Quantified Study of the Aesthetic Appeal of the Formal Conceptual Elements in New Products Design Through Conjoint Analysis

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Abstract Would it be possible to know exactly what do people want regarding the form of the products they buy? Different studies were created to give us such answer, but those studies tend to use images of already existing products and because of that, such studies throw much more than the answers that we are looking for. Besides what people want, those studies reveal what the brands want people to want. That is why the following study makes an analysis of some of the various formal elements used in the design of new products, highlighting some representative ones to use them in a conjoint analysis study that will show which are the most appreciated formal attributes in a specific demographic group.

Introduction

Design methods and the study of form in product design processes are important because they allow designers to structure their work in a methodical and reasoned way while, at the same time, leave room for intuition and creativity to flourish. The study of the perception of the products and their relation to the observer's emotional response is one of the newest disciplines and there are already numerous works published.

Most of these studies are focus on the analysis of the response that causes the image of some product in the consumer. At present time the aesthetics of the products is the key factor in new product design even more than before, and this has come to be because the market give us a large scope of products to buy that have the same function and they are only set apart from each other because of how each one looks. Thus, aesthetics is use to give products an added value.

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On his book about the design of objects, Norman [1] makes a reasoned analysis of why design works best with attractive shapes and concepts.

He gives an explanation from a psychological point of view, focusing his research in three processing stages or levels of the human psyche: First, the visceral, this level could also be called the intuitive. Second, the behavioural or the level of customs and manners, where the decision making is made almost immediately for we do what we are used to do. And third, the reflexive level, that, as it name implies, this is the process in which we analyse the thinking process. What Norman proposes on this book is to make designs that appeal more to the first levels because those are the ones that could be seen as instinctive or intuitive and there for these are the easiest to approach and the harder ones to change as individuals.

Other authors, such as: Veryzer [2], explore the systematic nature of aesthetic responses to products and propose a conceptualisation of the aesthetic response to design principles, and he operate this principles on internal transformation as algorithms.

Hsu et al. [3] conducted a study that investigated the difference in the perception of the form of products between designers and the users. They used the semantic differential method, for this they showed images of telephones to the two groups and analysed their response to the formal elements of the designs.

Mokarian [4] developed a study that tested the aesthetic value of formal balance in objects. The author highlights the problem that presents the presentation of engineering design objects to the public, as it primarily focus is on the functional aspects, not the aesthetic ones. None the less, the study has two main hypotheses: the first is that you can make a classification of formal variables from the design in terms of their functional relevance, ergonomics and aesthetics, and the second hypothesis is that the formal element of balance helps to achieve product aesthetics, resulting in attractive objects. The paper concludes that to have an effective integration of the functional, ergonomic and aesthetic variables in the design of new objects, there is the need for an analysis and a classification of the formal variables in the design.

In a different line of work, Sharmin [5] presented a study in which he analysed the patterns of eye movements of people seeing design objects, with the help of a tracking eye movement device, he was able to measure the number and duration of stops that the eye of the subject had while seeing a picture of a product. These stops were identified as points of interest or attraction to the observer.

The work of Wrigley et al. [6] proposes that the design process should start by targeting the hedonistic visceral experience that the buyer have when introduced to a new product. The importance of analysing the hedonistic visceral reactions according to the authors is that these reactions will be responsible for creating guidelines to design attractive products, and by knowing how the costumer it's going to react is how one can create designs that will have better market acceptance.

There are other studies that have attempted to measure the formal appeal of the products. For example, Osborn et al. [7] performed a selection of features underlying the form, and these features were then used as attributes in a utility equation. It concludes that, once preferences are outlined in the utility equation, the results can be used as a base for the generation and modification or design verification on new products.

Following this line of research, the present study undertook the task of identifying some general formal elements of products and general elements of forms and shapes that were thought to be attractive to the consumers, to be used later on a conjoint analysis to see which are the most appreciated in a trial group. To achieve this it was necessary to identify a set of general elements that could constitute a form (shape). Such elements could be the contrast, rhythm, colour, texture, etc. The explanation and uses of these elements were based on the design fundamentals book by Scott [8].

Hypothesis and Objectives

The main observation with the studies and methods for the appreciation of needs, tastes and likes on products is that they are always tampered by the subjectivity of the person that the study is analysing, almost all studies try to capture and understand through an objective way a sensation or feeling that are by definition subjective. It would be interesting to develop a method that could show what people are really felling without them being any the wiser about it, this way we could really know what do they really want.

What this study proposes is to change the approach to the participant, and to achieve it this study will be using the same type of methods proven accurate by others, but changing the object of study: in this case, instead of pictures of products, the participant will be seeing abstract images with no references to any product. This way we will be able to analyse the elements of the product form instead of the paradigms around the products. The goal of this is to prove that people give a sincerer answer when they are asked whether they like or dislike something abstract, and also to show that if the information throw by the survey were used on the design of a new product, that product would have better acceptance among potential buyers.

Thus, the aim of this quantified study is to determine which are the attributes (between the selected ones for the survey) that people find to be more attractive. To achieve this we need to break off the elements of the form from the products that contains them, and to do so this study bases itself in the classification of elements found in Scott [8] and Wong [9] book. If these elements can be extracted so they can't be linked to the original object, we will get a separate design criteria and guidelines for the cataloging and quantification of products and objects.

Methodology

In order to know the individual contributions of each formal element to the attractiveness of a product, it was decided to conduct a survey that was processed through the Conjoint Analysis (AC). A short and concise explanation for this survey method is given by Joseph Curry:

Conjoint analysis is a popular marketing research technique that marketers use to determine what features a new product should have and how it should be priced. Conjoint analysis became popular because it was a far less expensive and more flexible way to address these issues than concept testing. […] three steps: collecting trade-offs, estimating buyer value systems, and making choice predictions, form the basics of conjoint analysis. Although trade-off matrices are useful for explaining conjoint analysis as in this example, not many researchers use them nowadays. It's easier to collect conjoint data by having respondents rank or rate concept statements [10].

The survey was applied to a specific market niche: young people between 20 and 30 years old, from an A, B+ and B demographic group. Also the survey was developed in paper and pencil format with the system of paired data comparison collection to facilitate the survey and make it faster. Once the data was collected, it was processed using the software: SMRT Sawtooth Software, Inc. The data analysis was conducted using multiple linear regressions.

The preference model used was the partial benefit and the selected attributes shown in the Fig. 1.

The choice of levels in the "Form" attribute was made searching for two opposite elements of the form. The conclusion was that, within the lines that make any figure, there are two types: the straight and the curve lines, from now on such lines will be referred to as inorganic and organic according to the notion that says that organic shapes have a natural look with a flowing and curving appearance, whereas the inorganic would be the exact opposite. In the case of the levels under "Contrast" the choosing of these elements were made with the idea in mind of showing one element that was easy to see and another one that wasn't. Finally, for the last attribute "Proportion (rhythm)" the levels were chosen to give a wider range of variations, choosing, once again, two opposites and one element in between. All this attributes were chosen because they were the easiest ones to apply on the survey since it was thought of to be done on paper, although other attribute that would have being interesting to examine was texture but, to be able to do so there was the need to add samples of different materials which weren't available.

Using these attributes and levels we generated the following images to be used in the conjoint analysis study (Figs. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 and 14).

As it can be seen, and for reasons of consistency with the study, the presented images are formed by sequences of squares and circles. With the idea that the respondent shouldn't be able to easily think his or her answer, the corners of these circles and squares were cut with a cross, in order for them to not be obvious

ATTRIBUTES		
Form	**Contrast**	**Proportion**
LEVELS		
Organic	Hi	Simetry
Inorganic	Low	Progretion
		Asimetric

Fig. 1 Attributes and levels

Fig. 2 Inorganic, high contrast with progression image

Fig. 3 Inorganic, high contrast and symmetric image

Fig. 4 Inorganic, high contrast and asymmetric image

Fig. 5 Inorganic, low contrast with progression image

Fig. 6 Inorganic, low contrast and symmetric image

Fig. 7 Inorganic, low contrast and asymmetric image

Fig. 8 Organic, high contrast with progression image

Fig. 9 Organic, high contrast and symmetric image

Fig. 10 Organic, high contrast and asymmetric image

circles and squares, through thanks to the principle of wholeness (Gestalt), our mind adds the missing elements to complete a figure and that's why the figures will still be perceived as circles and squares (the principles of organic and inorganic shapes) [8].

The survey was applied to a pilot group of twenty people at a shopping mall on a working day at a working hour (12 men and 8 women).

Fig. 11 Organic, low contrast with progression image

Fig. 12 Organic, low contrast and symmetric image

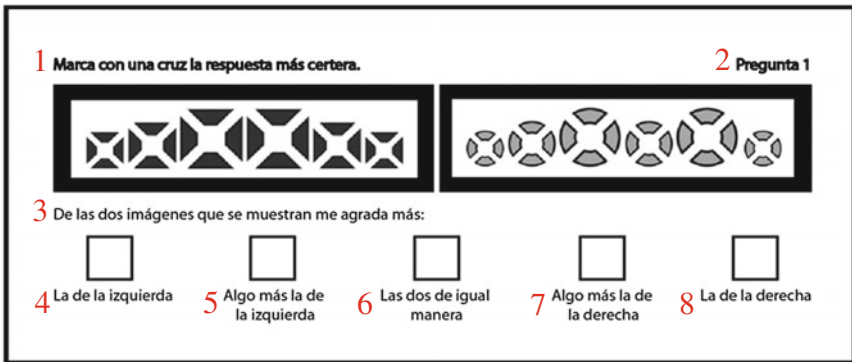**Fig. 13** Organic, low contrast and asymmetric image

Fig. 14 Example of the survey card

Translation of the original survey card:

1. Cross the most accurate response.
2. Question 1.
3. Which of the two images do you like the best.
4. The one on the left.
5. A little bit more the one on the left.

6. I like both images the same.
7. A little bit more the one on the right.
8. The one on the right.

Survey Results

This survey was analysed using the SMRT Sawtooth Software and the results from a 40 % women and 60 % men group are in Fig. 15.

The goodness of fit, represented by square R is 0.8235 and therefore we considered acceptable the result of this survey. The utilities are shown in Fig. 16.

Figures 17, 18, 19 and 20 show the results in a graphic mode.

Confirmation Survey

To confirm the reliability of the results a second survey was developed. This survey showed images of two objects of design that the original group could have been interested in according to their ages and demographics. We asked people within the same specifications than the first survey group, which of the two objects they liked most, if the symmetrical, contrasted and square design, or the arrhythmic, without contrast and circular one. These combinations were chosen because they were the two extremes of the results of the original survey.

The images displayed to people are shown in Figs. 21 and 22.

To do the second survey we interview twenty new people and from those eleven were men and the rest were women. Once again, the survey took place at a shopping mall on a working day at a working hour.

Thirteen people of the survey preferred sound system 1 and seven sound system 2. That means that 65 % of the people did like the sound system that the study said had to have better acceptance and only a 35 % choose the opposite which is consistent with the original survey.

Discussion

The study showed that objects that have a square shape, or have predominating straight lines, are symmetrical as a whole and have contrast between the colours of its elements, or components, shall, in accordance with the experiment, have a greater acceptance. On the other side, objects that are arrhythmic with circular or curved forms prevailing, and with a low colour contrast, will be less accepted by people.

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CVA System Ordinary Least Squares Estimation
Copyright 1990-2006 Sawtooth Software

Name/Description: CVA OLS Run
01:40:04PM Sunday, March 14, 2010

Tasks Included: All Pairwise

Recode Method: Logit

Successfully computed utilities for 20 respondents.

Average R-squared = 0.82535
 Median R-squared = 0.89761
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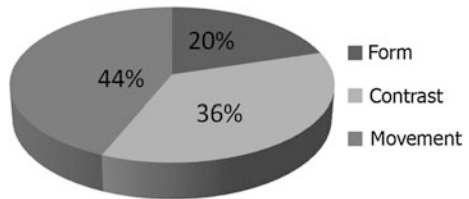
Fig. 15 Survey results

Fig. 16 Utilities

Average Utility Values
Rescaling Method: Zero-Cente...

	Total
Organic	-6.11
Inorganic	6.11
Hi contrast	38.61
Low Contrast	-38.61
Symmetry	36.28
Rhythm	-2.12
Arrhythmic	-34.16

Average Importances

	Total
Form	20.25
Contrast	36.01
Movement	43.74

Fig. 17 Importance of the attributes for the users

One of the most interesting things is the importance of the attributes for the respondents. In theory and according to the survey, people shall, first of all, appreciate the apparent motion of an object, and then appreciate the contrast, and finally the form. This is interesting because it forces us to consider that the form is not the most valued attribute.
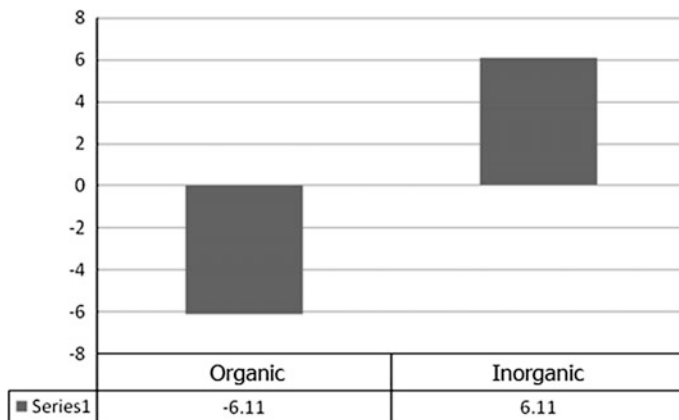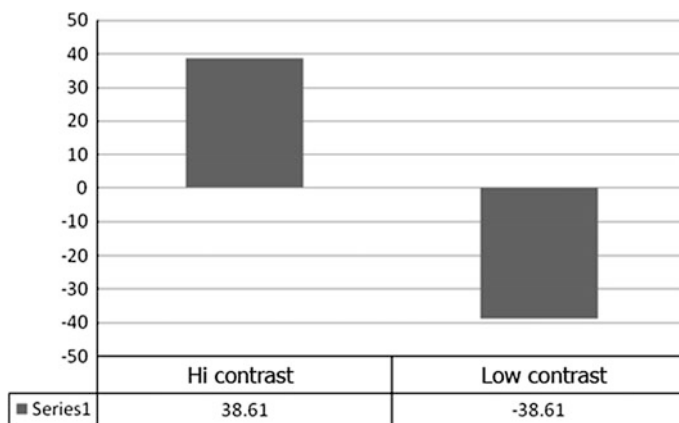
Fig. 18 Partial preferences per level (form)

■ Series1	Organic	Inorganic
	-6.11	6.11

Fig. 19 Partial preferences per level (contrast)

■ Series1	Hi contrast	Low contrast
	38.61	-38.61

Movement was the most important attribute to respondents and that can be explained by the fact that symmetry is something that human seeks instinctively [11]. It was, therefore, expected that the survey reinforced that premise.

Regarding the contrast, it was found that respondents preferred an obvious contrast in images over the low contrast and more subtle ones.

Finally, regarding the formal elements, although this attribute had the lowest weight in the decision of the respondents, people preferred the square forms over the circular ones.

The validation survey confirmed the results obtained in the first survey: Stereo 1 was the one that had the best acceptance and was more pleasing to the respondents, this sound system was the one that had the characteristics of symmetry, contrast and squared shape, which were determinant in the first survey as the resulting
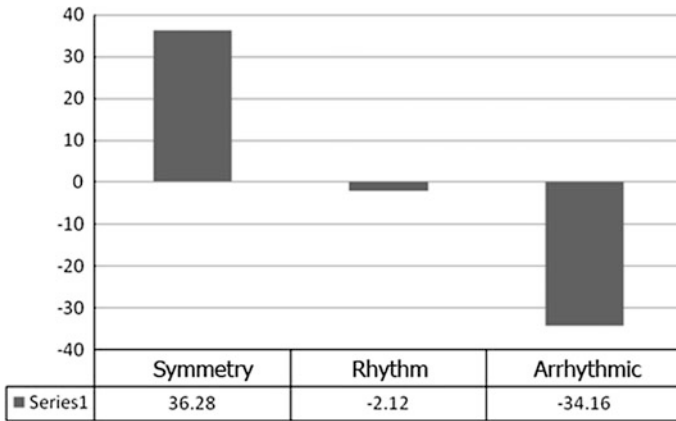
	Symmetry	Rhythm	Arrhythmic
■ Series1	36.28	-2.12	-34.16

Fig. 20 Partial preferences per level (movement)

Fig. 21 Stereo 1

preferences. This allows us to say that the perceptual response of the user to the abstract forms corresponds with the respond given when evaluating specific things, in this case, sound systems.

With this we can say that, for the purposes of a first attempt at analysing the aesthetic appeal of the conceptual elements of the form, the results presented in this study are accurate and valid from a methodological perspective. However, they are only an approximation to the overall vision of the market, since it only covers the perspective and scope explained on this text. Further studies will be needed to refine the results.

Fig. 22 Stereo 2

Conclusion

In this study we could observe and verify the existence of the relationship between the perception of abstract forms and the concrete forms of the products in the minds of consumers, which can generate a whole new line of research according to this findings.

Specifically, the study outcome support the conclusion that the proposed method yields results consistent with the general hypothesis. It also allows us to say that, as in any other conjoint analysis study, the attributes to be analysed can vary, by this we mean that we can use different elements to do the study for different cases.

Within the possible areas to continue this study we see the possibility of varying the way of presenting the stimuli to people. It would be possible, for example, to prepare physical samples with different materials, finishes, contrasts, shapes and silhouettes (proportions), this would allow us to go from two-dimensional visual stimuli to visual and tactile stimuli in three dimensions.

Another variation of this study could be applying it in the field of ethnography. In this case, one would have to change the collection data mode of the survey by observing people interacting with different objects in a store (the objects are to be previously classified within the different elements of the form) and the tabulation could be done depending the reaction to these objects, this way one can study the change between present images to an object itself. The values could be given by the approaching of people to the objects, so if people do not approach an object, this object would get a score of zero, if the subject approaches the object and looks at it, the score would be 1, and if he comes and touches it, the score would be 2. This scoreboard is proposed to measure the level of interest of people with objects and hence whether they like them more or less.

Finally, it is important to clarify that the intention of this study wasn't to elaborate a set of attributes to be use in the design of new products, this exercise had the task to try a hypothesis and meant to open the path to a new research line, therefore the survey had a very reduced amount of participants, the intention being to first confirm if the idea could be apply to a small pilot group. With this in mind, this study is rather a pre-study, so to speak: the confirmation survey was conducted in an expedite manner just to see if the hypothesis could be proven, now that we know it has work, the hole experiment should be re done to expand its grasp.

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