

# Effects of Location-Aware Computing On Rendezvous Behaviour

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**Abstract.** This paper presents a field study investigating the behavioral effects of mobile location-aware computing on rendezvousing. 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 rendezvousing scenarios. The results reveal key differences in communication patterns between the mediums, and in the type of contextual and state information provided. These results demonstrate the potential of location-aware devices and provide important design considerations.

## 1 Introduction

Mobile phones have transformed our social interactions and behaviours. They provide a verbal communication channel that enables us to exchange contextual information. However, location can be difficult to convey accurately through dialogue. The verbal exchange of locations, instructions, and descriptions between people can be ambiguous, misinterpreted, or misunderstood. Location-aware computing avoids these complications by providing visual cues and references.

The main goal of our research is to investigate how location-aware technology impacts rendezvousing behaviour (meeting at an agreed upon time and location). It is obvious that location information is beneficial for rendezvousing; however, it is unclear how this information will be used and how it affects social behaviours. Location-awareness is fundamentally different from active verbal communication over a phone and may significantly alter people's choices and actions.

This paper presents a field study that explored how location-aware devices could facilitate rendezvousing. Participants carried out rendezvous scenarios, mimicking typical real-life situations. They took part in one of three different device conditions: a mobile phone, a location-aware handheld, or both a mobile phone and a location-aware handheld. Results of this work provide important insights into the subtle differences between mobile phone and location-aware device usage and how these differences impact the design of location-aware applications.

We first present related work in the area of rendezvousing and applications of location-aware systems. We then present the methodology for our field study. The results are then presented in a narrative form with discussion of the rendezvous

outcomes for each scenario. Finally, we reflect on these results and discuss how this information should inform future considerations for location-aware mobile devices.

## **2 Related Literature**

### **2.1 Rendezvousing**

Rendezvousing is the social act of people meeting at a predetermined location and time. Group behaviours related to rendezvousing have been explored extensively by Colbert [1, 2] through detailed diary studies that illustrate common rendezvousing behaviours and challenges. An investigation of technology to support rendezvousing (mobile phones, text messaging, email, and voicemail) demonstrated that mobile phones were the preferred communication method [2]. Other work [3] investigated how mobile communication can alter rendezvousing behaviour. Rather than agreeing on a landmark and specific time to meet, mobile users can initially agree upon a general time and place and exchange several messages to further refine the rendezvous location and time, finally terminating in an eventual meeting [3].

### **2.2 Location-awareness**

Location-aware mobile devices have been explored by a number of researchers for a variety of activities including gaming [4], support for communication and collaboration among distributed groups [5-7], and support for awareness and collaboration among proximal groups [8]. Location aware devices can provide absolute or relative information. The Hummingbird system [8] is an example of relative location-awareness. While beneficial in some situations, relative location-awareness can be insufficient to allow people to find one another. Projects that have explored absolute location awareness include ActiveCampus [5] and a mobile, location-aware event planner [7]. These systems provide users with visual location-awareness of both themselves and other group members. The devices also provide an active communication channel (i.e. text messaging, voice). Both have been field tested, focusing primarily on the design, iteration, and use of the technology. WatchMe [6] provides additional contextual awareness information by comparing user movements to previous patterns terminating at user-defined locations. The context of the user's location is then displayed in a descriptive manner, such as "gym", and not in absolute coordinates or as annotations on a map.

## **3 The Rendezvous Study**

We conducted an experimental simulation in the field to explore how technology impacts rendezvous behaviour. Three different technology conditions were investigated: mobile phones; location-aware handheld computers; and both mobile

phones and location-aware handheld computers. We report on the participants and setting, the experimental conditions, rendezvous scenarios, and data collection and analysis. For further methodological details, including our procedure and Wizard of Oz technique for location-awareness, see [9] .

### 3.1 Participants & Setting

Forty-eight participants (28 male and 20 female) took part in this study. Some of the participants had a previous relationship with their partner while others did not. Eight pairs were assigned to each technology condition. The study took place in July 2004, encompassing a shopping district in downtown Halifax, Canada. This is a busy area with lots of shops, prominent landmarks, and pedestrian and vehicle traffic.

### 3.2 Experimental Conditions

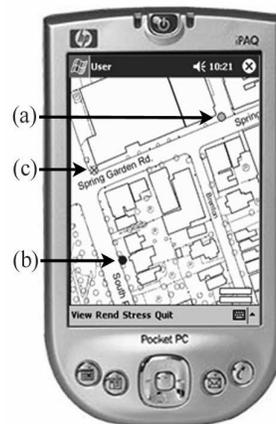
**Mobile Phone.** The mobile phone condition was intended to be the control group from which we could examine how location-aware technology on a handheld differed from previously identified rendezvousing behaviours (based on Colbert's earlier work [1, 2]). In the mobile phone condition participants were provided with a mobile phone programmed with their partner's mobile phone number. The participants were also given a laminated paper map of the area identical to the one provided on the handheld.

**Location-Aware Handheld.** In the location-aware handheld condition participants were provided with an HP iPAQ h4155 handheld computer. Each handheld ran custom location-aware software that enabled participants to view a street map of the area, annotated with the participants' locations as well as the rendezvous location (see Figure 1). Each participant was represented by a coloured dot on the map. The map also showed buildings in the area (without names) and approximately 1/6 of the map was visible at a time.

The software also provided participants with the ability to request a rendezvous location. This involved selecting the rendezvous icon (an 'X') and moving it to the desired location, then selecting the 'ask' feature. This caused a message to pop up on their partner's screen indicating that a rendezvous location had been requested. The partner could then view the suggested rendezvous location and respond by accepting, rejecting or ignoring the request.

#### Mobile Phone and Location-Aware Handheld Computer.

In the mobile phone and location-aware



**Fig. 1.** Handheld Device with location-aware information.  
a) The participant's location  
b) Their partner's location  
c) The rendezvous location

handheld condition, participants were provided with both technologies described above. Participants could use either device at any time during the session.

### 3.3 Rendezvous Scenarios

All participants completed each of three scenarios. The scenarios were based on three rendezvousing behaviours identified by Colbert [1, 2]: 1) arranging a rendezvous while separated; 2) negotiating a new rendezvous location when one partner is unresponsive and a prior rendezvous has been negotiated; and 3) one partner is delayed while the other is waiting at the rendezvous. At the beginning of each scenario, participants were required to complete individual tasks (e.g. visiting a store) in order to separate them prior to rendezvousing.

### 3.4 Data Collection & Analysis

Data was collected via *field notes*, *audio recordings*, *data logging*, *questionnaires*, and *semi-structured interviews*. Pertinent data from these sources was aggregated into a single, linear narrative, to enable us to understand how participants proceeded with the rendezvous scenarios given the device condition. Observers following the participants made *field notes*, recording participants' actions and verbal comments. Each participant was given a voice recorder to create a digital *audio recording* of all comments and conversations. *Data logging* captured all actions performed using the location-aware handhelds. The logging allowed for a more concise analysis of selected rendezvous locations and user interactions that were missed in field notes. *Questionnaires* gathered background information on participants and participants' perceptions pertaining to the ease of the rendezvous just completed. Finally, post-session *semi-structured interviews* further probed the participants' rendezvousing experience. Questions were designed to identify participant's choices in given situations and to explore how the available technology affected their actions.

There are limitations to the types of data easily collected in the field. Observers were unable to precisely count interactions, so recorded behaviours. In addition, the dynamic nature of the field environment and the individual differences of users (familiarity with each other and with the study area) combined to make timing information for the scenarios highly variable. The scenarios we set up did not always happen as planned (e.g. the participant meant to be late sometimes arrived first). As such, we report our results in a narrative manner.

## 4 Rendezvous Outcomes

Despite the fact that participants' individual differences shaped their rendezvous behaviours, common patterns were evident. The behavioural data collected provides important insights into rendezvous behaviour with cell phones and location-aware devices. This section characterizes the common trends observed for each rendezvous scenario in each of the mobile device conditions through narratives and associated

**Table 1:** Narratives for Scenario 1, for *Condition 1: Mobile Phones* (left) and *Condition 2: Location-Aware Handhelds* (right)

<p>Amanda arrived first at her task location and picked up the mobile phone to call Jason.</p> <p>A: "Hey, how are you doing?"</p> <p>J: "Hello, how are you?"</p> <p>A: "Good, good. Where are you?"</p> <p>J: "I am at John Allan's Cigar Emporium."</p> <p>A: "Alright."</p> <p>J: "Where are you?"</p> <p>A: "I am down at Clyde and Dresden."</p> <p>J: "You're down at Clyde and Dresden?"</p> <p>A: "Hair Design Centre."</p> <p>J: "What are you beside?"</p> <p>A: "Across from the liquor store."</p> <p>J: "Ok, I can be there. Do you want me to meet you?"</p> <p>A: "I can meet you at Shoppers. Is that better?"</p> <p>J: "Shoppers is fine."</p> <p>A: "Ok, I'll meet you at Shoppers then."</p> <p>J: "Shoppers, I can be there. Wait for me there."</p> <p>A: "Ok. Bye."</p> <p>J: "Ok. Bye."</p>	<p>Renee and Todd both arrived at their task locations at similar times. Todd decided to initiate the rendezvous with Renee. He looked at the handheld screen and noticed that Renee was just two blocks away on Dresden Row. Todd selected the top-left corner of the intersection of Spring Garden Rd. and Dresden Row for the rendezvous location. This point was midway between Renee's and Todd's locations. In the meantime, Renee looked at the screen on her handheld computer in preparation for requesting a rendezvous. A message appeared on Renee's screen indicating that Todd had suggested a rendezvous location. This looked fine, so she acknowledged, accepting Todd's request.</p>
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discussion. All of the narratives represent real data collected in the study. In each case, a rendezvous occurred, although often late and sometimes not as planned.

#### 4.1 Scenario 1

In this first scenario, participants needed to arrange a rendezvous location after completing their individual tasks. After successfully negotiating the rendezvous, they were instructed to proceed to its location. 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, and recorded any difficulties they encountered while completing the task.

**Condition 1: Mobile Phones.** Before arranging the rendezvous location, all pairs either explicitly asked their partner where they were located or offered their location without being prompted (Table 1, left). The exchange of location information often required further dialog to clarify the precise location. This ambiguity was common between our participants and demonstrates the difficulty participants had articulating their physical location. Once the location was agreed upon, they had no difficulty completing the rendezvous.

Even though awareness of their partner's location appeared to be important for this scenario, only two groups actually used the paper map to visually reference their partner's location. This suggests that the remainder of the pairs either felt they had an adequate understanding of where their partner was located or they didn't actually care, merely asking the question out of courtesy.

All groups chose a rendezvous location that was familiar to both partners or was a well-established landmark. The reliance on landmarks is consistent with previous literature that has shown that people typically use landmarks to navigate [10, 11]. Additionally, research has shown that people are better able to recall and relocate locations/landmarks if they are close to well known or important intersections[10].

**Condition 2: Location-Aware Handheld.** All of the pairs relied heavily on the location-awareness information during the rendezvous negotiation process (Table 1, right), and all felt that they picked mutually beneficial locations for the rendezvous. The usefulness of the location information was explicitly noted by seven of the eight pairs: *“It was nice to see she was here and I was there ... I just picked a middle point.”* The participant who did not use the location information commented that he *“just chose a location then looked to see where [my] partner’s location was”*. He then remarked that he *“probably should have done that first”*.

Only one pair selected a physical landmark on the map (a building midway on the main road) as the rendezvous location. The remaining pairs selected a street corner on the main street between the partners’ locations (which was relatively equidistant to both). This suggests that the participants felt comfortable using the icon representing the rendezvous location on the map as a point of reference (or ‘virtual’ landmark) to facilitate navigation.

**Condition 3: Mobile Phone and Location-Aware Handheld.** Despite being given both devices, six of the eight pairs used only the location-aware handheld to negotiate the rendezvous. These pairs exhibited similar behaviours to those in the handheld only condition. One pair used only the mobile phone to negotiate the rendezvous. The final pair used both devices – the mobile phone to first negotiate the rendezvous followed by the handheld to confirm the location.

The pairs that chose to use the handheld computer commented that they felt it would be easier and more convenient. The pair that chose to use the mobile phone commented that they wanted to ensure an exact location was chosen. The pair that chose to use both devices used the mobile phone initially because they felt it would be easier to converse and wanted to check and see if their partner needed anything.

## 4.2 Scenario 2.

In the second scenario, participants were asked to rendezvous at a pre-determined location (Fireside Restaurant). After completing their individual task, one participant was told that the rendezvous location was changed (to Deco) and to proceed to the new location. The other participant was told of the change and asked to notify their partner of the new location. However, we did not allow the communication to succeed. 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 previously set rendezvous location was changed. 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.

**Condition 1: Mobile Phone.** All of the participants tried to initiate communication with their partner multiple times (Table 2, left). Four of the pairs called 2-3 times while the remaining four pairs called continuously.

**Table 2:** Narrative for Scenario 2, for Condition 1: Mobile Phones (left), Condition 2: Location-Aware Handhelds (middle) and Condition 3: Both (right)

<p><i>Nathan picked up the mobile phone to call Robin and let her know about the change in plans. The call was not answered and was forwarded to a voice mail box. Nathan left a message:</i></p> <p><i>N: "Hey. Fireside cancelled. We're going to have to go to Deco which is on the south side of Spring Garden, just beside Rockport. I will be hanging around out there. I will try to get a hold of you again. Cheers."</i></p> <p><i>Nathan walked to Deco but continued to try to get a hold of Robin on the mobile phone (6 times). He didn't stop calling until he was close enough to Deco and could see Robin there.</i></p>	<p><i>Glen used the handheld to move the rendezvous point and suggest to Jill that they meet at the new location (Deco). Glen received no response from Jill so he continued to suggest the new location (using the handheld) as he walked toward Deco. He assumed that Jill would see the new location on the map and head there, even if she hadn't acknowledged his suggestion. Shortly thereafter, Glen saw Jill's location indicator moving towards Deco on the map, indicating to him that she received his message.</i></p>	<p><i>Michael used the handheld computer to suggest the new rendezvous location to Bill. No response was received from Bill. Michael decided to call Bill on the phone. Bill didn't answer and the call was forwarded to voice mail. Michael left a message for Bill:</i></p> <p><i>M: "Hi Bill. This is Michael. We are supposed to meet at 5518 Spring Garden Rd., Deco. So let me know. Bye."</i></p> <p><i>Michael glanced at his handheld, noticed that Bill was now at Deco and walked there.</i></p>
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Although we instructed one partner to inform the other of the location change, only half of the participants actually left voice messages for their partner. However, all of the participants proceeded to the new rendezvous location rather than the original meeting place. It is understandable why the participants who left a message proceeded to the new location: they had communicated their intent in a form they perceived would be accessible by their partner (voice mail). However, the participants who did not leave a voice mail message also chose to proceed to the new location, despite the fact that they had not notified their partner of the change. Only one of these participants exhibited any hesitation as to where to proceed. We speculate this may be attributed to the artificiality of the scenario.

All of the rendezvous excluding one were accomplished easily since both partners proceeded to Deco. One rendezvous was classified as difficult because the participant became increasingly agitated that his partner would not answer the mobile phone or return his messages. This was the same person who was unsure of whether to proceed to the old or new rendezvous location.

**Condition 2: Location-Aware Handhelds.** All the pairs made use of the location-awareness information provided on the handhelds (Table 2, middle). This information allowed the communicative partner to observe his partner's movement and infer whether or not the request had been received. All the groups except for one chose to proceed to Deco after viewing their partner heading in that direction: "I saw [my] partner's dot move towards the location, confirming that he was heading there."

The number of times the new rendezvous location was suggested varied between groups. Half the groups made requests once or twice while the remaining groups made several attempts. It appeared that most of the groups stopped suggesting the new location after they observed their partner heading to the new rendezvous.

**Condition 3: Mobile Phone and Location-Aware Handheld.** Seven of the eight pairs chose to use both devices to arrange the new rendezvous location while the remaining pair used only the mobile phone. Six of the pairs initially used the location-aware handheld to suggest the new rendezvous location and then followed-up with the

mobile phone when no acknowledgement was received (Table 2, right). When no response was received from the phone call, several of the pairs switched back and forth between the handheld and mobile phone in an attempt to reach their partner: *“I tried the handheld, then the cell, then the handheld again, then the cell again. I then saw where her dot was and I went there.”* (Referring to Deco).

All of the groups used the location-awareness information provided by the handheld to decide how to proceed with the rendezvous and easily met up with their partner. Similar to the handheld only condition, all pairs chose to proceed to the new rendezvous location after observing their partner’s location or movement. Even the pair that relied strictly on the mobile phone to arrange the new location used the location-awareness information on the handheld to monitor their partner’s progress.

### 4.3 Scenario 3

In the final scenario, participants were asked to rendezvous at a pre-determined location (London Hair Design) in seven minutes. After completing their individual task, one participant was told they needed to complete an additional task (count a bag of pennies at Curry Village) before proceeding to the rendezvous location, making it difficult for them to arrive on time. 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, whether or not the waiting participant chose to stay at the rendezvous location, and recorded any difficulties encountered.

**Condition 1: Mobile Phone.** Three participants chose to call and check in when their partner was late for the rendezvous (Table 3, left). They all inquired where their partner was and why they were delayed. Two other participants chose to call their partner to let them know they were running late and wouldn’t be able to make the rendezvous time. For the remaining three pairs, no calls were made. In the post-session interviews, two participants indicated that if the wait-time had been longer, they would have called their partner. A participant from the third pair indicated he would have called if he knew his partner was waiting at the rendezvous location. In both cases that the participant called to inform their partner they would be late, the caller was not the partner that we intentionally delayed. These participants were running late because of navigational errors they committed. The participants who were delayed for reasons outside of their control (i.e. we asked them to count pennies) did not choose to call their partners to let them know they would be late.

None of the participants left the rendezvous location to find their partner. One participant continually looked down the street trying to see their partner approaching; however, they were looking down the wrong street. As a result, they were unaware of their partner approaching in the other direction. Despite the delay in completing the rendezvous, all pairs were able to meet without any difficulty.

**Condition 2: Location-Aware Handheld.** All participants who arrived first made use of the location-awareness information while waiting. Upon arrival at the

**Table 3:** Narrative for Scenario 3, for Condition 1: Mobile Phones (left), Condition 2: Location-Aware Handhelds (middle) and Condition 3: Both (right)

<p>Laura arrived first at London Hair Design (the rendezvous location), one minute before the targeted time. Four minutes later when Vanessa still hadn't arrived, Laura took out her mobile phone and called Vanessa.</p> <p>L: "Hello." V: "Hello." L: "Hi. Where are you?" V: "I am trying to find Curry Village. Brenton St. I can't find it. Where are you now?" L: "I am at South Park. London Hair Design. I'm waiting for you." V: "So you made it. Ok. I'll be there in about five minutes." L: "Ok. Goodbye." Laura continued to wait until Vanessa arrived three minutes later.</p>	<p>Emma arrived first at the rendezvous location, on time. She checked her handheld computer to see where Natasha was. "Uh oh. Where is she going?" Emma looked up and down the street and frequently looked down at the handheld. Emma started making noises ("Whoa whoa whooooo") as Natasha appeared to be going the wrong way. Emma suggested a new rendezvous location on the corner of South Park St. and Brenton Place. She indicated that she wanted a quick rendezvous. She began to walk toward the new rendezvous location and saw Natasha approaching. They met up and walked to the final rendezvous location together.</p>	<p>Jessie arrived first at the rendezvous location, right on time. She observed her partner getting closer on the handheld. The next time she looked at the handheld her partner's location-indicator was no longer moving. Jessie picked up the mobile phone and called Sandy.</p> <p>J: "Hi. Are you still coming?" S: "Hello. Hi. At some point. I have to count pennies first." J: "Ohhh, ok. Have fun." S: "Ok, I will." J: "Call me if anything changes." S: "Alright. Bye." Jessie waited and shortly afterward Sandy arrived.</p>
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rendezvous location, they immediately checked their handheld to determine the location of their partner. These participants continued to monitor the progress of their partner until they made visual contact. In four instances, the person waiting at the rendezvous location chose to walk toward their partner's location (Table 3, middle). The remainder of the pairs waited at the rendezvous location for their partner to arrive.

Besides general concern over their partner being late, the location-awareness information did contribute to some uncertainty and confusion when the partner's location-indicator wasn't moving (while they were counting pennies). One participant explained that she was frustrated that her partner's location-indicator was not moving and she wanted to tell her to move up.

**Condition 3: Mobile Phone and Location-Aware Handheld.** All participants who arrived first utilized the location-awareness information and immediately checked their handheld computer to determine the location of their partner. Four pairs also chose to communicate with their partner with the mobile phone. In three cases, the waiting participant placed a call to her partner to inquire where they were and why they were delayed (Table 3, right). In the fourth case, the delayed participant used the mobile phone to call his partner to say he was running late and would arrive shortly. The remaining pairs simply monitored their partner's movements with the handheld and did not use the mobile phones. None of the participants who were waiting left the rendezvous location to attempt to meet up with their partner.

#### 4.4 Participant Comments

Participants had several suggestions for information that could augment a location-aware map application for rendezvousing and facilitate communication. Many suggested text messaging with simple pre-defined notes to reduce text entry. Useful

notes included ‘stuck in traffic’, ‘behind schedule’, ‘forgot something’, ‘bringing someone’, ‘can’t make it’. Some suggested that it might be easier to write directly on the map with the stylus rather than send text messages or scrolling through message menus. They could then annotate the map with such things as arrows providing directions, caution symbols suggesting places to avoid (e.g. construction), or brief scribbled notes. Another idea was to have the participant’s location dot portray some contextual information much like an emoticon (e.g. emoticon flexing a weight to indicate at the gym). From these comments, we envision a combination of text entry using map annotation and scribble-messaging using the stylus to augment text-entry.

## **5 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.

### **5.1 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 mobile phone and location-aware handheld condition).

### **5.2 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.

In the location-aware handheld condition, half of the participants chose to leave the rendezvous location to attempt to meet their partner. These participants seemed confused about their partner's actions or believed that they were lost. Being aware of their partner's location allowed them to easily find (and intercept) them. However, when the participants had access to both a mobile phone and a location-aware handheld, none of the participants chose to leave. Several participants called their partner to inquire about their status. This gave them a better understanding of how their partner was proceeding, allowing them to make a more informed decision as to how the rendezvous was progressing. This suggests that the reason participants left the rendezvous location in the location-aware handheld condition may have been more a result of missing contextual information (gained using the mobile phone) rather than the ease with which they could meet up with their partner.

## 6 Conclusion

In location-aware systems that maintain a continual awareness of activities, privacy is a concern. However, location-awareness can also be a tool used periodically. People can choose when they want the benefit of location awareness and actively give up their privacy to a discrete group of people. Obviously, device protocols must ensure that only this discrete group would have access to the information.

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.

The results from this work illustrate that the type of technology provided 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 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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