Visual aesthetics and the user experience

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ABSTRACT
This paper describes the outcomes of a project that focused on the integration of non-instrumental qualities like aesthetic and symbolic aspects and emotional user reactions with traditional, instrumental-focused approaches to users' experience of interaction. A research framework is described that conceptualizes user experience as a phenomenon consisting of instrumental and non-instrumental quality perceptions as well as emotional user reactions. Methodological consequences are discussed in particular for the measurement of visual aesthetics of interactive systems. Selected results of two studies are reported that addressed the influence of perceived usability and visual aesthetics on emotional user reactions and consequences of user experience and studied the effect of user characteristics and contextual parameters on these relations.

Author Keywords
User experience, non-instrumental qualities, visual aesthetics, emotional user reactions.

ACM Classification Keywords
H5.2. Information interfaces and presentation: user interfaces: user-centered design.

INTRODUCTION

To date, various approaches to the evaluation of interactive systems go beyond the notion of efficiency and aim to better understand how people experience technology. In this regard, two important concepts have been explored in particular: emotions and non-instrumental qualities (Hassenzahl & Tractinsky, 2006).

The term emotional design has received significant attention (Norman, 2004). For example, Desmet & Hekkert (2002) presented an explicit model of emotions according to product perceptions. Zhang & Li (2005) studied the concept of affective quality as the ability of interactive systems to cause changes in the user's affective state.

Non-instrumental qualities can be described as quality aspects that address user needs that go beyond tasks, goals and their efficient achievement (Hassenzahl, 2006). Different approaches to non-instrumental qualities can be found in the literature. Jordan (2000) argued for a hierarchical organization of user needs and claimed that along with the functionality and usability of the product, different aspects of pleasure are important to enhance the user's interaction with it. Further analyses studied selected non-instrumental quality aspects of interactive systems in detail, such as hedonic quality (Hassenzahl, 2003) and visual aesthetics (Lavie & Tractinsky, 2004).

Visual aesthetics is one important dimension of non-instrumental qualities. Liu (2003) proposes that a discipline of engineering aesthetics should address two major questions: first, how to use engineering and scientific methods to study aesthetic concepts in system and product design, and second, how to incorporate engineering and scientific methods in the aesthetic design and evaluation process beyond designers' intuitions.

A few early studies addressed these request. Burmester, Platz, Rudolph and Wild (1999) have studied the influence of visual aesthetic design on users' quality perceptions by using a traditional version of a user interface and one that was worked over completely by a designer to find that the later version received higher rating with respect to quality impression, apparent usability and superiority. Kleiss and Enke (1999) conducted a study to identify the visual appearance attributes of automotive audio systems that impact users' judgments. The results reveal specific visual appearance attributes that contributed separately to the perception of stylish appearance and to the perception of quality. Schenkman and Jönsson (2000) have studied users' first impressions of websites and found that beauty was the best predictor for the overall judgment.

Other studies focus on specific design dimensions to improve aesthetic quality. Park, Choi and Kim (2004) conducted empirical studies with professional web designers and users to identify critical factors for the visual aesthetics of websites. They identified thirteen aesthetic dimensions and instructed designers to design example websites with respect to selected dimensions. They found that users rated the quality on a specific aesthetic dimension higher if the designer had focused on it. Laugwitz (2001) concentrates on the impact of the use of color on aesthetic perceptions in the context of software systems and found interrelations between system properties and users' judgments. Leder and Carbon (2005) report a study in which the influence of stimulus properties on the appreciation of car interiors is investigated. Three design components (complexity, curvature, and innovativeness),

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which were all thought to affect design appreciation, were combined in a fully factorial design. All dimensions were confirmed to affect users' ratings. In particular curvature and innovativeness affected the attractiveness ratings. Curved and non-innovative designs were generally preferred.

These examples demonstrate how to studiy visual aesthetics in human-technology interaction. The project described in the following aimed at better understanding users' experience of interaction and took into account visual aesthetics as one aspect of user experience. In this paper, I will demonstrate how visual aesthetics can be incorporated into a model of user experience, discuss available methods to measure the perception of visual aesthetics in HCI, present selected results on the role of aesthetics as part of user experience and discuss important topics for the research of visual aesthetics in human-technology interaction.

THE USER EXPERIENCE RESEARCH FRAMEWORK

In Mahlke & Thüring (2007) we describe an integrated research approach to the experimental study of emotional user reactions in consideration of instrumental and non-instrumental quality perceptions of interactive systems (Figure 1).

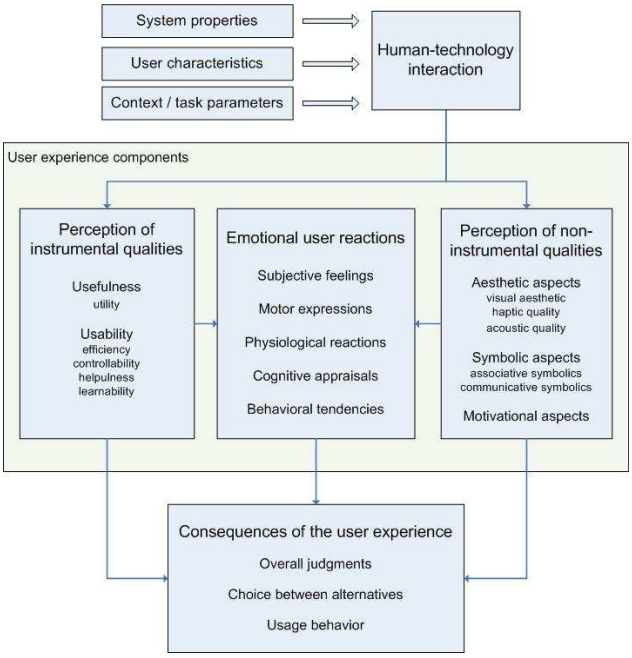

Figure 1. User experience research framework.

A model is presented that defines instrumental and non-instrumental quality perceptions as well as emotional reactions as three central components of the user experience. Characteristics of the interaction impact these three components. Interaction characteristics primarily depend on system properties, but also user characteristics and context parameters can play an important role. The actual consequences of the user's experience of an interaction, meaning the overall judgments of a product, usage behavior or user preferences are defined as outcomes of all three central components of the user experience.

Instrumental and non-instrumental qualities are defined in more detail (Thüring & Mahlke, 2007). Aesthetic aspects of non-instrumental quality are divided into various dimensions related to the human senses. Visual, haptic, and acoustic perceptions are most relevant in human-technology interaction and therefore stated in the model. Visual aesthetics of products is defined as the extent to which sensory (e.g. colors, see Laugwitz, 2001) and formal (e.g. shapes, see Leder & Carbon, 2005) attributes of a product provide positive visual experiences for the user (Lang, 1988). Process theories can be used to explain the visual aesthetic experience in more detail (Lindgaard & Whitfield, 2004; Leder et al., 2004; Reber et al., 2004; Hekkert et al., 2003).

METHODOLOGICAL ASPECTS

Visual aspects of products have often been stated as most relevant for users' aesthetic response (Bloch, 1995). Various approaches exist to assess the visual aesthetics of interactive products. For example, Kleiss and Enke (1999) used 18 pairs of bipolar attributes to assess the visual appearance of automotive audio systems. Nonetheless, like in other approaches some of the items also represent instrumental and symbolic qualities. Schenkman and Jönsson (2000) used seven variables to assess visual aesthetics: complexity, legibility, order, beauty, meaningfulness, comprehension, and overall impression. However, each variable is only represented by one item and the names of the concepts seem somehow ambiguous.

Lavie and Tractinsky (2004) present the most validated approach to the measurement of visual aesthetics in human-technology interaction. They developed a questionnaire based on four empirical studies that consists of two main dimensions of visual aesthetics, which they named 'classical aesthetics' and 'expressive aesthetics'. The classical aesthetics dimension pertains to aesthetic notions that emphasize orderly and clear design. The expressive aesthetics dimension is manifested by the designers' creativity and originality and by the ability to break design conventions. To measure each of the dimensions they give a five-item scale. One weakness of this approach is outlined by Hassenzahl (2007). He argues that the dimension of expressive aesthetics measures more symbolic or motivational aspects that are conveyed by visual attributes of an interactive product than directly focusing on aesthetic aspects. Nonetheless, the dimension of classical aesthetics proposed by Lavie and Tractinsky (2004) can be considered as one validated dimension to measure visual aesthetics in human-technology interaction.

EMPIRICAL RESEARCH

Selected results of two studies are reported that used the dimension of classical aesthetics proposed by Lavie and Tractinsky (2004) to better understand the relation of perceived visual aesthetics to the perception of usability, emotional user reactions and consequences of the user experience.

Study 1

Simulations of portable audio players were designed to influence the perceptions of instrumental and non-instrumental qualities experimentally and independently (Mahlke & Thüring, 2007). To produce two versions with different impact on perceived instrumental qualities, the information presentation on the display was varied (the number of simultaneously discernible menu lines: five versus two, a scrollbar on the left side as indicator for available but hidden menu items: given or not, and a cue about the actual position in the menu hierarchy at the top of the display: given or not). With respect to system features that should influence the perception of non-instrumental qualities, we manipulated the visual aesthetics by creating two different body designs (symmetry: high and low, color combination: low and high color differences, and shape: round and square). The variations resulted in four different combinations: (a) 'high usability' and 'high aesthetics', (b) 'high usability' and 'low aesthetics', (c) 'low usability' and 'high aesthetics', (d) 'low usability' and 'low aesthetics'.

Forty-eight individuals participated in the study. All participants tested two of the simulations. Five short tasks were given to the participants for each version. Before accomplishing the tasks, subjects rated the visual aesthetics of the version. During task completion, heart rate and dermal activity as physiological measures as well as an EMG to assess facial expressions were applied. After completing each task, participants filled in a scale to measure subjective feelings. When all tasks were finished, the usability of the system was rated, and finally the two system versions were ranked.

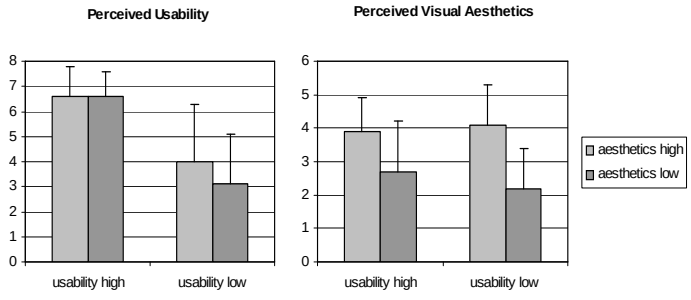

Figure 2. Perceived usability and visual aesthetics ratings for the four conditions.

The results showed that the variations of usability as well as aesthetics had the predicted impact on the perception of both types of qualities (Figure 2). Systems with features associated with a high degree of usability and attractiveness received better ratings than their impaired counterparts. No interaction effect was found for neither of the variables.

The results of the subjective feelings questionnaire revealed that the effect of usability was greater than the one of visual aesthetics for both the valence and the arousal of the subjective feelings. Consequently, the system of high usability and appealing design was experienced as most satisfying, while the system of low usability and least attractiveness was most annoying. Since no statistical interaction of usability and aesthetics was found, both factors contributed to these emotions additively (Figure 3).

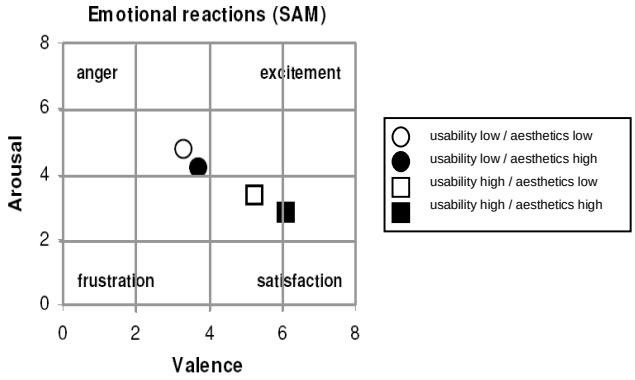

Figure 3. SAM ratings for the four systems (squared high vs. round low usability; filled high vs. unfilled low aesthetics).

Finally, the overall judgments pointed in the same direction as the ratings of perceived qualities and emotions, and revealed a greater impact of usability on the overall appraisal of the systems (Figure 4).

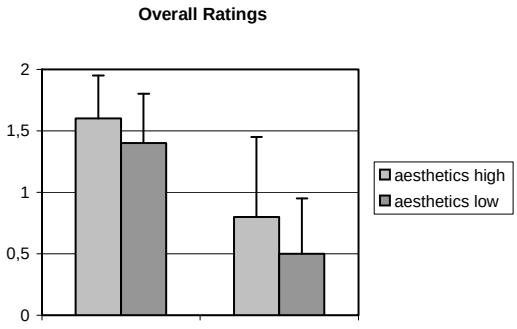

Figure 4. Overall ratings for the four conditions.

Study 2

In a second study, four similar simulations of portable audio players were used that differed in usability and visual aesthetics (Mahlke & Lindgaard, 2007). Furthermore, contextual parameters were varied. In a goal-mode participants had to accomplish given tasks, while they had the same amount of time to explore the system on their own in an action-mode (Hassenzahl & Ullrich, 2007).

Additionally, data was collected in two cultural settings (North America and Europe) to address differences in user characteristics and users' centrality of visual product aesthetics (CVPA) was taken into account (Bloch, Brunel & Arnold, 2003). The same methods as in Study 1 were used to measure the components of user experience.

Study 2 replicated the results regarding the independence of the influence of the perception of instrumental (i.e. usability) and non-instrumental qualities (i.e. visual aesthetics) and their influence on emotional user reactions and overall judgments.

Furthermore, Study 2 demonstrated the relevance of user characteristics and contextual parameters. The influence of centrality of visual product aesthetics on the interrelations of user experience components was demonstrated. The influence of perceived visual aesthetics on subjective feelings was higher for users with a high CVPA value (Table 1). A similar effect was found for overall judgments.

Table 1. Regression analysis of subjective feelings using usability and visual aesthetics ratings as predictors – overall, only for high and only for low CVPA.

Predictors	Overall		High CVPA		Low CVPA	
	Valence	Arousal	Valence	Arousal	Valence	Arousal
Perceived usability	.44 ***	-.19 *	.32 **	-.15	.54 ***	-.23
Perceived aesthetics	.20 **	.12	.32 **	.21	.08	.02
R^2	27 %	3 %	25 %	2 %	30 %	3 %

* p < .05; ** p < .01; *** p < .001

The usage situation as an example of context variation showed additional impact. The influence of perceived visual aesthetics on subjective feelings was higher for users in action-mode than in goal-mode (Table 2). Again, a similar effect was found for overall judgments.

Table 2. Regression analysis of subjective feelings using usability and visual aesthetics ratings as predictors - overall, only for goal-mode and only for action-mode.

Predictors	Overall		Goal-mode		Action-mode	
	Valence	Arousal	Valence	Arousal	Valence	Arousal
Perceived usability	.44 ***	-.19 *	.57 ***	-.10	.34 **	-.30 *
Perceived aesthetics	.20 **	.12	.04	- .05	.33 **	.32 **
R^2	27 %	3 %	33 %	1 %	28 %	11 %

* p < .05; ** p < .01; *** p < .001

CONCLUSIONS

In the user experience framework, no direct link between instrumental and non-instrumental quality perceptions is made, although previous empirical studies have shown an influence of visual aesthetics on perceptions of usability (Tractinsky et al., 2000). However, Hassenzahl (2007) explains these findings as a result of attribute overlap. He argues that it is possible that already the system attributes that have been varied to influence visual aesthetics are also related to usability. Furthermore, other studies have not replicated these interrelations (Lindgaard & Dudek, 2003).

The findings of Studies 1 and 2 demonstrate that it is possible to manipulate groups of system properties, which either influence instrumental or non-instrumental quality perceptions. In this case, properties that are associated with information presentation had an impact on the perception of usability and system properties related to product appearance determined users' perceived visual aesthetics. In this way, it was possible to resolve the problem of attribute overlap and to demonstrate that instrumental and non-instrumental quality perceptions occur independently. Therefore, the suggestion by Tractinsky et al. (2000) who claim what is beautiful is usable has to be reconsidered.

The studies also show the relevance of perceived visual aesthetics for emotional user reactions and consequences of user experience. However, the relation of perceived visual aesthetics and emotional aspects of user experience have to be studied further. Various authors discuss a direct influence of the interaction on affective components of user experience. For example, Hassenzahl (2006) differentiates emotions as consequences of product use and affective reactions. Referring to Zajonc (1980) and Schwarz and Clore (1983), he describes how affective reactions can influence the cognitive processing of information about the interactive product. These affective reactions may in particular play a role in the perception of aesthetic aspects since aesthetic appreciation is often described as a partly affective process (Hassenzahl, 2007).

From my point of view, further challenges regarding visual aesthetics in human-technology interaction that should be addressed in the future are the role of inter-individual differences of aesthetic judgments that seem more important as for example in comparison to the perception of usability issues and the consideration of visual aesthetics in interactive system design projects.

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