

# Enticing People to Interact with Large Public Displays in Public Spaces

Harry Brignull & Yvonne Rogers

Interact Lab, School of Cognitive & Computing Sciences, University of Sussex, Brighton BN19QH, UK

harrybr, yvonner@cogs.susx.ac.uk

**Abstract:** Large displays are increasingly being placed in public places to support community and social activities. However, a major problem that has been observed with this new form of public interaction is the resistance by the public to participate. A main reason is due to the prominence of the affective aspect of the user experience. In particular, feelings of social embarrassment often act as a barrier. Our paper is concerned with understanding why this is the case and considering how we can attempt to overcome these aspects through improving the design of public interaction. Our focus is on how groups of people socialize around large public displays, the way they move towards them, congregate around them and change from being onlookers to participants and back again. We describe a system – the Opinionizer – which we designed and placed in two authentic social gatherings, intended to encourage socializing and interaction. We present our findings in terms of the patterns of physical and social engagement that take place around it. We then present a model of public interaction flow, which we use as the basis from which to provide design recommendations for encouraging public participation.

**Keywords:** Situated public displays, social computing, public space, CSCW, community, digital bulletin board, affective aspects

## 1. Introduction

We are witnessing a proliferation of large digital displays in public spaces, serving the role of advertising billboards, information boards (e.g. timetables) or showing television or video. These displays typically present predetermined feeds offering no interactivity. However, with rapid advances in touch-screen technology (e.g. Dietz and Leigh 2001, Paradiso et al, 2002) and interoperability between devices (e.g. Edwards et al, 2001), it will soon be possible for large displays to enable *public interaction*.

The focus of much ongoing research into public displays has been to investigate how sharing and broadcasting can be put to good effect through supporting community and social activities (e.g. Agamanolis, 2002; McCarthy, 2002; O'Hara & Brown, 2001). Specifically, Greenberg's Notification Collage (Greenberg & Rounding, 2001) looked at how users post notes and other media elements to a large public display as a way of enhancing communication and awareness within the community. XRCE's Community Wall (Grasson et al, 2002) explores how users post opinions, documents and news items with the aim of 'fostering social encounters' while FXPAL's Plamsa

Poster (Churchill et al, 2002) examines how users post 'community information' with the aim of increasing ad hoc social encounters.

Many of the studies have revealed a widespread problem: simply, it is hard to entice people to interact with them. For example, Greenberg's Notification Collage (2001) showed that co-present use of the public display rarely occurred (although remote usage flourished), Churchill et al. (2002) found that their users needed "*constant encouragement and demonstration*" (p.6) to interact with the interactive public display; Carter et al. (2002) noted that their users did not attend to the public display because they tended "*not to perceive information on which they do not have reason to focus*" (p.3) while Agamanolis (2002) found that "*Half the battle in designing an interactive situated or public display is designing how the display will invite that interaction*" (p4). How might we overcome this barrier? One recommendation is to introduce novelty and ambiguity to draw users in. However, this may prove to be a short-term solution, since as people become more experienced with interactive public displays, they are likely to become more wary, and may only be motivated to interact if it is clear what the system has to offer them.

To begin addressing this problem, requires us to understand what is causing the resistance. Social

embarrassment has been identified as a key factor, especially in determining whether people will interact with a public display in front of an audience (Rogers & Brignull, 2002). We draw an analogy here with a street performer in a public place, who invites a participant from the audience to ‘help out’ with their show. Such a person can often be wary of volunteering, not knowing what exactly will be required from them, especially if it entails making them look foolish in the eyes of the on-looking audience.

In this paper, we look at how this barrier can be overcome. To this end, we consider the way groups of people interact around large public displays, focusing on how people group around, attend to, reference to (e.g. talk, gesture) and move around the display. These are quite different issues compared to those associated with single user interactions at a desktop computer. A key difference is that people around a public display are typically carrying out other activities, and as such requires them to be drawn to the display for it to become their focus of attention. Hence, the flow of people around a display is critical to understanding public-display based interaction.

The analysis of the flow of people in public spaces has been studied by urban planners (Whyte, 1980) and retailers (Underhill, 2000), who use physical counts or time lapse photography to record crowd movements and computer simulations to model and predict future patterns. These models often use analogies taken from the dynamics of fluids, whereby the movement of the crowd is described as *flow*, containing *streams* and being constrained by *bottlenecks* (Helbing, 1997; Fruin, 1971). The focus of this research is largely on traffic and the management of congestion, relating to large crowds in large urban spaces or facilities (e.g. town centres, malls or stadiums) – rather than on understanding how groups of people flow around and interact with public displays in public spaces (e.g. rooms, halls or foyers). The concepts, nevertheless, can also be useful in characterizing public interactions.

To this end, the goal of our research is to examine:

- the flow of people around public displays
- the level and types of interaction around displays
- the transitions that occur between types of interaction
- factors that cause social awkwardness and embarrassment around public displays

We describe here two observational studies we carried out, exploring how an interactive public display we developed called the ‘Opinionizer’ was reacted to and interacted with by the general public. Based on our findings we put forward a preliminary

model of public interaction flow, intended to provide designers with a framework by which to understand and conceptualise public display-based interactions.

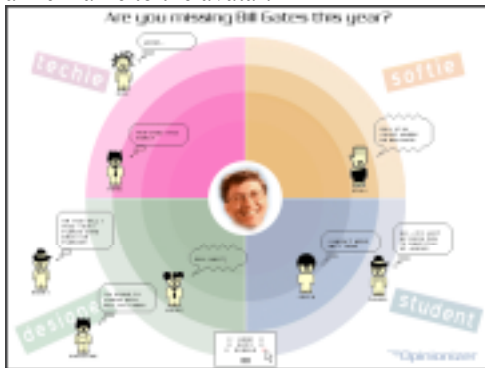
## 2. The Opinionizer system

We were interested in creating a public display that people could interact with in a lightweight way, while simultaneously observing others taking part. We decided upon a shared display that people could add their views and opinions to, which they and others could observe and then add further comments to if they felt inclined. These could be added simply by typing in a few words at a keyboard, which would then be projected onto a wall display. A key decision was to design the display such that there would be no obligation to take part, and that the space would organize itself in a way that would make it socially acceptable to take part without feeling embarrassed or overcommitted. Moreover, we wanted to create an interactive display that strangers felt comfortable and enticed to take part in rather than be wary of.

The collective building up of shared content on the display was intended to provide a talking point to others standing besides it, to comment on to their neighbour, again with little commitment or embarrassment. Hence, a further aim of the Opinionizer system was to encourage people in a public setting, to create and display content for public viewing, that would encourage conversation initiation and socializing between bystanders. The target setting for this was informal gatherings, where there is a mingling crowd, for example welcome parties, where there is a mix of strangers and people who know each other. In such social settings, it is often the case that newcomers are ‘outside the network’ and find it very difficult to break the ice and become part of it (Borovoy et al, 1998).

We designed our interaction space so that it could be projected onto a large wall, inviting people to type in their comments, via an adjacent laptop, that would then appear on the public display. A key issue was to consider how we might design a shared display that presented the right kind of content which anyone could observe or add to and which changed sufficiently over time to continue maintaining interest among the people at the social event. Moreover, we wanted to design it so that people could use it as a way of initiating a conversation with the person/s standing besides them, either commenting on the ongoing virtual happenings on the board or discussing what to contribute themselves. Having broken the ice in this way, it could then lead onto further topics of conversations.

The Opinionizer was designed around various themes, consisting of eye-catching images and a provocative phrase or question relevant to the social gathering (see figure 1). The rationale was to invite people to post up their opinions relating to the topic being displayed. To add 'colour' and 'personality' to their opinions, people were given a selection of small cartoon avatars and speech bubbles. These communicated their gender and the mood of the message (chosen from a simple menu). The screen was also divided into four labelled quadrants, representing different backgrounds (e.g. 'techie', 'softie', 'designer' or 'student'). Hence, a person could label their opinion according to their background by simply moving it into that space. If they did not want to provide the information, they could simply move their avatar outside of the area or near to the center, where the target question/graphic was positioned. There was also the option of adding a nickname to the avatar.



**Figure 1: A screen shot from Opinionizer taken at the book launch party**

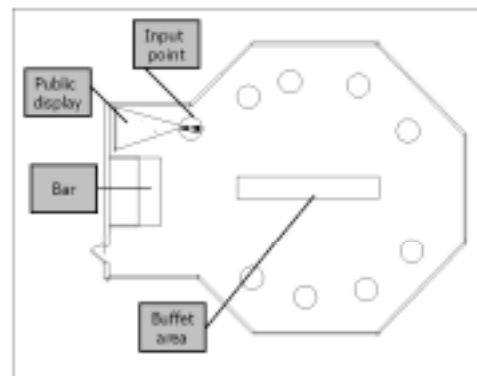
The Opinionizer was placed in two party settings; one a book launch party held at a large international conference and the other a welcome party for new students just arrived at a university. Specifically, we were interested in observing the different ways people interacted with the display and how they moved around the space. Our goal was to examine the social activities that took place around the display and what motivates people to join in.

### 3. Study 1: The Book Launch Party

Our first study exploring how people would take to the Opinionizer in a social setting took place during an evening book launch party held at a large conference in Minneapolis (CHI'02). The display was set up in a prominent place (a raised platform next to the bar) in a large octagonal room, as shown in figure 2.

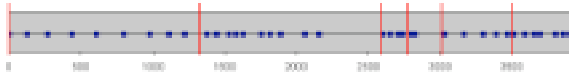
The size of the Opinionizer screen was approximately 6' wide by 4.5' tall. The text on the screen was legible from approximately 5 meters away, while the screen itself was visible from anywhere in the room. The laptop, providing the user-interface, was positioned on a table close to the display. The projected display mirrored the laptop's, providing an identical but larger view. A helper stood by to explain to people what was going on. The party lasted for 2 hours, during which approximately 300 people passed through, milling around the area near the display (usually on their way to and from the bar). Two of us observed how the crowd moved around and interacted with the Opinionizer.

At the beginning of the party, the first people to arrive tended to congregate near the buffet table, a few meters from the Opinionizer screen (in the center of the room). At this point, few people came forward to try out the Opinionizer, and when we tried to invite some of them over, they were rather wary of doing so, concerned that it might involve too much time or effort, or that it would involve looking stupid in public. Hence, we came up against the barrier of social embarrassment. Would it be possible to show people what lay in store if they were to commit themselves? Given that they had not seen the system in use, they did not know what to expect and so their natural resistances took hold. The key was to find a way of allowing people to observe its use first and get drawn into its use that way.



**Figure 2: Floor plan of set-up at conference party**

As the room filled up more and more people moved towards the Opinionizer and were able to observe it in action. Initially, we added opinions ourselves. This seemed to create a momentum effect, whereby the more people who interacted with it, the more other people wanted to follow suit (cf. Whyte, 1971). This resulted in an increase in rate of contributions to the Opinionizer over time (see figure 3).



**Figure 3: Timeline showing incidence of participation (in seconds). Dots represent comments, vertical lines represent theme changes.**

We also noticed as the evening wore on that people were able to interact with the Opinionizer without needing any explanation from the helper – they appeared to have picked up this knowledge through observing over the shoulder of others interacting with the Opinionizer. This form of vicarious learning was also helped by the fact that we designed the Opinionizer to have a limited, easy to grasp interface, that could be readily understood. About 40 people typed in their opinions to the shared display and many more stood around observing what was going on. Over 60% of the opinions were humorous and befitting to the setting. Generally people chose to identify themselves on screen only by their first names or nicknames. This was interesting given the fact that it was quite easy for nearby onlookers to see who was typing each comment. Perhaps they were choosing to do this because it provided ‘just enough’ identification for immediate social contact (e.g. those in close proximity or conversation with the person interacting with the Opinionizer) while still leaving it vague enough to prevent social embarrassment and identification from a wider, unknown audience.

### 3.1 The honey pot effect

Around the display itself we noticed a social affordance which we call the ‘honey-pot’ effect. By this, we mean the progressive increase in the number of people in the immediate vicinity of the Opinionizer, where people were typing in their comments, creating a sociable ‘buzz’ in the area. By standing in this space and showing an interest (e.g. visibly facing the screen and reading the text), people seemed to give a tacit signal to others that they were open to discussion and interested in meeting new people.

This claim is supported by our observations of people standing around the display, making a number of comments to their neighbors. These included direct references to the opinions being posted on the board, what the Opinionizer was about, and whether they had had a go themselves.

To analyze further the nature of the flow of people around the display we conceptualised it in terms of the analogies drawn from fluid dynamics. We can see how the flow of people towards and away from the Opinionizer can be hindered by *bottlenecks* at various places up or down *stream*. However, the bottlenecks are not just the physical

constraints of the environment, they also are very much part of people’s conceptions of what is happening around them. These include:

- Beliefs as to whether the public display is interesting, enjoyable or worthy of attention.
- Perception of what it is, how to use it, and how long it takes to use.
- Understanding of its social standing and required etiquette (what other people think of it, the type of people who use it and how they behave towards it).
- Knowledge of the social system of practices around it, for example, the nature of the queue or the socializing activities going on in the immediate locality.

This analysis shows how a person’s conceptions can result in a negative feeling which prevents them from moving towards the display. Conversely, positive conceptions can entice someone to move towards the display and take part. The combination of trajectories and momentum can create viscosity or fluidity, restricting or facilitating the flow.

The findings from our first study revealed aspects about public interaction in terms of flow and people’s conceptions. In a follow-up study, we examine these aspects in more detail, paying close attention to the transitions that take place between stages of the flow. We were also keen to see whether the honey-pot effect would arise when the Opinionizer was placed in a quite different physical space and social and cultural setting.

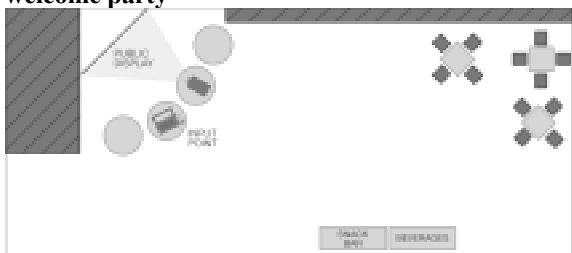
## 4. Study 2: A Welcome Party

The setting for the second study, was a welcome party for postgraduates entering a school at a university. The same Opinionizer system was used but with different themes selected for people to post their opinions about. These were selected to be relevant to the students being welcomed to the University. An example was ‘What do you think of the food at Sussex University?’ The projection screen was the same size, with the same legible and visible distances (legible from approx. 5 metres, visible from anywhere in the room, occlusion from crowding notwithstanding). As shown in figures 4a and 4b, the room was a different shape, being rectangular. Approximately 150 people, came along, which was a smaller number than in the first study. Several had met before and joined into groups but there was a sizeable number of students who were by themselves. The party lasted for about five hours, with the Opinionizer active for the first two and a half of those. Two video cameras were deployed near the display to record group behaviours and track people’s movement. They were placed high up to be unobtrusive as possible, so as not to affect people’s

behaviours. Most people did not notice them at all, and if they did, were likely to have assumed they were part of the CCTV security system which has become an accepted and ubiquitous part of public buildings in the UK. As well as video, other forms of data were collected. One person was employed as a roaming interviewer, another as an observer, taking notes and photographs, and a third stood on-hand next to the input point, to help participant and explain the system if asked.



**Figure 4a: Photo of the set-up used at the welcome party**



**Figure 4b: Floor-plan of the set-up at the welcome party**

Similar to the book launch party, we observed that at the beginning of the party, people congregated some distance away from the Opinionizer, collecting food and beverages from other tables. One person commented, later *"Nobody really knew what it was when they came in and there was a whole kind of fear because it was something new"*. A similar change in perceptions to that which happened at the book launch also emerged as the welcome party wore on: as the room filled up and the party got busier, the honey-pot effect emerged. People began to pay the Opinionizer display more attention, and began to congregate around the display, watching others using it and talking about it between themselves.

During the party, we interviewed 23 participants who had used or observed the Opinionizer (mean age 29; 14 males, 9 females). Over half of those interviewed were very positive about the display, citing that it was a good mechanism for supporting socializing activities. In particular, many comments focused on its 'lightweight' nature – it was available if desired, and did not interfere with people's activities if not desired. A significant finding was that over three quarters of them stated that they had

socialized with people they hadn't previously met while standing near to the Opinionizer. Hence, it proved to be a highly effective ice-breaker.

The negative comments from the interviewees mainly centred around the activity of taking part, and as expected, social embarrassment featured highly. A particular feature of this that was noticed was the feeling of 'public shame' – akin to that felt in the classroom when asked to write something on the blackboard in front of the class and you spell it wrongly. As we had designed the contributions to the Opinionizer to be broadcast in real-time on the large display, it meant that human foibles, like making and deleting mistakes, and being hesitant or shaky with the cursor, were highly visible and very public. It required a considerable amount of confidence to cope with the pressure. Some of the participants also experienced the pressure to provide a comment that was socially accepted by their peers. For example, one participant said, *"...there was pressure to formulate something not too dumb"*.

This level of self-consciousness and embarrassment was also noticed by the onlookers. Participants who were interviewed who chose not to provide their own opinions all indicated embarrassment as the core reason, and that they expected not to be relaxed if they were to have had a go. Furthermore, over half of those interviewed who did have a go experienced embarrassment and did not feel relaxed. As one participant noted: *"I was definitely aware of other people watching, which made it kind of awkward."*

One way of reducing social awkwardness is to allow participants to add their comments remotely and anonymously. This idea has been used in a number of public debates, where the audiences are allowed to type in comments remotely via their mobile phones. These appear as SMS text messages on a public screen on the stage. However, while potentially reducing social awkwardness there is a downside- it removes the honey-pot effect. The opportunities of socializing are greatly reduced as people focus on their handsets. Moreover, they become inward-looking and in many ways enter an anti-social space, one which they are only party to. In the interviews, we asked the participants whether they would have liked to have been able to input remotely. The majority indicated mixed or negative opinions about the idea. For example, one person said: *"It's perhaps safer [to input remotely] but not all the fun of going round the table together"*. In other words, while remote input would reduce pressure on people, it would defeat the purpose of having a public display as a place for encouraging socializing. An alternative way of reducing public shame is to allow participants to enter their

comments ‘off-line’, before posting them on the display.



**Figure 5: Photo showing the three spaces of activity**

With respect to the flow of public interaction around the display, we analyzed our findings in terms of the kinds of activities that took place and the transitions between them. We identified three distinct ‘activity spaces’:

- A ) **Peripheral awareness activities:** Typically eating, drinking and socializing elsewhere at the party. In general, people in these activity spaces are peripherally aware of the display’s presence and do not know much about it.
- B ) **Focal awareness activities:** People in these activity spaces are engaging in socializing activities associated with the display - talking about, gesturing to and watching the screen being used. Here they give the display more attention and learn more about it.
- C ) **Direct interaction activities:** In this activity space, an individual (or a group acting cooperatively) type in their opinion to the display

Examples of these activity spaces are illustrated in figure 5, a photo taken during the party. In activity space A, groups of people are standing away from the immediate vicinity of the Opinionizer and engaged in conversations or similar activities with each other, perhaps also fetching food or beverages. At some point, they become aware of the large display through peripheral monitoring of their surrounding environment, noticing some ongoing ‘public’ activities in the space around it (e.g. ‘there are people doing something over there’, ‘it involves a big display’, ‘I’m not sure what it is but it’s intriguing so I may go have a look’). For example, one participant said: *“I didn’t see people using it at first, but I did see people standing around it so I stood beside and watched it for a while”*

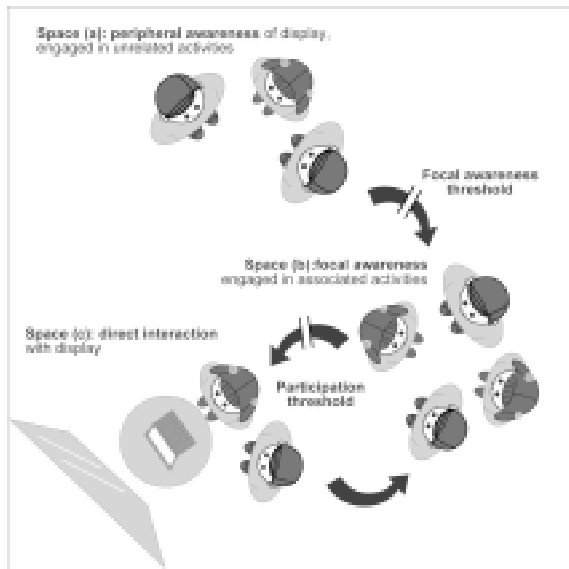
If their curiosity is sufficiently aroused, people will move from activity space A to activity space B. They do this by taking a closer look at the display,

either as a part of a group or as an individual. At this stage, they may begin socializing around the display. We also noticed that many individuals, by themselves, with apparently no-one to talk to and in a window of ‘dead time’, or maybe as a consequence feeling socially uncomfortable, chose to enter activity space B. In so doing, it allows them to join in with the ‘focal awareness’ socializing activities without feeling socially embarrassed or awkward. Conversations in this space often begun with reference to the large screen, using it as a shared point of reference to boot-strap the conversation (c.f. Borovoy et al, 1998).

Groups or individuals then have the choice to become interacting participants by moving into activity space C. Although ultimately only one person can add comments to the display at a time, group efforts were observed where the adding of an opinion was cooperative and where different individuals took turns to be ‘the driver’ and enter data via the keyboard. In this space, participants become the central focus of attention and social embarrassment can become high.

## 5. A conceptual framework for analysing public interaction

Our two studies have provided us with data about how people move around and interact with public displays. Based on our analysis, it appears that key bottlenecks occur in public interaction when people have to make the transitions between the different activity spaces. In particular, in crossing the *threshold* from peripheral to focal awareness activities (e.g. from chatting to someone on the other side of the room to deciding to move within view of the display to have a better look), people need to be motivated. In other words, their conception of what the display is and what it has to offer has to entice them forward to cross the threshold to focal awareness. This is shown in the schematic diagram in figure 6.



**Figure 6: A diagram showing a model of public interaction flow across thresholds**

Once participants have moved into activity space B and decided to give the display more attention, their interest needs to be stimulated enough to maintain their attention. The display has to provide them with affordances about what it has to offer in order for them to become motivated to cross the participation threshold. These affordances need to reassure the person that the potential for social embarrassment is low. Key information that needs to be made readily available to the person to decide whether to cross the threshold is:

- How long an interaction takes
- What they will get out of it
- What steps are involved
- If it will be a comfortable experience
- If there is a quick let out, where they can walk away gracefully, without it disturbing the ongoing public activity

## 6. Implications for design

Our public interaction flow model shows how people move between the different activity spaces and what is needed for them to cross the different thresholds. It can also provide us with a framework from which to draw some implications for designing interactive public displays. Below we suggest these in terms of how to encourage people to cross the focal and participation thresholds.

### 6.1 Encouraging people to cross the threshold to ‘focal awareness’

People’s initial understanding of a public display system is based on peripheral awareness, i.e. fleeting glances from a distance. This means that they will

judge the system rapidly on the ‘broad-grained’ details available to them at a distance. These should be designed to show the display and the activities around it in an attractive and easy to ‘pick-up’ way. It is also important to plan for bodily occlusion, and so placing the display at least partially above head height will allow people to see it from a distance. In our studies, we noticed that when there is a big empty space around the display, people become wary of crossing the participation threshold.

There is also the problem of getting the first people to use it at the start of an event. Using a helper can help instil confidence in people. Then as a space starts to fill up as the event progresses, one can remove the helper from the proceedings. To allow this filling up to occur smoothly, requires placing the display in a vicinity that has sufficient empty space around it, but also to maintain a continued flow of people across it, to allow people to pass the thresholds comfortably.

One way of achieving this is to position the display near a traffic flow from which to draw a stream of people. For example, in our first study, we positioned the display next to the bar where there was a constant flow of people, who were waiting in a queue. Another obvious way of getting people to cross the threshold into focal awareness is to offer free goods like food and beverages, and to put up posters and hand out flyers.

### 6.2 Encouraging people to cross the threshold to ‘participation’

Crossing this threshold requires a higher level commitment from the participant. The person’s time and effort can be likened to a currency which they are only willing to spend if they see themselves benefiting. For example, a lengthy registration process involving form filling is well known to put people off taking part. The form of interaction needs to be very lightweight and visible from the offset; it should be easy to do and importantly, not embarrassing to recover from mistakes that are made. Participants need to be able to learn how to interact with the system vicariously, rather than be told or have to follow a set of instructions. They need to be able to simply walk up and use it, having watched others do the same. The interface needs to be clear to the person such that they are reassured that their interaction with it will be a low commitment activity, that will be quick to do and enjoyable.

## 7. Conclusions

In conjunction with previous research, our studies of public interaction around situated displays have shown that a major deterrent preventing people from

participating is social embarrassment. For public interaction to become a more acceptable mode of social activity requires the purpose behind it and how it is manifested around and at the display to have strong physical and social affordances, that people can easily and unambiguously pick up on. There also needs to be a highly visible means of conveying this, which enables the public to rapidly develop their conceptions of the purpose of the social activity, and to be able to move seamlessly and comfortably between being an onlooker and a participant. One means of achieving this is to design ways of encouraging people to cross the thresholds from peripheral awareness to focal awareness, to participation and back again, without becoming self-conscious.

## 8. Acknowledgements

This research was carried out as part of the Dynamo project, grant no. GR/N01125 awarded by the EPSRC. Thanks to Tom Rodden and Mike Twidale for useful feedback on the study; to Jon Mathews and Rowanne Fleck for helping to collect data; and to Mia Underwood for the graphic design work.

## References

- Agamanolis, S. (2002) 'Designing displays for Human Connectedness'. In: *Workshop on Public, Community and Situated Displays at CSCW'02*, New Orleans.
- Borovoy, R., Martin, F., Vemuri, S., Resnick, M., Silverman, B., Hancock, C. (1998) Meme Tags and Community Mirrors. In: *Proc. ACM CSCW'98*, Seattle pp. 159-168.
- Dietz, P. & Leigh, D. (2001) DiamondTouch: A Multi-User Touch Technology. In: *Proc. ACM UIST '01*, Orlando, pp. 219-226.
- Edwards, K., Newman, K. & Sedivy, J. (2001) *The Case for Recombinant Computing* Xerox PARC Technical Report CSL 01-1.
- Greenberg, S. & Rounding, M. (2001) The Notification Collage: Posting Information to Public and Personal Displays. In *CHI Letters* 3(1) pp. 515-521.
- Fruin, J. (1971) *Pedestrian Planning and Design* Metropolitan Association of Urban Designers and Environmental Planners, Inc: New York.
- Helbing, D. (1997) *Traffic Dynamics: New Physical Modeling Concepts* Springer-Verlag: Berlin.
- McCarthy, J. (2002) Using Public Displays to Create Conversation Opportunities. In: *Workshop on Public, Community and Situated Displays at CSCW'02*, New Orleans.
- O'Hara, K. & Brown, B. (2001). Designing CSCW Technologies to Support Tacit Knowledge Sharing Through Conversation Initiation. In: *Workshop on Managing Tacit Knowledge at ECSCW'01*, Bonn.
- Paradiso, J, Leo, C. K., Checka, N. & Hsiao, K. (2002) 'Passive Acoustic Knock Tracking for Interactive Windows' In *Proc. ACM CHI'02*, Minne, Ext. Abstracts, pp. 732-733.
- Rogers, Y. & Brignull, H. (2002) Subtle ice-breaking: encouraging socializing and interaction around a large public display in: *Workshop on Public, Community. and Situated Displays at CSCW'02*, New Orleans.
- Scaife, M. and Rogers, Y. (1996) External Cognition: how do graphical representations work? *Int. J. of Human-Computer Studies*, 45, pp. 185-213.
- Underhill, P. (2002) *Why We Buy* Texere, NY.
- Whyte, W. H. (1971) *The Social Life of small Urban Spaces* Anchor Books, NY.