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**The role of context in perceptions of the aesthetics of web pages over
time**

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Abstract

An important aspect of the empirical study of user experience is the process by which users form aesthetic and other judgements of interactive products. The current study extends previous research by presenting test users with a context (mode of use) in which to make their judgements, using sets of web pages from specific domains rather than unrelated pages, studying the congruence of perceptions of aesthetic value over time, including judgements after use of a web site, manipulating the aesthetic design of web pages and studying the relationship between usability and aesthetic value. The results from two experiments demonstrate that context increases the stability of judgements from perceptions after brief exposure to those after self-paced exposure and from perceptions after self-paced exposure to those of after site use. Experiment 1 shows that relatively attractive pages are preferred over relatively unattractive pages after brief exposure, but only if no context is provided. Experiment 2 shows that after brief exposure, classically aesthetic pages that are information-oriented are rated as more attractive than expressively aesthetic pages. Perceptions are not correlated with measures of task performance or mental effort. We conclude that context is a pivotal factor influencing the stability of users' perceptions, which must be explicitly addressed in the study of users' product experience. Furthermore, the type of aesthetics that is relevant to users' perceptions appears to depend on the application domain. The principle 'what is beautiful is usable' is not confirmed.

Keywords: user experience; aesthetics; web site; product experience; context

Word count of manuscript: 6558

1. Introduction

The empirical study of 'user experience' is increasingly recognised as an important aspect of human-computer interaction (Hassenzahl & Tractinsky, 2006). The process by which users form aesthetic and other judgements of interactive products is an important aspect of this research (Hassenzahl & Tractinsky; Hassenzahl, 2003; 2004). Naturally, this process is important for the success of web sites in attracting potential users' attention in the first place, where they make an immediate judgement of the attractiveness (within half a second; Lindgaard et al., 2006) of the first page of a site that they encounter - frequently the homepage - and if this judgement is unfavourable then the web site in question may not be considered further. Next, following an immediate positive judgement, users must then make a further, more considered, positive initial deliberate judgement (within about 10 seconds; Tractinsky et al., 2006) of this first page before they start interacting with the site. This stage is also an essential condition for success; otherwise users will again turn away from the site before actually using it. Finally, positive perceptions of a web site after use are crucial to ensure that users will consider returning to the site in the future.

Some research has investigated the very early stages of the process by which users form aesthetic judgements. Lindgaard et al. (2006) and Tractinsky et al. (2006) investigated the congruence of perceptions of web pages after a brief exposure and after self-paced exposure or a fixed exposure of 10s. Lindgaard et al. found that perceptions after brief exposure (aesthetic impressions), when web pages were presented for 500ms or 50ms, were stable. They also found that perceptions after a brief exposure were positively correlated with deliberate perceptions (after viewing web pages without a time limit). The stability of perceptions after a brief exposure (i.e. ratings after 500ms exposure) were positively correlated with those made after 10s, was confirmed by Tractinsky et al. (2006).

However, both studies presented web pages from a wide range of unrelated domains without presenting a context of use and did not include a test of users' use of web sites and, consequently, did not examine their perceptions after use. Lindgaard et al.'s and Tractinsky et al.'s results may be explained by Schwarz and Clore's (1983) 'affect-as-information' approach (see Hassenzahl, 2008): judgements of aesthetics are immediate affect-driven responses to the visual Gestalt of an object and other judgements may use this as further input. In this approach, the size of correlation between judgements after brief exposure and those after longer exposure depends on the amount of additional processing taking place and the less additional processing the higher the correlation. As the pages displayed in these two studies were unrelated and (consequently) presented without a context, little additional processing would be expected and therefore a high correlation would be predicted.

Regarding context of use, previous work (Hassenzahl, 2003; Hassenzahl & Ullrich, 2007) has introduced the concept of *mode of use* to describe the mental state of a user in relation to a product or system. According to Hassenzahl (2003, p.39), "usage *always* [emphasis in original] consists of behavioural goals and actions to fulfil these goals". When human-system interaction occurs in goal mode, users focus on the accomplishment of goals and the product is just 'a means to an end' (Hassenzahl, 2003, p. 39). In action mode, users focus on actions and the product can be 'an end in itself' (Hassenzahl, 2003, p. 40). The particular mode of use is triggered by the situation in which the product is used and users' perceptions of the system are expected to depend on the mode in which they approach the system. In particular, users' perceptions may be influenced by their judgement of the extent to which the system will support their goals or actions and may be more consistent when judgements are made in a particular mode of use. If users have no

information about their goals or actions and are not even contemplating system use, their perceptions could be very different.

In relation to the stability of perceptions over time, Tractinsky et al. (2006) found that users' perceptions were stable from a 500ms exposure to 10s exposure. Yet, how stable these perceptions continue to be beyond such exposure times and in particular after system use remains uncertain. Previous work (Hassenzahl, 2004) suggests that judgements of aesthetic value rather than of ease of use should remain stable because use of a web site does not add further information about the aesthetic value of the homepage. However, use could provide more information about the aesthetic value of the site as a whole, depending on the similarity of the homepage and the remaining pages and, according to Hassenzahl, should provide additional information about its ease of use.

Lavie and Tractinsky (2004) distinguished between two main types of aesthetic design and aesthetic perception - classical and expressive - based on their extensive analysis of existing research and their own empirical investigation of people's perceptions of web pages. Classical aesthetics is characterised by order (regular or harmonious arrangement) and familiarity, increases understanding and sense-making, and reduces ambiguity. Expressive aesthetics, on the other hand, is characterised by complexity, and increases arousal and involvement. Because of the presumed correspondence of design and users' perceptions, differently designed web pages should produce different aesthetic responses. For example, classical design should produce a strong classical-aesthetic response rather than a strong expressive-aesthetic response. However, this congruence of design and perceptions may depend on the appropriateness of the type of design for the content of a particular web site (e.g. users may consider classical aesthetics, but not expressive aesthetics, an appropriate dimension for judging information-oriented pages).

There is a fundamental difference in presumed causality between Hassenzahl and Tractinsky, and the relationship between usability and aesthetic value remains unresolved (see e.g. Tractinsky et al., 2000; Hassenzahl, 2004, 2008). Tractinsky et al. assume that good aesthetic design will influence perceived usability positively, based on the principle 'What is beautiful is good' (Dion, Berscheid & Walster, 1972). However, the research that claimed support for this principle (Tractinsky et al., 2000) suffered from methodological problems (e.g., see Hassenzahl, 2004). Others (e.g. Hassenzahl, 2003, 2004) believe that aesthetics and usability are independent and that they both contribute to a user's perception of the overall quality of an interactive system. At the level of an individual user, products can produce pleasure-inducing arousal fluctuations (stimulation); fluctuations are mainly determined by comparison of stimulus elements, such as complexity, or aspects of experience, such as novelty (Berlyne, 1971). At a social level, product use operates to confirm (aspects of) a user's identity to the user and others (Hassenzahl, 2004). Other mechanisms of the aesthetic effect of products on a user's experience of aesthetic value include the following. First, preferences can depend on the categories to which a stimulus belongs as judged by the perceiver and therefore preferences for particular prototypical artefact characteristics develop (McManus & Weatherby, 1997) that can presumably be independent of usability (given a minimum required level of usability). Second, an artefact can evoke memories in its users that produce an experience of aesthetic value (Hassenzahl, 2003; Norman, 2004).

To sum up, Lindgaard et al. (2006) and Tractinsky et al. (2006) studied test users' perceptions of homepages after a brief exposure (500ms or less) and after exposure over several seconds. However, these studies did not present test users with a context in which to make their judgements, used web pages from various unrelated domains, did not examine congruence of these perceptions with perceptions after system use, manipulate

the aesthetic design of web pages or study the relationship between usability and aesthetic value. The current study addresses these limitations and was designed to address the following hypotheses in two experiments.

H₁: Aesthetic perception of web pages in a particular domain presented with a context of use (mode of use) is different from that without context (Experiments 1 and 2). The effect of context follows as users' perceptions are expected to depend on the mode in which they approach the system, with more stable perceptions when an explicit context is provided. For instance, Ben-Bassat, Meyer and Tractinsky (2006) provide a demonstration of the context-dependency of aesthetic value. They found that beauty was of no value to the participants (working in goal mode) due to the very performance-oriented task they had to complete with the software.

H₂: Relatively attractive pages are rated higher than relatively unattractive pages, but this depends on context (Experiment 1). Tractinsky et al. (2006) found evidence supporting the hypothesis when 'test users' (who were presented with web pages, but did not use them) were not given a context and were presented with web pages from various unrelated domains. However, the effect of attractiveness may depend on context and, with very brief exposure, the effect may disappear when users have been given an explicit context. With the introduction of context, aspects of the presented page related to actual system use, such as perceived usability, may enter into users' judgement of attractiveness. Thus, the effect of attractiveness is moderated by context. Context may lose its influence in users' perceptions when they have time to deliberately view and judge the aesthetic value of web pages. Thus, the effect of context is moderated by the time of judgement (after a brief self-paced exposure). Furthermore, deliberate perceptions may depend on the type of content and the appropriateness of the type of aesthetics being judged to that content. For

example, users may consider classical aesthetics, but not expressive aesthetics, an appropriate dimension for judging information-oriented pages.

H₃: In perceptions after a brief exposure, classically aesthetic pages of an information-oriented nature are rated as more attractive than expressively aesthetic pages (Experiment 2). The effect of aesthetic design is expected to be moderated by the content of the web pages that are presented. For example, local-government web pages are information-oriented and their users expect this type of content rather than entertainment, for which expressive aesthetics could be more appropriate. Thus, users may consider a judgement about classically aesthetic design more pertinent to these web pages than a judgement about expressively aesthetic design.

H₄: 'What is beautiful is usable' (see Tractinsky et al., 2000) (Experiment 2). Invoking this principle, Tractinsky et al. found a relationship between *perceived* usability and perceived aesthetic value, but the research suffered from methodological problems (Hassenzahl, 2004). Moreover, usability was not measured objectively and therefore the relationship of aesthetic value with *objectively measured* usability could not be established. Furthermore, other conceptualizations of aesthetics (e.g. Hassenzahl, 2003, 2004) are not consistent with Tractinsky et al.'s principle.

Experiment 1 examined the methodological validity of the findings of previous research by studying the effect of mode of use on web users' perceptions and its effect as a moderator on the effect of relative attractiveness of web pages. Experiment 2 studied the longevity of the congruence of perceptions by extending the time span to include system use, investigating the effects of mode of use and aesthetic design as well as the relationship between usability and aesthetic value.

2. Experiment 1

Experiment 1 aimed to test the effect of intended mode of use on perceptions of web sites (rating of attractiveness - as in Tractinsky et al., 2006) after a controlled brief exposure (500ms) in Phase 1 of the experiment. The effect on perceptions (rating of aesthetic quality - as in Tractinsky et al.) after self-paced exposure in Phase 2 was also tested.

2.1. Method

2.1.1. Design

A 3×2 independent measures design was used. The first independent variable was mode of use with three levels: goal mode, action mode and control (in which no instructions indicating mode of use were given). The second independent variable was attractiveness of design with levels of relatively attractive and relatively unattractive (as in Tractinsky et al., 2006). Dependent variables were attractiveness and aesthetic quality (using Tractinsky et al.'s measures).

2.1.2. Participants

There were 125 undergraduate psychology students (105 females and 20 males), with a mean age of 22.08 years (SD = 6.00). They took part in the experiment as a course requirement. All had used the Web. Mean experience using the Web was 8.00 years (SD = 2.14), mean time of confidence in using the Web was 7.42 years (SD = 2.40), mean time per week spent using the Web was 14.34 hours (SD = 12.48) and mean frequency of Web use per week was 11.65 hours (SD = 9.01).

2.1.3. Materials and equipment

Participants gave responses to two questionnaires. In Phase 1 of the experiment, as in Lindgaard et al.'s (2006) Experiments 1 and 2, a single item with endpoints Extremely unattractive and Extremely attractive was used to measure perceptions of attractiveness

using a visual analogue scale (but, contrary to Lindgaard et al.'s study, a midpoint was not shown at the start of a rating). In Phase 2, Tractinsky et al.'s (2006) rating scales were used to measure the quality of classical and expressive aesthetics. There were three statements for classical aesthetics (sophisticated, creative and fascinating) and three for expressive aesthetics (clean, pleasant and aesthetic). Reliability analysis was conducted for each page separately. Responses on all scales were converted to the range [0; 100]. Reliabilities ranged from .77 to .89 for classical aesthetics and from .63 to .84 for expressive aesthetics over all 25 relatively attractive pages and from .71 to .90 for classical aesthetics and .66 to .88 for expressive aesthetics over all 25 relatively unattractive pages. Therefore, the aesthetics scales were judged to be reliable. Correlations between the two types of aesthetics ranged from .54 to .78 for the experimental conditions with relatively attractive web pages and from .41 to .79 for the conditions with relatively unattractive web pages. These results indicate a moderate to strong association, but the two constructs were not identical.

The home pages of 62 English local-government Web sites were captured at a resolution of 1024×768 pixels saved as 24-bit files. Two judges independently rated each page in terms of attractiveness as well as both classical and expressive aesthetics using the scales described above. Per judge a mean score was calculated for each home page. Interrater-reliability was high, intraclass correlation co-efficient = .80, $F(61,61) = 4.95$, $p < .001$. The mean scores over the two judges were calculated over the seven items because in Experiment 1 a set of web pages would be judged in terms of both attractiveness and classical- and expressive aesthetic value. The 25 highest ranking and the 25 lowest ranking were selected as stimulus materials for the main trials in the experiment (see Figure 1). The five next-highest and five next-lowest runners-up were selected as stimulus materials for the practice trials in the experiment.

Insert Figure 1 about here.

The experiment ran on personal computers (Intel Pentium, 1.86 GHz, 2 Gb RAM, Microsoft Windows XP operating system, 15 inch monitors). The screen dimensions were 1024×768. Contrast and brightness were set to optimal levels.

2.1.4. Procedure

In both experiments, Phases 1 and 2 used essentially the same procedure as those employed by Lindgaard et al. (2006) and Tractinsky et al. (2006). The experiment was run in a computer lab with groups of 15 to 20 participants who worked independently. Phase 1 started with a series of 10 practice trials. Participants in the goal-mode and action-mode conditions, but not those in the control conditions, were presented with specific instructions regarding the context of use (see Appendix) for the pages that were going to be presented. As in Lindgaard et al. (2006) and Tractinsky et al. (2006), the homepage of a Web site was presented for 500ms in each trial. Next, the page was replaced by the rating scale for attractiveness and participants rated the page. The following 25 main trials used the same procedure. The 25 highest-ranking items or the 25 lowest-ranking were presented, depending on experimental condition. Next, Phase 2 started with one practice trial. Again, participants in the goal-mode and action-mode conditions, but not those in the control conditions, were presented with specific instructions regarding the context of use of the pages that were going to be presented. As in Lindgaard et al. (2006), Experiment 2, the home page of a Web site was presented for as long as participants wished. Next, participants responded to each of the six rating scales for expressive- and classical aesthetics separately, while the homepage remained visible on the screen. The 25 main trials that followed used the same procedure. Finally, participants answered questions requesting demographic details.

2.2. Results

In order to test H_1 , as in previous research (Lindgaard et al., 2006; Tractinsky et al., 2006) correlations were calculated between perceptions after a brief exposure and those after self-paced exposure. The correlations were calculated for each of the 25 local-government web pages. A(2)×3×2 analysis of variance (ANOVA) with independent variables aesthetic dimension (classical, expressive), mode of use and attractiveness and using the correlation (after Fisher's transformation) as the dependent variable showed that only the effect of mode of use was significant, $F(2, 144) = 15.11$, $\epsilon^2 = .14$, $p < .001$ (see also Table 1). Multiple comparisons with Bonferroni corrections showed that the positive correlations in the control condition were significantly lower than those in the other conditions (goal mode and action mode), both $p < .001$, but the other two conditions did not differ significantly, $p > .05$. These results demonstrated that perceptions were more stable when context was provided.

Insert Table 1 about here.

Regarding H_2 , for perceptions after a brief exposure (rated attractiveness), a 2×3 analysis of variance (ANOVA) showed no significant main effects of mode of use and attractiveness of page, both $F < 1$, but the interaction effect approached significance, $F(2, 119) = 2.70$, $\epsilon^2 = .14$, $p = .07$ (see also Table 2). Simple effect tests with Bonferroni correction demonstrated that the positive difference between relatively attractive and relatively unattractive pages was significant in the control condition, $t(41) = 2.50$, $r = .36$, $p < .05$, but not in the other conditions (goal mode and action mode, both $|t| < 1$).

Insert Table 2 about here.

For perceptions of classical aesthetics after self-paced exposure, a 2×3 ANOVA demonstrated a significant positive effect of attractiveness, $F(1, 124) = 5.73$, $\epsilon^2 = .04$, $p < .05$.

.05, but the effects of mode of use and the interaction were not significant, both $F < 1$ (see also Table 3). For expressive aesthetics, the same pattern of results occurred, but this time attractiveness was approaching significance, $F(1, 124) = 2.70$, $\epsilon^2 = .01$, $p = .10$, and the remaining effects were not significant, both $F < 1$. Thus, for deliberate perceptions (aesthetic quality) the results from ANOVA demonstrated that relatively attractive pages are rated higher than relatively unattractive, irrespective of context, but only for classic aesthetics rather than expressive aesthetics, presumably because of the information-oriented nature of the Web pages.

Insert Table 3 about here.

3. Experiment 2

Experiment 2 aimed to examine the effect of experience of using a web site on its users' perceptions of it. Three phases were included: brief exposure (Phase 1: rating of attractiveness after a controlled brief exposure - 500ms), self-paced exposure (Phase 2: rating of aesthetic quality after self-paced exposure) and site use (Phase 3: rating of quality after using the site). The experiment investigated the effects mode of use and aesthetic design as well as the relationship of usability with aesthetic value.

3.1. Method

3.1.1. Design

A 3×2 independent measures design was used. As in Experiment 1, the first independent variable was mode of use which only applied to Phases 1 and 2 and had three levels: goal mode, action mode and control. The second independent variable was design aesthetic with levels of classical and expressive (as in Tractinsky et al., 2006). Dependent variables were attractiveness and aesthetic quality (using Tractinsky et al.'s measures). In addition

to the dependent variables used in Experiment 1, mental workload and task performance were included as measures of usability.

3.1.2. Participants

There were 115 undergraduate psychology students (94 females and 21 males) who had taken part in Experiment 1 a week earlier, with a mean age of 22.61 years ($SD = 6.36$). They took part in the experiment as a course requirement. All had used the Web. Mean experience using the Web was 8.83 years ($SD = 1.78$), mean time of confidence in using the Web was 7.17 years ($SD = 2.23$), mean time per week spent using the Web was 15.21 hours ($SD = 12.53$) and mean frequency of Web use per week was 11.25 hours ($SD = 7.57$).

3.1.3. Materials and equipment

The same item was used to measure perceptions of attractiveness and the same rating scales were used to measure the quality of classical and expressive aesthetics as in Experiment 1. Reliability analysis showed that Cronbach's alpha ranged from .79 to .89 for the different combinations of scale (classical or expressive aesthetics), type of design (classical or expressive aesthetics) and time of judgement (before site use or after use). Therefore, the aesthetics scales were judged to be reliable. The correlation between the two types of aesthetics was .55 (Phase 2) and .76 (Phase 3) for the site with classical aesthetic design and .65 (Phase 2) and .79 (Phase 3) for the site with expressive aesthetic design. These results indicate a moderate to strong association, but the two constructs were not identical. In addition, participants gave responses to the Subjective Mental Effort Questionnaire (SMEQ) (Zijlstra, 1993). The SMEQ consisted of a single-item visual analogue scale with graded categories and numerical values (range: [0; 150]).

The homepages of the Web sites of five British university psychology departments as well as the homepage of two versions of a fictitious psychology Web site were captured at a

resolution of 1024×768 pixels saved as 24-bit files. The fictitious Web site was modelled after a typical psychology site for university students and especially designed and programmed for the experiment. In addition to the homepage, the main sections were Teaching, Research, Staff, Library, External, Careers and About, with 227 further Web pages and links to Web pages. Two versions of the Web site were developed: one with characteristics of classical design and another with characteristics of expressive aesthetic design (see Figure 2). The two versions were identical except for differences in characteristics that define classical and expressive aesthetics. Features of the classical version were orderly, familiar, sans serif font, familiar colour combination for text (black) and links (blue) and light colours for background as is usual on web pages. Features of the expressive version were original, but attractive, sans serif font, unusual colour combination of text (white) and links (light blue), and a dark (black) background for the content area and an artistic background for the menu area. Experiment 2 used the same equipment as Experiment 1.

Insert Figure 2 about here.

3.1.4. Procedure

The procedure for Phases 1 and 2 was essentially the same as in Experiment 1. (For instructions regarding context see Appendix.) The homepages from five British university psychology departments were used in the practice trials of Phase 1. The single practice page in the practice trial of Phase 2 was one of these homepages. The homepage in the main trial of Phase 1 was that of one of the two versions of the fictitious site, which was also used in the main trials of Phases 2 and 3. Following Phases 1 and 2, an information retrieval task followed which included typical tasks that users perform with educational intranet sites. (This task could only be performed in goal mode; for instructions regarding context see Appendix.) In each trial, a question appeared at the top of the screen, for

instance 'How long is the exam for the module Introduction to Psychology: Personality and Social Psychology?'. Once participants had read the question, they had to click on a button labelled 'Show web site'. The home page of the site then appeared on the screen and they had to find the answer to the question using the site. Participants were told to take the most direct route possible to locate the answer. Having found this, they clicked on a button labelled 'Your answer', which opened a dialogue box at the bottom of the screen. Participants typed their answers into the box, clicked on 'OK', completed the SMEQ for the task they had just performed and moved on to the next question. After three practice questions, the main phase of the information retrieval task followed, with a duration of 20 minutes - in which a maximum of 27 further questions were presented. After the information retrieval task, Phase 3 followed the same procedure as Phase 2, though without a practice trial. Finally, participants answered questions requesting demographic details.

3.2. Results

In order to test H_1 , correlations between perceptions after a brief exposure, after self-paced exposure and after site use were calculated. Correlations between perceptions after a brief and self-paced exposure were significant in the action-mode and goal-mode conditions, but not in the control condition (see Table 4). Correlations between perceptions after a brief exposure and after site use were not significant, except for expressive aesthetics in the action mode condition (see Table 4). Correlations between perceptions after self-paced exposure and site use were significant in the action-mode and goal-mode conditions, but not in the control condition (see Table 4). These results confirm that the aesthetic perceptions of an educational web site were stable when context was provided from ratings after a brief exposure to those after self-paced exposure and from ratings after self-paced exposure to those after site use, but not from ratings after brief exposure

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to those after site use. Without context, perceptions were not stable among the three stages.

Insert Table 4 about here.

Regarding H_3 , a 2×3 ANOVA showed that the effect of aesthetics on perceptions after a brief exposure (attractiveness) was significant, $F(2, 109) = 6.77$, $\epsilon^2 = .05$, $p < .05$, and classical aesthetics were judged to be more attractive than expressive aesthetics, but the effects of mode of use, $F(1, 109) = 1.90$, $p > .05$, and the interaction, $F(2, 109) = 1.34$, $p > .05$, were not (see also Table 5), confirming the hypothesis. A $(2) \times (2) \times 2$ ANOVA with independent variables aesthetic perception, time and aesthetic design and using perceptions after self-paced exposure as the dependent variable showed that only the effects of aesthetic perception, $F(1, 113) = 41.59$, $\epsilon^2 = .07$, $p < .001$, and time, $F(1, 113) = 25.25$, $\epsilon^2 = .03$, $p < .001$, were significant (see also Table 6). Overall, the homepage was judged to be of higher classical aesthetic value (mean = 30.28; SD = 1.64) than expressive aesthetic value (mean = 23.94; SD = 1.36) and more highly aesthetic after using the web site (mean = 32.31; SD = 1.75) than before use (mean = 21.92; SD = 1.41). These results confirm the notion that classical aesthetics are more applicable to information-oriented pages than expressive aesthetics.

Insert Tables 5 and 6 about here.

In order to test H_4 , correlations of perceptions after a brief exposure, self-paced exposure and after site use with mental workload and effectiveness and efficiency of task performance were calculated. There was no significant positive relationship; moreover, three of the negative correlations with number of tasks completed were significant (see Table 7).

Insert Table 7 about here.

4. Discussion

This section discusses the evidence related to each of the hypotheses proposed in the Introduction. It then addresses the research issues of mode of use, aesthetic design and the role of experience.

H₁. Together, the two experiments demonstrate that context increases the stability of judgements from those after a brief exposure to those after self-paced exposure and from those after self-paced exposure to those after site use, but not from judgements after brief exposure to those after site use. Overall, stability from rating after a brief exposure to after self-paced exposure was relatively low, but stability from rating after self-paced exposure to after use was relatively high.

H₂. We found in Experiment 1 that in perceptions after a brief exposure relatively attractive pages are preferred over relatively unattractive pages, but only if no context is provided. In perceptions after self-paced exposure, relatively attractive information-oriented web pages are preferred over relatively unattractive pages in terms of classical aesthetics, but not in terms of expressive aesthetics, indicating that judgements of classical aesthetics are (more) pertinent to information-oriented pages.

H₃. Our results from Experiment 2 show that, in perception after a brief exposure, classically aesthetic pages of an information-oriented nature are rated as more attractive than expressively aesthetic pages. Furthermore, our findings from Experiment 2 again confirm the notion that classically aesthetic design is more pertinent to information-oriented pages than expressively aesthetic design.

H₄. The principle ‘what is beautiful is usable’ was not confirmed in Experiment 2. No pattern of positive correlations between usability in terms of task performance and mental workload and perceptions of aesthetic value were found. Overall, the results of the two

experiments using two different domains (local government and Higher Education) converged, further strengthening the generality of findings.

4.1. Mode of use

The current study found that perceptions of aesthetics are more stable in both goal mode and action mode than when no context is provided. It seems that the effect of (providing a) context on users - before they have used a Web site - is to focus their judgement related to their potential use of the site, thereby producing less volatile judgements. Context makes the judgements more stable from the stage of a brief exposure (Phase 1 in our experiments) to the stage of self-paced exposure (Phase 2 in our experiments) and even more so from Phase 2 to the stage after site use (Phase 3 in our experiments). These results provide evidence for the effect of mode of use in producing more stable judgements *before* actual system use. The results also confirm both Hassenzahl's (2004) prediction and his results that deliberate judgements of aesthetics are stable with system use.

Taking a broader view, mode of use is likely to influence perceived product quality in general (Hassenzahl, 2003; Hassenzahl & Ullrich, 2007) rather than solely perceptions of aesthetic value. According to Hassenzahl (2003), in goal mode, low arousal is preferred and experienced as relaxation. Because classically aesthetic design is characterised by order and familiarity - thereby increasing understanding and sense-making as well as reducing ambiguity and thereby likely producing low arousal - it should be able to support users' interaction in goal mode. Perceptions of usability (which Hassenzahl calls *pragmatic quality*) will be more important when a product is used in goal mode than when it is used in action mode because - *ceteris paribus* - highly usable products will produce low arousal. In contrast, in action mode high arousal is preferred and experienced as excitement. Because expressively aesthetic design is characterised by complexity and increasing

arousal and involvement it should be able to support users' interaction in action mode. The current study manipulated mode of use - by giving test users instructions to 'induce' a particular mode - only *before* (Experiment 2) or *without* (Experiment 1) actual system use. Furthermore, irrespective of instructions given in Phases 1 and 2, after Phase 2 in Experiment 2 the web site was always used in goal mode because users searched for answers to specific questions using the site and therefore the effect of mode of use after actual use could not be examined. The effect of mode of use could be stronger if users are actually using a product in a particular mode of use (e.g. Hassenzahl & Ullrich, 2007; van Schaik & Ling, under review). Hassenzahl and Ullrich found that mental effort during use was strongly negatively associated with retrospective system evaluation after system use in goal mode, but spontaneity during system use was strongly positively associated with retrospective system evaluation after system use in action mode.

4.2. Aesthetic design

Our results support the notion that for a particular type of application or genre (e.g. information-oriented web sites) users expect a particular type of aesthetics (e.g. classical). According to Nielsen (2004), once certain design conventions in general (not just regarding aesthetics) have become pervasive and users have become used to them, it is unwise for web sites to deviate from them because users will prefer sites that conform to conventions over those that do not ("atypical examples are poor indicators", Nielsen, 2007). Obviously, there are successful exceptions (e.g. cluttered (non-aesthetic) pages on Amazon's Web site, Nielsen, 2005), but these are famous sites. Therefore, new commercial or non-profit business web site that does not conform will thereby typically reduce its chances of success.

Although the two are not synonymous, the quality of classically aesthetic design and the quality of information presentation of usable designs are likely to be correlated. The reason is that the characteristics of classically aesthetic design (order and familiarity) and its goals (increasing understanding and sense-making as well as reducing ambiguity) are shared with guidance for the usable design of human-computer interaction (see e.g. Nielsen, 2000, for guidance on usable web design)¹. However, there are additional aspects of usable designs, such as their interaction structure, that are not addressed by classically aesthetic design. Therefore, classically aesthetic design can improve the usability of system designs, but is not a sufficient condition for their usability.

The characteristics of expressively aesthetic design (complexity, originality, sophistication) and its goals (increasing arousal and involvement) do not overlap with those of usable design. From a usability perspective, Nielsen (2007) highlights the appropriateness of type of design for Web sites. He argues that new, technology-driven, features may not be appropriate for information-oriented Web sites because they may 'hurt users' and undermine usability and thereby a business's profitability. However, the same features - some of which can be considered as examples of expressive aesthetic design may also reduce rather than enhance potential users' perceptions of aesthetic value, possibly so much that they will not even consider exploring a site beyond its homepage. Naturally, expressive design may benefit entertainment-oriented products, such as computer games or hedonic web sites. As long as an expressively aesthetic design does not violate usability guidelines, it is expected not to harm a product's usability. However, expressive

¹ Working independently, both the authors of this paper and Hassenzahl (2008) make essentially the same point.

design that hurts users and undermines usability may - after some initial hype - attract fewer visitors and repel other potential visitors in the first place.

4.3. The role of experience

One conceptualisation of change in users' perceptions of a product with experience has been expressed in the notion of anchoring and adjustment. Venkatesh (2000) has applied this idea to modelling technology acceptance and in principle this also applies to aesthetic experience. According to Venkatesh, anchors (general information in the absence of specific knowledge) strongly influence effort expectancy (the extent to which using a system will be free of effort) initially, but - over time - adjustments based on additional information that has become available as a result of direct experience with a target behaviour, for example system use, gain influence. However, anchors do not lose their authority. When modelling aesthetic experience, anchors are individual-difference variables - such as proficiency in using computers, computer anxiety and aesthetic preference - and general beliefs regarding computers based on prior experience with computers in general. Adjustments are the specific experience of aesthetic and other system qualities. Immediately perceivable appearance and individual-difference variables, such as a particular consistent aesthetic preference, are not likely to change (or at least do not change quickly), but users can learn more about a product's aesthetic quality with experience. In particular, typically, the homepage is only a very small part of a Web site and thus users can learn more about the aesthetics of the site as a whole when navigating other pages of the site, although this will depend on the similarity in aesthetic design between the homepage and the remaining pages. A resulting change in perceived aesthetic value is more likely in essentially hedonic products, such as computer games or hedonic web sites (Childers et al., 2001), than in (predominantly) utilitarian products, such as human-performance supporting software (such as utilitarian web sites or office

applications). However, in the current study, the perceived aesthetic value increased as a result of the use of an information-oriented web site presumably because, after test users had examined the homepage, the remaining pages gave additional information about the aesthetic value of the web site.

Our results are also consistent with Schwarz and Clore's (1983) affect-as-information approach (see Hassenzahl, 2008). Immediate affect-driven judgements of aesthetic value may be used by subsequent judgements as input, but the longevity of their influence depends on the amount of additional processing taking place (i.e., additional work on the judgement). The attractiveness rating in our two experiments is arguably rather an affective response (which can only be triggered by the visual Gestalt due to the short exposure). Subsequently, the deliberate judgment of aesthetic value takes up the initial affective response and more or less elaborates or modifies. The influence of immediate affect would be weakest or nullified after system use, as confirmed by the lack of correlation between judgements of attractiveness after brief exposure and perceived aesthetics after system use in Experiment 2. More generally, as the pages displayed in the current study were not completely random but related, more additional processing would be expected and therefore lower correlations overall would result than in previous research (Lindgaard et al., 2006; Tractinsky et al., 2006) and our findings confirm this conjecture.

5. Conclusion and future work

The current study has demonstrated that context (mode of use), aesthetic design and experience of using a product are all important factors in users' perceptions of Web sites. We conclude that context is a pivotal factor influencing the stability of users' perceptions, which must be explicitly addressed in the study of users' experience (see also Hassenzahl,

2008). Furthermore, the type of aesthetics that is relevant to users' perceptions appears to depend on the application domain. The principle 'what is beautiful is usable' is not confirmed (but see Hassenzahl (2008) for conditions under which the principle may apply). Future research should investigate the extent to which these factors apply to other types of product. From the perspectives of business and users, a crucial factor in the success of interactive systems is the way in which they promote a high-quality experience, of which aesthetics - as is increasingly recognised - forms an important part. From a scientific perspective, users' experience of their interaction with computers and interactive systems more generally is becoming increasingly important, both in terms of psychological modelling and in terms of creating high-quality interactive systems from a design perspective (Hassenzahl & Tractinsky, 2006). Cognitive models of human-computer interaction (e.g. GOMS, Card, Moran & Newell, 1983 and CoLiDeS, Kitajima, Blackmon & Polson, 2000) have focused on the cognitive antecedents of human task performance with computers. On the other hand, social cognition models of human-computer interaction such as Hassenzahl's (2003) model of user experience, the Technology Acceptance Model (Davis, 1993) and the Universal Theory of Acceptance and Use of Technology (Venkatesh et al., 2003) have focused on the social cognition antecedents of users' acceptance of computer systems. Although cognitive and social-cognition aspects of HCI are both important, these two aspects are usually not systematically integrated in a single model and this is an important avenue for future work.

Appendix - Instructions to manipulate context (mode of use)

Experiment 1 (Phases 1 and 2)

Goal mode. Imagine you are about to move to a new town or city. You want to find the answer to some specific questions, for example how much council tax you will need to pay. You are considering visiting the Web site of your new council for this purpose.

Action mode. Imagine you are about to move to a new town or city. You want to find out more about your new council. You are considering visiting the Web site of your new council for this purpose.

Control. [No specific instructions regarding context]

Experiment 2

Goal mode (Phases 1 and 2). Imagine you are about to move to a new university to study psychology. You want to find the answer to some specific questions, for example what the assessments for your psychology course are. You are considering visiting the Web site of the psychology department of your new university for this purpose.

Action mode (Phases 1 and 2). Imagine you are about to move to a new university to study psychology. You want to find out more about the psychology course at your new university. You are considering visiting the Web site of the psychology department of your new university for this purpose.

Control (Phases 1 and 2). [No specific instructions regarding context]

Phase 3. Same instructions as for goal mode in Phases 1 and 2.

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Table 1

Correlations between perceptions after a brief and self-paced exposure (Experiment 1)

	Goal mode	Action mode	Control	Overall
Relatively unattractive	0.30 (0.21)	0.31 (0.14)	0.19 (0.20)	0.26 (0.19)
Relatively attractive	0.27 (0.17)	0.32 (0.24)	0.04 (0.20)	0.21 (0.24)
Overall	0.28 (0.19)	0.32 (0.19)	0.12 (0.21)	0.24 (0.22)

Note. Numbers are means with SD in brackets. Correlations with perceptions after self-paced exposure are averaged over classical and expressive.

Table 2

Perceived attractiveness of home pages as a function of mode of use and relative attractiveness (Experiment 1)

	Goal mode	Action mode	Control	Overall
Relatively attractive	43.52	42.79	48.14	44.82
	(9.67)	(10.26)	(8.16)	(9.56)
Relatively unattractive	45.57	43.05	41.12	43.18
	(7.66)	(10.34)	(10.12)	(9.52)
Overall	44.57	42.91	44.55	43.99
	(8.64)	(10.18)	(9.78)	(9.54)

Note. Numbers are means with SD in brackets.

Table 3

Perceptions of classical aesthetics of home pages (Experiment 1)

	Goal mode	Action mode	Control	Overall
Relatively attractive	52.53 (10.04)	52.32 (13.74)	55.60 (9.75)	53.50 (11.33)
Relatively unattractive	47.78 (8.97)	49.42 (12.73)	48.71 (11.46)	48.65 (11.04)
Overall	50.10 (9.69)	50.90 (13.18)	52.08 (11.09)	51.06 (11.40)

Note. Numbers are means with SD in brackets.

Table 4

Correlations among aesthetic perceptions (Experiment 2)

	Brief exposure- expressive (before use)	Brief exposure- classical (before use)	Brief exposure- expressive (after use)	Brief exposure- classical (after use)	Expressive (before use)- expressive (after use)	Classical (before use)- classical (after use)
Goal mode	** .51	** .50	.24	.18	** .41	*** .76
Action mode	*** .54	** .48	* .41	.23	*** .67	*** .68
Control	.18	.19	.24	-.06	.31	.37

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 5

Perceived attractiveness as a function of aesthetic design and mode of use (Experiment 2)

	Goal mode	Action mode	Control	Overall
Classical aesthetics	28.17 (17.62)	34.32 (17.33)	27.89 (17.65)	30.16 (17.47)
Expressive aesthetics	27.30 (14.81)	23.10 (17.91)	15.89 (13.42)	22.20 (15.97)
Overall	27.71 (15.99)	28.56 (18.30)	21.89 (16.62)	26.08 (17.12)

Note. Numbers are means with SD in brackets.

Context in perceptions of the aesthetics of web pages over time

Table 6

Perceptions as a function of type of aesthetics judged and time of judgement

(Experiment 2)

	Before use	After use	Overall
Perceptions of classical aesthetics	24.85 (18.45)	35.66 (21.98)	30.26 (17.51)
Perceptions of expressive aesthetics	18.99 (15.07)	28.86 (18.42)	23.92 (14.52)
Overall	21.92 (15.03)	32.26 (18.71)	27.09 (14.60)

Note. Numbers are means with SD in brackets.

Table 7

Correlations of perceptions of aesthetic value with measures of task performance and mental effort (Experiment 2)

	After a brief exposure	Expressive (before use)	Classical (before use)	Expressive (after use)	Classical (after use)
Number of tasks completed	-0.02	*-0.19	-0.06	***-0.31	*-0.22
Number of correctly answered tasks	-0.11	-0.13	-0.05	-0.14	-0.06
Percentage of correctly answered tasks	-0.13	0.02	0.00	0.15	0.16
Mean of SMEQ ^a	0.10	0.18	0.11	-0.02	-0.13
SD of SMEQ ^a	0.02	0.01	-0.02	-0.11	-0.15
Variance of SMEQ ^a	0.03	-0.02	0.00	-0.08	-0.11
Maximum of SMEQ ^a	0.09	0.14	0.06	-0.07	-0.13
Peak/end of SMEQ ^a	0.04	-0.11	-0.08	-0.12	0.00
Change over time of SMEQ ^{ab}	0.05	0.13	0.10	0.15	0.15

^a Various measures of workload using the SMEQ discussed by Hassenzahl and Sandweg (2004) and related measures were included.

^b Spearman's rho of SMEQ sequence with position in time

* $p < .05$ *** $p < .001$

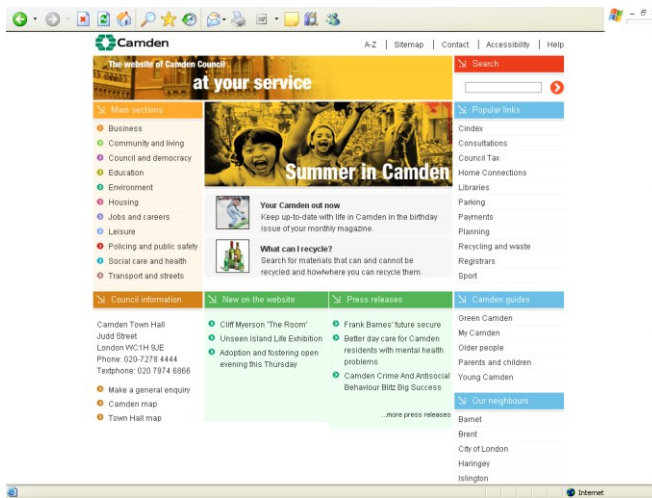
Figure captions

Figure 1. Sample homepages used in Experiment 1

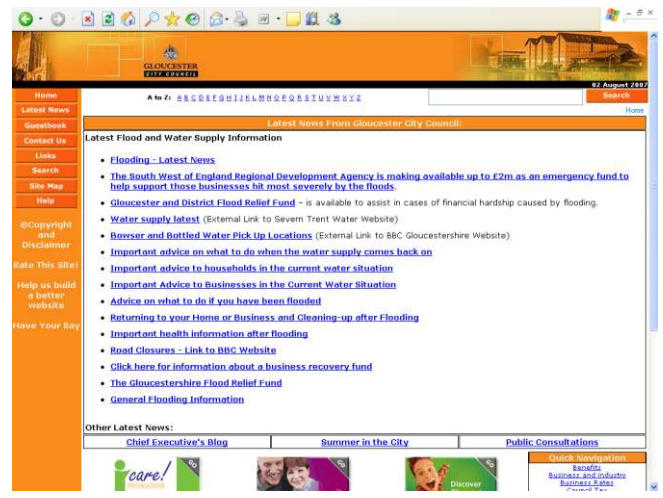
Figure 2. The two versions of the homepage used in Experiment 2

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Immediate, initial and subsequent perceptions of web pages



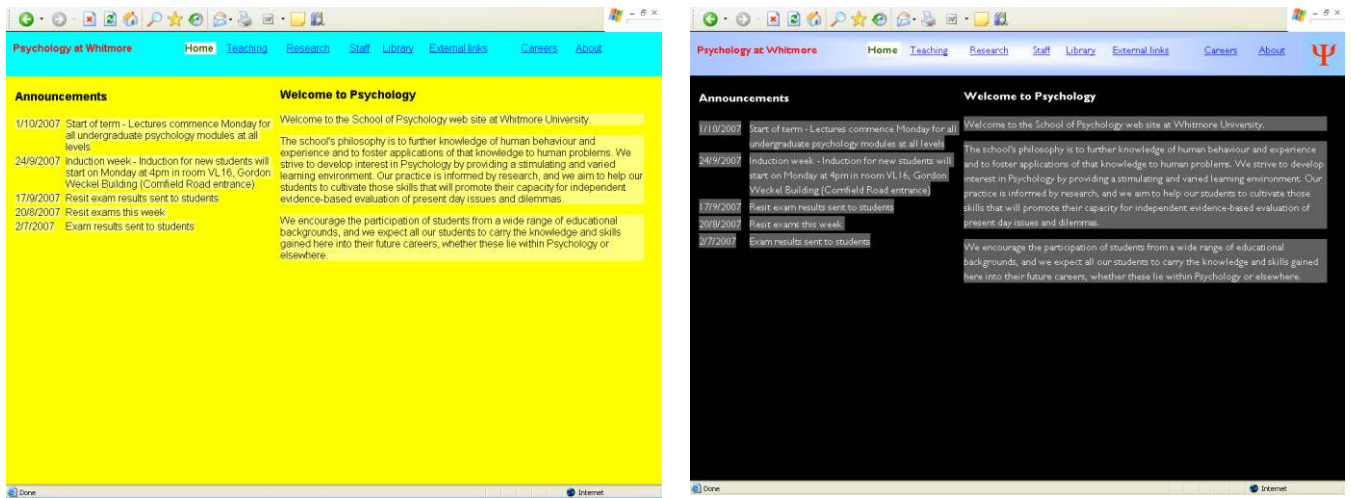
a. Relatively attractive homepage



b. Relatively unattractive homepage

Figure 1

Immediate, initial and subsequent perceptions of web pages



- a. Homepage with classically aesthetic design b. Homepage with expressively aesthetic design
- design

Figure 2