investigate if brightness of stimulus affects product evaluation.
- Seventy front & side combination images as *Binominal Reality Sets* that stands for **F&S**. This stimulus was prepared to investigate if stimulus's separation affects product evaluation.

In the pre-task, subjects separated stimuli 'Like' and 'Dislike' around half and half [Figure 4]. After that, they selected both twenty-five 'Like' images among 'Like' group and twenty-five 'Dislike' images among 'Dislike' group. Then, arranged each twenty-five 'Like and Dislike' images from the most to least. Through the process, twenty-five from 'the most Like' to 'least Like' preferred images and twenty-five form 'the most Dislike' to 'least Dislike' images were prepared per subject.

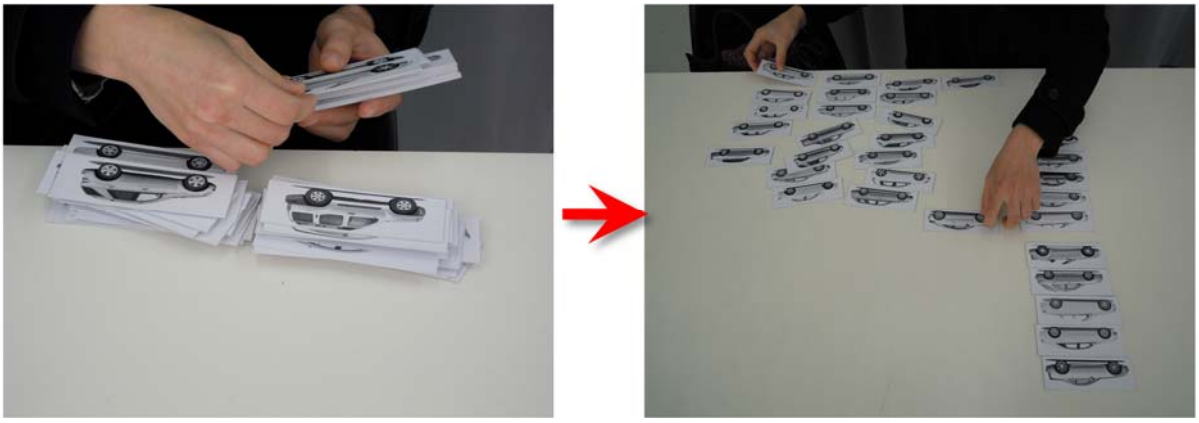


Figure 4. Item screening process

2.4 Generating stimuli

Using the selected twenty-five images reflecting their *Subjective Preference (like-dislike)* per subject, stimuli were reconciliated by logics as follows.

2.4.1 Uninominal stimulusgenerating by car-front-face, car-side images

(1) With car-front-face images, the headlights were separated from car-front-face images. The bodies and headlights were prepared [Figure 5]. Then, headlights were combined with bodies into new stimuli: **LL** (a stimulus consists of preferred car body and preferred car headlights), **LD** (a stimulus consists of preferred car body and non-preferred car headlights), **DL** (a stimulus consists of non-preferred car body and preferred car headlights), and **DD** (a stimulus consists of non-preferred car body and non-preferred car headlights) stimuli were generated. Totally, forty-eight car-front-face stimuli were parepared per subject.

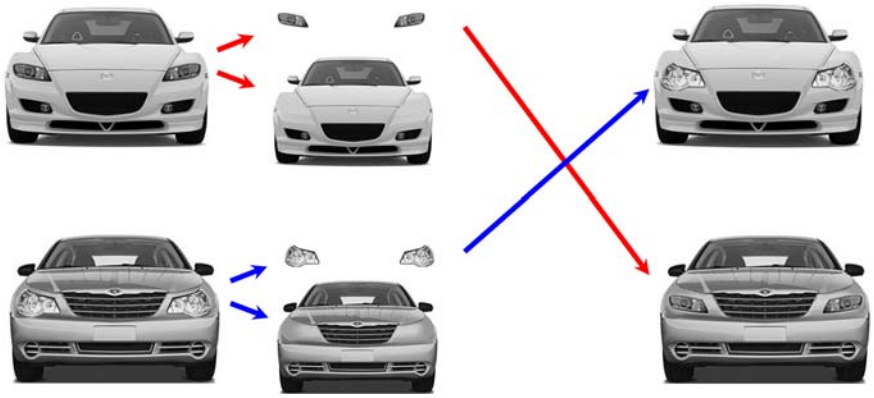


Figure 5. Stimuli reconciliation process in car-front-face

(2) With car side images the wheel was separated from car side images. The bodies and wheel was prepared [Figure 6]. Then, wheel was combined with bodies into new stimuli: **LL** (a stimulus consists of preferred car-front-face and preferred car side), **LD** (a stimulus consists of preferred car-front-face and non-preferred car side), **DL** (a stimulus consists of non-preferred car-front-face and preferred car side), and **LL** (a stimulus consists of non-preferred car-front-face and non-preferred car side) stimuli were generated. Totally, forty-eight car side stimuli were parepared per subject.

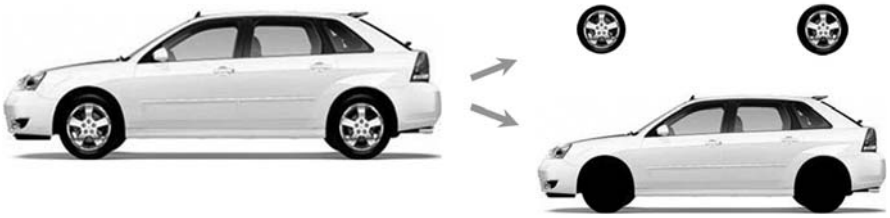


Figure 6. Attributes which applied to stimuli reconciliation process in car-side

2.4.2 Uninominal stimulus producing by car front and side multi-aspects images

With car fron and side multi-aspects images, the headlights & wheel were separated from car front and side multi-aspects images. The bodies, and headlight and wheel were prepared [Figure 7]. Then, headlights and wheel were combined with bodies into new stimuli. In the car front and side multi-aspects view: **LL** (a stimulus consists of preferred car body and preferred car headlights & wheels), **LD** (a stimulus consists of preferred car body and non-preferred car headlights & wheels), **DL** (a stimulus consists of non-preferred car body and preferred car headlights & wheels), and **DD** (a stimulus consists of non-preferred car body and non-preferred car headlights & wheels) stimuli were generated. Totally, forty-eight multi-aspects stimuli were parepared per subject.

Figure 7. Attributes which applied to stimuli reconciliation process in car multi-aspect

2.4.3 Binominal stimulus producing by car-front-face and side combination images

With car front and side pair images, the sides were separated from selected car-front-face & side combination images. The car-front-face and car side were prepared [Figure 8]. Then, car-front-face

was combined with bodies into new stimuli. In the car-front-face and side combination image: **LL** (a stimulus consists of preferred car-front-face and preferred car side), **LD** (a stimulus consists of preferred car-front-face and non-preferred car side), **DL** (a stimulus consists of non-preferred car-front-face and preferred car side), and **DD** (a stimulus consists of non-preferred car-front-face and non-preferred car side) stimuli were generated. Totally, forty-eight car front & side combination stimuli were parepared per subject.

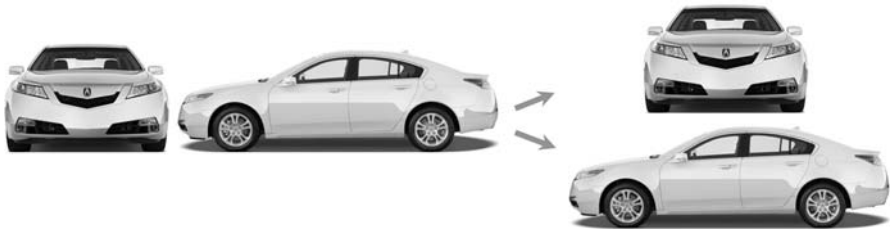


Figure 8. Attributes which applied to stimuli reconciliation process in binominal stimuli

2.5 Evaluation

Each forty-eight car-front-face (**F**), car side (**S**), front and side multi-aspects (**FS**), and front and side combination (**F&S**) were used as stimuli in four consequtive sessions. This study was on the influence of information assimiliation per user and therefore used stimuli were prepared per subject reflecting one's *Subjective Preference (like-dislike)*. In other words, all subjects evaluated stimuli reflecting their own *Subjective Preference (like-dislike)*, and all stimuli were prepared only for 'the subject.' The subjects were informed general instructions including the way of evaluation in the experiment. They evaluated on three evaluation values, i.e. preference, aesthetic, and pleasure with nine scales from strongly disagree to strongly agree [Figure 9]. "Don't know" was explained as neutral. In each evaluation explained as follows: I like this car (Preference); The connection of design attributes of this car is good (Aesthetic); I feel happiness while I saw this car (Pleasure).

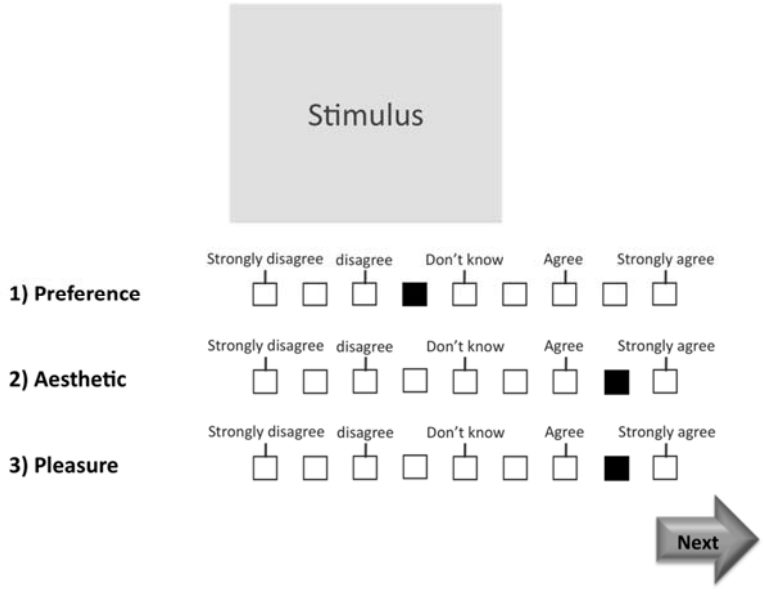


Figure 9. Product evaluation

3. Analysis & result

A 2×2 (*Subjective Preference* in car body × *Subjective Preference* in car headlights, wheels, or headlights & wheels; *Subjective Preference* in car-front-face × *Subjective Preference* in car side) two-way mixed-design analysis of variance (ANOVA) performed to investigate if *Subjective Preference* was related to product evaluation. Figure 10 shows the factors of each stimuli types.

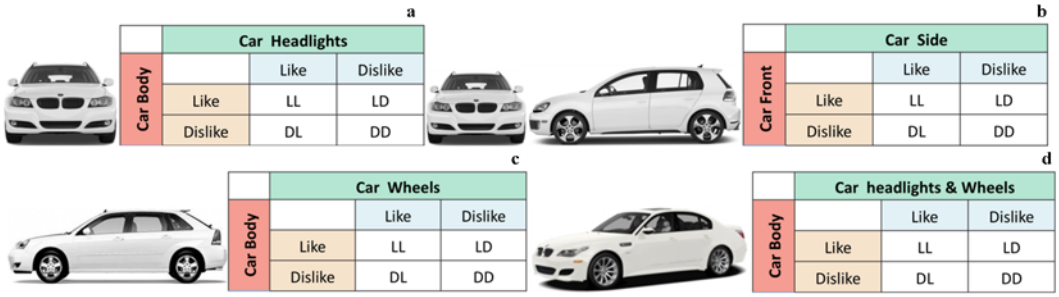


Figure 10. Factors of car-front-face (a), car front & side (b), car-side (c), and car-multi-aspect (d)

3.1 Result & consideration in uninominal reality sets

There was no significant interaction effect in *Uninominal Reality Sets*.

(1) Car-front-face: There was no significant interaction effect in *Uninominal Reality Sets*. All evaluation values showed significant main effects in car-front-face images [Table 1].

Table 1. Evaluation values showed significant main effects in car-front-face images

	Car body	Car headlights	Body × headlights
Aesthetic	p < .0001	p = .004	p = .7633
Pleasure	p < .0001	p = .0004	p = 1.0000
Preference	s	s	n.s

The graph in Figure 11 shows that aesthetic and pleasure were evaluated as affirmatively when the stimuli consisted of a car body that came from subjective preferred image. Moreover, it shows a significant main effect in *Uninominal Reality Sets*. LL and LD showed similar tendency in the product evaluation, affirmative whereas DL and DD showed similar tendency in the product evaluation negatively.

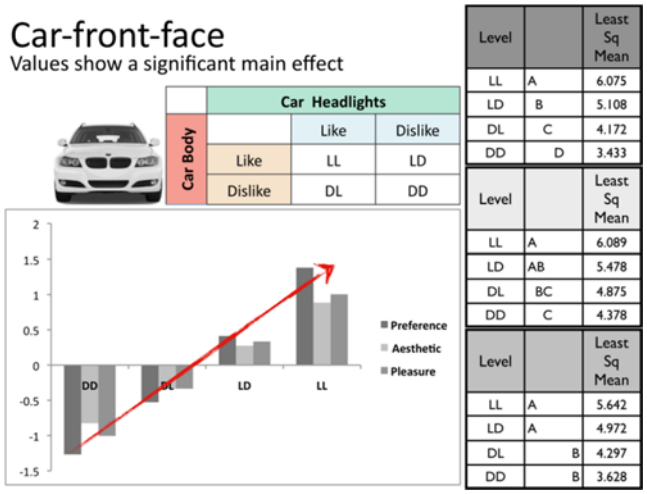


Figure 11. Values show a significant effect

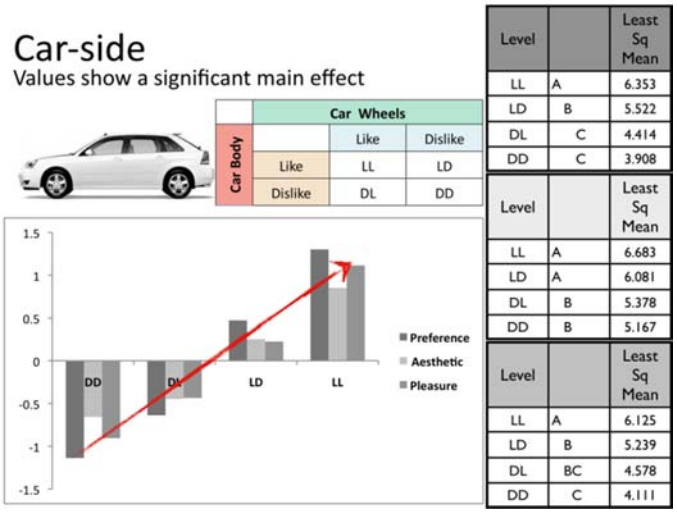
(2) Car-side: All evaluation values showed significant main effects in car-side images [Table 2].

Table 2. Evaluation values showed significant main effects in car-side images

	Car body	Car wheels	Body × wheels
Aesthetic	p < .0001	p = .0289	P = .2893
Pleasure	p < .0001	p = .0011	P = .3002
Preference	s	s	n.s

The graph in Figure 12 shows that aesthetic and pleasure were evaluated as affirmative when the stimuli consisted of a car body that came from subjective preferred image. Moreover, it shows a

significant main effect in *Uninominal Reality Sets*. LL and LD showed similar tendency in the product evaluation, affirmative whereas DL and DD were showed similar tendency in the product evaluation negatively.



Level		Least Sq Mean
LL	A	6.353
LD	B	5.522
DL	C	4.414
DD	C	3.908

Level		Least Sq Mean
LL	A	6.683
LD	A	6.081
DL	B	5.378
DD	B	5.167

Level		Least Sq Mean
LL	A	6.125
LD	B	5.239
DL	BC	4.578
DD	C	4.111

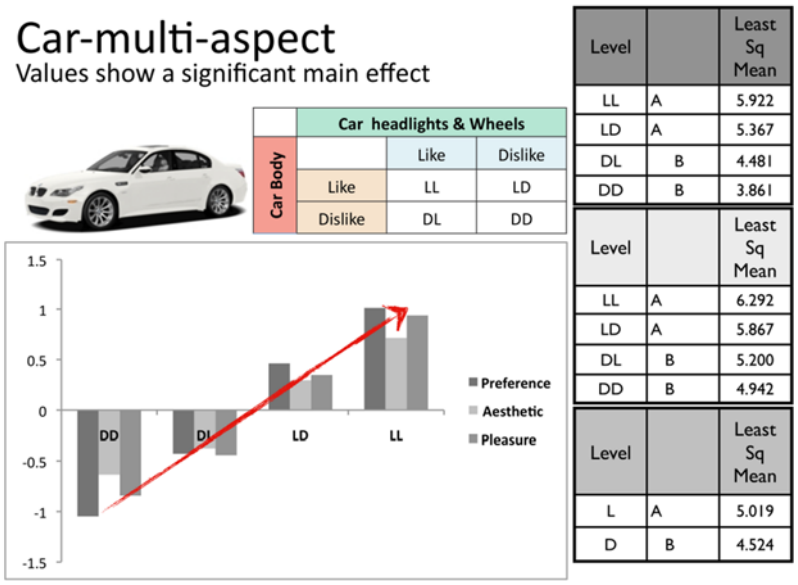
Figure 12. Values show a significant effect

(3) Car-multi-aspect: All evaluation values showed significant main effects in car-multi-aspect images [Table 3].

Table 3. Evaluation values showed significant main effects in car-multi-aspect images

	Car body	Headlights & wheels	Body × headlights & wheels
Aesthetic	p < .0001	p = .0564	p = .6392
Pleasure	p < .0001	p = .0203	p = .6595
Preference	s	s	n.s

The graph in Figure 13 shows that aesthetic and pleasure were evaluated as affirmative when the stimuli consisted of a car body that came from subjective preferred image. Moreover, it shows the values shoed a significant main effect in *Uninominal Reality Sets*. LL and LD showed similar tendency in the product evaluation, affirmative whereas DL and DD showed similar tendency in the product evaluation negatively.



Level		Least Sq Mean
LL	A	5.922
LD	A	5.367
DL	B	4.481
DD	B	3.861

Level		Least Sq Mean
LL	A	6.292
LD	A	5.867
DL	B	5.200
DD	B	4.942

Level		Least Sq Mean
L	A	5.019
D	B	4.524

Figure 13. Values show a significant effect

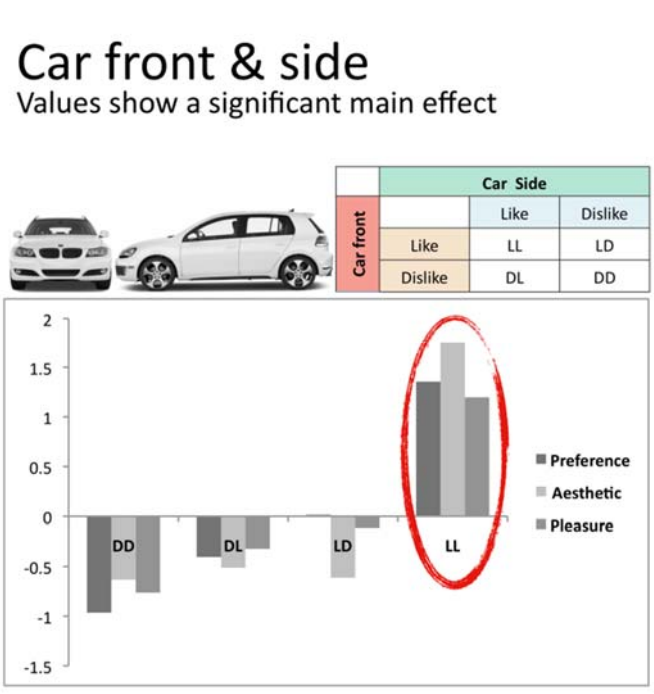
3.2 Result & consideration in binominal reality sets

All evaluation values showed significant main effects. Preference, and aesthetic values showed significant interaction effects in *Binominal Reality Sets* in car front & side images [Table 4].

Table 4. Evaluation values showed significant main effects in car-multi-aspect images

	Car front	Car side	Front × car side
Aesthetic	P = .0013	P = .0002	P = .0018
Pleasure	P < .0001	P < .0001	P = .0526
Preference	s	s	n.s

The graph is mean rating of standard deviations of preference [Figure 14]. The graph shows that preference was evaluated as negative when the stimuli consisted of a factor which came from non-preferred image whether it was car front or side.



Level		Least Sq Mean
LL	A	6.086
LD	B	4.750
DL	BC	4.325
DD	C	3.769

Level		Least Sq Mean
LL	A	5.972
LD	B	4.697
DL	B	4.600
DD	B	4.581

Level		Least Sq Mean
LL	A	5.917
LD	B	4.606
DL	BC	4.400
DD	C	3.861

Figure 14. Values show a significant effect

4. Discussion & conclusion

In *Uninominal Reality Sets*, the results showed the correlation between *Subjective Preference* in factors (car body, headlights, or wheels…), and preference in reconciliated images: combinations of non-preferred car body and non-preferred car headlights were evaluated as non-preferred in product evaluation. Combinations of non-preferred car body and preferred car headlights were evaluated as more preferred. Combinations of preferred car body and non-preferred car headlights were evaluated as further more preferred. Combinations of preferred car body and preferred car headlights were evaluated as most preferred [Table 5]. Furthermore, similar correlations between the attributes of factors and reconciliated images found in aesthetic and pleasure as the same as preference. Contrary, there was no correlation in *Binominal Reality Sets*: combinations of non-preferred car-front and non-preferred car-side were evaluated as non-preferred in product evaluation. However, combinations of non-preferred car-front and preferred car-side were evaluated as non-preferred. Combinations of preferred car-front and non-preferred car-side were also evaluated as non-preferred. Only the combinations of preferred car-front and preferred car-side were evaluated as preferred [Table 6]. Furthermore, similar correlations between the attributes of factors and reconciliated images found in aesthetic and pleasure as the same as preference.

Table 5. Correlation between the attributes of factors and reconciliated images in the evaluation values in *Uninominal Reality Sets*

Uninominal Reality Sets			
Factors of images reflecting ***Subjective Preference***			Results of product evaluation
Factor 1 (body)		**Factor 2 (headlights, wheels, headlights & wheels)**	**Combination of factor 1 & 2**
Preferred	?	Preferred	**Most** preferred (balanced, pleasant)
Preferred	?	**Non**-preferred	**Further more** preferred (balanced, pleasant) than non-preferred body and preferred headlights
Non-preferred	?	Preferred	**More** preferred (balanced, pleasant) than a combination of non-preferred body and headlights
Non-preferred	?	**Non**-preferred	**Non**-preferred (balanced, pleasant)

It assumed that there is a relationship between the attributes of factors and reconciliated images by *Reality Sets*. According to the relationship between *Subjective Preference* of factors and reconciliated images in *Uninominal Reality Sets*, preferred factors influence the reconciliated images linearly; if conciliated images involve preferred factor, it was evaluated preferred (balanced, pleasant) [Table 5]. On the other hand, in *Binominal Reality Sets*, preferred factors influence reconciliated images if it consists of preferred factors only; if the reconciliated images involve non-preferred factor, it was evaluated only non-preferred (unbalanced, unpleasant) [Table 6]. Although subjects were asked to assimilate the separated-image as one, they could not: The separated-image could not be integrated as one whole, thereby evaluating as isolated wholes. This finding shows the consequence of assimilation of factors of image as one whole in product evaluation: To be evaluated as more preferred (balanced, pleasant), factors of image should be assimilated as one whole. Considering the difference between one image and separated images, separate images are considered as separated wholes. Although separate d images come from one object, the separation isolates the evaluation boundary within one image. In other words, there was a correlation between the attributes of factors and the results of combined factors in product evaluation in *Uninominal Reality Sets*. On the other hand, there was not a correlation between the attributes of factors and the results of combined factors in *Binominal Reality Sets*. This relationship is found in not only car body and car headlight but also car body and car wheels; car body and car headlight & wheels. Then, why *Subjective Preference* is related to product evaluation differently by the *Reality Sets*? It can be assumed that while partial factors of reconciliated images influence product evaluation according to the sum of *Subjective Preference* in *Uninominal Reality Sets*, partial factors of reconciliated images do not influence product evaluation according to the sum of *Subjective Preference* in *Binominal Reality Sets*. In *Binominal Reality Sets*, partial factors influence product evaluation independently. As the results, while partial factors influence product evaluation in *Uninominal Reality Sets* as the author hypothesized, partial factors do not influence product evaluation according to the sum of *Subjective Preference* in *Binominal Reality Sets*.

As further study, it will be needed to increase the samples. To generalize the findings, it can not say that 30 subjects enough for the verification process. Additional investigation also will be needed to prove if other designed-object images show the same consequence as the findings. It can lead the designers to understand what users appreciate in product in various *Reality Sets*: (1) *Subjective Preference* is related to product evaluation independently in *Uninominal Reality Sets* whereas *Subjective Preference* is related to product evaluation dependently in *Binominal Reality Sets*, (2) partial preferred images influence product evaluation in *Uninominal Reality Sets* whereas *Binominal Reality Sets* did not influence it.

Table 6. Correlation between the attributes of factors and reconciliated images in the evaluation values in *Binominal Reality Sets*

Binominal Reality Sets			
Factors of images reflecting ***Subjective Preference***			Results of product evaluation
Factor 1 (front)		**Factor 2 (side)**	**Combination of factor 1 & 2**
Preferred	**?**	Preferred	Preferred (balanced, pleasant)
Preferred	**?**	**Non**-preferred	Non-preferred (balanced, pleasant)
Non-preferred	**?**	Preferred	Non-preferred (balanced, pleasant)
Non-preferred	**?**	**Non**-preferred	**Non**-preferred (balanced, pleasant)

References

Definition of Design, http://www.icsid.org/about/about/articles31.

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