

Influence of Interactivity on Social Connectedness

A Study on User Experience in an Interactive Public Installation

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Abstract. Public installations have the opportunity to influence many people due to their location and the vast amount of people that are exposed to them. New technologies and materials bring new opportunities to the forms of public installations. Many of these installations are interactive. This paper investigates how interaction with public installations affects its users by evaluating the experience of social connectedness with a specially designed prototype.

Keywords: social connectedness, public installation, public arts, interactivity, user experience.

1 Introduction

Looking into the development of public arts or public art installations, especially the introduction of interactivity, based on the work of Edmonds, Turner and Candy [1], Wang, Hu and Rauterberg defined three generations of art installations and generative technology according to the carrying material, technology and interactivity [2, 3]: 1) Static forms: there is no interaction between the art artifact and the viewer, and the artifact does not respond to its context and environment. 2) Dynamic forms: the art artifact has its internal mechanism to change its forms, depending on time or limited to reacting to the changes in its environment such as temperature, sound or light. The viewer is however a passive observer and has no influence on the behavior of the artifact. 3) Interactive forms: the viewer has an active role in influencing the dynamic form of the installation. When interactivity is introduced, the “dialog” between the viewer and the perceived dynamic form of the installation can always vary depending on the difficult-to-predict behavior of the human viewer.

When designing for public spaces it is important to understand what types of activity spaces they are. According to Brignull et al [4] users can find themselves in three types of activity spaces: peripheral awareness activities in which people are peripherally aware of the installation’s presence but do not know much about it; focal awareness activities in which people are engaging in socializing activities associated with the installation; direct interaction activities in which an individual (or a group) can

directly interact with the installation. This paper focuses on the activities spaces in which people are actively engaged in the installation by either giving it their attention or interacting with it.

Public art installations have the opportunity to reach a large crowd at once, therefore also the opportunity to influence a lot of people at the same time [5]. However, many installations have no interaction with the user, limiting the user in being able to engage with the installation and creating a richer experience, or when they offer the interactivity, many of them can only be interacted with by a single user. This paper reports the research that tries to understand how the user experience with public installations is enriched by different levels of interactivity and especially, the influence of interactivity on the feeling of social connectedness – one of the experiences that many public installations aim at to offer [6-8].

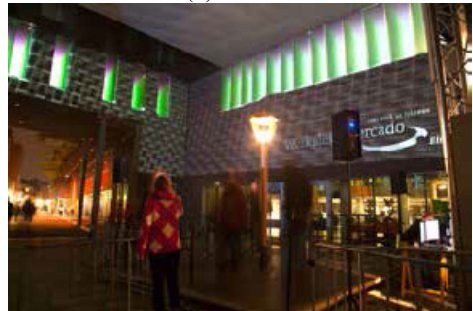
Next we will first introduce the levels or types of interactivity that we are interested in, and the concept of social connectedness. One would assume that having multiple users interacting with an installation would give them more feeling of being socially connected, and having no interactivity at all would give people less feeling of being connected. The experiment to investigation the relation between the interactivity and the social connectedness is described, including the questionnaire, prototype, setup and the procedure, followed by the results and conclusion.



(a) Les Orpailleurs de Lumière



(b) Skertzo



(c) Shift

Fig. 1. Installations at GLOW 2012, Eindhoven, the Netherlands

2 Interactive Installations

As to interactivity of installations in public spaces [2], according to whether an installation is interactive and whether multiple users are involved, interactive public installations can be categorized simply into three types:

1. Non-interactive installations: This category includes both static and dynamic installations, with passive observers who have no influence on the behavior of the artifact. An example is the installation by Les Orpailleurs de Lumière (Fig. 1a), which was a video show on the Catherina church (Eindhoven, the Netherlands) using projection mapping techniques during the GLOW festival in 2012 [9].

2. Single-User interactive installations. This category includes installations where the behavior of the installations can be influenced by the observers, but this is limited to one person at the same time. An example is the GLOW 2012 installation by Skertzo (Fig. 1b), where a single user could influence the projected image shown on a public building [10].

3. Multi-User interactive installations: This category includes installations where the behavior of the installations can be influenced by multiple users at the same time. Either multiple users can influence one feature as a group, or every user can influence a different feature while together creating a whole. An example is the GLOW 2012 installation Shift (Fig. 1c), where the public could walk over or stand on a big tilting platform and shifting of the weight influenced the movement of the projections on the surrounding walls and the accompanying sound [11].

3 Social Connectedness

Design of a product, include public installations, should yield not only a usable product but an interaction which is satisfying, if not rich, experience. The term rich experience in this paper means the experience that has a positive and pleasing value for the user, allowing her to perceive beauty in the product and its use. Social connectedness is one of the rich experiences. It is described as the momentary affective experience of belonging by Rettie [12]. Studies by Jose et al. [13] show that a greater social connectedness has a direct correlation with a greater sense of wellbeing. Van Bel [14] described the concept of social connectedness along 5 dimensions: relationship saliency, closeness, contact quality, knowing each other's experiences and shared understanding:

1. Relationship saliency – The prominence of the relationship in one's mind, which is the outcome of thinking of another person or being aware of him/ her.
2. Closeness – The experience of feeling close to another. This does not relate to physical proximity, but rather to the social presence in one's mind.
3. Contact quality – The perceived quality of social contact with another person.
4. Knowing each other's' experiences – being aware of each other's' experience, both in terms of subjective experiences (e.g. love, enjoyment, sadness), as well as awareness of things that happen in one's life.
5. Shared understanding – having a similar view on the world, having similar opinions or being “on the same page”.

4 Experiment

4.1 Installation

To evaluate the level of social connectedness with different types of interaction, an installation was designed with the focus on producing similar output while the installation is in a non-interactive setting (Fig. 2a), controlled by one user (Fig. 2b) or controlled by multiple users simultaneously (Fig. 2c), providing three experiment setups in which the only variable was the type of interaction.

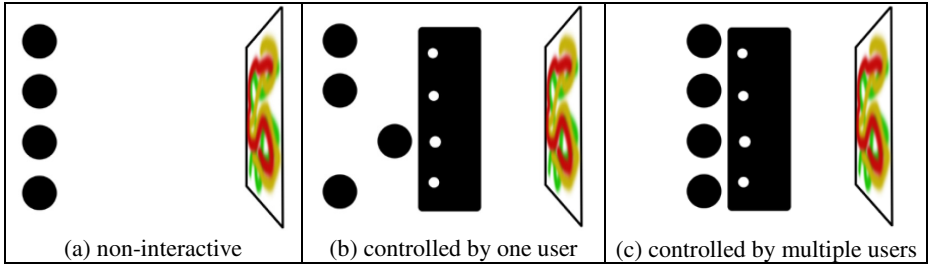
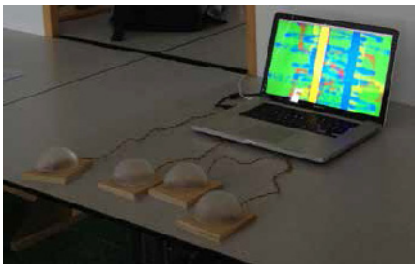


Fig. 2. Experiment setups

The installation itself consisted of four interactive components, which could control a colored dot on a big display (Fig. 3a, the image on the laptop screen is duplicated on the big display). The colored dot was controlled by the four rotatable knobs. Each of the knobs controls one aspect of the colored dot: X and Y positions, the color and the saturation. By the users controlling the X and Y positions, the colored dot would leave a trace on the background, enabling the users to draw on the display. In order to make the system more engaging, the resulting image was continuously scrolling up in such a way that the part which left the display at the top, returned at the bottom. This made it more challenging for the users to actually create something. If the system was in its non-interactive setting, the input was generated randomly.



(a) prototype



(b) users interacting with the installation

Fig. 3. Experiment

4.2 Questionnaire

The Social Connectedness Scale Revised (SCS_R) questionnaire [15] was chosen to measure the level of social connectedness of the participants during this study. SCS-R consists of 20 items (10 positive and 10 negative). All of the questions could be scored from Strongly Disagree to Strongly Agree and had a range from 1 to 6. The negatively worded items are reverse scored and summed with the positively worded items to create a scale score with a possible range from 20 to 120. A higher score on the SCS-R indicates a stronger feeling of social connectedness.

4.3 Participants

24 participants were recruited from a student flat and randomly divided in 6 different groups. The group dynamics were important as a group of friends vs. a group of people who were not familiar with each other could have a different influence on the social connectedness. The random grouping was checked to prevent friends from being in the same group. There were 9 females and 15 males, the age ranged from 18 to 29 and the background was spread over 4 different schools, including Eindhoven University of Technology, Fontys Hogeschool Eindhoven, Summa College Eindhoven and Design Academy Eindhoven.

4.4 Procedure

The experiment took place in one of the rooms in the student flat, where the participants were sat next to each other, in front of the big display where the output was shown (Fig. 3b).

When the participants arrived, they were asked to fill in the SCS-R questionnaire to measure their initial level of social connectedness. The experiment consisted out of 3 different rounds, after each round the students were requested to fill in the questionnaire again.

In every round, the participants engaged with the installation in the 3 different settings as described before. Each of the sessions was filmed for later evaluation of the actions of the users. In order to rule out the influence of the sequence in which the participants were engaging in the different modes, each of the six sessions were done in a different and randomized sequence.

4.5 Results

SCS-R was used to investigate if there was a difference in the level of social connectedness throughout this study. Table 1 shows the descriptive statistical results.

Mauchly's test indicated that the assumption of sphericity had been violated $X^2(5) = 24.35$, $p < .05$. Therefore the results are corrected using the Greenhouse-Geisser estimate of sphericity ($\epsilon = .603$). The results show that the level of social connectedness was significantly affected by the different levels of interaction $F(1.81, 41.64) = 8.29$, $p < .05$, $\eta^2 = .72$.

Table 1. Descriptive statistics

	Mean	Std. Deviation	N
Control Test	96.79	9.948	24
Non-Interactive	99.04	10.063	24
Single-Interactive	98.00	10.138	24
Multi-Interactive	101.13	10.535	24

Using a Helmert contrast revealed that the fact that the user engages with an installations raises the social connectedness significantly $F(1, 23) = 37.40, p < .05$ ($M = 96,79$ vs. $M = 99.39$) (Table 2). However, using the same contrast also reveals that the change in social connectedness between a not interactive installation and an interactive installation ($M = 99,04$ v.s. $M = 99.57$, respectively) is not significant ($p = .58$).

Table 2. Tests of Within-subjects contrasts

Source	Tests	Mean Square	F	Sig.
Tests	Level 1 vs. Later	161.894	37.403	.000
	Level 2 vs. Later	6.510	.315	.580
	Level 3 vs. Level 4	234.375	9.547	.005
Error(Tests)	Level 1 vs. Later	4.328		
	Level 2 vs. Later	20.663		
	Level 3 vs. Level 4	24.549		

Table 3. Pairwise comparisons

(i) Tests	(j) Tests	Mean Difference (I-J)	Sig. ^b
1	2	-2.250	.070
	3	-1.208	.117
	4	-4.333 [*]	.000
2	1	2.250	.070
	3	1.042	1.000
	4	-2.083	.723
3	1	1.208	.117
	2	-1.042	1.000
	4	-3.125 [*]	.031
4	1	4.333 [†]	.000
	2	2.083	.723
	3	3.125 [*]	.031

Finally, a poc hoc test using the Bonferroni correction revealed that the social connectedness improves significantly ($p = 0.031$) between the single user ($M = 98$) and the multiple user interaction ($M = 101.13$) (Table 3).

5 Discussion and Conclusion

During the non-interactive and single user interactive tests, there was little to no engagement between the participants. While during the multiple user tests every group, some sooner than others, ended up interacting with each other in a social way; either by discussing how they should work together in order to create something, or by discussing their opinion about the installation or how and where they would see the installation implemented (for instance up-scaled at the city square, or as a game during a house party).

The experiment was successful in providing evidence that if a public installation is interactive, having the users interact simultaneously increases the level of social connectedness significantly compared to a single user interaction. However, there was no significant difference in the level of social connectedness between having a non-interactive installation and having an interactive installation. Therefore, no conclusions can be drawn from this experiment and this would be a topic for further investigation.

Another topic for further investigation would be a comparison with the interaction as described by Hu et al. [2] in the new generation of public installations, where the installation is not created by the designer as a final result, but as a platform and growing system for the public to participate and for social creativity to contribute to the artifact.

An example of is an installation designed for the Science and Education New Town, Taicang, China. One of the concepts for this installation is a platform where the public is allowed to contribute their photos from social media, for an interactive photo show to induce the feeling of social connectedness, and reinstate the historical values of Taicang as the port to world (Fig. 4).



Fig. 4. Public art installation for Taicang

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Foreword

The 16th International Conference on Human–Computer Interaction, HCI International 2014, was held in Heraklion, Crete, Greece, during June 22–27, 2014, incorporating 14 conferences/thematic areas:

Thematic areas:

- Human–Computer Interaction
- Human Interface and the Management of Information

Affiliated conferences:

- 11th International Conference on Engineering Psychology and Cognitive Ergonomics
- 8th International Conference on Universal Access in Human–Computer Interaction
- 6th International Conference on Virtual, Augmented and Mixed Reality
- 6th International Conference on Cross-Cultural Design
- 6th International Conference on Social Computing and Social Media
- 8th International Conference on Augmented Cognition
- 5th International Conference on Digital Human Modeling and Applications in Health, Safety, Ergonomics and Risk Management
- Third International Conference on Design, User Experience and Usability
- Second International Conference on Distributed, Ambient and Pervasive Interactions
- Second International Conference on Human Aspects of Information Security, Privacy and Trust
- First International Conference on HCI in Business
- First International Conference on Learning and Collaboration Technologies

A total of 4,766 individuals from academia, research institutes, industry, and governmental agencies from 78 countries submitted contributions, and 1,476 papers and 225 posters were included in the proceedings. These papers address the latest research and development efforts and highlight the human aspects of design and use of computing systems. The papers thoroughly cover the entire field of human–computer interaction, addressing major advances in knowledge and effective use of computers in a variety of application areas.

This volume, edited by Gabriele Meiselwitz, contains papers focusing on the thematic area of Social Computing and Social Media, addressing the following major topics:

- Designing and evaluating social computing and social media
- Analysing, visualising, and modelling social networks

- Online communities and engagement
- Identity and presence in social media
- Games, gamification, and entertainment in social media

The remaining volumes of the HCI International 2014 proceedings are:

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I would like to thank the Program Chairs and the members of the Program Boards of all affiliated conferences and thematic areas, listed below, for their contribution to the highest scientific quality and the overall success of the HCI International 2014 Conference.

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The 15th International Conference on Human–Computer Interaction, HCI International 2015, will be held jointly with the affiliated conferences in Los Angeles, CA, USA, in the Westin Bonaventure Hotel, August 2–7, 2015. It will cover a broad spectrum of themes related to HCI, including theoretical issues, methods, tools, processes, and case studies in HCI design, as well as novel interaction techniques, interfaces, and applications. The proceedings will be published by Springer. More information will be available on the conference website: <http://www.hcii2015.org/>

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