Why Do We Want to Interact With Electronic Billboards in Public Space?

Daniel Michelis, Miriam Meckel

1Anhalt University of Applied Science, Germany
d.michelis@wi.hs-anhalt.de
2University of St. Gallen, Switzerland
miriam.meckel@unisg.ch

Abstract. Interactive large format displays have presently found their way into many places in public space. After a long phase of experimenting with prototypes only recently have technically mature applications been observed that are used in an increasing number of potential areas. This short paper examines the motivations behind the use of these applications. On the basis of an empirical investigation we present an experimental analysis of user-motivations in which motivational factors are determined from which design elements for interactive large format displays in public space can be derived.

Keywords. HCI, Ubiquitous Computing, Pervasive Computing, Situated Displays, User-Motivation, Public Space, Interactive Advertising, Digital Signage

Introduction

Following a long phase of prototypical experimentation, interactive large format displays are now finding their way into public space. In the process it is sparking wide interest: commercial advertisers look for new ways to enter the dialogue with their clients, large-scale event organizers attract thousands of visitors with new interactive screens broadcasting sporting events, retail chains advertise with dynamic shop window displays that react to shifting bodily movements in grabbing the attention of passersby, and culture makers appeal to the community creating potential of interactive urban architecture, which promotes active public participation in the “Media-City” of the 21st century and creates new sites for urban encounters. [1]

The entry of interactive displays into public space is part of a greater tendency: computer usage is spreading into public life and no longer restricted to mere task fulfillment at the workplace. [2,3,4] While task oriented theories simply regard the “how” of an activity but not the “why”, they leave questions concerning underlying motivations unanswered. In spite of its increasing significance in human-computer interaction, motivation has been only an isolated object for investigation. Up until now there exists a significant need for advancement in understanding the motivation behind the user's activity. [5] Particularly, only little is known about how the design of public displays will invite interaction. [6]
In-situ Research by Prototype-Design

We present an empirical investigation during which the installation Magical Mirrors with four interactive displays in Fig. 1 served as experimental prototype.

![Fig. 1. Passers-by interacting with the interactive displays of our experimental set-up](image)

The investigation is oriented around the research field of Ubiquitous Computing (UC), which takes the entry of computers into the physical environment as its starting point. In addition to the omnipresent linking of mobile technologies, large format displays are integrated into the urban environment. They become stationary components of UC and they do not therefore stand in the tradition of analogue advertising surfaces but in the tradition of interactive computer displays [11].

![Fig. 2. Observed examples of body movements in front of the experimental set-up](image)

As interaction with public displays takes places in both the digital and the real world, lab based user studies are no longer sufficient [7]; Instead by designing real-world settings, we become able to fully understand the process of public interaction as drafted in Fig. 2. [8,9] By altering the prototype-design in situ, we were able to observe resulting changes in real-world behavior. [10]
Within the scope of our experiments, a number of design elements shown in Fig. 3 were altered, e.g. the interface design, the number of displays operating, the design and reaction time of particular effects, and also the name-giving mirror-effect. The goal of this experimental approach was to examine what role the design of each variation played in motivating the usage of the prototype shown in Fig. 4.

As a starting point for our investigation we developed intrinsically motivating design elements that were identified in the context of a motivation theory analysis and that should serve as the orientation point for the development of interactive applications in public space. Initial experience from these areas of application are providing valuable insight into design guidelines, usage behaviour and success factors for the future application of interactive displays in public space. [13]

According to previous research work and in consideration of the demands specific to interactive large format displays a number of motivational factors are determined. In the analysis of these factors a set of tools of fundamental motivations are identified from which design elements for interactive large format displays in public space can be derived. The findings of our analysis were subjected to an empirical examination. In 15 partial experiments the observed user behavior of a total of 4640 passersby is analyzed.

Results

The results of our empirical research clearly show central design elements that can influence awareness, perception and usage of interactive displays. Observation revealed that user-motivation is based on the five motivating factors in Table 1:
Building Blocks for Motivating Interaction in Public Space

### Challenge and Control
In interaction with public displays people strive for an optimal level of competency that allows them to master the challenges presented by the application. Viewing the consequence of one’s own interactive behavior was described as the most important element for challenge as a motivating factor. In addition to this visibility, the presence of a goal to the interaction, in which a distinction between set and emerging goals can be made, also plays an important role. Whereas a set goal is established by cultural or social conventions, emerging goals arise from the interaction of the individual with his or her environment. Since emerging goals have a strong motivating effect, interactive environments should allow the designing of one’s own emerging goals. Moreover, the intrinsic motivating challenge of an activity appears to increase if, in interacting with the environment, a clear and direct feedback follows from one’s own behavior and the attaining of the goal. In order to turn an interaction into a challenge, the behavioral outcome should however be somewhat uncertain and the end result should remain unknown prior to being conducted. The motivating effect of control is based primarily on recognizing a cause and effect relationship, as well as on powerful effects and the freedom of choice in performing the interaction. For motivation the perception of control is more important than actual control.

### Curiosity and Exploration
Curiosity appears to belong to the most important characteristics of intrinsically motivating environments. In order to stimulate curiosity and to influence motivation, the interaction shouldn’t be designed in a way that is either too complex or too trivial. Interactive elements should be novel and surprising, but not incomprehensible. On the basis of prior experiences the user should have initial expectations for how the interaction proceeds, but these should only be partially met. In reactive environments a motivating optimum of complexity is therefore also fostered through the interplay of surprising and constructive interaction. The desired behavior for the interaction can be initially activated by surprising elements and maintained through constructive elements. In contrast to perceptible changes that appeal to people’s sensory curiosity, cognitive curiosity relates to anticipated changes. People are motivated in this way to optimize their cognitive structures. To increase motivation through curiosity, it appears at first sufficient to convey to the individual a sense of incompleteness, discrepancy or dissipation and to present through the interaction the possibility to abate these sensations. However during the interaction it should be made especially clear how to attain completeness.

### Choice
The offer or presence of interaction alternatives is the third motivating factor within interaction with public displays. Choice encourages the performing and maintaining of specific interactions. The existence of choice possibilities alone, however, doesn’t always lead to a maximum of intrinsic motivations. Concrete
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interaction alternatives, in which a motivating effect was demonstrated in other areas, are for computer games for example, the possibility to select speed levels, camera settings, time limits or degree of difficulty. But alternative software features designed to correspond to one’s own preferences could motivate in other areas as well, perhaps through the activation of flow. Moreover through the allocation of explicit choice possibilities the user can be provided with a greater control potential.

**Fantasy and Metaphor**

In interacting with computers one of the initial user reactions is oftentimes the incitement of fantasy; the extent to which interactive environments incite fantasy determines their attractiveness and generates interest in the reception of the interaction. The use of metaphors allows inadequately concretized fantasy concepts to function. By employing metaphors fantasy elements can be directly integrated into the interaction process. Since they refer to physical or other systems metaphors can help the user to comprehend the interaction even prior to actual use, motivating him or her toward the reception of the interaction. Since the interaction bears resemblance to already known situations, it can be more easily grasped and utilized more efficiently. In so doing metaphors must not reproduce the real world in any way, since the abstract, conceptual or symbolic representation can prove equally as effective as true to life images. If new forms of interaction are linked to familiar traditions, it appears easier for users to carry over already established behaviors.

**Collaboration**

In contrast to the first four motivating factors, collaboration is based on the interaction with other human beings. A condition for its motivating effect is the possibility that the individual can influence the interaction of other people. In addition to social interaction over the internet, the use of interactive large format displays increasingly plays an important role in collective interaction located in one place. The motivation to collaborate is increased for example through functionalities that make visible the effects of one’s own behavior and group allegiance, whereby visibility as well as viewing the enacting is a result of the goal behavior as well as viewing the effects of the behavior.

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<th>Table 1. Building Blocks for Motivating Interaction</th>
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During the experiments the usage-motivation clearly depended on the impact the display design had on each of these motivating factors.

By providing a first list motivating factors our experiments aimed at collectively developing a better understanding of the design foundation of interaction with public displays and encouraging future research within the next couple of years. On the basis of our empirical investigation this paper presents a contribution to the understanding of the fundamental motivations behind the use of interactive large format displays in public space.
References

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