

## Usability of a Mobile, Group Communication Prototype While Rendezvousing

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### ABSTRACT

*Mobile phones are increasingly being used collaboratively by social networks of users in spite of the fact that they are primarily designed to support single users and one-to-one communication. It is not well understood how services such as group SMS, SMS-based discussion lists and mobile Instant Messaging (IM) will be used by mobile groups in natural settings. Studying specific instances of common styles of in situ, group interaction may provide a way to see behavior patterns and typical interaction problems. We conducted a study of a mobile, group communication probe used during a rendezvousing activity in an urban environment.*

*Usability problems relating to group usage, phone interface design and context were identified. Several major issues included: multitasking during message composition and reading; speed of text entry; excessive demand on visual attention; and ambiguity of intended recipients. We suggest that existing mobile device designs are overly-focused on individual users to the detriment of usability for mobile groups of users. We provide recommendations for the design of future mobile, group interfaces, used in similar situations to those explored here.*

**KEYWORDS:** Mobile Interface Design, Group Usability, Activity Context, Mobile Group Collaboration

### 1. INTRODUCTION

People are increasingly using mobile devices to coordinate their actions according to the needs of other group members and the activities they are engaged in. Emerging behavioral effects of ubiquitous, rapid, group communication include micro-coordination [1], swarming [2] and passive mutual awareness [3]. Group SMS, and Instant Messaging (IM), which supports higher conversational rates, are increasingly available on

handhelds. Further, services enabling groups of mobile SMS users to broadcast messages in a fashion similar to e-mail discussion lists are appearing (e.g. www.txtmob.com). However, the standard mobile phone platform on which these technologies operate poses several problems for their use. Many handhelds have small screens and slow text-entry mechanisms. SMS was designed for one-to-one communication, and IM was designed for stationary groups with larger screens. Several studies have looked at mobile group needs, but little emphasis has been placed on how all members of a group use messaging services in a mobile setting.

This paper focuses on the usability of a prototype used in a group rendezvousing and wayfinding activity, and situational issues affecting usage. We begin by discussing themes in mobile group interaction motivating this work. Then we present the structure of our investigation of a mobile probe and results related to usability. We conclude by discussing usability problems with the prototype and how these may inform improvements in future technologies supporting mobile groups in similar situations.

### 2. INTERACTION IN MOBILE GROUPS

People are increasingly mobile and the ability to communicate or be contacted anywhere is an often cited reason for owning a mobile phone [4]. Very few groups share all of their time in one physical location. Consequently, understanding how groups move, their communication needs and group usability are of increased importance for mobile device design.

#### 2.1. How Networks Use Mobiles

Several studies show how groups adapt devices originally designed for one-to-one communication for group usage. In one of these Swedish teens exhibited varied methods of sharing. Examples include calling one person's phone to talk to another person in the group, referring to the group state during remote conversation (or

vice-versa), borrowing and lending, sharing visual and audio communications and turn-taking [5]. Similarly, studies of groups of push-to-talk users provide insight into natural group adoption of a new technology and social norms affecting its use [6, 7]. Mobile device use may blur the distinction between direct and indirect users of technology often indicated in software engineering models [8]. It may be most appropriate to view the phone as a collaborative resource for usage by a group and sociability will be increasingly important [9].

Technology both shapes human behavior and is shaped by how people decide to use and modify it. Mobile communication technologies reduce reliance on static communication methods (e.g. land-line phones), and increase confidence and perceived safety when moving [4]. This can in turn affect how much groups choose to be mobile [10].

The use of devices by distributed, social networks of users, rather than just the owner, hinders understanding and predicting mobile device use. Existing usage of usability testing or ethnographic approaches often take individual or static perspectives, and may need modification for studying mobile, distributed groups. We need to identify research and design methods for mobile groups which account for the effects of device sharing and networks of remote users.

## 2.2. Effects of Interface on Group Behavior

Phone ergonomics are primarily designed to support one-to-one, speech-based conversations. Text-entry speed for multi-tap mobile keyboards is about 8 wpm. Experienced users of predictive text (T9) on mobiles average 20 wpm [11], at the expense of visual attention. Whilst other methods are being investigated, poor text-entry speeds are likely to hinder adoption of mobile e-mail, IM and text-messaging [12]. Text entry is further complicated when users are operating within rapidly changing physical environments such as when moving. "This means that they cannot devote all of their attentional resources – especially visual resources – to interacting with their device; such resources must remain with their primary task, often for safety reasons." [13, 14] Mobile IM is now available and many phones offer the ability to form groups of contacts for broadcasting SMSs. However, we have yet to understand the use of these messaging services by mobile groups in natural settings.

Small changes in user interfaces may be able to affect cooperation, group awareness, trust, competition, role development and other variables [15, 16]. The structure and availability of communication channels have been shown to affect reciprocity, efficiency, accuracy and norm development within groups [17]. Mobile, textual, communication technologies such as SMS, IM, or e-mail

is a primary communication channel for some groups. These devices mediate relationships between members and their design may greatly influence group effectiveness and social norms which arise

## 2.3. Common Behavior Patterns

There are common styles of interaction amongst the wide variety of activities mobile groups engage in, which may simplify the design space. For example, a study focusing on naturally occurring rendezvous found that usability decreased during a rendezvous and stress increased with larger groups [18]. Other mobile group studies have examined socializing of mobile teens [19]; a bird-hunting group traveling in formation with limited visual and audible communication [20]; and usage of mobile proximity detectors to maintain awareness of the location of friends [21]. The first three studies are common actions during coordinated movement and the third is passive observation. In this paper we explore group wayfinding, which is a common type of coordinated movement which includes going to familiar or unfamiliar destinations and exploring unfamiliar places.

We wanted to probe what usability issues arise from in-situ device usage during a typical group activity such as this. The next section describes the structure of our investigation.

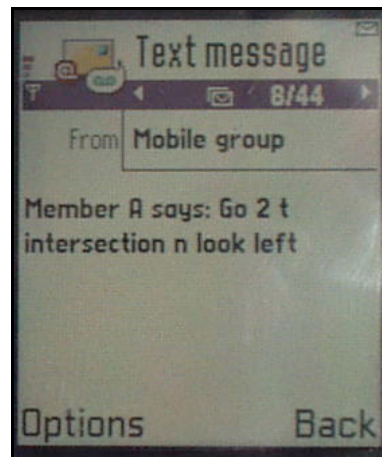
## 3. THE TERRITORY IS THE MAP STUDY

*The Territory is the Map* study was conducted in the City of Palmerston, Northern Territory, Australia as a formative investigation of a mobile probe used during a rendezvousing and wayfinding activity. Three participants were placed in separate, unfamiliar locations (central bus-station; suburban park; university bus-stop) approximately 1.5km from a central meeting point. They were given a detailed description of a playground in a small park of unknown location, and were requested to find it and gather all of their group members there. It was requested that they use only a prototype SMS-based, mobile discussion list to communicate with their team members and that they not ask directions from people in the environment.

Each participant used a customized Nokia 3650 (see Figure 1) during the study. Each user sent messages to the discussion list via a number labeled 'mobile group' in the contacts listing. This message was then received by an SMS server, prefixed with the sender's identity and redistributed to the group, excluding the sender (see Figure 2). Mean lag time between sending and receipt by the group was about 28 seconds.



**Figure 1.**  
**Hardware**  
**Interface.**



**Figure 2. The Interface For**  
**The Mobile Discussion list.**



**Figure 3. Member B Sits In The**  
**Shade While Awaiting Instructions**  
**From The Group.**

Each participant was followed by an observer who recorded behavior on a clipboard and took photos when SMSs were received or sent, or other interesting events happened. An SMS server logged the sender identity and time for all communications received. Photos recorded aspects of the environment and the participants' activities that seemed informative (see Figure 3). Written observations recorded gestures, stance, interaction with the environment and other factors.

Participants were trained to use the phones' software and hardware interfaces and practiced sending messages to the group discussion list for 20 minutes prior to the activity. This aimed to reduce novice user effects and familiarize participants with the radial keyboard. Phones used standard (multi-tap) entry, rather than predictive text. Participants memorized assigned pseudonyms (A,B,C) prior to the activity. A pre-study interview and questionnaire obtained demographic information and familiarity with similar types of group activities.

Participants were males between 20-30 years of age and recruited from a local WI-FI enthusiast discussion forum. They were friends and had extensive network gaming experience. All participants were experienced SMS users, had used SMS for several reasons in the previous week and reported recent SMS use for: planning events/activities, organizing communication in another form (e.g. plan for a phone call), and while in transit. Member A's employment involved providing re-routing information to aircraft in emergencies. Member B worked in networking and communicated with mobile sales personnel. Member C had participated in orienteering activities as a scout leader.

Following the rendezvousing activity, a questionnaire and workshop were conducted. The workshop utilized photos taken and SMSs sent during the activity. Participants individually paged through SMSs on their phones recounting the narrative of their travel, followed by a group review using pictures of the activity as memory aids for participants. The following day, the photos were displayed on a tablet computer and used to re-walk the paths of all participants, marking location and orientation for each photo on a map. An aerial photo of the precise area was taken from 2000m and used for further analysis. This enabled detailed geographical and temporal mapping to relate the content of messages sent and received with the participant's environment.

## 4. RESULTS

The average message rate was 1.4 messages / minute over the activity. The distribution of the total of 56 messages was approximately balanced between participants: Member A (42%), B (27%), C (31%). Member A found the destination in 57 minutes and the entire group arrived in 94 minutes. Member A spent over a third of the overall time guiding the other two to the destination which may account for him sending more messages.

### 4.1. Situational Effects

The participants were separated approximately 500m from each other at the start, and were originally unable to see each other. Participants walked on sidewalks, and through parking lots, an abandoned lot and grassy and wooded areas. The sun shone brightly and, as the temperature was 80°F (30°C), standing in the direct sun

for long periods was uncomfortable. Participants sometimes found shaded areas to stand in when waiting for messages or composing. Member A said “*Bugger off! Its hard to read the screen.*”, indicating that glare off the screen was an issue.

Participants sometimes had to wait for car traffic to clear or pedestrian crossings to activate while walking. Although participants composed messages while walking and standing, they often sat on or leaned against the ground, trees, walls, benches, and other features of the environment. The ‘activity context’, which consisted of what stage of the activity they were in and what immediate goals were, affected device usage. In this case it can be described as five sequential and overlapping phases: 1) Determining the starting positions of self and others; 2) Heading towards a known location; 3) Searching for the target; 4) Establishing the location of the target to others 5) Guiding others to the target. These phases related to changing goals, behavior and information resources and affected device usage. For example, at the beginning, two participants stood still while sending messages to determine a course of action. Later when the destination had been found, Member C stopped composing messages and walked quickly, having a clear idea of where to go. Emotional state also affected usage, such as an occasion where annoyance over a confusing message resulted in several quick follow-up messages.

The activity demanded both high frequency of movement and messaging. While, participants did communicate while moving, they often paused in convenient locations such as under trees or on benches. Sometimes the activity context required them to wait in inconvenient locations (e.g. side of a sunny street) to wait for directions or information.

## 4.2. Usage Behavior

Participants alternated between periods of movement and periods of resting or standing. Communications arrived fairly frequently and composing messages took extensive visual attention and time. Much of the users’ attention was dedicated to reading composed or received messages while walking. Users alternated between looking at the screen and looking up or around to monitor the sidewalk, street, pedestrians and other obstacles. One participant was repeatedly observed walking near the edge of the sidewalk (either on or off it). This may have been to avoid running into people and to make peripheral monitoring of walking easier. One participant came close to walking into a pedestrian and another stumbled while messaging.

*Member B: It takes a lot of concentration to use a keyboard you're not familiar with to start with, that's why you seeing me sitting or standing while I was sending*

*these bloody messages. I'm tripping over tree roots and stuff.*

In some cases, the focus on the interface hindered participants’ ability to search the surrounding environment.

*Member B: I walked by the bloody place [destination park], I could have spat on it, but uh, I probably was pretty focused on the phone, on the technology itself. I was always looking at the display. I was concentrating on this as I followed it around. I think the phone was part of it, being focused on that.*

Phones were used both one and two-handed. One participant carried a drink in one hand and composed and received messages with the other.

## 4.3. Usability

Users commonly complained about the effect receiving new messages had on composing a message. The phone interface supports abandoning a message or saving it to a drafts folder. However, it is impossible to switch to a new message and immediately back to the message being composed and users complained of accidentally deleting messages being composed. Receiving a message while composing created a dilemma since the arriving message might contain information obviating the need for the composed message.

*Member C: It would be accepting the message and writing a reply...*

*Member B: <interrupting> Ya, reading the message, swearing about the message, half-writing it, reading it again, swearing again, having another go, getting another message, saving another draft, reading another one, and then going back to it, and canceling it all together, and writing another one.*

*Interviewer: So there was a lot of issues with receiving messages while writing messages?*

*Member B: That was a bit of an issue.*

*Member C: There's a lot of messages in my drafts folder that are like two characters.*

Sometimes retyping message content already entered was faster than trying to find unfinished drafts. Furthermore, it became possible that the new message composed was out of context with the message just received and natural turn-taking was disrupted [22].

**Member B:** *Say, [Member A] started the conversation, and [Member C] and I started replying at the same time, if I had a long reply and [Member C] had a short reply, he'd finish the conversation, once these two are happy that it's finished. Five minutes later I put the middle of the conversation back in. It's out of sync.*

While participants frequently remembered the content of messages they sometimes sought to review a previous message. This required finding a Sent folder and opening a desired message based on sender name. Since conversations developed over multiple messages, users needed to remember past information about location and directions, or spend valuable time searching for it.

Perceived message latency and lag time in conversations was a problem. Due to the nature of the activity, messages were frequent and carried specific, critical information for participants. Test timings taken off-site showed a 28 second round-trip time, and on-site tests were similar. However, users complained of waiting long periods of time for information they needed.

**Member B:** *It's amazing actually, the difference between, the times it took to actually relay some of those messages out, because by the time, when [Member C] saw [Member A] walking up the hill, and me seeing where he was, he'd already moved from the tower down onto the road, and [Member A] was outside, yes, the time difference made quite a few things [hard].*

Other research has discussed misattribution of usability problems between user-interface, external interface and service interface [23]. In this case the time necessary for users to a) read one or two incoming messages, b) think of a response, c) wayfind in their environment, d) compose and send a new message and e) that message to be transferred, were collectively perceived by remote users as “time to relay”.

However, some participants did realize that the slow input speed was affecting their ability to communicate effectively.

**Member A:** *If the speed of input was to come down, give you a full size keyboard and blast it out, you'd take a message that fully take fully 4 and half minutes to write, for about three lines, you know, blast out in 30 seconds, and 45 for it to get there, then it wouldn't have been an issue.*

A number of usability issues involving the keyboard were identified. Participants complained about needing to access punctuation symbols or letters which required multiple key-presses.

**Member C:** *Ofentimes I had to retype the same letter 3 or 4 times because it had just gone over. Cus you'd overshoot it, and then you'd have to get back to it, and then you'd overshoot it...*

Movement and distractions in the environment probably increased the chance of over-shooting desired letters. A combination of factors including an atypical keyboard layout, moving, the multi-tap input system, small key size, message frequency and the constraints of the activity collectively caused user frustration.

**Member A:** *We're trying to give detailed descriptions of where we are and what we're trying to do, and ya know, it is pretty information rich messages we're trying to get across, albeit on such a chunky transfer medium.*

#### 4.4. Group Coordination and Visualization

Much of the activity required understanding the approximate location of other members and developing a representation of the area being explored. The interface supported only the participant's individual textual representation of location. One user drew a map in the sand of the playground to visualize locations of landmarks. Member C (against instructions) entered a gas station and asked for a map. Ironically the appropriate map had been torn from two different phone books and wasn't available.

While the interface showed the sender by default it did not explicitly support indicating specific recipients. The concise nature of SMS and time constraints often led to misunderstandings or confusions over the intended recipient.

**Member B:** *It [the interface] caused some confusion towards the end, umm, because, uh, [Member C] said that he'd got to the end of the road, and was turning left to go down the main drag, and I didn't want him to go any further, cus he was going too far down the road, so I said stop. Problem is, to quickly type in stop and send, to a group, means everyone in the group at the same time goes, is this for me? Do I stop? So uhm, sending to a group can be good, but for the same time, it was for one particular person, so [Member B] has come back to me and said, what the fuck, as in like, do you want me to stop or what?*

Once he had experienced this problem, Member A developed a workaround for it. Seven minutes after sending the confusing message “Stop!” and getting back responses “Member C says: Me?” and “Member B says: Wtf! This is not mking any sense...”, Member A switched his syntax to “4 b [Member B]. Goto 13th hole”.

A number of usability issues mentioned by participants were related to visualizing the rest of the group. These

were associated with location, future movements, or current status of a member. Similarly, high message latency compromised the ability of a mobile group to integrate information accurately.

## 5. DISCUSSION

The mobile discussion list prototype adequately supported the actions users undertook within the context of the activity and environment. However, it was somewhat unpopular with the users and further analysis of the many design and usage problems may valuably inform future designs.

One of the most significant usability problems was the inability to see both messages being composed and incoming messages simultaneously. This made comparing, reviewing and revising content very difficult. Recent Nokia phone models have improved switching between received messages but have not resolved the issue. Chat rooms and instant messengers have solved this problem on desktops by the traditional scrolling conversation with a compose field. While this solution may work for larger screens, it may not be as suitable for small ones. It is likely that for activities with high communication traffic needs, group SMS functions may be insufficient, even when clearly stating the sender's identity. A balance needs to be found between the large amount of information presented in desktop chat and IM clients and the minimal contextual information of SMS, as has been noted elsewhere [3]. Another significant problem was text entry speed and the degree of visual attention needed for text entry. The non-standard radial keypad slowed text entry slightly. However, traditional 12-key layouts have similar difficulties and non-standard layouts are increasingly common.

Several aspects of the study were controlled for practical reasons and several issues were specific to the environment used. Limiting the group size and communication mediums used ensured comprehensive probing and data logging, of one mode of user generated representation of the environment. It also provided a detailed understanding of one technology. It is assumed users would choose other mediums in many complex ways, had they been available (e.g. mobile IM, group SMS, push-to-talk, Bluetooth chat, or mobile e-mail). Many real-world constraints such as poor reception, low SIM credit, low batteries, high cost of voice/conference calls, and social norms requiring silence often result in exclusive SMS usage amongst groups. Additionally, seeing the difficulties of using SMS in certain situations may enhance understanding of why medium-switching occurs. Environmental factors, such as weather may also be specific. This formative study has provoked consideration of issues arising in situ and

indicated factors which may bear upon designs of similar technologies.

## 6. CONCLUSION

We suggest that the focus of existing mobile device designs on individual users is often to the detriment of usability for mobile groups of users. Several usability issues have been revealed by studying the use of a prototype, SMS-based, mobile discussion list during a rendezvousing and wayfinding activity. These include problems with simultaneous composing and reading of messages, speed of keyboard entry, excessive demand on visual attention, and ambiguous message recipients.

### 6.1. Recommendations for User-Interface Design for Mobile Group Communication

The following recommendations may be most applicable for mobile, distributed groups, using mobile devices, for rapid collaboration in urban environments.

- The demands on visual attention required by texting hinders engaging in communication with groups, via SMS, while moving. Possible solutions include methods of touch-typing or providing summarized content in locations on the body (e.g. an arm) where it can be rapidly glanced at while moving.
- Text entry speeds on traditional phone keypads are likely to create usability problems for rapid text-based communication by groups. QWERTY keypads or compromise layouts (e.g. Blackberry 7100t) offer a partial solution, but faster input methods would help mobile messaging adoption by groups.
- Rapid communication between multiple parties places new demands on messaging interfaces. Current SMS, and possibly mobile IM interfaces are not structured for handling fast communications or multiple, simultaneous groups. Methods of viewing message history (to minimize cognitive load) while composing and visualizing multiple conversations on mobile devices are needed.
- Distributed groups may not see each others' behavior directly and consequently misattribute delays and form inaccurate models of behavior and location. Location-tagged aerial views offer a partial solution but need to be customized to support specific physical, social and activity contexts.
- Directing messages to specific recipients out of larger groups can be necessary for collaboration and presents design challenges. Shortcuts for tagging of intended

recipients may assist faster mobile communication. The ability to keep these targeted messages public, should be retained to assist group awareness.

We are currently running further research studies investigating in situ, mobile, group behavior and social networks of backpackers.

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