

Exploring the Behavioural Effect of Location-Awareness within the Social Context of Rendezvousing

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ABSTRACT

This paper presents an exploratory field study investigating the behavioral effects of mobile location-aware computing within the social context of rendezvousing. We introduce a study where participants took part in one of three mobile device conditions (a mobile phone, a location-aware handheld or both a mobile phone and a location-aware handheld) and completed three different rendezvousing scenarios. We discuss the effect of location-awareness on established communication patterns and the effect of context on user behaviour.

INTRODUCTION

Technological innovation that is meant to aid in the interaction of people brings with it not only the possibility of new applications but possible change in social interactions. Mobile technologies such as mobile phones are a pertinent example of innovation that has transformed social interactions and individual behaviour. Mobile phones provide users with a rich verbal communication channel enabling the exchange of contextual information on demand. However, location information can be difficult to convey accurately through dialogue complicating what could be a simple conversation. The verbal exchange of locations, instructions, and descriptions between people can be ambiguous, misinterpreted, or misunderstood. Location-aware computing can avoid the complication of verbal exchange by providing visual cues and references.

Projects using precise location awareness include an location-aware event planner [8] and ActiveCampus [4]. These systems provide visual location-awareness of all collaborators and an active communication channel (e.g. text messaging, voice). WatchMe [7] builds upon location-awareness, providing additional contextual information by comparing user movements to previous patterns terminating at user-defined locations. The context of the user's location is displayed descriptively (e.g. "gym") rather than with absolute coordinates or map annotations.

The term *hyper-coordination* has been coined to refer to expressive use of mobile phones for emotional and social communication [6]. Hyper-coordination has arguably augmented our social interactions [5, 6]. Ambient virtual co-presence has been identified with mobile phone users sending text messages [5]. The ability to text message allows users to maintain a continuous awareness of the people they are messaging back and forth with [5].

Location-aware technology can provide users with hyper-coordination and ambient virtual co-presence similar to what is offered by mobile phones. Although not as socially rich and active, users can maintain constant awareness of others simply by viewing and communicating via their location-aware device.

The main goal of our research is to investigate how location-aware technology impacts social behaviour within the context of rendezvousing (meeting at an agreed upon time and location). Group behaviours related to rendezvousing have been explored [1, 2] through detailed diary studies whose results illustrate common rendezvousing behaviours and challenges. An investigation of technology to support rendezvousing (mobile phones, text messaging, email, and voicemail) demonstrated that mobile phones are the current preferred method of communication [1]. When mobile, people often initiate a rendezvous by first agreeing upon a general time and place and then refining the location and time through subsequent messages [5].

This paper presents a field study exploring the use mobile phones and location-aware devices during rendezvousing scenarios mimicking typical real-life situations. The methodology for our study is briefly introduced with focus on a discussion of the findings and implications. Finally, we reflect on the results, providing insights into the differences between mobile phone and location-aware device usage and how their impact upon users' behaviours.

RENDEZVOUS FIELD STUDY

We conducted a field study to explore how technology impacts rendezvous behaviour. Three different technology conditions were investigated:

- Mobile phones
- Location-aware handheld computers
- Both mobile phones and location-aware handheld computers.

For further methodological details, including our procedure and Wizard of Oz technique for location-awareness, see [3].

Experimental Conditions

Pairs of participants took part in one of three technology conditions.

In the *mobile phone condition*, both participants were given a mobile phone programmed with their partner's phone



Figure 1. Interface for the location-aware device. (a) Partner's dot; (b) participant's dot; (c) rendezvous 'X'.

number and a laminated paper map that showed most of the buildings in the area (without names).

In the *location-aware handheld condition* participants were provided with an HP iPAQ h4155 handheld computer. Each handheld ran custom location-awareness software that enabled participants to view a street map of the area (identical to the paper map) annotated with the participants' locations as well as the rendezvous location (see Figure 1). Different coloured dots on the map represent each participant. Approximately 1/6 of the map was visible at a time and participants panned the display to see the rest of the map. The software also provided participants with the ability to request a rendezvous location. Participants selected the rendezvous icon, moved it to the desired location (mirrored on their partner's screen), and then selected the 'ask' option from the rendezvous menu at the bottom of the screen. This caused a request message to pop up on their partner's screen. The partner responded by accepting, rejecting or ignoring the request. The rendezvous 'X' turned green when the location was agreed upon.

In the *mobile phone and location-aware handheld condition*, participants were provided with both a mobile phone and the handheld. The participants were free to use either device at any time during the study.

Rendezvous Scenarios

The scenarios used were based on three rendezvousing behaviours identified by Colbert [1, 2]:

- Participant-arranged rendezvous: Arranging a rendezvous while separated
- Change in plans: Negotiating a new rendezvous location when one partner is unresponsive and a previous rendezvous has already been negotiated
- Delayed: One partner is delayed while the other is waiting at the rendezvous location

Based on these behaviours we constructed three rendezvous scenarios for use in our study. For further details, including

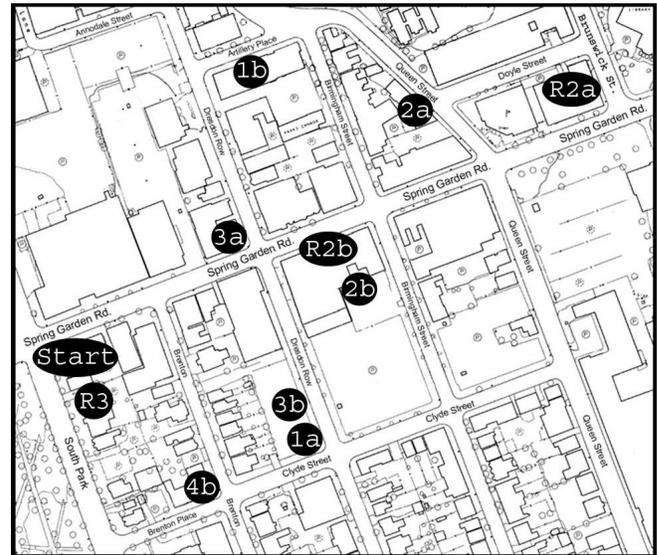


Figure 2. Complete map used by participants. (1-3)a and (1-4)b represent task locations for each partner. R(2-3) represent provided rendezvous locations. Start represents the initial starting location.

an overview of the rendezvous outcomes and narratives for each scenario, see [3].

Scenario 1: Let's meet here.

In this first scenario, participants were instructed that they would be given a task to complete (finding the store located at 1a or 1b, see Figure 2) after which they were to arrange a rendezvous location (either partner could initiate the rendezvous). After successfully negotiating the rendezvous they were instructed to proceed to the rendezvous location or their choosing. The goal of this scenario was to see if two distributed people could easily arrange and carry out a rendezvous. We observed how the participants negotiated the rendezvous, how they made use of the technology provided (depending on the condition), and recorded any difficulties they encountered while completing the task.

Scenario 2: Why won't they respond?

In the second scenario, participants were asked to complete individual tasks and then rendezvous at a pre-determined location (store located at R2a, see Figure 2). After completing their individual task (finding the store located at either 2a or 2b, see figure 2), one participant was told that the rendezvous location was changed (to R2b, see Figure 2) and that they would need to notify their partner where the new rendezvous location was. The other partner was also made aware of the rendezvous location change, however, they were not able to communicate with or respond to their partner. If the cell phone was used, the call was automatically forwarded to voice mail. If the location-aware handheld was used, no acknowledgement was sent. The goal of this scenario was to observe what the requesting partner would do when their partner was unresponsive and a previous rendezvous had already been negotiated. We

observed the behaviours of the requesting participant, how they made use of the technology provided, where they chose to go to meet their partner, and recorded any difficulties they encountered while completing the task.

Scenario 3: Why are they late?

In the final scenario, participants were again asked to complete an individual task (finding the store located at 3a or 3b, see Figure 2) and then rendezvous at a pre-determined location (store located at R3, see Figure 2). After completing their individual task, one participant was told that they needed to complete an additional task (at 4b, see figure 2) before proceeding to the rendezvous location (R3, see Figure 2). The goal of this scenario was to force one partner to be late for the rendezvous and observe what the waiting partner would do. We observed the behaviours of both the waiting participant and the delayed participant, how they made use of the technology provided (depending on the condition), whether or not the waiting participant chose to stay at the rendezvous location, and recorded any difficulties encountered.

DISCUSSION

Regardless of the technology provided to the participants, all pairs completed the rendezvous tasks without difficulty. However, the results of this study demonstrate that the participants exhibited different behaviours depending on the technology used. A detailed overview of the rendezvous outcomes for each scenario and device condition

Differences in Communication Patterns

Social norms influenced how comfortable people were making inquiries as to their partner's status. For example, in the mobile phone condition, when one partner was late for the rendezvous, the other partner always waited before calling to inquire about their state. In contrast, in the conditions involving the location-aware handhelds, upon arriving at the rendezvous location, if the person's partner was not at the location, they immediately used the device to view their partner's location. Using the handheld device, the participants frequently (or constantly) monitored their partner's location until they arrived. It would be considered rude to continue calling someone on a mobile phone to maintain a similar state of awareness. We noted a large variance in the length of time participants felt was appropriate to wait before engaging in a call.

The location-aware handheld devices were frequently used as a background communication channel in our study. People could easily monitor their partner's location (as well as their own) without interrupting their partner. As such, when people had access to both the location-aware handheld and a mobile phone, they tended to use the handheld first to gather all relevant information and then follow-up with the mobile phone if needed. For example, when participants were confused about their partner's movements via the handheld, they called their partner to gain additional information (in the combination mobile phone and location-aware handheld condition).

Location-Awareness Doesn't Tell Us Everything

The results from our study clearly demonstrate that mobile phones and location-aware devices have different roles in rendezvousing behaviour. Mobile phones are an easy medium to assist people in communicating information about actions and intentions (i.e. 'what are you are doing?' or 'where are you planning to go?'). In contrast, sensor-based devices are very good at gathering overt contextual information, such as location, in a very unobtrusive manner. However, they provide little assistance in interpreting the associated state of the person. In our study, when participants were given both devices, they easily recognized the strengths of each device and utilized each appropriately (i.e. monitoring their partner's location with the handheld and using the mobile phone to clarify what the person was doing).

The amount and type of information available to people can additionally influence their rendezvousing behaviour. This was evident from our observations of the third scenario (for all three conditions). In the mobile phone condition, when one partner was waiting for the other, none chose to leave the rendezvous location in an attempt to meet their partner. This is not surprising given that without location information they may not have known where their partner was. Even if they used the mobile phone to determine their partner's location, it would still have been difficult to infer the direction they would proceed in and subsequently be able to intercept them.

Privacy Concerns

Privacy is an important concern for many people, including the participants of our study. During post session interviews a few of the participants commented on their concern over the continuous location-awareness that our technology provides. One comment made by a participant was the Orwellian "big brother" effect of location tracking technology. The same participant additionally commented that there are two sides to the location tracking coin. A guardian of a child might see this technology as a blessing, whereas the child could view it as an invasion of their independence. These concerns must be addressed given the adoption of technology can be affected by the perceptions of the public. However, location-awareness does not need to be continuous. It is a tool that can be used periodically to reinforce social activities such as rendezvousing. Outside of the context of the social activity location-awareness need not be used. People wanting the benefit of location-awareness can actively choose to give up their privacy during the rendezvous to a discrete group of people and regain their privacy upon completion. Obviously, hardware and device protocols must ensure that only the discrete groups have access to the information.

CONCLUSION

The results from this work illustrate that the type of technology provided significantly impacts rendezvous behaviour. One of the most compelling observations was how communication patterns differed depending on the

devices used. Mobile phones, although a rich method of communication, require people to use social protocols when initiating conversation. This can unnecessarily lengthen and complicate the exchange of contextual information. Location-aware technology can avoid the social protocols by focusing on visual contextual exchange. However, both mediums have associated strengths and weaknesses that must be balanced.

The observations gathered in our study clearly demonstrate that location-aware information is beneficial for rendezvousing. Our initial hypothesis was that location-awareness information would always be beneficial to people attempting to rendezvous. The results from our study revealed instances where location-awareness information was extremely beneficial and other instances where it was detrimental. For example, in our third scenario, location-awareness information was beneficial because participants could see their partner's location and track their progress in an unobtrusive manner. This arguably provided the waiting partner with enough information to wait contently. However, when their partner appeared to be lost or not making progress, it was very disconcerting because the waiting partner did not have enough information to determine what the problem was. This uncertainty was strong enough in some cases to draw the waiting partner away from the rendezvous location.

Privacy must be addressed with location-aware technology. Given the usefulness of location-awareness, the benefit of the technology can supersede the privacy that is relinquished. However, this is a decision that the user must remain in control. Location-awareness is a tool that we can use to augment our social interactions. It need not be used continuously but periodically.

The main design implication stemming from this work is the importance of providing both a verbal communication channel and a passive, background channel. A verbal communication channel can provide detailed information

on context and state and answer specific inquiries when necessary (although it may be obtrusive). A passive, background channel can provide supplementary information (such as location and direction of movement) in a very unobtrusive, socially acceptable manner.

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