



The role of non-visual aesthetics in consumer product evaluation[☆]

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ABSTRACT

The present article addresses the impact of non-visual aesthetics of consumer products on the outcomes of usability tests such as perceived usability, user performance and user affect. Building on the research surrounding the impact of visual aesthetics in usability testing, the present work aimed to determine whether the same pattern of effects repeatedly found for visual aesthetics will also be found for non-visual aesthetics. A series of three experiments was carried out, all examining sound and touch as two prominent dimensions of non-visual aesthetics. To increase the robustness of the results, the experiments were conducted with three different consumer products, which were a smartphone ($N=60$), vacuum cleaner ($N=60$), and video racing game ($N=60$). Although manipulation checks confirmed that users generally experienced both sound and tactile product properties as intended by the experimental manipulation, in none of the studies the results showed an effect on perceived usability. Other outcome variables such as affect and performance showed a few selected effects. Overall, this suggests that findings from the field of visual aesthetics cannot be easily transferred to the domain of non-visual aesthetics. The findings of the present studies are discussed within the framework of Schifferstein's work on sensory dominance.

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1. Introduction

The work of Kurosu and Kashimura (1995) and of Tractinsky et al. (2000) has established an important new research strand addressing the relationship between visual aesthetics and usability. Their work showed for the first time that the aesthetic properties of a product had an influence on how its usability was perceived by users. This finding has had important implications for the use of product evaluation methods like usability testing since it demonstrated that the outcomes of product evaluation (e.g. perceived product usability) can be influenced by aesthetic properties although they are by definition unrelated to aesthetic product properties. While the link between visual aesthetics and perceived usability has received increasing attention in the research community in the past decade, the link between visual aesthetics and measures relevant in human-computer interaction (e.g. perceived and objective performance, emotions) has received less interest. Including measures of performance and emotion when examining the influence of aesthetics in human-computer interaction is essential for a better understanding of the user experience, especially against the background of recent changes in human-computer interaction. A mere

functional view of the user-system interaction has been extended to a more holistic approach, addressing the whole user experience with a stronger focus on user emotions such as fun, pleasure and frustration (Norman, 2004).

Virtually all empirical work in that research strand has focused on visual aesthetics while other senses (e.g., taste, smell, hearing and touch) have been largely neglected. Against this background, theoretical and empirical work has addressed the relative importance of the different sensory systems when product features are evaluated (Schifferstein, 2006). Across a range of consumer products, Schifferstein's work found the following overall rank order of senses with regard to their importance: vision, touch, smell, hearing, and taste. However, there were considerable differences between products in the rank order, showing that for about half of the products one of the non-visual senses was considered to be more important for evaluation than the visual sense (e.g. for a vacuum cleaner it was audition and for a computer mouse it was touch).

The relative importance of different sensory modalities in product evaluation might hint at a potential effect of non-visual aesthetics on outcome measures of usability tests, similar to the effect of visual aesthetics. Since previous research on visual aesthetics has shown that validity and reliability of usability evaluation methods are influenced by visual aesthetics (see Sonderegger et al., 2012), a similar effect of non-visual aesthetics would imply for usability practitioners that they need to control for non-visual aesthetics in usability tests. Furthermore, very little

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is known so far about the influence of non-visual aesthetics on the outcomes of usability tests, such as perceived usability, user performance, emotion, and perceived workload. Therefore, in the present article three experiments are reported in which the influence of non-visual aesthetics in usability testing is evaluated. They all adopted a broad methodological approach by measuring a large range of variables relevant in usability testing. The results may then be compared to the findings in the research literature on the effects of visual aesthetics in usability tests.

1.1. Visual aesthetics in product evaluation

The influence of the aesthetic appeal of a product on perceived usability has been well researched, producing a rather consistent pattern of findings, with more attractive products also being considered to be more usable (Tractinsky, 2013). The positive effect of aesthetic appeal has been found across a range of national cultures, including Japan (e.g., Kurosu and Kashimura, 1995), Israel (e.g., Tractinsky et al., 2000), Switzerland (e.g., Tuch et al., 2010), Germany (e.g., Thüring and Mahlke, 2007), and United Kingdom (e.g., De Angeli et al., 2006). Furthermore, the positive effect of aesthetic appeal has been found across a range of products, including mobile phones (e.g., Quinn and Tran, 2010), cash machines (e.g., Tractinsky et al., 2000), web pages (e.g., De Angeli et al., 2006; Van Schaik and Ling, 2008, 2011) and digital audio players (e.g., Thüring and Mahlke, 2007). As a theoretical explanation for the positive relationship between aesthetics and perceived usability, the halo effect has often been cited (e.g., Tractinsky et al., 2000; Hartmann et al., 2008). It refers to a rater's tendency to overestimate the association between different traits or behaviours of a person that are actually independent (e.g. the judgement of a researcher's quality of teaching could be influenced by the same person's research record). One example for a halo effect is the "what is beautiful is good"-stereotype (Dion et al., 1972), describing the phenomenon that certain salient features of a person (e.g., physical attractiveness) have an influence on the perception of less salient features (e.g. intelligence, personality). The empirical findings mentioned above suggest that the halo effect is not limited to characteristics of humans but also seems to apply to product properties. Recent empirical work also suggests a moderating influence of the general evaluation of the product ('goodness') on the link between visual aesthetics and perceived usability (Hassenzahl and Monk, 2010; van Schaik et al., 2012). While goodness is an interesting concept, it appears not to be well defined, relying only on a single-item measure. In addition, the work addressing the influence of goodness is based on correlation studies only so that the cause-effect relationships between the different concepts could not yet be established. Other work put forward moderating variables such as affect and emotions (Thüring and Mahlke, 2007; Porat and Tractinsky, 2012), arguing that affective states need to be considered when addressing the influence of aesthetics in usability tests. In their components of user experience model (CUE), Thüring and Mahlke (2007) suggest that the interplay of instrumental (e.g. effectiveness) and non-instrumental experiences (e.g. visual and haptic quality) and the emotional reactions to those experiences influence the product evaluation.

In contrast to the robust relationship between aesthetics and perceived usability, the effects of aesthetics on performance have been characterised by some inconsistency. Most often, it was assumed that aesthetics had a positive influence on performance as predicted by the affect mediation model (e.g., Norman, 2004; Moshagen et al., 2009). It suggests that positive aesthetic experience is associated with positive affect. This might influence motivational and behavioural processes (Ashby et al., 1999; Isen, 2001) and is expected to increase user performance. Similarly, a positive effect on performance for aesthetically pleasing products was predicted

by the 'increased motivation'-hypothesis (Sonderegger and Sauer, 2010). While such a positive link between aesthetics and performance was demonstrated by several studies (e.g., Moshagen et al., 2009; Sonderegger and Sauer, 2010; Quinn and Tran, 2010), other studies reported no effect of aesthetics on performance (e.g., Chawda et al., 2005; Hartmann et al., 2007; Thüring and Mahlke, 2007). A third cluster of studies showed exactly the opposite pattern, that is, when using an aesthetically pleasing product, user performance decreased (e.g., Ben-Bassat et al., 2006; Sauer and Sonderegger, 2009, 2011). An attempt to explain the negative association between aesthetics and performance in some studies is the 'prolongation of joyful experience'-hypothesis (Sonderegger and Sauer, 2010). It suggests that when users have been distracted by the beauty of the consumer product, they have concentrated less on the task, resulting in decreased user performance. The inconsistent pattern of effects suggests the existence of moderating factors that may have contributed to the conflicting findings. For example, the performance focus of a usage situation may play a moderating role (Rheinberg et al., 2007; Sonderegger et al., 2014). In a domestic work context (e.g. vacuum cleaner usage) with a high need for efficient task performance, an appealing product may increase the user's motivation for efficient task performance. Conversely, when using an appealing interactive product in a leisure context (e.g. video game usage), it may lead users to wish to prolong this pleasant experience (Sonderegger et al., 2014).

In addition to perceived usability and performance, research has examined further outcome variables that might be influenced by aesthetic appeal, such as the affective state of the user. While the goal of usability testing initially was to evaluate the functional qualities of a product, experiential aspects such as fun and pleasure have become increasingly important in product evaluation (Desmet and Hekkert, 2007). The aesthetic experience is expected to have an impact on the affective states of the user of an artefact (Leder et al., 2004). In HCI research, aesthetic appeal was generally positively related to users' affective states (Thüring and Mahlke, 2007; Sonderegger et al., 2012; Cai and Xu, 2011; Porat and Tractinsky, 2012). Affect may also play an important role in the modulation of motivational and behavioural processes and thus influences user behaviour in usability tests (Moshagen et al., 2009; Sonderegger and Sauer, 2010).

A further measure to be considered in usability evaluation is the subjective evaluation of mental workload (Jordan, 1998). Mental workload has also been considered as an objective indicator for usability (e.g. van Schaik and Ling, 2009). However, previous research has shown that measures of mental workload are often considerably correlated with subjective measures of usability (e.g. meta-analysis of Hornbæk and Law, 2007). Little is known about its association with visual aesthetics, though one study indicated that visual aesthetics did not show an influence on mental workload (van Schaik and Ling, 2009).

For the purpose of the present work, the most relevant finding from the research literature is the highly consistent relationship between visual aesthetics and perceived usability, which was even unaffected by the cultural background of the user and the particularities of specific consumer products. This established relationship is of particular relevance because it raises the important question of whether such a finding could also be observed for the non-visual sensory systems. Among the non-visual sensory systems, we will focus on the auditory and haptic sense. This is because for many interactive products, hearing and touching are of particular importance for user-product interaction (Mahlke et al., 2007).

1.2. Auditory aesthetics

The perception of sound is a complex process (Baldwin, 2012). Perception is largely influenced by the two main physical

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