Computers in Human Behavior 49 (2015) 375–389

Contents lists available at ScienceDirect

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh

Linking objective design factors with subjective aesthetics: An experimental study on how structure and color of websites affect the facets of users' visual aesthetic perception

Mirjam Seckler *, Klaus Opwis, Alexandre N. Tuch

University of Basel, Dept. of Psychology, Cognitive Psychology & Methodology, Missionsstr. 62a, 4055 Basel, Switzerland

ARTICLE INFO

Article history:
Available online 28 March 2015

Keywords:
Aesthetics measures
Aesthetic perception
Web-design factors
VisAWI
Visual aesthetics

ABSTRACT

The present study examines how objective design factors of a website are linked to different facets of subjective aesthetic perception. Five online experiments based upon the screenshots of real-existing websites with a total of $N = 194$ participants were conducted to isolate and analyze the effects of two objective structural factors (vertical symmetry, visual complexity) and three objective color factors (hue, saturation, brightness) on the different facets of subjective aesthetic perception (simplicity, diversity, colorfulness, craftsmanship) measured with the Visual Aesthetics of Website Inventory (Moshagen & Thielsch, 2010). Although all investigated factors are apparent features in website design, their effects on different facets of subjective aesthetic perception are not yet well understood. Our results show that websites of high symmetry, low complexity, blue hue, medium brightness or medium and high saturation received the highest overall aesthetics ratings. Furthermore, data reveal that structural factors compared to color factors have a manifold and greater impact on the different facets of subjective aesthetic perception than the color factors. Both structural factors have a great impact on simplicity, diversity and craftsmanship whereas the color factors have a great impact especially on colorfulness. Only complexity affects all facets of subjective aesthetic perception. The other objective design factors had effects on specific facets. Our findings shed light on the relationship between objective and subjective factors of aesthetic perception and may help designers to systematically target specific facets of visual aesthetics.

1. Introduction

Within the field of human–computer interaction (HCI) and especially in the context of user experience research, the aesthetics of user interfaces has become a topic of major interest. Aesthetic factors beyond traditional usability are increasingly recognized as contributing to the overall user satisfaction (Hartmann, Sutcliffe, & De Angeli, 2007; Schenkman & Jonsson, 2000; Tractinsky, Katz, & Ikar, 2000) and overall success of a product or system (Green & Jordan, 2001; Norman, 2004). Furthermore, numerous studies show the influence of aesthetics on perception of usability (e.g., Phillips & Chaparro, 2009; Thüring & Mahlke, 2007), on usability testing (Sonderegger & Sauer, 2010), on trust and credibility (Karvonen, 2000; Robins & Holmes, 2008), on intention to revisit (Mahlke, 2002; Yoo & Donthu, 2001), and on fun and enjoyment (Mathwick, Malhotra, & Rigdon, 2001).

Previous studies point out that there are two different approaches to measuring visual aesthetics of user interfaces: One is an objective screen-design-based approach and the other a subjective questionnaire-based approach (Altaboli & Lin, 2011a; Mõttus, Lamas, Pajusalu, & Torres, 2013; Tractinsky, Cokhavi, Kirschenbaum, & Sharfi, 2006). The first approach assumes that specific features such as structure and color factors in the interface's design trigger users' perception of aesthetics of the interface. This approach therefore corresponds to the concept of "beauty in the observed object" (Altaboli & Lin, 2011a). An example of this approach is the study of Bauerly and Liu (2006) in which they use computational aesthetic quantification algorithms based on symmetry, balance and quantity of elements of websites and subsequently relate them to subjective aesthetic ratings. The second approach argues that the analysis of aesthetics should view beauty within the subject and not in the object and focuses therefore on the users' subjective perception of aesthetics. As an example for this approach, Lavie and Tractinsky (2004) developed a

* Corresponding author at: University of Basel, Dept. of Psychology, Center for Cognitive Psychology & Methodology, Missionsstr. 62a, CH 4055 Basel, Switzerland. Tel.: +41 (0) 61 267 06 17; fax: +41 (0) 61 267 06 32.

E-mail addresses: mirjam.seckler@unibas.ch (M. Seckler), klaus.opwis@unibas.ch (K. Opwis), a.tuch@unibas.ch (A.N. Tuch).

http://dx.doi.org/10.1016/j.chb.2015.02.056
0747-5632/

questionnaire to measure the visual aesthetics of websites. They were able to show that users' subjective aesthetic perception of websites consists of two main aesthetic facets, which they termed "classical" and "expressive" aesthetics.

Although highly relevant for web design, there has been little effort in systematically combining the two approaches. Many studies only investigated a single objective design factor on its influence on multiple subjective facets (e.g., Cai & Xu, 2011; Michailidou, Harper, & Bechhofer, 2008; Tuch, Bargas-Avila, & Opwis, 2010) or multiple objective design factors on a global aesthetic dimension or a single aesthetic facet (e.g., Purchase, Freeman, & Hamer, 2012; Reinecke & Gajos, 2014; Reinecke et al., 2013; Wu, Chen, Li, & Hu, 2011). The few studies that assessed multiple objective screen-based measurements of websites (e.g., symmetry) and correlated them to different dimensions of users' subjective aesthetic perception did not find consistent results (Altaboli & Lin, 2011a, 2011b; Mõttus et al., 2013). Previous research, furthermore, lacks experimental studies that ensure that the investigated design factors are not confounded with other factors. There are several studies who applied computational modeling with a high number of stimuli and participants to predict the aesthetics of a website (e.g., Ivory, Sinha, & Hearst, 2001; Reinecke & Gajos, 2014; Reinecke et al., 2013), however, these studies are only correlational and potential confounding variables are not identifiable. Consequently, how different objective design factors affect different facets of subjective aesthetic perception is not well understood.

We conducted five experimental online studies in which we systematically manipulated five different objective design factors on 25 different websites and measured their effects on different facets of users' subjective aesthetics perception. The five factors included structural elements (symmetry and complexity) as well as color characteristics (hue, saturation and brightness). With our study we make the following two contributions: (1) By combining the objective factors with different facets of subjective aesthetic perception, we achieve a better understanding about how well qualified the objective screen-design-based approach is for assessing users' perception of interface aesthetics. In doing so, we gain insight into how the subjective facets of aesthetics are formed by different objective factors. (2) From a practical point of view, our findings may help interface designers to find better layout and color solutions by systematically targeting specific facets of visual aesthetics.

2. Theoretical background

2.1. Measurement approaches to studying aesthetic perception

There are two measurement approaches to studying aesthetic perception, as laid out in the Introduction. First, the objective screen-design-based approach relates screen design factors and layout elements to the users' perception of visual aesthetics (e.g., Kim, Lee, & Choi, 2003; Tuch et al., 2010). Early attempts to identify attributes of objects that may critically influence aesthetics (e.g., Berlyne, 1960; Birkhoff, 1933; Eysenck, 1941) were inspired by the objectivist perspective on aesthetics (Moshagen & Thielsch, 2010). Measurement methods for this approach use simple numerical counts of visual features on the screen (e.g., number of words or images) or more complex mathematical formulas (e.g., complexity or symmetry). Michailidou et al. (2008) used the structural elements (such as text, tables, links, and images) of a web page and their characteristics (such as color and size) to determine its visual presentation and complexity level. Ngo and Byrne (2001) developed 14 objective measures of screen aesthetics such as symmetry, simplicity and order. Bauerly and Liu (2006) also objectively quantified symmetry and balance of web pages to investigate their effects on subjective aesthetic perception.

Second, there is the subjective approach that uses questionnaire-based instruments to measure users' perception of visual aesthetics (e.g., Lavie & Tractinsky, 2004; Moshagen & Thielsch, 2010). Due to the complexity and inter-relationships among screen design elements, this approach argues that the analysis of aesthetics should view beauty within the subject and not in the object (Lavie & Tractinsky, 2004). Two widely accepted measurement methods from this approach are the classical and expressive aesthetic scales (Lavie & Tractinsky, 2004) and the visual aesthetics of websites inventory (VisAWI; Moshagen & Thielsch, 2010).

Lavie and Tractinsky (2004) found two dimensions of perceived website aesthetics, termed "classical aesthetics" and "expressive aesthetics". The authors conducted multiple studies where participants evaluated websites on different adjectives. Adjectives such as clear, organized and pleasant showed high loading in exploratory factor analysis for the classical dimension. Adjectives such creative, colorful, original are linked to the expressive aesthetics dimension and show the designers' creativity and originality and to the ability to break design conventions.

Moshagen and Thielsch (2010) developed a new measure covering broader aspects of perceived interface aesthetics. Their instrument has 18 items and captures four different facets of the user's subjective visual aesthetic perception. The facet "simplicity" is strongly correlated to the "classical aesthetics" and the facet "diversity" is strongly correlated to the dimension "expressive aesthetics" from Lavie and Tractinsky (2004). Beside these, Moshagen and Thielsch (2010) postulate "colorfulness" and "craftsmanship" as new, discrete facets. "Colorfulness" comprises items related to the evaluation of individual colors and their composition and "craftsmanship" reflects whether the site has a harmonious design and uses modern technologies (Moshagen & Thielsch, 2010).

2.2. Linking objective web-design factors to facets of subjective aesthetic perception

Although there is a considerable amount of research into objective design factors and subjective facets, there are only a few studies combining these approaches (see Table 1 for an overview). On one hand, many studies only investigated a single design factor. Michailidou et al. (2008) found a negative correlation between visual complexity and classical and expressive aesthetics. Tuch et al. (2010) could show in an experimental study that the perception of classical and expressive aesthetics is also affected by vertical symmetry. Coursaris, Swierenga, and Watrall (2008) as well as Cai and Xu (2011), furthermore, focused on how color factors influence subjective aesthetic perception. Both studies found an effect of color on expressive aesthetics. However, Coursaris et al. (2008) could not find an effect on classical aesthetics. On the other hand, there are authors who investigated multiple objective design factors but used only one subjective aesthetic measure such as a single-item scale or a general aesthetic score (e.g., Purchase et al., 2012; Reinecke & Gajos, 2014; Reinecke et al., 2013; Wu et al., 2011).

Altaboli and Lin (2011b) made a first attempt by systematically investigating the effect of multiple different objective web-design factors (balance, unity and sequence) on facets of subjective aesthetic perception. They were able to show that the objective factors affected users' perception of classical and expressive aesthetics as well as the four facets of the VisAWI in different ways. The validity of these findings, however, is somewhat unclear because the study had a correlational design. In a further study, the same authors assessed eight different objective screen-based measurements (e.g., symmetry, balance, rhythm) and correlated them to the same