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Do "Attractive Things Work Better"?
An Exploration of Search Tool Visualisations

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A study was conducted to explore associations that may exist between user perceptions of aesthetics and usability in an attempt to validate Norman's assertion that "attractive things work better". Participants were run in a semi between-subjects design study. Judgements for aesthetics and usability were elicited prior to and after each test run with a record kept of performance. Pre-use and post-use measures indicated strong relations between judgements of aesthetics and usability, but an association was not found between aesthetics and performance, leading us to conclude that "attractive things are perceived to work better" though attractive systems may not work any better than unattractive systems. These results resemble past research and partly support the work of Norman proposing that valued aesthetics lead to a positive affective response, which opens the mind to creative thinking altering judgements made but not actual behaviour. The findings stress the importance of aesthetics in HCI and design, as an influential factor on perceptions of usability, which in turn influence higher order decisions.

HCI, usability, aesthetics, system acceptability, search tools, visualisations.

1. INTRODUCTION

"….it requires a somewhat mystical theory of aesthetics to find any necessary connection between beauty and function." (Herbert Read, Art and Industry, p.61)

Historically, usability has dominated as the focus of Human-Computer Interaction (HCI). However, expressions such as "form and function", "beauty and brains" and "pleasure and usability" appear in literature which hint at a possible relationship between the presentation of a system and how well it functions. The latter part of each expression has generally been favoured but now HCI has begun to look more closely at the role of aesthetics (Norman, 2004) [7].

Norman (2002) [6] states that usable designs are not necessarily pleasurable ones and usability may not be the key factor when deciding upon acceptability or purchasing a product from an array of designs. Other factors present within a framework of acceptability such as likeability, cost, etc (Nielsen, 1993) [5] may override usability as being the dominating factor in establishing product acceptability, if these factors become more salient to the user. Consideration of these factors is essential to fully understand user behaviour and decision making within any given situation.

Norman (2004) [7] believes that the emotional side of a design can be the overriding factor in its success rather than its practical elements. The beauty of a product can elicit positive emotions such as pleasure and these can alter how we think and behave. Interacting with a pleasing, attractive product "the behavior seems to go along more smoothly, more easily, and better. Attractive things work better" (Norman, 2002) [6]. According to Norman (2004) [7] attractive things make people feel good resulting in a positive emotional state. Appreciated aesthetics in turn opens up the cognitive system making people think more creatively and solutions to problems become easier to find. Thus, based on the work of Norman, happy people are more effective in finding alternative solutions and tolerant of minor difficulties. These effects are central to measures of usability and their positive nature indicates a positive role for aesthetics in usability.

As yet, limited attempts have been made to test the crucial relationship that appears to exist between aesthetics and usability, but where work has been carried out a relationship has been established. In the work of Kurosu and

Kashimura (1995) [3] designs of automatic teller machines (ATMs) were used to elicit interface usability and aesthetic judgements prior to any form of use of the systems. They found a surprisingly high relationship between judgements of aesthetics and apparent usability concluding a possible association between aesthetics and usability prior to the use of a system. Furthermore, Tractinsky (1997) [8] tested the original findings for cross-cultural robustness, response dependency bias and medium bias. Results supported the original contention that perceptions of interface aesthetics were closely related to apparent usability but also held across cultures. Tractinsky, Katz and Ikar (2000) [9] extended the work studying both pre- and post-use judgements of aesthetics and usability. Their aim was to test whether initial aesthetic-usability relationships would hold after a period of system use. Results resembled that of earlier work in that a relationship was present between pre-experimental perceptions of aesthetics and usability but remained even after use of the system. This reinforced the claim that an aesthetics-usability association is a genuine phenomenon. Users take interface aesthetics as an indicator of how usable a system is, highlighting the importance of aesthetics in HCI.

However, for aesthetics to be accepted as an influential phenomenon, the methodology of past research needs to be robust enough to support a relationship found. Studies on websites have gone as far as only using a single question to elicit user perceptions on aesthetics and usability. A single question is likely to be insufficient to quantify phenomena that are so rich and diverse. Also, past research is limited to specific domains i.e. websites and ATMs and prevents the generalisation of the findings.

Overall, the theory documented and the research carried out in the area of aesthetics and usability presents a foundation for further work. The purpose of this study was to carry out exploratory research in line with past research to validate Norman's assertion that "attractive things work better" examining user perceptions of aesthetics and usability before and after using a system, and to understand how this interacted with the user's actual experience with a system.

2. METHOD

Participants were 12 Masters Degree students, all of whom participated in this study voluntarily and all had some level of experience with computers and search tools. The average age of participants was 27.66 and the standard deviation for age was 5.66. Of the 12 participants, 9 were male (75%) and 3 were female (25%). The nationality of participants included British, American, Canadian and German. Search tool visualisations and search tasks were manipulated in a semi between-subjects design to produce 6 conditions: Radial interactive visualisation / Search task A, Sammon cluster visualisation / Search task A, Dendro map visualisation / Search task A, Radial interactive visualisation / Search task B, Sammon cluster visualisation / Search task B, Dendro map visualisation / Search task B. Using a randomised procedure, each participant was assigned to 2 of the 6 conditions.

2.1 Materials

This study was based on a newly developed search tool (Carey et al., 2003) [2] which presented three variations (radial interactive, sammon cluster and dendro map) for visualising and manipulating the results of a requested search. For the purpose of this study both objective usability testing and subjective usability opinion gathering was required. Two adapted versions of the System Usability Scale (SUS) (Brooke, 1990's) [1] were used to elicit pre-use usability judgements and post-use usability judgements. The two versions differed in terms of the phrasing of the items to reflect the time in the test run at which they would be administered. Objective usability testing was implemented to elicit the user's actual performance during task completion in terms of errors made and time taken to complete the task.

Aesthetic opinion gathering was also required. A limited range of measures exist for the adequate study of aesthetics that can elicit data which is effective and verified to be beneficial beyond a solitary study of the concept. We developed a suitable aesthetics survey based on the format of SUS. "Designing Visual Interfaces" (Mullet & Sano, 1995) [4] was used to generate the contents of the items. Two aesthetic surveys were developed to elicit pre-use aesthetic judgements and post-use judgements. The two surveys differed in terms of the phrasing of the items to reflect the time in the test run at which they would be administered. A demographic section and two search tasks were also developed.

2.2 Procedure

For each assigned condition, the user was initially presented with the visualisation, requested to view it and complete the pre-use aesthetics and usability questionnaires that had been administered. After completion, users were given a one minute training period with the visualisation, after which they were presented with the assigned task and asked to complete it as quickly and efficiently as possible. A record of the duration of the task, errors made and feedback was kept by the experimenter. Following completion of the task, the user was presented with the post-use aesthetics and usability questionnaires and asked to complete them. The testing session ended with the administering of the demographic section.

3. RESULTS

Research holds that aesthetic judgements are related to usability judgements prior to the use of a system and this association persists after the use of a system occurs. Therefore, pre-use aesthetic and usability judgements were analysed followed by post-use aesthetic and usability judgements. Also, the effect of actual usability (performance rates) on relationships was analysed.

Raw data scores were calculated for pre- and post-use usability, pre- and post-use aesthetics and these scores including errors made and completion times were inputted into a correlational analysis. Pearson's correlation coefficients were computed for each pair of variables to identify any relationships that may exist.

TABLE 1: A correlation matrix of pre- and post-use aesthetics and usability scores, errors made and time taken for combined data from task A and B (*$p < 0.01$ level, **$p<0.05$)

	Errors made	Completion times	Pre-Usability	Post-Aesthetics	Post-Usability
Pre- Aesthetics	0.01	0.18	0.76*	0.26	0.08
Pre-Usability	-	-	-	0.22	0.32
Post- Aesthetics	-	-	-	-	0.71*
Errors made	-	-	-	-	-0.67*
Completion times	-	-	-	-	-0.52*

Correlations were performed where data for each visualisation and task had been combined into a single analysis. Results can be viewed in Table 1. Pre-use perceptions of search tool visualisations aesthetics and usability were highly correlated ($r = 0.76$). Those who registered a high score on the pre-aesthetics measure also registered a high score on the pre-usability measure. The high correlation resembles those found by Kurosu and Kashimura (1995) [3], Tractinsky (1997) [8] and Tractinsky et al. (2000) [9]. The correlation remained high ($r =0.71$) even after testing. Those who registered a high score on the post-use aesthetics measure also registered a high score on the post-use usability measure. Therefore, if a user liked the look of the visualisation then they also believed it to be usable and this belief followed through even after use of the visualisation had taken past. This supports the findings of Tractinsky et al. (2000) [9]. No significant correlation was found between pre-use aesthetic judgements and errors made ($r = 0.01$) or completion times ($r = 0.18$). Therefore, aesthetic perceptions had no relation to performance.

Correlations were also carried out on the individual data for each visualisation and the following summarises the results. For the radial interactive visualisation the correlation between pre-use perceptions of the visualisations aesthetics and usability was low ($r = 0.34$). However, the correlation between perceived aesthetics and usability was high ($r =0.80$) after testing. Therefore, those who registered a high score on the aesthetics measure also registered a high score on the usability measure after testing. For the sammon cluster visualisation, pre-use perceptions of the visualisations aesthetics and usability were highly correlated ($r = 0.79$). Those who registered a high score on the pre-aesthetics measure also registered a high score on the pre-usability measure. The correlation between perceived aesthetics and usability remained high ($r =0.69$) even after testing but the relationship was not significant. Those who registered a high score on the post-aesthetics measure were also likely to register a high score on the post-usability measure. Finally, for the dendro map visualisation pre-use perceptions of the visualisations aesthetics and usability were highly correlated ($r = 0.93$) and the correlation remained significant ($r =0.79$) even after testing. Hence, those who registered a high score on the aesthetics measure also registered a high score on the usability measure. For all three visualisations, no significant correlation was found between pre-use aesthetic judgements and errors made or completion times. Thus, aesthetic perceptions had no relation to subsequent performance on a task.

4. DISCUSSION

This study corroborates the results of earlier studies which found strong relationships between user judgements of interface aesthetics and usability of a system. For the tool as a whole, strong relationships were present between judgements of aesthetics and usability prior to use, reproducing findings by Kurosu & Kashimura (1995) [3] and Tractinsky (1997) [8]. Furthermore, in agreement with the findings of Tractinsky et al. (2000) [9], the relationship remained strong after use of the system had taken place. Individually, the dendro map visualisation produced results consistent with the described trend, the sammon cluster visualisation produced a strong relation between pre-use judgements of aesthetics and usability and the radial interactive visualisation produced a strong relation between post-

use judgements of aesthetics and usability. We believe these findings have more significance than equivalent findings that have been asserted in the past because of improvements made in the design of the study and the survey instruments. Our findings strongly reinforce the belief that a genuine association between aesthetics and usability may exist and that attractive things are *perceived* to work better, revising the original assertion by Norman (2002) [6]. This is subtly different to Norman's original beliefs.

This study itself cannot suggest any explanations for the association but literature does propose a possible rationalisation. Norman (2004) [7] proposes an affective response in users, initiating an interplay between beauty and use. The positive aesthetics of a product can elicit positive emotion and this can alter how the user thinks. The shift is positive; it leads to an increase in tolerance for difficulties within a design and also induces creative thinking. In turn, creative thinking opens the users mind allowing for a positive reaction to a system's state of usability (Norman, 2004) [7]. Thus, the rationalisation is an affective response in users, where the positive aesthetics induced emotion which induced positive judgements of usability. However, this rationalisation does not relate to performance. A relationship between aesthetics and error rates or completion times *was not* found for the tool as a whole or any visualisation on its own. Hence, attractive systems are only *perceived* to work better but may not actually work any better than unattractive systems. Regardless, it is our judgements that guide our decisions thus it is important to design for good aesthetics as this can directly influence how usable a system is perceived to be, and in turn potentially influence higher order decisions.

As is the case with all exploratory research, certain limitations exist which warrant a certain degree of caution in generalising the results beyond the domain of the study. Particularly, the measures used were either developed from scratch or adapted from existing measures and the reliability or validity of the measures was not established. However, the fact that the same trend of results was found for three individual visualisations indicates that the measures were successful and appropriate. The direction of future work could attempt to establish whether the aesthetic measure is reliable, valid and universally applicable. These findings support the existence of a framework of system acceptance which incorporates both aesthetics and usability (Nielsen, 1993) [5]. Now the trend has been set for further work to be carried out to understand the role of additional factors believed to exist within this framework and to understand how these factors and the association established in this study interplays with system acceptance, the ultimate goal of any development.

4.1 Conclusion

This research was motivated by a need to increase the standing of aesthetics in HCI. The results of this study, suggesting a significant effect of aesthetics on prior use perceptions of ease of use and more importantly post-use perceptions of ease of use, may aid in encouraging those in HCI to value the role of aesthetics to a greater degree. If nothing else, aesthetics can influence users' beliefs regarding the usability of a system. The appearance of a system is what users acknowledge foremost and is what cues users to the contents of the system. Therefore, it is important to induce positive aesthetics in systems in order to gain the benefits it can give. Designers must manipulate aesthetics to their advantage. As users take aesthetically pleasing interfaces as an indication of usable systems, designers must take the two seemingly unrelated phenomena as being equally influential in design.

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