I, the Device: Observing Human Aversion from an HCI Perspective

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Abstract

We describe our experience in designing a system that would render a human operators job obsolete. In the course of a three year research project, we devised a 3D interactive system for the automotive design industry. Currently, automotive designers demonstrate prototype designs with the help of a showroom operator. With the addition of a new input device, the operator is no longer required; thus, this device which generated concern and opposition from the operator. In this report, we discuss how an awareness of user aversion toward new HCI developments can benefit practitioners by helping them to understand users and thereby enable design improvements.

Author Keywords

Luddite Behavior; Large-Scale Display Operator; User Experience

ACM Classification Keywords

H.5.2 [Information Interfaces and Presentation]:

General Terms

Design

Introduction

Industrial advances have often been met with a certain degree of aversion. The most famous example is the



Figure 1: Before: Sitting at the back of the room, an operator follows the request of a presenter and utilizes a desktop to interact with a large-scale display. The presenter has no control over the visualization.



Figure 2: After: The presenter has control over the visualization through a 3D interaction device.



Figure 3: A 3D interaction device introduced as a navigation system.

Luddites of 19th century Britain, where textile workers and artisans destroyed mechanized looms in an attempt to halt the socio-economic advances of the Industrial Revolution [15].

Although this type of destruction is rare, technological mistrust similar to that of the Luddites, is on par with new technological advances that can render current professions obsolete. Indeed, human aversion toward new technology is still observable in contemporary society, including sentiments directed against advances in Human-Computer Interfaces [16]. In this study, we describe the lessons learned by observing a "Luddite-like user" involved in a research project and explain you should include such a user in your next study. Herein, we use *Luddite* as a broad term for a user who shows aversive behavior toward new HCI developments that are integrated into the workplace. By no means are we criticizing such behavior; rather, we use it to understand better how to introduce new technologies to users.

Context

Within the scope of a three-year research project, we focused on large-scale display interaction techniques for design review scenarios. The project consortium was composed of multiple specialist teams that include developers, hardware manufacturers, HCI researchers (us) and a design studio for the automotive industry as the end user. The overall goal of the project was to improve interactive large-scale displays as tools for end users to engage in design review meetings. Automotive designers often adopt large-scale displays as virtual showrooms in which 3D models can be viewed on a 1:1 scale. The virtual showcase is generally conducted by a designer who is supported by an operator sitting at the back of the room, acting as a *Wizard of Oz* interface.

Our task was to collaborate with a showroom operator (herein after referred to as *Ned* for anonymity) to develop a novel input device for the navigation of 3D models in a large-scale environment. The result was a device that enables any designer to manipulate a 3D model without requiring the assistance of an operator. During the first half of the project, Ned consistently affirmed his approval of new technology. However, in the last year, he reluctantly admitted his opposition to the project altogether and expressed concern that the success of our endeavors could ultimately result in the loss of his employment. Ned exhibited behaviors resembling those of the Luddites and motivated us to change the way we conducted our research and, eventually, the project's outcome.

Related Work

Resistance to change is an opposing force to new developments, as has been thoroughly described by Laudon [11] and Rogers [14]. Even with the most practical of developments, such as the introduction of mobile phones [4], there are people who complain that "(...) mobile phones are making people lazy". A clearer emotion is *anxiety* about technology. Chua et al. [2] studied a target population of students and teachers and found that computer experience was inversely related to computer anxiety. Olatoye identified anxiety as a negative psychological construct, in the context of a Nigerian high-school population [13]. Lambert explored the correlation between computer experience and user aversion [10], identifying a corollary in which he suggests that user aversion decreases with frequent use of computers. Perhaps the most overt action users can take is the *refusal* to use new technology. Herbsleb et al. [7] introduced Instant Messaging (IM) to the workplace and found evidence of resistance to change. Participants

refused to use the system because they found chat to be superfluous and lacking a clear, well-defined need.

Resistance can also arise from the fact that users are reluctant to take risks due to fear of *failure*. Through a participatory design and evaluation process, Hill understood that subjects were reluctant to accept failure as a component of their learning process [8]. Risk management involves careful consideration by users facing new systems, regardless of the setting. Furthermore, when users are empowered with higher control of the system (as Hill describes), it is clear that risks are carefully managed from a lower bound in the sense that they are rarely taken. In the scope of novel interaction techniques for replacing or removing human intermediate operators, we are clearly looking at user empowerment: the end-user is now in full control (or, at least, has greater degree of control).

Replacing the operator

The question of when to replace human presence with computers is relevant to our study. Nimwegen et al. propose that assisting users by externalizing task-related information, in our case to a system operator, can reduce performance [17]. These researchers argue that without this assistance, task-information must be internalized, i.e., stored in the user's memory, which leads to more planning and thinking and perhaps to better performance and knowledge. Fikkert et al. propose a set of gestures to control a large-scale display (that would replace a *de-facto* operator) [5]. However, there are situations where the presence of humans may be more appropriate. Bonito et al. [1] show that, after completing desert survival tasks, participants prefer to engage in dialogue with humans, even when computer interfaces have *human-like* qualities (e.g., speech).

Zotkin describes how smart video-conferencing, a

synergistic multi-camera, multi-microphone implementation, has replaced the need for operators behind dedicated control software [18] and become an unattended system. When presented with such systems users may exhibit bipolar/symmetrical opinions: on one hand, it is clear to them that the system alleviates and facilitates autonomous operation by reducing the knowledge requirements for the operator; on the other hand, it is also clear that their sense of awareness is affected, due to the removal of one of the human elements of the system (the operator).

Ned's influence on the project

As one of two automotive design company employees responsible for the project, Ned was involved for the entire duration of the project; the second employee was from the human resources department. During the first year, Ned introduced us to the automative designers, who were interviewed for the task analysis and contributed to the user requirements for the role of showroom operator. However, he was not involved in the drafting of the requirements document nor provided feedback after receiving the document. In the second year, he followed the prototype development and was included in follow-up revisions as the final user representative. The final user tests, conducted in the third year, took place in the automobile design showroom; due to a company policy that required that all guests be accompanied when visiting the facilities. Ned was present and strongly involved in the organization of the user tests.

A strong reflection of Ned's involvement throughout the project is the form of the final solution. Indeed, the solution matches an accurate description of Ned's job, as a showroom operator and provides many of the functions that currently require an operator. Therefore, this HCI

development may undermine Ned's position, which explains his behavior during the execution of the project.

We acknowledge that this behavior may have diverse origins and, given the threat to his position, be justified. Thus, we do not condone his actions, but merely observe how someone that is against the development can affect the outcome. To further understand the effect human aversion can have on an HCI study procedure, we conducted two user studies, six months apart. All variables such as apparatus, tasks, environment, and study procedure were kept as similar as possible between the two tests. The one exception was the exclusion of Ned from the second user study, thus allowing us to observe the effect the presence of a Luddite can have on user studies. We next present the observations we extracted from the subjects' behaviors.

Observations

The aforementioned user test sessions (with and without Ned) allowed us to create a baseline and compare observations. The majority of the described situations occurred in the showroom or the meeting room, where questionnaires were administered. Several observations concern the full span of the project, e.g., aversion toward user requirements. The observations are supported by video recordings of all user sessions (with the consent of all users); audio was transcribed from the automotive designers' native language into English for latter analysis. Three HCI observeres were present at each testing or questionnaire session.

User Requirements

Ned demonstrated passive-aggressive behaviors beforehand. Although the project was in the user-requirement definition phase, input was solicited from the interested parties: the showroom operator and automotive designers. When the first requirements were proposed, Ned showed a light aversion to them, creating several additional reviews and suggesting that unlike rendering and visualization, interaction techniques were not an issue for automative designers. This suggestion is the first concrete evidence of Ned's concerns regarding our HCI proposal, which, once completed, could render his job obsolete.

Development Cycle

During the development cycle, Ned exhibited disinterest in the interaction proposal. Rather, he focused on the ergonomics of the device or requested further new functionalities to mimic the existing showroom software. In one development meeting, where we presented the input device and requested Ned's feedback, after playing with the device for approximately one minute, he dropped the device and commented "Yeah, this is okay. You should build a strap on the device so that you can hold on to the device.", further proposing that the device should have an retractable cable and be attached to his belt. In another development meeting, Ned stated the following: "The interaction is acceptable for me, but I do not expect designers to hold the object ... because it's heavy." (the device weights less than 100 grams).

During the last semester of the development cycle, a meeting was held in the automative design facilities. Ned showed us that a gyroscopic mouse could be attached to his workstation and enable him to control the showroom using his traditional tools. This information that was withheld until that point, and stated: "*This interface is already integrated into the showroom, but nobody uses it.*". After we explained the difference between our solution and the gyroscopic mouse, we asked Ned to



Figure 4: Ned's zone of influence during the user tests (top) and the ideal designer situation (bottom).

execute several tasks with both the gyroscopic mouse and our solution. Difficulties in executing the tasks with the gyroscopic mouse led him to acknowledge the difference between the devices.

This difference in opinions suggests that even after being told otherwise, Ned thought of the device as something for himself (that he did not need), rather than something for the designers, the target audience.

Preparing the User Tests

We conducted two user tests, both executed at the automotive design facilities, in which an employee escort was required. For the first user test, Ned volunteered to be our permanent escort, whereas, for the second test, we requested a translator as an escort. Ned stated that he was required to conduct the test briefings himself, presenting this requirement as a company policy and arguing that several subjects were not fluent in English; we found that neither assertion represented a practical issue. Ned's apparent intention to assert control over the test procedures constitutes evidence of Ned's fears that our device may eliminate his job as a showroom operator.

Furthermore, Ned consistently constrained our access to all possible test participants and thus gain control of the testing situation. In particular, he selected the subjects, briefed the subjects, performed the training session for the device, conducted the tests, and debriefed the subjects; Ned even stood by their side during the questionnaires. The counterexample is supported by the fact that Ned demonstrated no intention of conducting the visualization/rendering test. We believe that this behavior reflects his concerns regarding interaction techniques that could replace his functions as a showroom operator.

User tests conducted by Ned

Throughout the test session conducted by Ned, we identified several behaviors that clearly indicate Ned's aversion to our proposal. At every stage of the test, Ned was a constant presence in the user's workspace. He deliberately positioned himself into the central area facing the display wall, pushing the user space to his right, in an uncomfortable zone near the display projector *frustum*, as depicted in Figure 4.

The observed tendency was that Ned would occupy the majority of the space in front of the projector, and even in front of the camera (See figure 4) used to videotape the sessions. Ned was instructed not to block the camera during video recording, although shortly after this request, he was again moving in that area, monopolizing the interaction space. Our only solution was to move the camera to a different position in the following tests.

Briefing and Demonstration Throughout the briefing, Ned insisted on reading the test script to the users out loud, not allowing any user to read or consult the test tasks throughout. Furthermore, we provided the user's with language translations of the test script and introduction in their native language, which were discarded by Ned. Instead, he used the English version translating it aloud to the users in their native language, effectively reducing our control over (and understanding of) the briefing. Throughout the task component of the test Ned was rarely silent, even after being advised otherwise. His positive remarks were mostly about the display projection, which presented no threat to his job, whereas negative remarks were directed at the interaction techniques. **Tasks** One observation that we captured was how Ned was easily satisfied with the users performance in each task. For example, several of the sub-tasks included zooming of automobile details (e.g., headlights, logos, or tire rims). After the user performed any zooming motion, he would verbally inform him that it was completed, adding remarks such as the following: "Perfect; that's more than enough". Many users even continued the task after his remark, trying to fine-tune the zooming scale factor. He also verbally questioned user comments; for example, when a user said, "This is very intuitive" (after zooming in on a headlight detail), Ned replied "Are you sure?". Finally, Ned physically constrained the user's movement; users were required to stand (as they would during a presentation), but in several cases, Ned suggested that they interact while sitting, even though he was previously briefed otherwise.

Questionnaire After each test session, the users were requested to complete a questionnaire describing their experience in the showroom. Once again, Ned was conducting the sessions. Ned often made several remarks and observations while the participants completed the questionnaire, e.g., "We have to improve upon a certain aspect of the interaction" or "We need a better system than this", which we believe may have biased user expectations regarding the future development of the interaction techniques.

User Tests conducted by the HCI experts A second user study, in which Ned did not participate, was conducted by a HCI expert, allowing us to observe the participants without biasing. Because we intended to compare their behaviors against those observed throughout the first sessions, we deliberately asked the participants to enter the presentation room before the test conductors without instructions regarding a specific interaction position. This approach us to observe how designers position themselves in the interaction area without explicit orders. As depicted in Figure 4 (right), each subject had an interaction area were they could interact, and chairs were available behind them. We observed that four out of the eight participants immediately sat when entering the room; among the four initially seated subjects, one stood to execute the tests. Of the four initially standing participants, one explicitly asked whether he should sit or stand. This evidence only surfaced once the Luddite was removed from the test procedure, suggesting that Ned was aware of this preference and was influencing users to sit rather than stand (even though he was brief otherwise).

Tasks Throughout tasks, the users were more verbose regarding the system. There was an increase in user feedback, with comments such as: "This [the interface] allows me to be autonomous during design reviews" and "I think I like this. [the input device] (...) if this is without a wire, then you have a perfect presentation tool". Although Ned did not conduct the user tests, he still made his presence known in between the sessions. Moreover, in the last session, he appeared alongside the subject and insisted on conducting the user test. We later found that this particular participant was a direct collaborator with Ned, unlike the other participants in this study. During this test. Ned repeated the behavior observed in first user study and inadequately described the input device as a "Wiimote". Ned did make positive remarks about the system and was pleased to see that the device had improved and seemed more fluid; however, the system had undergone no optimizations since the first study.

Analysis

We group the behaviors described above into four categories: embodiment, resistance to change, group dynamics, and contribution to development.

Embodiment

Satchell discusses the sense of **displacement**, which can be observed as positive feedback in removing traditional processes and empowering users with an active control that is somewhat invisible (the apparent removal of computers) [16]. Our observations strikes back to the notion of the user experience and what displacement actually meant to our users. If users tend to prefer invisible-computing and non-pervasive interaction techniques — such as gestural control, the so-called hands-free natural interaction, instead of physical devices — we might be experiencing a trend that demonstrates that designers prefer to be non-users, or at least to forget the burden of sensing that they are operating a service or task through a system by the use of a *Wizard of Oz* interface.

Ned showed a clear tendency to control the device during user tests, and further suggested that the device should provide affordances for ownership. This observation seems congruent with the intention of Ned to undertake the role of a *Wizard of Oz* interface, and therefore feel challenged by other means of interaction, such as our device. Interestingly, it appears that other designers do not share this perception. Whereas several designers acknowledged that an input device would be useful, none mentioned that this could replace the operator. This finding suggests that there is space for informal design review meeting, where the input device could replace the operator, and for formal design reviews with clients, where the operator expertise is valued and in no danger of being replaced. If the device is deployed alongside with an operators, there is the strong possibility that the operators will appropriate the device and maintain control over the showroom interaction.

Resistance to Change

Resistance to change does not always translate into Luddite behavior. Luddite-like behavior was only observed in the test session, where Ned insisted on participating in the user tests, therefore invalidating the evaluation of the input device and supporting the suggestion that the presence of an operator is required at every design review meeting. When analyzing this behavior in the context of user requirements, it becomes clear that showroom demonstrations are performed with great attention to details such as fine zoom, panning motions, and others. Thus, Ned's resistance may reflect his opinion that our interface is not good enough for actual design meetings (especially if it is designed to replace a human operator).

Group Dynamics

Ned's behavior around his peers — superimposing his position in the interactive space during the tests and occupying the social and personal space between himself and the user [9] — reveals a tendency toward a dominant status within the showroom social environment [3, 14]. Our assumption is that this behavior derives from his familiarity and hierarchical status in the workplace, where he is in control of the presentation.

It becomes clear that Ned only protested against the input device when his group dynamics were not affected. Thus, in the presence of a superior staff member, he would state that the input device and interaction techniques were of interest. In fact, as Cummins [3] suggests, social dominance is the earliest stable dimension of peer group social organization and one of the most striking observable personality traits of the human being.



Figure 5: Alternative views used for navigation.

In the first test session, we had the distinct impression that the briefing of the users was coerced. Ned described the device and interaction techniques in his own words, rarely paraphrasing the briefing documentation. Moreover, because he is not an HCI expert, many of his suggestions and explanations to the users were incorrect from an HCI perspective. Throughout the videotaping of the test sessions, we transcribed such comments as "*Press and rotate the object*", instead of "*Click the right button to* grab *and turn your arm to* rotate", as detailed in the briefing document. These actions resulted in a clear biasing of the test outcome, furthermore it is somewhat evident that Ned intended to convey his opinions into the user's mental model, stressing the importance of his task and the showroom operator.

During the first user study, Ned tried to maintain his status in the design review scenario. To assert his position, Ned issued direct commands (e.g., "*Click there*") whenever participants demonstrated any indecision and took possession of the input device to exemplify a solution for the task, rather than letting the participant interact; he also told users to sit, restricting their movement and mimicking the designer-operator dynamic. When the participant was a superior staff member, Ned became less assertive and asked permission to interrupt the user. Regardless of the social dynamics, Ned did not refrain from intrusive assistance, suggesting that even when the interaction device is available, his know-how is relevant and that the showroom requires expert operation.

Contributions to development

The development process was slightly altered by Ned's behavior. Whenever a concern was raised by Ned, the development team expended effort to solve that particular issue, thereby inadvertently aligning the prototype's

functionality to the functions of the operator (as related to their embodiment). The more refined the prototype became, the more Ned believed it to be a thread. This threat became clear when the prototype exposed information that designers were not aware of because this information was formerly part of the operator's expertise. A suitable example is the 3D navigation system, which we implemented using eight viewpoints (three perspective and five orthogonal; see Figure 5) that act as shortcuts in navigating the model. The designers were not aware that these eight views functioned to quicken navigation tasks. However, Ned identified this requirement during task analysis. We thus argue that removing Luddites from the project reduces the opportunity to identify relevant requirements.

Lessons for practitioners

Human aversion is a common reaction to change and is evident whenever technology changes the workplace. Therefore, we recommend that practitioners identify such behaviors and take them into account when determining the direction of the project. Due to the inherent complexity of analyzing human behavior, we discuss how user aversion can be beneficial in an HCI research context. It is then left the practitioner to judge whether the presence of a Luddite is suitable for the project at hand.

Luddites can be a beneficial addition to your HCI research, because they offer a perspective that is not easily attainable from the researcher's perspective, as they will counter your developments from different angles [8]. Moreover, Luddite behavior generally comes from expert users who will raise relevant issues regarding why the technology may fail. Therefore, although not all of their criticism may be objective, researchers can expect to obtain interesting observations. This type of user will try

to highlight your design weakness and often is quite keen to note defects, which is a desired trait for participatory evaluations [6]. In summary, the inclusion of Luddites during task analysis, particularly when other experts are present, may enable the creation of stronger requirements and therefore mitigate the effect of aversion in subsequent steps.

Luddites can also provide insight into the workplace hierarchy, that might be otherwise elusive. In our case, Ned behaved differently when confronted with colleagues who frequently requested his services, thereby allowing us to understand better who was going to benefit from our project and pay closer attention to their contributions. Luddites can also be considerate to be surrogate users, who have proven to be of use in project development [12]. In our case, automotive designers were a scarce resource, and therefore, despite of his aversion, Ned provided a valuable source of input that, would otherwise have been unavailable.

Even extreme behavior can be meaningful for HCI experts, as it presents a clearly structured insight into how technology can unbalance the workspace. This finding is in accord with the statement by Satchell [16], that non-use is "not an absence or a gap; it is not negative space (...) it is meaningful". These guidelines are validated by our experiment, where, due to Luddite behavior, we ultimately test various designs that we would normally not have addressed.

Conclusion

We describe several findings that may help HCI researchers face user aversion and present an argument, which is drawn from the results of a three-year project, that a wide variety of social behaviors can be identified

aversive behavior. We discuss these findings from an HCI perspective, highlighting the possible effects of having a Luddite involved in your next user study.

Our findings support the argument that a project can benefit from the inclusion of users who are averse to the project, rather than dismissing their opinions. In our case, these benefits became clear because we were able to refine the prototype based on requirements directly contributed by the aversive user and introduce functionalities that would otherwise have been overlooked.

We suggest that Luddite-like users are not to be feared and should be included in HCI projects such that the solutions integrate their knowledge, rather than attempt to replace the human presence in the workplace. To the best of our knowledge, no operator has lost his employment due to the introduction of the novel input device in the automotive design industry.

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