

The Development of a Reliable and Valid Scale to Measure Aesthetic Pleasure in Design

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Abstract

There is a lack of consistency regarding the scales used to measure aesthetic pleasure. They are often chosen ad hoc or derived from other research fields but never validated for design. Moreover, those scales often do not measure aesthetic pleasure in isolation, but instead include its determinants (e.g., novelty). Therefore, we developed a scale to measure aesthetic pleasure. We also included scales to measure determinants known to influence aesthetic pleasure for discriminant validity purposes. In the exploratory phase, we identified highly reliable items representative of aesthetic pleasure and its determinants across product categories. In the validation phase, we confirmed these findings across different countries (Australia, Netherlands). Apart from the theoretical contribution, this research has practical implications for guiding designers.

Keywords: Aesthetic pleasure, Design, Scale development. Determinants of aesthetic pleasure

Introduction

Research on aesthetic pleasure derived from designed artifacts has stimulated increasing interest in the design, marketing and psychology literature (e.g., Veryzer & Hutchinson, 1998; Hekkert, 2006, 2014; Leder, Belke, Oeberst, Augustin, 2004; Hoyer & Stokburger-Sauer, 2011; Blijlevens, Carbon, Mugge & Schoormans, 2012). It is known that people's aesthetic pleasure derived from designs depends on the presence of certain design properties in the design (e.g., typicality, symmetry, simplicity). However, the findings regarding how design properties influence aesthetic pleasure in design are often contradictory. For example, some research showed that people have a preference-for-prototypes (Whitfield & Slatter, 1979), while other research showed that people are also drawn to novel designs (Schoormans & Robben, 1997; Hekkert, Snelders & Van Wieringen, 2003; Lindgaard & Whitfield, 2004, Moshagen & Thielsch, 2010; Blijlevens, et al, 2012). We believe that such contradictory findings are partly due to a lack of consistency among the scales used to measure aesthetic pleasure. Up until now, no

research has been conducted to develop a reliable, valid and generalizable scale to measure aesthetic pleasure in design. Scales used in the literature are often chosen ad hoc or are derived from other fields of research (e.g., art, Human-Computer Interaction), however those scales have never been validated for usage in design. In addition, those scales often do not measure aesthetic pleasure in isolated form, but include constructs known to influence aesthetic pleasure, its determinants (eg., typicality, symmetry) (see for example Augustin, Carbon & Wagemans, 2012; Hassenzahl, Burmester, & Koller, 2003). These scales can be used to assess whether a certain given design or object is expected to be aesthetically pleasing, because we have general knowledge of what makes something aesthetically pleasing. However, we lack a reliable and valid scale to measure aesthetic pleasure in design if the goal is to build constructive theory on what factors influence aesthetic pleasure and how it is that they do. Therefore, we contribute by developing a reliable, validated and generalizable scale to measure aesthetic pleasure in design.

Theoretical Framework

Aesthetic Pleasure

Traditionally, research within the domain of aesthetics has been directed primarily towards artworks; however, any object can be aesthetically appreciated, and objects are often deliberately designed to induce aesthetic pleasure (Postrel, 2003). Despite this, uncertainties exist regarding the concept of 'aesthetic pleasure'. In fact, the question of what denotes aesthetic pleasure has been the subject of debate over the past centuries. Three main viewpoints can be distinguished: objectivist, subjectivist, and interactionist. Some believe that aesthetic pleasure is based on inherent properties of an object itself that causes pleasure in the perceiver (objectivist view). According to this view, there are critical features that contribute to aesthetic pleasure, including symmetry, balance, proportion, complexity, and so on (Moshagen & Thielsch,

2010; Reber, Schwartz, & Winkielman, 2004). The subjectivist view proposes that an object is aesthetically pleasing if it gratifies the senses. Accordingly, beauty is a function of the qualities of the perceiver – thus, this viewpoint has led to statements such as: “beauty is in the eye of the beholder” (Moshagen & Thielsch, 2010; Reber et al., 2004). The modern-day, interactionist interpretation, and the one that we will adopt in this research, is that aesthetic pleasure is a function of both the objective properties of an object, and the characteristics of the perceiver – that is, aesthetic pleasure is a consequence of how perceivers and objects relate. According to this viewpoint, aesthetic pleasure is value positive, intrinsic, and objectified. It is considered positive because it provides pleasure. It is intrinsic in that objects are perceived without any reasoning about utility. That is, aesthetic pleasure is said to occur immediately upon first sight as opposed to after long lasting cognitive processing. And lastly, it is objectified because people experience aesthetic pleasure as something that is evoked by the object, rather than being exclusively a positive sensation of the body (Moshagen & Thielsch, 2010; Reber et al., 2004).

Determinants of Aesthetic Pleasure

Historically, much research has been conducted to define determinants of aesthetic pleasure. These can be roughly divided into two categories: perceptual and cognitive determinants. The perceptual determinants include symmetry, simplicity, harmony, proportion, balance, unity, and variety (Berlyne, 1971, Fechner, 1879; Hekkert, 2006, 2014; Post, Blijlevens & Hekkert, 2013). Perceptual determinants like symmetry, unity and simplicity aid in processing the object as a whole, and this fluent processing is marked by pleasurable feelings (Reber, Schwarz & Winkielman, 2004; Hekkert & Leder, 2007; Hekkert, 2006). Determinants like variety and complexity make a design more interesting and, therefore, more aesthetically pleasing (Berlyne, 1971; Hekkert & Leder, 2007; Hekkert, 2006). The relationships between perceptual determinants with aesthetic pleasure have mostly been empirically tested for art and artificial stimuli such as polygons, and have only recently gained interest in design (Post, et al, 2013). Cognitive determinants of aesthetic pleasure have been more thoroughly tested within design, but have mainly focused on the relationships of typicality and novelty with aesthetic pleasure. As for these cognitive determinants, people often prefer typical designs, because they are easily recognizable and therefore meaningful (Whitfield & Slatter, 1979; Veryzer & Hutchinson, 1981; Hekkert & Leder, 2007). On the other hand, research has shown that people are also drawn to novel designs (Schoormans & Robben, 1997; Hekkert, Snelders & Van Wieringen, 2003; Blijlevens, Carbon, Mugge & Schoormans, 2012). Even though it is pleasurable to understand something within the first instance, we also have a need to learn new things and ‘solving a puzzle’ is rewarding and therefore pleasurable (Venkatesan, 1973; Armstrong & Detweiler-Bedell, 2008). Therefore, a design that is more novel than what people are often exposed to in daily life can also

provide aesthetic pleasure. Several researchers have tried to reconcile these seemingly opposing findings by empirically testing long known design principles such as ‘unity in variety’ (Fechner, 1876; Berlyne, 1971) and Most Advanced, Yet Acceptable (Loewy, 1951; Hekkert et al., 2003). When trying to understand aesthetic pleasure in design such research is very important. However, as indicated previously, between studies, aesthetic pleasure is measured in different ways. Thus, the findings are not always comparable, making it difficult to draw strong conclusions regarding the relationships between these determinants and aesthetic pleasure.

Measuring Aesthetic Pleasure

Many of the scales used in the literature to measure aesthetic pleasure are chosen ad hoc or were chosen based on previous studies of aesthetic pleasure, which were not empirically tested to determine whether they do actually reliably and validly measure aesthetic pleasure. For example, many researchers refer back to Page and Herr (2002) who used attractive as an item to measure aesthetic pleasure. Others opt for multiple item measures and include items such as beautiful, pleasing and liking. In those cases, often no references to articles from which the items were taken are included. Within the field of design no reliable and valid measures exist to assess aesthetic pleasure derived from designs. In other fields of research, scales do exist that measure aesthetic pleasure. For example, in Human-Computer Interaction (HCI), the scale *AttrakDiff* was developed and is now widely used (Hassenzahl & Monk, 2010). This scale measures pragmatic value, hedonic value, beauty and goodness. In particular, the hedonic value is described to assess aesthetic pleasure. Items that assess the hedonic value include captivating, stylish, premium and creative. In the field of art a scale to measure aesthetic pleasure for artworks is currently being developed that includes items such as beautiful, incomprehensible, fascinating, ordinary, original, innovative, attractive, happy, warm and overwhelming (Augustin, Carbon & Wagemans, 2012). The aforementioned scales have not been validated in design and thus generalizability cannot always be assumed. Designs also serve utilitarian and symbolic purposes and are not purchased for aesthetic pleasure alone (Creusen & Schoormans, 2005). Accordingly, designs are evaluated with partly different goals in mind than artificial stimuli, which may influence the effect of different physical properties on aesthetic pleasure derived from a design (Armstrong & Detweiler-Bedell, 2008). Next to that, in these existing scales items are included that measure determinants of aesthetic pleasure and not aesthetic pleasure as a singular construct. For example, innovative, original and ordinary are items used in scales developed to measure aesthetic pleasure, but, at the same time, these items are used to measure the determinants of novelty and typicality in research assessing the effects of these factors on aesthetic pleasure (e.g., Hekkert et al., 2003). In this research, the goal is to provide a reliable, valid and generalizable scale to help constructive theory building

regarding the factors that influence aesthetic pleasure and the role that it plays within design. In order to be able to contribute to constructive theory building on aesthetic pleasure in design, a scale must be created that is independent, but of course related to, the determinants of aesthetic pleasure in design.

The Current Research

In this research, we assure generalizability by constructing the scale while using different product categories and within those product categories including several designs that together represent the wide variety of designs possible within that product category. Reliability is mainly tested in the Exploratory Phase: exploring the complete factor model and all factors separately. In addition, comparisons of factor structures between product categories and a re-test reliability study were performed. Factor model validation was performed in the Validation Phase: Confirmatory Factor Analysis was performed using Structural Equation Modeling (SEM), wherein the resulting factor model from the Exploratory Phase was now tested on new samples of respondents taken from two different countries (Australia, the Netherlands) and including stimuli from a new set of product categories than those used in the Exploratory phase. In addition, to assess convergent validity in the Exploratory and Validation phases, next to items to measure aesthetic pleasure, items intended to measure its determinants typicality, novelty, unity, and variety were included. Even though these constructs are assumed to be related to aesthetic pleasure, we expect them to be separate factors from aesthetic pleasure in an exploratory factor solution.

Item Generation

First phase

Three researchers performed an extensive literature review of all literature discussing, theorizing and empirically researching aesthetic pleasure in the fields of design, arts, HCI, perceptual psychology and consumer psychology. The researchers all made a list of items or descriptions of the construct used in the literature. All these items and descriptions were collected and were then carefully investigated and replicates were removed. This left 86 items to continue with for further analyses.

Second phase

Two researchers familiar with the literature on aesthetics categorized all the items that were written on individual post-its into two categories: 'aesthetic pleasure' or 'determinant of aesthetic pleasure'. In making our decisions, we considered whether the items adequately reflected our construct of interest, aesthetic pleasure, or whether they reflected perceptual or cognitive constructs known to influence aesthetic pleasure. This categorization process resulted in 37 items for aesthetic pleasure and 49 items that were determinants of aesthetic pleasure. Examples of determinants include familiar, novel, understandable, patchy, and fluent to

process. The 37 items for aesthetic pleasure were then used as input for a second categorization task wherein the researchers rated the items on their relevance to the concept 'aesthetic pleasure' on a scale from 1 to 5 (1 = not at all relevant, 5 = very relevant). When the researchers did not agree, they discussed until they reached a communal decision. The items that received a score of 3 or above were then used as input for the third phase of item generation (23 items).

Third phase

In the form of a web-based questionnaire, a total of seven established researchers in the field of aesthetics rated all items (23) on the level to which they thought these items were representative of the construct aesthetic pleasure. The average scores of each item were then used as input for an extensive discussion between five researchers established in the field of aesthetics. They considered whether the items were all relevant to the construct of aesthetic pleasure, and whether they were also sufficiently different to each other in conceptual meaning so that the full conceptual construct of aesthetic pleasure could be captured. This resulted in the five final items: pleasant, attractive, nice, beautiful, and like. These items were then reworded with the help of two researchers with English as their first language to be relevant for measuring aesthetic pleasure in design. The final items used as input for the exploratory study were: "...this is a beautiful [object (e.g., camera)]", "...this is an attractive [object]", "...this [object] is pleasing to see", "...this [object] is nice to see", "...I like to look at this [object]".²¹

Exploratory Phase

Method

Stimuli selection

Four different product categories were chosen as stimuli (cameras, motorcycles, chairs and webdesigns) to assure that aesthetic pleasure was generalizable across a broad range of product categories. To assure robustness, within each product category five designs were selected to represent the variety of designs found within that product category.

¹This item generation procedure was replicated for generating items measuring typicality, novelty, unity and variety. The final items used as input for the exploratory phase of this research were: "... this is a typical [camera]", "...this is a good example of a [camera]", "... this is representative of a [camera]", "... this design is common for a [camera]", "... this is a standard design", "... this is characteristic of a [camera]" for typicality, and "... this is a novel [camera]", "... this design is original", "... this is a new example of a [camera]" and "... this design is innovative" for novelty, "this is a unified design", "this is a coherent design", "the elements of this design belong together", "this is an orderly design" for unity, and "this design is rich in elements", "this is a diverse design", "this design is made of different parts", and "this design conveys variety" for variety.

Respondents

A total of 157 respondents from a consumer panel participated in this research. Respondents were recruited from a consumer panel instead of a student population for generalizability purposes. Respondents received reward points for participation that can be exchanged for goods in an online shop when enough reward points are saved; a common compensation for respondents from this consumer panel. Of these 157 respondents, respondents' answers were deleted for people who did not finish the questionnaire and who did not have English as their first language. Finally, the respondents' answers were checked and all respondents that only answered extreme values (1 or 7), only neutrals (4) or only consecutive responses (e.g., 2,2,2.....,2,2,2) were deleted from the analyses. The final analyses were performed with a total of 108 respondents (mean age = 52, SD = 13, 66 females).

Procedure

Respondents were asked to indicate how much they agreed with statements describing the given designs using 7-point Likert scales (1 = strongly disagree, 7 = strongly agree). Within this research, items for aesthetic pleasure were included as well as items for its determinants typicality, novelty, unity and variety, to assess the discriminant validity of the aesthetic pleasure scale. These determinants were chosen to be deliberately related to, but not the same as, aesthetic pleasure.

Results

All data analyses have been performed with a non-aggregated dataset. Intra-Class correlations between the aesthetic pleasure ratings showed that people did not agree on the level to which they rated designs ($ICC = .084$, $p < .001$) and therefore aggregation would diminish a lot of the unique information present in the dataset.

Exploratory Factor Analysis

An Exploratory Factor Analysis with Varimax rotation revealed five separate factors (based on eigenvalues > 1.0). Two items were deleted from the final structure because they did not conceptually fit with the factor they loaded highest upon: "good example of the category" and "diverse". In the final factor solution, each factor made conceptual sense based on expectations and were named: aesthetic pleasure, typicality, novelty, unity and variety.

Reliability

Cluster analysis showed that all correlations were above .50 and significant so all items were retained. Factor invariance analysis showed no significant differences between product categories for each factor. Chronbach's alpha's were .98 for aesthetic pleasure, .873 for novelty, .925 for typicality, .899 for unity, and .828 for variety.

Re-test reliability

To assess re-test reliability, a sub-sample of the previous sample ($N = 50$) was administered the exact same questionnaire again after a week's time had passed. All

correlations between Time 1 and 2 for each item were above .5 and significant, except for the item "different parts" loading on the construct Variety (.463). Given that that item loads the highest on the factor variety and was not significantly different across the product categories we decided not to exclude it (invariance analysis). All correlations between the factors in Time 1 and Time 2 were significant and for most above .7, (Nunally, 1978), except for unity (.659) and variety (.584).

The goal is to create a reliable and valid scale to measure aesthetic pleasure and the focus is not on its determinants; therefore, we accept that re-test reliability is sufficient to enter all five factors and their items into the factor model tested in the validation phase of this research.

Validation Phase

Method

Stimuli selection

For replication purposes, two product categories used in the Exploratory Phase were used as stimuli in the Validation Phase: cameras and chairs. For generalization purposes two new product categories were chosen as stimuli: sunglasses and sanders. We chose these two product categories because we wanted to be able to validate our results from the Exploratory Phase to product categories that differ in symbolic, aesthetic, functional and ergonomic value (Creusen & Schoormans, 2003). Again, within each product category five designs were selected to represent the wide variety of designs found within that product category.

Respondents

Again, respondents from a consumer panel participated in this research. Respondents' answers were deleted for people who did not finish the questionnaire and who did not have English (for the Australian sample) or Dutch (for the Dutch sample) as their first language. Finally, the respondents' answers were checked and all respondents that only answered extreme values, only neutrals or only consecutive responses were deleted from the analyses. The final analyses were performed with a total of 400 participants (200 from Australia, mean age = 46, SD = 16, 113 females, and 200 from the Netherlands, mean age = 50, SD = 14, 131 females).

Procedure

Respondents were asked to indicate how much they agreed with statements describing the given designs using 7-point Likert scales (1 = strongly disagree, 7 = strongly agree). In this phase, the items that served as final output from the Exploratory Phase were used in the Validation Phase. A balanced design was used wherein respondents rated all designs of all product categories, but were randomly assigned to start with one of the four product categories. For group comparison analyses, only the first block (1 product category) was used for each respondent.

Results

All data analyses have been performed with a covariance matrix used as input in AMOS 16 (Arbuckle, 1995) for Structural Equation Modeling.

Confirmatory Factor Analysis

Structural Equation Modeling was used to assess whether the input model that resulted from the Exploratory Phase was structurally confirmed with the results of the sample from the Validation Phase. In other words, the same factors should underlie the items of the second sample as in the input model based on the sample of the Exploratory Phase. The five-factor model (aesthetic pleasure, typicality, novelty, unity and variety) from the Exploratory Phase was used to test the data obtained in the second part by means of the two-step approach of Structural Equation Modeling described by Anderson and Gerbing (1988).

The output file generated through

Structural Equation Modeling performed by AMOS provided fit measures and suggested no modifications to the model were needed and were thus not administered to the tested model. The results validated the five-factor model that resulted from the Exploratory Phase: the goodness of fit measure (GFI) was 0.90; the normed fit index (NFI) was 0.95; and the comparative fit index (CFI) was 0.95.

Additionally, the root mean square error of approximation (RMSEA) shows an acceptable fit (0.076) (acceptable: $0.05 < \text{RMSEA} < 0.08$; Jais, 2006). All descriptions have statistically significant loadings on their factors that vary between 0.60 and 0.95, which is consistent with the five-factor model taken as input from the Exploratory Phase of the research. The average variance extracted (AVE) for each attribute is higher than 0.50. Composite reliability of the attributes was assessed with the Fornell and Larcker criterion (1981). All attribute reliability measures were high (lowest is 0.79 for variety). As expected, all inter-correlations between aesthetic pleasure and its determinants were positive and significant (all $> .31$).

The final five-factor model is depicted in Table 1.

Group Comparisons

Preliminary group comparisons show that the five-factor model that was found in the Exploratory Phase of the research and was confirmed in the Validation Phase, fits for both the Dutch and Australian samples (GFI = 0.891, AGFI = 0.857, NFI = 0.947, CFI = 0.949, RMSEA = 0.056). For the Australian sample, all regression weights were significant and $> .50$. For the Dutch sample all regression weights were significant and $> .70$.

Table 1: Factor loadings for the full five-factor model

	Aesthetic Pleasure	Typicality	Novelty	Unity	Variety
Like to look	,934	,000	,000	,000	,000
Nice to see	,950	,000	,000	,000	,000
Pleasing to see	,943	,000	,000	,000	,000
Attractive	,936	,000	,000	,000	,000
Beautiful	,917	,000	,000	,000	,000
Standard	,000	,874	,000	,000	,000
Common	,000	,903	,000	,000	,000
Representative	,000	,830	,000	,000	,000
Typical	,000	,877	,000	,000	,000
Characteristic	,000	,854	,000	,000	,000
Innovative	,000	,000	,822	,000	,000
New example	,000	,000	,835	,000	,000
Original	,000	,000	,812	,000	,000
Novel	,000	,000	,791	,000	,000
Coherent	,000	,000	,000	,815	,000
Orderly	,000	,000	,000	,878	,000
Unified	,000	,000	,000	,825	,000
Conveys variety	,000	,000	,000	,000	,797
Different parts	,000	,000	,000	,000	,632
Rich in elements	,000	,000	,000	,000	,795

Discussion

Research within the domain of aesthetics lacks a consistent scale to measure the construct of interest: aesthetic pleasure. Thus, this research set out to develop a reliable, valid and generalizable scale to measure aesthetic pleasure in design. Aesthetic pleasure can be measured with the items: "...this is a beautiful [object (e.g., camera)]", "...this is an attractive [object]", "...this [object] is pleasing to see", "...this [object] is nice to see", "...I like to look at this [object]". These items measure the construct aesthetic pleasure, separate from its determinants. This was our aim, because we wanted to create a scale that measures aesthetic pleasure in design that can be used to further advance theoretical knowledge on design aesthetics through studying which factors determine aesthetic pleasure in design.

Data analyses including group comparisons between different countries (including a Taiwanese sample), and product categories are currently underway. In addition, discriminant validity will be tested using constructs measuring emotions and general usability. It is intended that the development of this scale will enable meaningful comparisons between studies of design aesthetics that will help to elucidate the relationships between aesthetic pleasure and its determinants. Thus, the research also has practical implications for guiding designers in creating aesthetically pleasing designs.

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