Blobulous:
Computers As Social Actors

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Abstract
Public interaction experiences are becoming ubiquitous recently, however, interaction is usually limited to broadcasting and the actual experience not very rich. Especially social connectedness and bonding are important aspects of public interaction that are often overlooked. This paper reports on research investigating how a publicly displayed application can improve social connectedness by acting in a socially accepted way. Blobulous is a novel interactive installation that interacts with participants through projected avatars, which react to the participants' movement and body signals. A functional prototype was implemented and evaluated.

Author Keywords
Interactive Installation; Public Display; Social Connectedness; Social Actorship; Computers as Social Actors

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Public displays are effective in addressing multiple people and the same time aim at engaging bystanders, people passing by and others for a certain cause. While the use for advertisements, entertainment and promo-

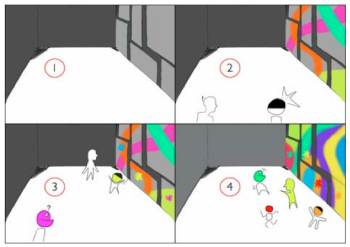

Figure 1. Example space for using Blobulous

tion is quite far-spread, the usual modus operandi of a single display is to engage people as a single person in a 1:1 message. A second drawback is the limited interaction space for people "using" a public display: messages are mostly unidirectional and there is a little that a person can actually *do* to be engaged in a richer interaction than simple information broadcast.

This work reports the research that aims at using public displays or installations to address multiple (previously unconnected) people at the same time and increase the level of social connectedness among them. The main challenge is that the public installation therefore acts as a social actor, a socially acceptable participant in a social multi-user setting. Part of this research is also to investigate whether computers (controlling the public installation) can indeed act as a social actor and improve social connectedness. "Social actor", in general ICT uses, was developed into a conceptualization model through a series of empirical studies. There are five dimensions in the conceptualization of a social actor: affiliations, environments, interactions, identities and temporalities [1]. Social connectedness also stands out to be a very important psychological feeling that links to personal health and well-being [2].

Related work

In the field of HCI, computers are considered to be able to handle social tasks and tend to be treated like humans [3]. From these cases, social connectedness stands out to be a very important psychological feeling that links to personal health and wellbeing [2]. There is a growing community around public display and large-scale installations, and social interaction of their users, which is picked up by user-dedicated devices such as RFID tags and mobile phones [4-6]. In the case of *Blobulous*, an interactive installation is combined with bio signals, i.e., the heart rate, which other research also consider as a reliable and effective bio signal implemented as a type of communication between people [7, 8].

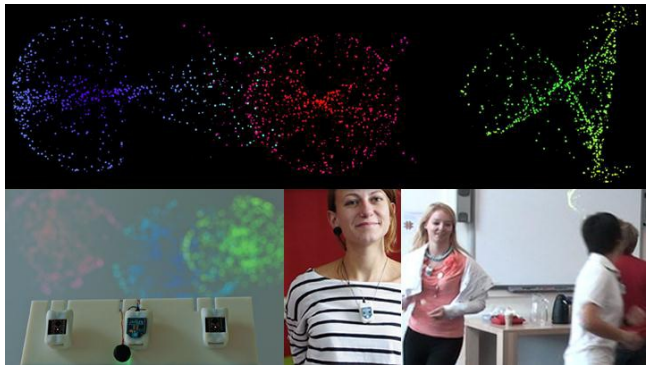

Figure 2. Overview of system components

Blobulous system

Blobulous is a novel interactive installation (see Fig. 1 for example settings and Fig. 2 for system overview) that interacts with participants through projected avatars, which react to the participants' movement and body signals. *Blobulous* uses a large (possible public) display to show abstract avatars, blobs of dots – therefore the name "*Blobulous*", one for each participant and moving around slowly. The movement of the avatars is connected to the participant's movement in the space in front of the display. The second mapping involved in the installation is from a participant's heart rate to the color of his or her avatar. The mapped colors range from blue (cold, low engagement) to red (warm, high engagement).

The *Blobulous* system consists of four parts: (1) Wireless heart rate sensors capture and send heart rate

	Protocol 1	Protocol 2
Session 1	A	B
Session 2	B	A
Session 3	Brainstorm & Demo	

A: Random Blobulous
B: Interactive Blobulous

Table 1. Evaluation protocols

data from users to a central instance, (2) a central instance, including a receiver and a visual program, receives data from users and derives avatar behaviors represented as visuals on the projected screen, (3) a projector connected to the central instance, and (4) a Zigbee network, which handles communication between sensors and the central instance.

Evaluation

The objective of evaluating the *Blobulous* system is to show an improvement of social connectedness among participants. Social connectedness is measure by means of a questionnaire that has been derived from Social Connectedness Scale Revised (SCS_R) questionnaire [9]. The hypothesis of the user test is straightforward: *Blobulous, a Social Actor, improves the feeling of social connectedness among its participants.*

Experiment setup

In order to evaluate the feeling of social connectedness of people while interacting with each other, it is better to include a group dynamics factor in the evaluation. 21 (14 male, 7 female) participants were recruited online and randomly divided into 7 groups according to their time preference. So, in most of the groups, participants did not know each other before the experiment. Users' backgrounds were distributed to Industrial Design (7), Electrical Engineering (4), Computer Science (3), Automotive/Logistics (3), Biomedical (2), Architecture (1), and Business (1).

Before coming to the experiment, participants were requested to answer the questionnaire to measure their initial level of social connectedness. During the experiment, this measure is repeated at the end of sessions 1 and 2. In the experiment, participants as a group were asked to perform three sessions: the first two sessions were planned to study social connectedness, the final one is so see how people can interact with *Blobulous*. Experiments were carried out following the two protocols shown in Table 1 to avoid a direction effect in the evaluation.

Figure 3. Experiment room with a) projection screen, b) heart rate sensors, and c) central control instance.

In both conditions A and B (Tab. 1), participants were asked to watch and explore the visuals projected on the wall (Fig. 3a) while wearing the sensor (Fig. 3b) and then have a short discussion about what they perceive from the visuals. Heart rate data was streaming automatically by the prototype while movement data was manually controlled via an Apple iPad using touchOSC [10] (Wizard of Oz) (Fig. 3c).

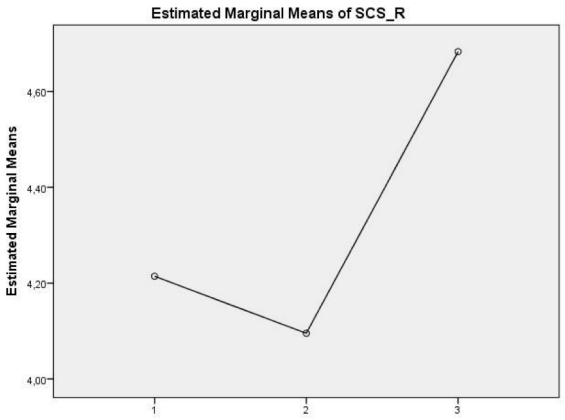

Figure 4. ANOVA repeated measures (SPSS)

Only afterwards, in the demo session, participants were explained details about the functionality of *Blobulous,* and then asked to come up with some ideas and try to demonstrate the ideas together with *Blobulous*. All sessions were recorded for later video analysis. The experiment room was prepared with a large display on the wall, an interaction space in front of the display, and an experiment control area (depicted at the bottom of Fig. 3).

Methodology

A video analysis was proposed to follow up psychometric test of social connectedness to investigate and capture social behaviors in real-time that might link to social connectedness but could not be captured by questionnaires. Therefore, the evaluation was carried out in two steps:

Firstly, the Social Connectedness Scale Revised (SCS_R) questionnaire [9] was chosen to evaluate the level of social connectedness of participants in this study. SCS-R consists of 20 items (10 positive and 10 negative). 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. Then, the mean score with a possible range from 1 to 6 is calculated by dividing the total scale score by 20 (or 20 scale items). A higher score on the SCS-R indicates a stronger feeling of social connectedness.

Secondly, the video analysis was carried out to check the feeling of social connectedness in conditions A and B. An observation scheme with behaviors and scores was developed to compare between conditions A and B.

Experiment results

SCS-R was used to study if there is an improvement or difference in the feeling of social connectedness of participants while interacting with the system. A repeated measures ANOVA with a Greenhouse-Geisser correction determined that the mean SCS_R score differed statistically significantly between different time points ($F(1.484, 8.107) = 3.791$, $P < 0.046$). Post hoc tests using the Bonferroni correction revealed that there is a slight reduction in the SCS_R score when bringing people from their own setting to a social setting or testing environment ($M = 4.21$ vs. $M = 4.09$, respectively), which was not statistically significant ($P = 1$). However, the SCS_R score had been improved after the interactive session with *Blobulous* ($M = 4.68$), which was statistically significantly different to the random session without *Blobulous* ($P = 0.002$) (Fig. 4). Therefore, it can be concluded that the *Blobulous* prototype elicits a statistically significant improvement in SCS_R score or the feeling of social connectedness of people but only in certain social contexts.

The internal reliabilities on the SCS_R questionnaire from pre-test, random and interactive condition had been found to be good ($\alpha = 0.936, 0.756, 0.751$, respectively). Strangely, there were slight drops in the alpha values between the testing and pre-test conditions. This can have resulted from the fact that the pre-test participants were at their own places while answering the SCS_R questionnaire, but during the test they were in a controlled room.

Results

The *Blobulous* prototype was designed to act as a social actor, specifically to improve social connectedness between people. *Blobulous* draws great attention from users due to its colorful appearances and lively movements. It also raises social awareness between people while they are together and informs them about individuals' and the group's condition. With those effects, *Blobulous* makes people talk about it, about each other and sometimes they try to understand *Blobulous* and interact with it. As a system with a physiological connection between humans and computers, *Blobulous* has more impact on social interaction than one without physiological connection: The experiment results showed a significant difference in the level of social connectedness between the two testing conditions (random avatars and interactive, mapped avatars).

Most importantly, the study showed that while *Blobulous* was mediating social activities, peoples' feelings of social connectedness were improved significantly (P = 0.002 – one way ANOVA).

The system needs to be further developed with the ability to act independently but not only mimicking to do so, which was a pragmatic design choice in this study. Also there are further experimental results such as AttrakDiff and a social connectedness survey, which deserve further dissemination.

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