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The Multidimensionality of Design Newness: An Empirical Survey of Product Appearance and Preference

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Abstract:

In this study, we examined the relationship between perceptual images and consumer preferences in product appearance. Specifically, we focused on the image of “design newness” and its multidimensionality. Previous studies have proposed that there is positive relationship between design newness and product performance measures such as sales. In other words, consumers prefer products that they perceive as “new.” However, there are some attributes or constructs of newness, for example, “novelty,” “originality,” “uniqueness,” and “atypical.” Previous studies rarely examine the differences in these newness attributes. Therefore, in this study, we compared these newness constructs and examined their relationships to performance measures. We surveyed consumers using a questionnaire in which hypothetical product pictures were offered as visual stimuli to represent each of the four newness attributes listed above, as well as product preferences. From the data analysis, we found that there were substantial differences among these four attributes. Since the correlations among these attributes were not high, we could not adopt them as measurements of a single “newness” construct. We observed the multidimensionality in the “design newness” image. Moreover, from the statistical analysis used to explain product preference using product images, we determined that each newness attribute had a different effect. For example, “novelty” positively affects preference, while the “uniqueness” has a negative effect. Our findings implied that we should recognize the multidimensionality of “design newness” images. Although previous studies supported the relationship between newness and performance, we determined that not all of the newness images positively affected consumers’ evaluations. Companies should carefully design the product to be “novel” rather than “unique.”

Key words: innovation, design innovation, design newness, differentiation strategy

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1. Introduction

Product design has a substantial impact on consumer choice and company performance. In the recent years, many studies have focused on this issue and presented various findings (e.g., Gemser and Leenders, 2001; Hertenstein, Platt, and Veryzer, 2005; Verganti, 2009; Utterback et al. 2006). In particular, many studies suggested that product design affects consumers' perception (Bloch, 1995; Veryser, 1999). Talke (2009) proposed elements of "design newness" from previous studies. According to the study, there are four elements of newness including originality, novelty, uniqueness, and atypically. In addition, design newness positively affects product sales. Subsequent studies supported the relationship (Radford and Bloch, 2011; Truong et al., 2013).

However, according to the results of this study, the design newness construct consists of more than two sub-constructs. Furthermore, from the results of the statistical analysis, some elements have a negative impact on product preference. "Novelty" encouraged consumer preference, while the impact of "originality," "uniqueness," and "atypically" did not have a positive effect. "Uniqueness" especially had a negative impact on preference. We also found that the "novelty" was related to technical images and positively evaluated by many consumers. On the other hand, "unique" products were not always preferred by consumers. We noted that companies and researchers should consider the differences between each "newness" image attribute.

In this paper, we will first review the studies examining the relationship between product appearance and consumer evaluation. Additionally, we will present previous studies related to the elements of the design newness and the impact on outcomes. Based on this discussion, we will introduce the hypotheses for this study, followed by the survey research designs and empirical results. Finally, we will discuss the results attained and propose future topics.

2. Previous Studies on Design Newness

Many existing studies focused on the effect of the product appearance on the consumer evaluations. These studies pointed to the relationship between the product appearance and consumption (e.g., Folkes and Matta, 2004) and brand images (e.g., Orth and Malkewitz, 2008; van Rompay and Pruyn, 2011). In addition, product appearance positively affects consumers' brand choice (e.g., Yamamoto and Lambart, 1994).

Based on these findings, recent studies have focused on "design newness" as a factor affecting consumer evaluations. Talke et al. (2009) proposed a construct of "design newness" from an empirical survey on the German vehicle market. Talke et al. (2009) also presented the attributes (or sub-constructs) of the "design newness" constructs from previous studies: "originality," "novelty," "uniqueness," and "atypically." The construct "originality" was proposed by Runco and Charles (1993) as it corresponded to the inverse construct of "appropriateness." This study discussed how "originality" affects the creativity. The "novelty" construct is proposed by Hekkert, Snelders, and van Wieringen (2003) with its corresponding inverse construct "typicality."

The “uniqueness” construct is discussed by Bloch (1995) as a construct of the source of differentiation. Loken and Ward (1990) examined the nature of “typically,” and found that correlated with family resemblance and attribute structure.

As Talke et al. (2009) supported the hypothesis that design newness positively affects sales, other related findings were reported in consequent studies. These results implied that the design newness has a positive impact on consumer behaviors and company performance (Radford and Bloch, 2011; Truong et al., 2013). Based on these studies, we expected that the “new” design would produce positive outcomes for companies. However, some studies doubt this *seemingly* general conclusion. For example, “typical” products are sometimes preferred by consumers (Veryzer and Hutchinson, 1998; Ward and Loken, 1988; Landwehr, Wentzel, and Herrmann 2013). Consumers may evaluate a product’s “new” design, while preferring a product that is similar to existing, ordinary products.

Moreover, consumers gather many impressions of a product’s appearance aside from its newness, including perceiving a product as “high tech” and “user friendly” (Hoegg and Alba, 2003; Creusen, and Schoormans, 2005; Muggie and Schoormans, 2011, 2012). These other images also affect consumer preferences. Therefore, we have to examine the interrelationships between design newness and other perceptual images. Table 1 lists the product images focused on in this study and related studies.

To summarize, in this study we propose the following two hypotheses. In the next section, we will explain the research design and show the empirical results.

H1: The “design newness” construct consists of four attributes: “novelty,” “originality,” “uniqueness,” and “atypical.”

H2: Design newness positively affects consumer preferences.

Table 1. Product Images

	Items	Related Studies
Design Newness	Novel	Hekkert, Snelders, and van Wieringen (2003), Heng and Cheng (2012), Talke et al. (2009)
	Original	Runco and Charles (1993), Talke et al (2009)
	Unique	Bloch (1995), Heng and Cheng (2012) ⁴ , Talke, et al. (2009)
	Atypical	Ward and Loken (1988), Loken and Ward (1990), Talke et al. (2009)
Other Design Images	High Technology	Creusen and Schoormans (2005), Muggie and Schoormans (2011)
	Fits the image of the product	Landwehr et al. (2013), Ward and Loken (1988), Loken and Ward (1990)
	User friendly	Creusen and Schoormans (2005), Muggie and Schoormans (2011)

⁴ Adopt the item “uniqueness” as a measurement item of the “novel.”

3. Research Design

3.1. Objective Products

The purpose of this study is to examine the impact of the perceptual design image on preference. To uncover this relationship, we conducted our research by surveying consumers through a questionnaire. In this section, we will present the survey design and items.

We chose the smartphone as our objective product for two reasons. The first reason is the high adoption rate in the market. According to the *Ministry of Internal Affairs and Communications* (2013), the adoption rate of the mobile terminal (including ordinary mobile phones and smartphones) is close to 100% in Japan. While the overall adoption rate of the smartphone is roughly 60%, recent survey reports indicate that nearly 90% of younger people have smartphones (Hakuhodo Inc. 2014). Therefore, we are able to obtain enough samples from the survey research. The second reason is related to the product lifecycle. As the adoption rate increases, smartphone technologies are rapidly maturing. Therefore, in the recent market, consumers rarely evaluate the functional aspects of the alternatives. Thus, they tend to choose smartphones based on appearance. As noted by Eisenman (2013) and Walsh (1996), we expect that the importance of the product design will increase as the product matures. In fact, according to the *Impress R & D Internet media sogo kenkyujo* (2013), when a consumer chooses a new mobile phone, 44.3% of them consider the design appearance. This is the second highest of 34 criteria, with battery efficiency (52.6%) being first. Smartphones are feasible objects for observing preference based on appearance. In the questionnaire, we prepared four types of hypothetical smartphones as visual stimulus to elicit preferences and images.

3.2. Visual Stimulus

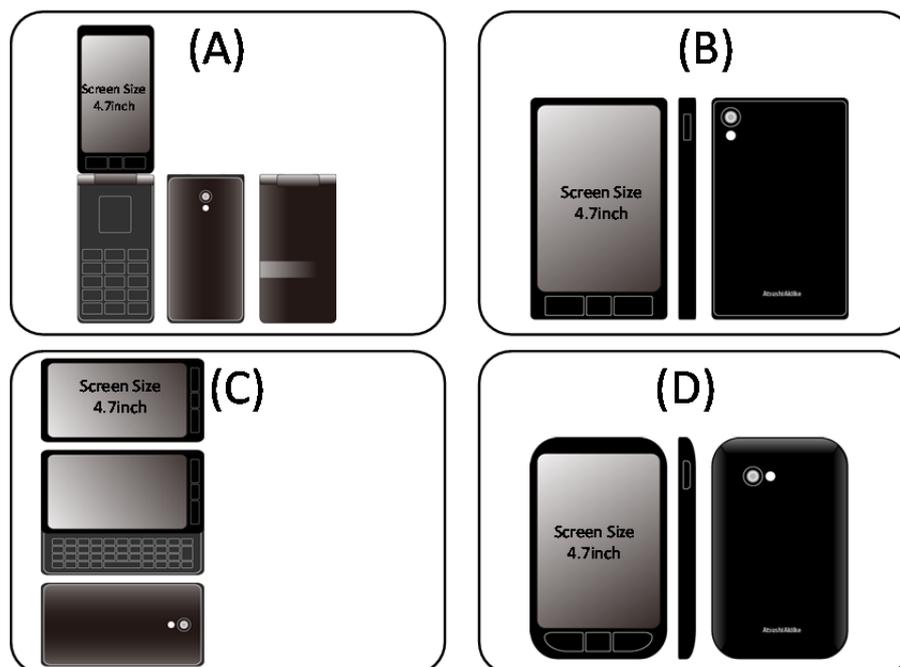
Many previous studies used a pictorial example as visual stimulus of the product to gather preferences or other perceptual images (Orth and Malkewitz, 2008; Randwehr et al. 2013). Based on these studies, we asked respondents to share their impressions on the products presented as visual stimuli. However, attaining measurements through visual stimuli had its shortcomings. Our purpose was to extract general tendencies in the relationship between preferences and perceptual images. Evaluations and perceptions based on appearances often varied among consumers. Some consumers evaluated a product design as “smart,” while other consumers did not always evaluate it as such, even if they viewed the same product at the same time.

To address this issue, we prepared four different hypothetical product pictures and solicited the perceptual images. The prepared visual stimuli are shown in Figure 1. In the analysis, we aggregate these data and discuss general results. In the following section, we will explain the data management in detail. Visual stimulus (A) is the clamshell-type smartphone that resembles the most frequently found feature phone design in Japan. Stimuli (B) and (D) resemble recognized smartphones such as Experia and iPhone. Stimulus (C) is the slider-type smartphone that is the least common design in this grouping.

In the questionnaire, we asked respondents to rate their preference using a 7-point scale for all four visual stimuli examples. In addition, we added the following

statement that *all of the examples from (A) to (D) are smartphones and have the same features including screen size, weight, size of battery, camera resolution, and operating system*. This was to declare that these examples were the same except in appearance.

Figure 1. Smartphone Visual Stimulus



3.3. Perceptual Images

As previously mentioned, we solicited perceptual images for each visual stimulus (hypothetical pictures). We listed seven perceptual images in Table 1. In this study, all items are measured using a binomial scale, the example fits the image or not. For one visual stimulus, we measured whether respondents felt that the appearance of the product fit these images. Note that the term “atypical” is replaced with “typical” in the questionnaire to be easy-to-answer.

4. Results

4.1. Data Collection

The survey was conducted on April 28, 2014, with students from the *Business Administration* class at *Nagasaki University*. There were 342 samples, excluding any inappropriate or missing samples. There were 214 males (62.6%) and 128 females (37.4%). The average age of the students was 19.9. In addition, 340 of 342 respondents (99.4%) owned at least one mobile phone. There were 14 respondents who had more than two mobile phones.

Table 2 shows the results of perceptual images. The numbers indicated the rate of respondents who replied that the stimulus fit the images. For example, 8.8% of the respondents felt visual stimulus (A) was “novel.” On the other hand, stimulus (A) received the highest rating for “typical,” followed by visual stimuli (B) and (D).

Stimulus (C) rated extremely low. Stimulus (A) was similar to the most recognized feature phone in Japan. Since the clamshell-type is the dominant design for feature phones, many consumers evaluated stimuli (A) as “typical.” However, the clamshell-type is not prominent among smartphones. Therefore, consumers did not evaluate (A) as “novel,” and “fits the image of smartphone.” We found that visual stimulus (C) was the “newest” design among all. However, in other perceptual images, visual stimuli (B) and (D) were ranked the highest and second highest.

Table 2. Summary Statistics of Differences

	(A)	(B)	(C)	(D)
Novel	0.088	0.363	0.371	0.371
Original	0.193	<i>0.143</i>	0.556	0.181
Unique	0.284	0.120	0.567	<i>0.105</i>
Typical	0.503	0.430	<i>0.064</i>	0.330
High Technology	<i>0.070</i>	0.544	0.351	0.459
Fit the image of "Smartphone"	<i>0.026</i>	0.702	0.050	0.635
User friendly	0.228	0.506	<i>0.076</i>	0.506

Note: Numbers in bold font indicate the highest, italic font indicates the lowest among four types.

4.2. Dimension of the Design Newness

Before the statistical analysis, we examined the dimensions of the design newness construct. At first, we calculated Cronbach’s alpha coefficients from four design newness items. The coefficients of (A), (B), (C), and (D) are 0.63, 0.26, 0.53, and 0.35, respectively. Note that the “typical” item is reversed. All of the coefficients are below the necessary level. We could not obtain one “newness” construct, which means that the items are heterogeneous. Therefore, we cannot support H1, which assumes the one-dimensionality of the design newness construct.

In this study, we defined the aggregated dataset to analyze the general characteristics. Let X_A be a matrix of the perceptual images of visual stimulus (A). The size of the matrix is 342 times 7 (number of respondents times dimensions of images). The aggregated dataset X is obtained from $X = (X'_A, X'_B, X'_C, X'_D)'$ where the prime denotes transpose. Since matrix X is obtained by the alignment of four matrices, the size of X is 1368 times 7. The aggregated matrix contains the general information set of the perceptions, which is not influenced by certain visual stimulus. Hereafter, we will analyze the dataset. As in the above, we calculated the Cronbach’s alpha coefficient from the aggregated matrix. The coefficient is 0.55. This implies that there is substantial multi-dimensionality in the newness items. Therefore, from the aggregated matrix, we also cannot support H1.

Table 3 shows the correlation matrix of the perceptual images obtained from the aggregated matrix. Note that “typical” is not reversed. We found that the correlations among newness items are not high. It is appropriate to incorporate these items as different explanatory variables to the regression model for preference. In the next section, we will assess the model that assumes multi-dimensionality of the design

newness items.

Table 3. Correlation Matrix

	Novel	Original	Unique	Typical	High Technology	Fit the image of "Smartphone"	User friendly
Novel	1.00						
Original	0.29*	1.00					
Unique	0.15*	0.52*	1.00				
Typical	-0.11*	-0.20*	-0.15*	1.00			
High Technology	0.35*	0.11*	0.01	0.04	1.00		
Fits the image of "Smartphone"	0.23*	-0.12*	-0.19*	0.17*	0.40*	1.00	
User friendly	0.13*	-0.10*	-0.17*	0.22*	0.28*	0.44*	1.00

Note) *: significant at 5% level

From Table 2 and Table 3, we can observe some interesting results. As mentioned in section 4.2, the visual stimulus (A) is the most “typical” example. However, (A) is not perceived as “fits the image of the smartphone.” While stimulus (A) is the most famous design of the feature phone, it is rarely found among smartphones.

When a product category market reaches maturity as a result of technical advances, sometimes radical innovation will alter the existing product category and the market competition becomes unclear again (Abnerthy, Clark and Knatrow, 1983; Abernathy and Clark, 1985). With this change, design images are often renovated. For example, there are substantial differences between the feature phone and the smartphone, as examined in this study, or the CRT and LC television. In these transitional markets, it is possible that the appearance design perceptions are affected by both old and new market images. In fact, we can observe the combined result in Table 3. The “novel” and “fits the image of smartphone” attributes show a positive correlation, and the “typical” and “fits the image” attributes also show a positive correlation. However, “novel” and “typical” are not positively correlated. We have to consider both new and old product categories when a market is in a state of de-maturity.

There are interesting relationships between “user friendly” and other images. Although “typical” is the closest image, “novel” also shows a positive correlation. Companies can design “user friendly” products that combine “typical” and “novel” images.

4.3. Empirical Results of the Preference Models

In this section, we assess two models to examine the relationship between preference and perceptual images. The objective variable is the aggregated preference, which is defined as follows: $y = (y'_A, y'_B, y'_C, y'_D)'$ where y_A denotes a 342 dimensional preference vector of visual stimuli (A). Model 1 estimates the aggregated preference based only on the design newness items. Meanwhile, Model 2 incorporates all of the measured perceptual images. In model 2, other images such as high technology,

fitness, and user friendly are added as control variables.

Table 4 shows the summary results from the estimation. At first, from the Adjusted R-squared, we find that the fitness of model 2, which incorporates other images, is better than model 1. This implies that model 2 is a more appropriate model to explain the preference. If consumers evaluate a smartphone as “high tech,” “fits the image of smartphone,” or “user friendly” from the visual appearance, the preference of the smartphone will increase. Among the newness items, we also found that some are significant in terms of having a negative effect. Novelty has a positive effect on both models. Therefore, the “novel” appearance products are more preferred. However, “uniqueness” negatively affects the preference. Similarly, “originality” is significantly negative in model 1. Typicality is rather positive in model 1, while the typicality does not show a significant affect in model 2.

As a result, we cannot entirely support H2, which assumes the positive relationship between design newness and preference. However, some attributes like “novel” positively affect the preference. Furthermore, this result reinforces the multidimensionality of the design newness construct. Therefore, we do not support H1 and partially support H2 based on empirical analysis.

Table 4. Summary of Empirical Analysis

	Model 1				Model 2			
	Estimate	S.E.	t value	Pr(> t)	Estimate	S.E.	t value	Pr(> t)
(Intercept)	3.908	0.079	49.61	***	3.234	0.077	42.16	***
Novel	1.103	0.113	9.74	***	0.384	0.107	3.59	**
Original	-0.310	0.137	-2.27	*	-0.162	0.121	-1.35	
Unique	-0.774	0.131	-5.90	***	-0.402	0.116	-3.45	***
Typical	0.309	0.108	2.87	**	-0.104	0.097	-1.08	
High Technology					0.414	0.105	3.96	**
Fits the image of Smartphone					1.305	0.110	11.86	***
User friendly					0.845	0.105	8.01	***
R ²	0.101				0.312			
Adj. R ²	0.099				0.310			
Sigma	1.83				1.61			
F	38.49				88.09			
N	1368				1368			

Note) *, **, ***: significant at 5%, 1%, and 0.1% level respectively

5. Discussions and Conclusions

As the results show, we found contradictory relationships between design newness and preferences. “Novel” has positive impact, while “unique” has a negative impact. Previous studies assumed that novelty and uniqueness are similar and both constructs are elements of a single common construct in “design newness.” However, our result shows that there are substantial differences among design newness sub-constructs.

In particular, “uniqueness” does not have positive impact on consumer choice. There are two possibilities as to why the empirical results show negative relationships. The first reason is related to our prepared visual stimuli. Heng and Cheng (2012) observed that consumers do not prefer products that are too unique. It is possible that the product pictures proposed in this study are too unique and perceived as unattractive. However, since we aggregated product image datasets in our analysis, the effect of the specific visual stimuli is reduced to some extent. The second reason is related to the preference variance. It is possible that although the unique products are heavily preferred by some consumers, many ordinary consumers avoid unique products; thus, we cannot observe a positive relationship from a statistical analysis. As Rogers (2003) classified consumers, we can presume that there are more than two classes of consumers: ones that prefer unique products and those who do not. It will be interesting to examine these consumer segments and behavioral/psychological characteristics. This reason is also related to the dominant design determination (Abernathy and Utterback, 1978; Abernathy, 1978). In general, the appearances of innovative products that create new markets or product categories are unique. However, as Rogers’ (2003) diffusion model defined, these unique products are not accepted by the majority and only purchased by innovators. It is difficult for companies to decide when a unique product should be released into the market.

In addition, there are relatively high correlations between “novel,” “fits the image of smartphone,” and “high tech.” This implies that consumers interpret and evaluate the concept of “novel” if the appearance of the product looks relatively new compared with its competitors, but not too eccentric. As Muggie and Schoormans (2011) observed, the technical elements and the design newness have a positive relationship; our study also supports this relationship. Based on this discussion, it is possible that design newness has more than two sub-constructs. The first construct “novelty” is related to the technical images and is positively perceived by consumers. On the other hand, the second construct “uniqueness” is related to radical differentiation and does not always affect preference in positive way. Unfortunately, we cannot determine the exact sub-construct structure from our analysis. Our future objective is to further explore the details of design newness sub-construct characteristics. However, our study’s findings indicate that there are more than two different dimensions within the “design newness,” which was not considered by previous studies.

There are some other questions to be answered. For future studies, we will need to expand the product categories and industries to ensure the robustness of the results. By examining these other cases, we will be able to reveal detailed or new construct properties. In addition, based on these findings, we will need to examine the structure of the “design newness” construct in detail, define the construct of “design newness,” and develop measurement scales. The re-examination of the “newness” definition and scale development will become a useful research tool for future studies. Although, this study has some limitations, our paper substantially contributes to findings related to the multidimensionality of “design newness.”

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