Study on Relationship between Purchase Intention, Product Aesthetics, Chromatic Harmony, and Centrality of Visual Product Aesthetics

Andrei DUMITRESCU[1]

DOI: 10.24818/mer/2026.01-05

ABSTRACT

An experiment was designed to study the relationship between purchase intention, product aesthetics, chromatic harmony, and the centrality of visual product aesthetics. Six research questions were formulated. The chromatic harmonies analysed were the uniform, monochromatic, analogous, and complementary. The products used as images were a cabinet and a heater. A questionnaire was designed to allow statistical analysis in the context of the research questions. The experiment was run with 236 participants, and the results were tested for reliability. The following conclusions were drawn from the statistical analysis of the results. Uniform and monochromatic harmonies ensure the highest levels of purchase intention and product beauty. A very strong direct correlation exists between the perception of product beauty and purchase intention. Centrality of Visual Product Aesthetics (CVPA) does not have a direct influence on purchase intention nor on product aesthetics. The CVPA only plays a significant role as a moderator in the positive relationship between product beauty and purchase intention.

KEYWORDS: *purchase intention, product aesthetics, centrality of visual product aesthetics.*

JEL CLASSIFICATION: *L60, L68, M31*

1. INTRODUCTION

One of the tasks of the marketing specialist is to determine which characteristics of the product and of the market segment contribute to the increasement of the purchase intention and implicitly ensure the success of her/his product. An important parameter of the manufactured object is product aesthetics, which is influenced by chromatic harmony among other characteristics. Considering the product aesthetics in the field of marketing, the centrality of visual product aesthetics (CVPA) was introduced to measure the knowledge and interest of consumers in visual aesthetics of products. To the author's knowledge, the relationship between all these characteristics has not been studied before and is worth investigating it for its practical implications.

2. LITERATURE REVIEW

It is common sense to assume that products with a remarkable aesthetic lead consumers to purchase them to a greater extent in comparison to products with a banal design. However, this fact has been tested and experimentally confirmed by numerous researchers (Hagtvedt & Patrick, 2014; Toufani et al., 2017; Le-Hoang, 2020; Shi et al., 2021; Li & Li, 2022; Liu et al., 2025).

[1] National University of Science and Technology Politehnica Bucharest, Romania, andrei.dumitrescu@upb.ro

Product aesthetics is that field of science of beauty whose subject of study is the utilitarian product, made in series production and whose meaning is designed in accordance with its content. There are many characteristics of product design that influence product aesthetics: unity, balance, proportion, compactness, elegance, complexity, continuity of form, harmony, etc. A very interesting characteristic for researchers is chromatic harmony, because colour has been intensively studied and because it allows the design of structured experiments.

Many authors have approached the definition of chromatic harmony. An interesting approach is to consider the correspondence between the harmony of colours and that of musical notes (Westland et al., 2007), but such a framework becomes difficult when analysing the relationship with other characteristics. However, based on this correspondence, it can be considered that chromatic harmony can only occur between similar colours, namely colours placed nearby on the colour wheel.

The definition proposed by Burchett (2002) is still very popular: "Colours seen together to produce a pleasing affective response are said to be in harmony." The definition is imprecise because it is difficult to objectively measure the "pleasing affective response". In addition, there are market segments whose values are: "safety", "friendship", "status-quo" and "faith", while other segments appreciate values such as: "ambition", "revolution" and "changing rules". It is obvious that these types of market segment will lean towards different combinations of colours: the first, towards analogous, static colours, and the others towards contrasting, dynamic colours. But it should be noted that "pleasing" is related to "calm", "tranquillity" and then chromatic contrasts (practically complementary harmonies) should not be taken into account.

A more precise definition and with the possibility of being applied objectively is the one according to which chromatic harmony is obtained with colours that meet without sharp contrast (O'Connor, 2010). These are colours placed nearby on the colour wheel or are variations in the saturation (chroma) of the same hue on the colour wheel.

Westland et al. (2007) rightly pointed out that a colour combination can be perceived as harmonious for two main reasons: it is simply harmonious per se, or it is harmonious because it achieves its purpose (certain colour designs may be effective, and hence harmonious, because those colours have symbolic meaning in the specific design context). It is worth emphasising that in situations where the average consumer can find herself/himself, she/he rarely gets to evaluate the harmony of abstract colours, but most often she/he is faced with colours applied on products.

In order to be scientifically analysed, chromatic harmonies should be classified. Most authors agree on the existence of three types of colour harmonies (Westland, 2007; Weingerl & Javoršek, 2018), to which a fourth must be added because it is relevant for the case of application harmony to products. Thus, the types of chromatic harmonies are as follows.

- monochromatic harmony (the colours are chosen with the same or nearly the same hue);
- complementary harmony (the opposite colours on the colour wheel);
- analogous harmony (the colours are chosen with similar hues);
- uniform harmony (the colours are exactly the same).

Research on chromatic harmony has varied both in methodology and formulation of principles defining colour harmony. Some experiments have been conducted with as few as

17 participants (Ou & Luo, 2006), while others have involved 95,000 participants over a 50-year period (Nemcsics, 2012).

Most researchers have found evidence in favour of the contribution of chromatic harmony (uniform and monochromatic) in enhancing product aesthetics (Ou & Luo, 2006; Schloss & Palmer, 2011; Wei et al., 2014; Weingerl & Javoršek, 2018) and against the contribution of complementary harmony (Wei et al., 2014).

It should also be emphasised that chromatic harmony is independent of cultural context, as revealed by a study conducted with British, Chinese, French, German, Spanish and Swedish participants (Ou et al., 2004).

If the discussion is about purchase intention, then it should be considered the consumer, and if product aesthetics also intervenes, then the characteristics of the consumer in relation to the product beauty should also be taken into account. It is important that the consumer has knowledge and interest in design, for example, to know what is perfect proportion (Dumitrescu, 2009), harmony (O'Connor, 2010) or to be able to identify visual pollution (Dumitrescu & Manolache, 2001), for example. The appropriate construct for knowledge and interest in design is the Centrality of Visual Product Aesthetics (CVPA) (Bloch et al., 2003; Dumitrescu, 2021). The latest construct of Centrality of Visual Product Aesthetics is composed by the following parameters: aesthetic pleasure and loyalty, response to beauty, aesthetic acumen, product involvement, and price indifference.

3. METHODOLOGY OF RESEARCH

Following the study of scientific literature, it emerged some niches that are worth investigating in order to obtain results that are essentially theoretical in nature, but with important practical applications. The scientific approach began with the formulation of several research questions. These questions are as follows:
RQ1: Which is the colour harmony type that ensures the highest level of beauty?
RQ2: Which is the colour harmony type that ensures the highest level of purchase intention?
RQ3: Is there a direct correlation between the perception of product beauty and purchase intention?
RQ4: Is there a direct correlation between CVPA and the perception of product beauty?
RQ5: Is there a direct correlation between CVPA and purchase intention?
RQ6: What is the role (if any) of CVPA in the relationship between product beauty and purchase intention?

The experiment design began with the selection of two types of products. It was decided that the product types should not be chromatically conditioned from functioning and ergonomics requirements. It was also established that the product types should be very well known to the general public and that there should be a clear difference between them in the way they function. After several comparisons, a piece of furniture (cabinet) and an electrical appliance (heater) were chosen.

Regarding the types of chromatic harmony, the following types were chosen for the experiment:

- Uniform;
- Monochromatic;
- Analogous;
- Complementary.

For a more comprehensive analysis, it was obvious that both chromatic and achromatic colours should be chosen. Given that a complementary harmony had to be achieved, the pairs of complementary colours (red-green; violet-yellow; blue-orange) were analysed. From the point of view of lightness contrast, the red-green contrast is too low, violet-yellow – too strong, so the blue-orange pair was chosen. To obtain an analogous harmony, orange was paired with red, and blue was paired with violet. So, the chosen colours were (in the RGB system): Red (255, 0, 0); Orange (255, 165, 0); Dark Orange (255, 140, 0); Blue (0, 0, 255); Light Blue (120, 170, 225); Dark Blue (0, 0, 139); Violet (128, 0, 255); Gray (128, 128, 128); Light Gray (210, 210, 210); Dark Gray (105, 105, 105).
The colour combinations selected for achieving chromatic harmony are presented in Table 1.

Table 1. Harmonious colour combinations

No.	Dominant colour	Detail colour	Harmony type
1	Light Gray	Light Gray	Uniform
2	Orange	Orange	Uniform
3	Light Blue	Light Blue	Uniform
4	Dark Gray	Light Gray	Monochromatic
5	Light Gray	Dark Gray	Monochromatic
6	Dark Blue	Light Blue	Monochromatic
7	Light Blue	Dark Blue	Monochromatic
8	Dark Orange	Orange	Monochromatic
9	Orange	Dark Orange	Monochromatic
10	Blue	Violet	Analogous
11	Orange	Red	Analogous
12	Blue	Orange	Complementary
13	Orange	Blue	Complementary

The two products were modelled using a computer aided design programme. They were then coloured in the chosen combinations, and the images to be used in the experiment were captured from a proper angle. Some examples of images used in the experiment are displayed in Figure 1.

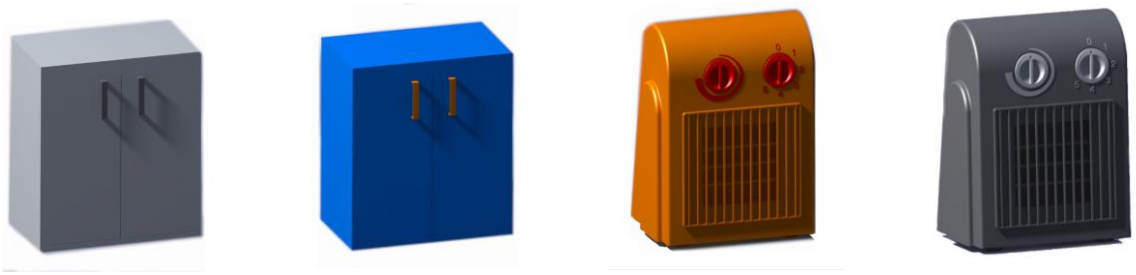

Figure 1. Example of images used in experiment

An online questionnaire was conceived to gather experimental data. It was analysed the opportunity to use a question associated with a pleasing affective response or a construct aimed to determine the product aesthetics. The last option was chosen because it presumes a stronger reaction from participants.

The questionnaire starts with two questions about to the participant's demographic data, the construct for determining the Centrality of Visual Product Aesthetics (Dumitrescu, 2021), the construct for determining the perceived beauty of the product (synthesis from different sources) and finally the construct of purchase intention (Vilches-Montero et al., 2018). Most

of the questionnaire items had a 7-point Likert scale. The questionnaire was submitted to and approved by the competent university authorities and is presented in the Appendix.

4. EXPERIMENTAL RESULTS

The participants in the experiment were students enrolled at a Romanian large university. The participants were not financially rewarded for their involvement in experiment. The participants were screened for visual deficiencies (Ishihara test, etc.), and all were assessed fit for the experiment. The product images were presented on computer screens, which appeared with a height of 9 cm. A gray screen was displayed between images to avoid the afterimage effect. All computer monitors were of the same model and were properly calibrated.

The experiment was performed with 236 participants (122 women and 114 men). The mean age was 25.08 years (SD = 5.01). The accuracy of results was tested using *Z-score*. No *Z-scores* were outside the interval [-3; +3]. The *Z-score* values ranged between -2.12 and 2.68. The reliability of the data was tested using the Cronbach's alpha coefficient. The calculated value for the complete set of data was $\alpha = 0.978$, value which indicates a very good reliability. The values of the Centrality of Visual Product Aesthetics (CVPA) of the participants are presented in Table 2. The average CVPA is high (5.16), and some participants recorded the maximum value (7.00), and it can be concluded that the majority of the sample is educated in product aesthetics.

Table 2. Participants' Centrality of Visual Product Aesthetics

Mean	Min	Max	SD
5.16	2.80	7	0.88

First, the relationship between the chromatic harmony type and product aesthetics was analysed to answer **RQ1** ("Which is the colour harmony type that ensures the highest level of beauty?"). The experimental results are presented in Table 3. The outcome is a hierarchy with two pairs of relatively close means, and a question can be raised as to whether the differences between the four types of chromatic harmony are really notable. Apparently, uniform harmony is the harmony that ensures the highest level of product aesthetics. Therefore, the null hypotheses were formulated:
H01: Perceived product beauty (of cabinet) does not depend on colour harmony type.
H02: Perceived product beauty (of heater) does not depend on colour harmony type.

The ANOVA single factor method was applied for each product type (Table 4) and it was found that there are certain differences between the harmony types, but it was not clear whether there are differences between absolutely all four types of harmony or only between some of them. Consequently, Tukey's honest significance difference (*HSD*) was calculated and it is displayed in the last column in Table 4.

The difference between the means (in Table 3) should be greater than the honest significance difference (*HSD* = 0.3) for the harmony types differentiation to be significant. It was found that significant differences are only between the group of the first two harmony types and the group of the last two, so both uniform harmony and monochromatic harmony can ensure the highest level of beauty.

Table 3. Product Aesthetics (Beauty)

Harmony Type	Cabinet	Heater	Mean
Uniform	3.82	3.73	**3.78**
Monochromatic	3.66	3.80	**3.73**
Analogous	3.11	2.98	**3.04**
Complementary	3.13	2.66	**2.90**

Table 4. Testing the difference between harmony types (product aesthetics)

F_{critic}	F	p-value (<0.05)	Decision	HSD
2.614	19.789	1.19×10^{-12}	H01 null hypothesis was rejected.	0.296
2.614	46.379	5.9×10^{-28}	H02 null hypothesis was rejected.	0.301

Table 5. Purchase Intention

Harmony Type	Cabinet	Heater	Mean
Uniform	3.49	3.73	**3.61**
Monochromatic	3.40	3.53	**3.46**
Analogous	2.78	2.64	**2.71**
Complementary	2.70	2.43	**2.57**

Then, the relationship between the type of chromatic harmony and purchase intention was analysed to answer **RQ2** ("Which is the colour harmony type that ensures the highest level of purchase intention?"). The experimental results are shown in Table 5. A hierarchy with two pairs of relatively close means was obtained and in this case the question is raised whether the differences between the four types of chromatic harmony are indeed significant. Apparently, uniform harmony is the harmony that ensures the highest level of product aesthetics. Therefore, the null hypotheses were formulated:
H03: Purchase intention (for cabinet) does not depend on colour harmony type.
H04: The purchase intention (for a heater) does not depend on the colour harmony type.

The ANOVA single factor was applied for each product type, and the results are shown in Table 6. It was noted that there are differences between the types of harmony, but it cannot be firmly stated that there are differences between absolutely all four types of chromatic harmony or only between a few. Consequently, Tukey's honest significance difference (HSD = 0.29) was calculated.

Table 6. Testing the difference between harmony types (purchase intention)

F_{critic}	F	p-value (<0.05)	Decision	HSD
2.614	25.03	1.39×10^{-15}	H03 null hypothesis was rejected.	0.296
2.614	50.55	2.69×10^{-30}	H04 null hypothesis was rejected.	0.293

The difference between the means should have been greater than the honest significance difference on order to harmony types differentiation to be significant. It was found, again, that significant differences are only between the group of the first two harmony types and the group of the last two, so both uniform harmony and monochromatic harmony can ensure the highest level of purchase intention.

An important task of the marketing specialist is to identify the product characteristics that influence purchase intention in order to increase the chances of commercial success of her/his product. In the context of products that display chromatic harmony, **RQ3** ("Is there a direct correlation between the perception of product beauty and purchase intention?") is formulated.

The simplest way to study this possible relationship is to calculate the correlation coefficients. All coefficients (Table 7) are above the value of 0.88 and it becomes obvious that the correlation between purchase intention and product beauty is very strong for products that display chromatic harmony.

Table 7. Correlation coefficients

Harmony Type	Cabinet	Heater
Uniform	0.890	0.905
Monochromatic	0.887	0.889
Analogous	0.887	0.938
Complementary	0.929	0.945

Another characteristic that might interest the marketer is the consumer's knowledge and interest in product aesthetics. This characteristic is best defined by the Centrality of Visual Product Aesthetics (CVPA). The direct correlation between CVPA and the perception of product beauty and the direct correlation between CVPA and purchase intention were the subject of **RQ4** and **RQ5**. As in the case of the previous research question, the correlation coefficients were calculated, but the majority were in the interval [-0.22, 0.17] with some notable exceptions presented in Tables 8 and 9. So, it can be concluded that the direct correlation between CVPA and product aesthetics or purchase intention is insignificant.

Table 8. Correlation coefficients in case of cabinet (only relevant values)

Overall / detail	Harmony Type	Product Aesthetics - CVPA	Purchase Intention - CVPA
Dark gray / Light gray	Monochromatic	0.72	0.66
Light gray / Dark gray	Monochromatic	0.52	0.47
Light gray	Uniform	0.47	0.38

Table 9. Correlation coefficients in case of heater (only relevant values)

Overall / detail	Harmony Type	Product Aesthetics - CVPA	Purchase Intention - CVPA
Dark gray / Light gray	Monochromatic	0.71	0.65
Light gray / Dark gray	Monochromatic	0.53	0.44
Light gray	Uniform	0.53	0.47

But does the Centrality of Visual Product Aesthetics (CVPA) play any role in the context of purchase intention and product aesthetics (**RQ6**)? Given the complexity of the approach, the Classical Process Model was used. Purchase Intention (PI) was the dependent variable and, respectively, Product Aesthetics and CVPA were the independent variables. In the Classical Process Model, there were tested the Process Types: Direct (Beauty – Purchase Intention); Mediator (CVPA);; Moderator (CVPA) and Confounder (CVPA). Each time, Direct Process confirmed the relationship between product aesthetics and purchase intention (which was already known), but the most significant indicator values were obtained for the cases where CVPA was the moderator (Figure 2).

The values resulted after applying Classical Process Model for uniform harmony (in the case of cabinet) are displayed in Table 10. Also, similar results were obtained in the other cases, and the following remarks are true in most cases. Only in the case of an analogous harmony applied to the heater, the CVPA-moderated influence of Beauty on Purchase Intention was insignificant (*p-value* = 0.326).

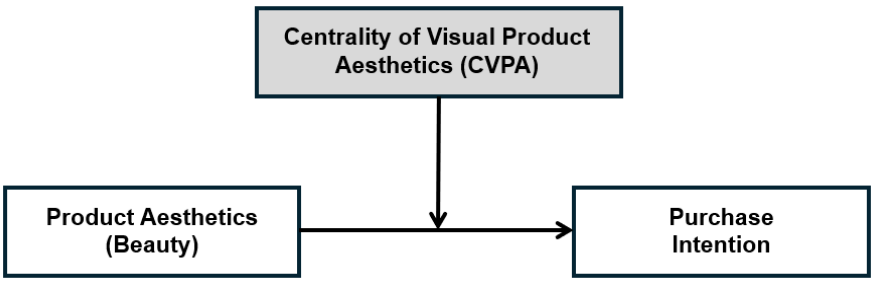

Figure 2. Conceptual path plot

Table 10. Path Coefficients after running Process Macro

	Estimate	Std. Error	z-value	p-value	95% Confidence Interval	
					Lower	Upper
Beauty → Purchase Intention	0.229	0.117	1.946	0.042	0.012	0.459
CVPA → Purchase Intention	-0.338	0.095	-3.552	< 0.001	-0.524	-0.151
Beauty: CVPA → Purchase Intention	0.126	0.022	5.834	< 0.001	0.084	0.169

The results in Table 10 are significant because the *p-value* is less than 0.05 and the confidence intervals do not include the value "0". So, product beauty has a positive influence on purchase intention. Also, the product beauty moderated by CVPA has a positive influence on purchase intention. However, CVPA alone has a slightly stronger and negative effect on purchase intention. That means that a consumer possessing a higher level of CVPA will be reluctant to buy a product (cabinet in this case) with a uniform chromatic harmony, with the product aesthetics being ignored.

5. DISCUSSION

The experiment demonstrated that the type of chromatic harmony does indeed matter in the perception of the product aesthetics. The assessment marks given by participants allowed the ordering of the harmony types, but some values were very close, and the order slightly differed depending on the product. The application of the ANOVA method revealed that there were significant differences between the harmony types. The Tukey test indicated that the notable difference was between the sets, respectively, between the set made up of the uniform and monochromatic harmonies and the set of the analogous and complementary harmonies, but there were no significant differences within each set.

The experimental results indicated that the type of chromatic harmony influences the purchase intention. The assessment marks given by the participants led to the ordering of the types of chromatic harmony, but some values were very close. The application of the ANOVA method revealed that there are significant differences between the harmony types from the point of the view of purchase intention. The Tukey's honest significance difference test indicated that the notable difference is between sets, namely between the set consisting of uniform and monochromatic harmonies and the set of analogous and complementary harmonies, but not within each set.

The experimental data also allowed the analysis of the direct correlation between product aesthetics and purchase intention. The calculation of the correlation coefficients revealed that

the relationship between the two characteristics was very strong, the actual values being very high ($r > 0.88$) in absolutely all cases.

Since the commercial success of a product is linked in the vast majority of cases to the appropriate choice of the market segment, the experiment was designed to allow the analysis of the influence of consumer's knowledge and interest in product aesthetics. The characteristic used in the experiment was the Centrality of Visual Product Aesthetics (CVPA). In the case of harmony types, a direct correlation between CVPA and product aesthetics or purchase intention was not detected, except for the particular cases of grey shades (for uniform and monochromatic harmonies).

Classical Process Model was applied to find out the possible role that CVPA could play in the relationship (already demonstrated) between product aesthetics and purchase intention. After testing different roles, CVPA was found to play the role of moderator (Figure 2). For only one case, this role was not confirmed, namely for analogous harmony applied to the heater.

From a practical point of view, the marketer should know that the product beauty (resulting from chromatic harmony) leads to a certain increase in purchase intention. Uniform and monochromatic harmonies are recommended, but this aspect may vary depending on the product class. Also, for each product class, harmonies based on shades of grey should be investigated. Centrality of Visual Product Aesthetics (CVPA) does not directly have a significant influence on purchase intention, but it moderates the positive influence of product aesthetics on purchase intention. In other words, for the educated public in industrial design, chromatic harmony really matters.

Finally, it should be emphasised that the product colour scheme must be tested with the target market segment, because as Albers (2013) wrote, "Good painting, good colouring, is comparable to good cooking. Even a good cooking recipe requires tasting and repeated tasting while it is being followed. And the best tasting depends on a cook with taste." (Arnkil & Schwarz, 2023).

6. CONCLUSIONS

An experiment was designed to study the relationship between purchase intention, product aesthetics, chromatic harmony, and the centrality of visual product aesthetics. Six research questions were formulated. The chromatic harmonies analysed were the uniform, monochromatic, analogous, and complementary. The products used as images were a cabinet and a heater. A questionnaire was designed to allow statistical analysis in the context of the research questions. Descriptive statistics, ANOVA, Tukey's honest significance difference, correlation coefficients, and Classical Process Model were employed to analyse the experimental results. The conclusions formulated in relation to the research questions are the following:

RQ1: Which is the colour harmony type that ensures the highest level of beauty?
Uniform and monochromatic harmonies ensure the highest level of beauty. A special attention should be paid to chromatic harmonies based on greys.

RQ2: Which is the colour harmony type that ensures the highest level of purchase intention?
Uniform and monochromatic harmonies ensure the highest level of purchase intention. A special attention should be paid to chromatic harmonies based on greys.

RQ3: Is there a direct correlation between the perception of product beauty and purchase intention?
Yes, there is a very strong direct correlation between the perception of product beauty and purchase intention.

RQ4: Is there a direct correlation between CVPA and the perception of product beauty?
There is no significant direct correlation between CVPA and the perception of product beauty.
RQ5: Is there a direct correlation between CVPA and purchase intention?
There is no significant direct correlation between CVPA and purchase intention.
RQ6: What is the role (if any) of CVPA in the relationship of product beauty and purchase intention?
The CVPA plays the role of moderator in the positive relationship of product beauty and purchase intention.

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APPENDIX

The Questionnaire used in experiment:

Personal questions

Please state your gender.

Please indicate your age (just the numerical value in years).

Centrality of Visual Product Aesthetics (CVPA) questions with a Likert scale ["Totally disagree" 1 – 7 "Totally agree"]

I enjoy seeing displays of products that have superior designs.

A product design is a source of pleasure for me.

I am proud of my product brands.

Sometimes the way a product looks seems to reach out and grab me.

When I see a product that has a really great design, I feel a strong urge to buy it.

I like to think that the products that belong to me express my identity.

I love products that have the same personality as mine.

Being able to see subtle differences in product designs is one skill that I have developed over time.

I see things in a product design that other people tend to pass over.

I have the ability to imagine how a product will fit in with designs of other things I already own.

I like to find out how a certain product is made.

I like to make detailed comparisons between products of the same kind.

I read carefully the articles written by experts about the products that interest me.

I am not interested in the products that have the lowest price in their category.

The low price of a product probably hides major quality deficiencies.

Product beauty questions

How beautiful is product X? ["ugly" 1 - 7 "beautiful"]

How much do you like product X? ["not at all" 1 – 7 "very much"]

How attractive is product X? ["completely unattractive" 1 - 7 "very attractive"]

Purchase intention questions with a Likert scale ["Totally disagree" 1 – 7 "Totally agree"]

I would definitely buy product X.

I would buy product X, even if there are promotions on other products.

I will recommend product X to my acquaintances to buy.