

I Wanted to Settle a Bet! - Understanding Why and How People Use Mobile Search in Social Settings

Karen Church
Telefonica Research
Pl. de Ernest Lluch i Martn, 5
08019 Barcelona - Spain
karen@tid.es

Antony Cousin
University of Nottingham
University Park, NG7 2RD
Nottingham - UK
psxawjc1@nottingham.ac.uk

Nuria Oliver
Telefonica Research
Pl. de Ernest Lluch i Martn, 5
08019 Barcelona - Spain
nuriao@tid.es

ABSTRACT

Recent work in mobile computing has highlighted that conversations and social interactions have a significant impact on mobile Web and mobile search behaviours. To date, however, this social element has not been explored fully and little is known about why and how mobile users search for information in social settings. The goal of this work is to provide a deeper understanding of *social* mobile search behaviours so that we may improve future mobile search experiences that involve a social component. To this end we present the results of two studies: a survey involving almost 200 users and a two-week diary and follow-up interview study of 20 users. Our results extend past research in the mobile search space, by exploring the motivations, circumstances and experiences of using mobile search in social settings to satisfy group information needs. Our findings point to a number of open research challenges and implications for enriching the search experiences of mobile users.

Author Keywords

Mobile search; social mobile search; shared mobile search; search behaviour; collaborative search; survey; diary study

ACM Classification Keywords

H.5.m Information Interfaces and Presentation: Miscellaneous

General Terms

Measurement, Design, Experimentation, Human Factors

INTRODUCTION

Year after year, mobile Web usage has continued to grow at a staggering pace. The number of users accessing the mobile Web has quadrupled in the US and tripled in Western Europe in the past four years¹. Given that usage and adoption of the mobile Internet is growing at a much faster rate than the desktop ever did, many believe that the mobile Web will inevitably

¹*Mobile Internet Usage Rising; Android Users Catching Up with iPhone Counterparts* See <http://bit.ly/g10vA1>

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MobileHCI'12, September 21–24, 2012, San Francisco, CA, USA.
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overtake the desktop as the primary means of searching and accessing online content².

Search engines remain the main gateway to finding information on the Web — over 18 billion search queries were submitted in December 2011 to the leading search engines³. While mobile search has not yet reached the same levels of usage, it is quickly gaining on desktop search. Nearly one in seven of all search queries is now conducted via mobile, compared to just one in fifteen in 2010⁴. And the rapid adoption of smartphones looks set to drive further increases.

As mobile Internet usage has increased, there has been a growing body of research aimed at understanding why and how mobile users search and browse the Web via their mobile handsets. Some of this research has subsequently pointed to an interesting social element in mobile search. For example, it has been shown that mobile search is a social act, often conducted in the presence of others [3]. Recent research has also shown that conversations have a significant impact on the types of information needs that arise while mobile and how those needs are addressed [4, 9, 11, 20]. To date, however, this social component has not been fully explored and little is known about why and how mobile users search for information in social settings. A deeper understanding of this social dynamic will help improve future mobile search experiences.

As such, the focus of this paper is on *Social Mobile Search*, which we define as the *use of mobile search in co-located group settings to satisfy a shared information need*. In this paper we describe two studies examining why and how people use mobile search in co-located social groups to satisfy a shared need for information: (i) a survey (N=193) to gather some initial insights into different aspects of social mobile search behaviour; and (ii) a two-week diary study and follow-up interviews (N=20) to probe more deeply into the dynamics of using mobile search in social settings. We conclude with a comprehensive discussion of our findings and outline a number of open research challenges and design implications.

RELATED WORK

In this section we discuss two areas of related work: (1) studies aimed at understanding mobile Web behaviours, and (2) research focused on the social dimension of mobile search.

²*The Mobile Internet Report* See <http://bit.ly/4JJDq4>

³*comScore December 2011 U.S. Search Engine Rankings*, See <http://bit.ly/A5nXeG>

⁴*1 in 7 Search Queries is on Mobile*, See <http://bit.ly/oztn5R>

Understanding Mobile Web and Search Behaviours

The first set of studies aimed at capturing qualitative insights into mobile Web experiences involve large-scale surveys, contextual inquiries, interviews and in-situ diary-based studies [7, 10, 12, 18, 21]. These studies have highlighted the contexts in which mobile Web access is most useful [18], the main motivations of mobile Web usage (*i.e.* staying aware and up-to-date) [7, 21] as well as key usability issues compared to desktop-based Web access [10, 12].

Researchers have begun to explore and identify changes in mobile Web behaviours as the mobile space has evolved. For example, it has been shown that mobile Web access is occurring in more stationary, familiar environments rather than on-the-move [19]. In fact, most recently, Church & Oliver [3] found that over 70% of mobile Web accesses are conducted at home or at work.

Other work has focused on understanding location-based mobile search [1, 22]. In a recent large-scale survey of local mobile search, Teevan *et al.* [22] found that just 12% of local mobile searches were conducted at home compared to 64% while on-the-move.

The second set of studies aimed at understanding mobile Web behaviour involves analyzing the usage patterns of real mobile subscribers available in search logs [2, 5, 6, 13, 14, 15, 23, 24]. These studies show that mobile users issue few queries per session when compared to desktop users, mobile queries are short, and adult content is popular. Recent studies show that mobile queries have become more diverse over the past few years and that device type impacts on mobile search behaviour, *i.e.* iPhone users search in very similar ways to desktop users [15].

The Social Dimension of Mobile Search

Several studies of mobile information needs have identified that social interactions have an impact on the types of information needs that arise, *e.g.* [4, 9, 11, 20]. For example, Sohn *et al.* [20] found that conversation prompted information seeking behaviour in 27% of cases.

The user-centric studies of mobile Web behaviour mentioned earlier have also hinted at the influence of social interactions on mobile Web use in particular as a *conversation enhancer* [7]. Mobile search has been found to be a social act, often conducted in the presence of other people. For example, Church & Oliver found that in > 65% of cases, mobile search was carried out in the presence of others [3]. Amin *et al.* [1] found that 76% of the local mobile searches were conducted whilst co-located with other people. According to a recent study by Teevan *et al.* [22], local mobile searches are more *social* when the searcher is in-transit than stationary (67% vs. 53% for stationary searches). Despite the fact that previous work hints at a definite social element in the mobile search space, this dimension has not been explored fully and little is known about the use of mobile search in such social settings.

Finally, there has been some recent research aimed at addressing the various design challenges for co-located collaborative mobile search [16, 17]. In [16], features such as clipping, ranking and sharing of search results between mobile devices is supported via a proof-of-concept prototype. Meanwhile in

[17], evaluations of sharing, comparing and analyzing mobile search results within a group of co-searchers is described. However, both works involve lab-based evaluations, with few participants and a narrow range of search tasks. While such research provides initial insights into how collaborative mobile search experiences can be improved, the fact remains that very little is understood about the situations and the dynamics that lead to the use of mobile search in social settings. Before designing new tools and services to help mobile users in such settings, we must first understand the intricacies of such social behaviours.

Hence, the primary contribution of this paper is that we show, both qualitatively and quantitatively, how, why and in what situations people use mobile search in social settings for shared information needs. Our work extends the results of past research by exploring the motivations, circumstances and experiences of using mobile search in social settings for group information needs. And our findings point to a number of open challenges and implications for the design of future social mobile search services. In the following sections we describe the methodology we employed and key results from our study.

STUDY METHODOLOGY

We employed a mixed-method approach in our study consisting of (i) a survey and (ii) an online diary & interview study.

Study 1: Survey

We first carried out a survey to gather initial insights into different aspects of social mobile search behaviour. The survey comprised of three main parts. Part 1 included a series of questions related to demographics and mobile phone usage. In part 2, users were asked to recall their most recent social mobile search experience. That is, carrying out a Web search on their mobile phone in the physical presence of at least one other person in order to satisfy a shared need for information. After recalling this experience, users were asked to answer a series of questions related to that experience including: what they searched for, their information need, their motivation, who they were with, their relationship(s) to the people present, where they were located, what they were doing before and after the search activity, if and how they shared the search results, and if the search had any effect on their future plans. In part 3 of the survey participants were asked about their general mobile search experiences and behaviours whilst in co-located group settings. The survey included a mix of closed and open-ended questions so that we could capture a rich set of data points related to their social mobile search experiences, while minimizing the time burden on the respondents.

Our survey resulted in 193 responses gathered between October and November 2011. Survey participants were recruited from external mailing lists, online social networks such as Facebook as well as online discussion forums. A pre-requisite to the survey was that all participants must own an Internet-enabled mobile phone and must perform mobile Web searches at least a few times per month. This pre-requisite was used to ensure at least some level of familiarity with mobile search engines. Survey participants ranged in age between 18–61, with an average age of 31 (SD: 6.9). Responses

were provided by 134 men (69.4%) and 59 women (30.6%). The users came from a diverse range of backgrounds (*e.g.*, IT, engineering, sales, telecommunications, education, customer service, etc.). The majority of our participants were residents of Spain (68%), Ireland (17%) or the UK (10%). Respondents primarily used Android (40.4%) to perform their searches, followed by iPhone (30.6%), Blackberry (10.9%), Nokia (6.7%) and other types (11.4%) of mobile devices. Finally we found that the majority of participants (87%) stated that they used mobile search in social settings at least once per week, with 54.9% of participants using it at least once per day. In terms of search engines used, 183 participants (95%) responded using Google's mobile search service.

Study 2: Online Diary & Interview Study

While the first study allowed us to capture a single social mobile search experience from each participant (*i.e.* their most recent experience), we designed the second study so that we could investigate multiple social mobile search experiences over a longer time period and in more depth. In particular the second study was designed to help us understand *why* mobile users engage in such behaviours. For this second phase, we conducted an online diary and follow-up interview study. Users were asked to share details of their mobile searches carried out in co-located, group settings. Instead of asking users to carry around a notebook, users accessed an easy to use, online diary tool. We employed follow-up interviews to clarify entries and elaborate on their experiences. We focused on *active* mobile search users so that we could draw interesting insights from this user group. We define *active mobile search users* as those who use mobile search on their smartphones daily or multiple times per day⁵.

Participants

Diary study participants were recruited from the 193 users who took part in the survey phase of the study. Participants were selected based on the frequency at which they engage in mobile search behavior (as reported by them), in particular in group settings for satisfying *shared* information needs. In total 20 participants were chosen (11 male and 9 female) who actively search for mobile Web content. Participants ranged in age between 22-52, with an average age of 30.5 (standard deviation: 6.5).

Procedure

The diary study ran for a period of 2 weeks in November 2011. Participants were asked to report all of their social mobile search sessions in an online diary tool that was accessible via a Web browser in both mobile and desktop environments. The survey included a mix of open and closed questions so that we could record the motivations, circumstances and experiences of social mobile search while limited the effort required by the participants. Below is a list of the questions we asked each user to answer along with a flag indicating whether the question was open/closed⁶.

1. Approximate date and time of the social mobile search [closed]

⁵We focused on smartphone users to avoid any bias that may have been introduced by users of less sophisticated phones

⁶Aside from the questions listed, users were also free to provide additional comments on their experience.

2. The information need they were trying to address [open]
3. Their motivation for using mobile search in the given social setting [open]
4. Their location at the time of the mobile search [closed]
5. How many people were in their group? [closed]
6. What was their relationship to each member of the group? [closed]
7. What they were doing just before the mobile search? [open]
8. What they did immediately after the mobile search? [open]
9. What search engine was used? [closed]
10. What query did they submit to the search engine? [open].
11. Did the search have any effect on future plans for group activity? [open]
12. Was their information need satisfied? [closed]
13. If their need was left unsatisfied, why was this the case? [open]

Users were asked to submit a single diary entry for every social mobile search session they conducted over the 2-week period and to do so (1) as soon after the mobile search as possible and (2) as accurately as possible. Each participant was sent a daily SMS reminder for the duration of the study and the time at which the reminder was sent was varied so that we could gather a diverse range of social mobile search experiences. At the end of the study, each participant took part in a semi-structured interview (approx. 30 minutes in duration) in which we delved into their experiences, focusing in particular on what they feel are the most positive and negative aspects of using mobile search in social settings and what would improve their social mobile search experiences. We also used these interviews to clarify any issues with the previously recorded diary entries. Each user was given a 25 euro voucher for taking part and we also raffled three 100 euro prizes to three participants.

Data Collected

Over the 2-week period the 20 participants generated 123 diary entries, with an average of 6.2 social mobile search experiences per user (min=2, max=15, standard deviation=3.3). Only 14 of the diary entries (11.4%) were generated from a mobile handset, with the remaining entries submitted via a desktop/laptop. Of the 123 diary entries, 111 (90%) were searches issued via Google's mobile search engine.

RESULTS

In this section we analyze the data collected in both studies and provide a characterization of social mobile search behaviours. We focus on the types of needs that arise in these social settings, the contextual factors that play a role, how these mobile search interactions are shared and the effects of social mobile search experiences on the future behaviours and plans of the group. Note that across both studies, the reported social mobile search instances typically involve ONE member of the group (*i.e.* the instigator of the search) carrying out the search while the others are waiting for the answer or continuing the conversation. The findings of the survey and diary study are reported alongside each other for comparison.

Some differences in patterns emerged from these two studies and as such are highlighted where applicable. However, we found common trends across both studies and the main findings presented within this section reinforce these common behaviours.

Where Do People Use Social Mobile Search?

While recent research shows that the majority of mobile Internet usage occurs in stationary, familiar settings like at home or at work [19, 3], investigations of mobile search behaviour highlights a different trend. For example, mobile users are often away from familiar contexts while searching and at times they search for information about a geographic location [22]. A recent study by Church & Oliver [3] shows that 42% of mobile searches occur when users are away from familiar environments. While we find a similar trend, our results show that *location* seems to play a more important role in social mobile search (see Table 1). In the survey we found that 56.5% of searches were issued when users were away from their home and their work. In the diary study this percentage dropped to 47%. Note that social environments like bars, cafe’s, restaurants as well as other people’s homes (*i.e.* the homes of friends) account for a significant percentage of search experiences in both the survey (11.4%) and diary study (12.2%) responses. We also found the presence of an *other* category, which includes locations related to (1) shopping, *i.e.* supermarkets, shopping malls, book stores, (2) leisure, *i.e.* in a hotel, on holidays, etc. or (3) general errands, *i.e.* at the doctors, in a meeting, etc.

Table 1. Total number and percentage of mobile searches per location for both the survey and the diary study.

Location	Survey		Diary Study	
	# num	% perc	# num	% perc
Home	51	26.4	36	29.3
Work	33	17.1	29	23.6
Walking	27	14	11	8.9
Other persons home	25	13	7	5.7
Commuting	24	12.4	16	13
Bar/Restaurant/Café	22	11.4	15	12.2
Other	11	5.7	9	7.3
Total	193	100	123	100

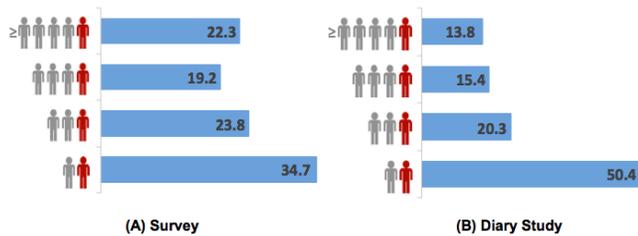


Figure 1. Percentage of social mobile searches in both the survey and the diary study along with the associated number of people present in the group at the time of the search. Note that red person icon represents the instigator of the social mobile search.

Who Do People Search With?

When it comes to who users interact with, we find that group sizes are varied and dynamic and *relationships* appear to play

an important role. Figure 1 shows the number of co-located group members (including the instigator of the search) during the recorded social mobile search instances for the survey (A) and the diary study (B). The instigator of the mobile search is highlighted in red while the remaining group members are shown in grey. We find that social mobile search is most often conducted within groups of 2 people, that is, the searcher and one other person (approx. 35-50%). However, at times, group sizes are quite large with ≥ 4 people (approx. 29-41%).

In terms of relationships (See Table 2), friends were by far the most common group type accounting for 60% of search instances in the survey and 41% of search instances for the diary study. Family (26% vs. 33%) and partners/spouses (15% vs. 29%) were also popular in social mobile search instances. Interestingly, in approximately 30% of cases for both the survey and diary study, two or more relationship types were reported. That is 30% of the time, users searched while with family and friends, or friends and partners, etc. While social mobile search does occur among work colleagues, it appears to occur more often with people with whom users have a closer, more intimate relationship. Note that the *other* category listed in the set of relationships includes items like *taxi driver* and *tourists asking for help/directions*. Therefore in a small number of cases, social mobile search is used with people the user does not actually know.

Table 2. Total number and percentage of mobile searches for both the survey and the diary study and the associated relationship with people present in the group. Given that multiple relationship types could be present in a single social mobile search experience, the percentages extend beyond 100%.

Relationship	Survey		Diary Study	
	# num	% perc	# num	% perc
Friends	115	59.6	50	41.0
Family	50	25.6	41	33.3
Partner	56	29.0	19	15.4
Colleagues	41	21.2	27	22.0
Other	5	2.6	4	3.3
Total	267	138	141	115.0

Why Is Social Mobile Search Used?

In this section we investigate the motivations behind conducting mobile searches within social groups. Past work by Taylor *et al.* [21] has shown *awareness* is the key motivations for mobile Web usage. Awareness is defined as the desire to stay current and up to date. Using a similar methodology to Taylor *et al.* we manually classified all social mobile search instances reported in both the survey and diary study according to one of four key motivators, shown in Table 3: (1) Curiosity, (2) Assisting an activity/a task, (3) Staying informed generally (awareness) and (4) Alleviating boredom. Note that two of the authors manually classified the dataset so that total agreement was reached.

In contrast to past work we find the top motivators behind social mobile search are *Curiosity* and *Assisting an activity / task*, as opposed to *Awareness*. Curiosity, as defined by Taylor *et al.* [21], reflects the user’s interest in an unfamiliar topic, which normally occurs by chance, *e.g.* conversing with a friend and wanting to settle a friendly bet, watching

a movie, wanting more information about an actor, etc. Approximately 47% of survey responses and almost 37% of diary entries belonged to this category. This motivation is primarily driven by conversations and brief chance encounters. Some real examples from the diary study include: **P1**: “The name of the beer from Zaragoza — All of us were thinking about it and nobody remembered”, **P7**: “New actress in Gossip Girl — who is the new character?” and **P14**: “The length of Dun Laoghaire West pier — Someone said it was a mile long and others thought it was half that”.

Table 3. The main motivations for using mobile search in social settings.

Motivation Classification	Survey		Diary Study	
	# num	% perc	# num	% perc
Curiosity / fact-finding	91	47.2	45	36.6
Assisting an activity / a task	76	39.4	74	60.2
Staying informed generally	22	11.4	4	3.3
Alleviating boredom	4	2.1	0	0.0
Total	193	100	123	100

In contrast, the *Assisting an Activity or Task* category reflects the desire to be more efficient, to plan for things and to get things done. These can relate to work or study, to finding directions, contact and address details or to planning activities/making decisions. We found approx. 39% of survey responses and 60% of diary entries belonged to this category. Some real examples from the diary study include: **P17**: “Palau Sant Jordi — We wanted the best route to reach a specific location. We decided the best route and means of transport and the entire group moved on to the concert”, **P2**: “Timetable cathedral Salamanca — We were planning a trip” and **P10**: “What time the car boot sale was on in the pavillion bar in Cork — We wanted to go along to the car boot sale”.

What do People Search for in Social Settings?

In this section we highlight the information needs associated with the recorded social mobile search instances. Dearman *et al.* [8] previously explored the information needs of average mobile users and devised a comprehensive taxonomy of information needs. To help us assess what types of information needs lead to social mobile search behaviours, we used the original Dearman *et al.* high-level categorization as a basis and manually classified both the diary study entries and survey responses according to one of 10 categories, shown in Table 4⁷. For space reasons, we focus on the top 4 categories which account for > 70% of survey and diary study responses, however, we refer the interested reader to the Dearman *et al.* paper for a full description of all the information need categories [8]. Furthermore, given that Dearman *et al.* provide results of mobile-specific needs we provide comparisons where possible.

The most popular information need is *Trivia & Pop Culture* accounting for approx. 31% of survey responses and 37% of

⁷We made some small modifications to the original Dearman *et al.* classification: (1) We associated news items with the *trivia & pop culture* category, (2) we added a *learning* category which reflects the desire to learn something new, (3) needs related to distances, the time it takes to get from one point to another point and locating intangible/virtual items such locating a group on LinkedIn to the *finding* category. Again two authors manually classified the dataset so that total agreement was reached.

diary study entries. This need type relates to random thought references, factual knowledge, popular culture, definitions, translations and meanings of foreign words; as well as news queries. Some diary study examples include: **P7**: “The writer Patrick Rothfuss”, **P9**: “What lake was Greenville close to?”, and **P3**: “Videos and music from Elvis”. Interestingly, in a study of mobile information needs by Sohn *et al.*, trivia was also the most popular need type, however the volume of such needs was much lower (18.5%) [20]. In the Dearman *et al.* study the volume of trivia-related needs generated while mobile was just 5.4% [8].

Next in popularity is *Finding*, which accounts for 28% of survey responses and 22% of diary entries. This category relates to finding the name or location of a company, service or person; the distance between two points or different routes to a given destination; as well as the time it takes to travel from one point to another. Examples from the diary study include: **P6**: “Hotel dazzler buenos aires”, **P17**: “Finding the location of a restaurant”, and **P7**: “Where to get the DVD of Pulp Fiction?”. The occurrence of this need type appears to be in line with findings of [20] which shows that *Directions* and *Points of Interests* account for 25.7% of mobile information needs. However, *Finding* type needs were more prevalent in the Dearman *et al.* study (41.9% for mobile users) [8].

Guidance type needs relate to instructions, advice, opinion or recommendations. For example, **P1**: “Recipe for risotto with mushrooms.”, **P7**: “How to get rid of a computer virus” and **P14**: “Best chip shop in Dublin”. This category of needs account for 8.3% of survey responses and 10.5% of diary study entries. Dearman *et al.* found a similar trend for mobile users (10.6%).

Finally, the *Establishments & Organizations* category includes information about a specific business, association, organization, etc. Most queries associated with this category relate to finding contact details or resource information for a given business or service. For example, **P12**: “Morrison BMW. I was looking for their contact details as I needed to ring them to confirm an appointment time” and **P5**: “Guinness storehouse — I needed to find out if there are parking facilities at the Guinness brewery”.

Overall our results show that many of the information needs that arise in social mobile search sessions are comparable with general mobile information needs. However, a significant difference exists when it comes to the volume of *trivia*-type needs. This is perhaps due to the fact that social mobile search tends to occur quite randomly and is sparked by chance conversations. This phenomenon is more apparent when analyzing the mobile queries submitted by our users. Past research on mobile search has shown that although mobile queries are evolving and are becoming less homogeneous, high levels of query repetition still exist among mobile users [6, 5, 24]. However, when it comes to social mobile queries, we that found that there is far less repetition among the queries issued. In fact query repetition rates across the diary and survey study was <1%. This means that diversity among the search queries recorded during both studies was very high and in terms of the queries/keywords entered, users searched for very different things.

Table 4. The information needs behind the social mobile searches.

Information Need	Survey		Diary Study	
	# num	% perc	# num	% perc
Trivia & Pop culture	72	37.3	38	30.9
Finding	54	28.0	27	22.0
Guidance	16	8.3	13	10.6
Establishments & Organisations	12	6.2	13	10.6
Offerings	11	5.7	10	8.1
Availability	9	4.7	11	8.9
Unknown	8	4.1	3	2.4
Events	4	2.1	4	3.3
Environmental Conditions	3	1.6	2	1.6
Learning	2	1.0	2	1.6
Persons	2	1.0	0	0.0
Total	193	100	123	100

How are Social Mobile Search Experiences Shared?

In both the survey and diary study, users were asked if and how they shared the search experience and results with the members of their group. In our study, one person was typically carrying out the search on behalf of the group. The reporter of the social mobile search instance was the person who conducted the search. Given that the search was issued to address a shared information need, we wanted to understand how the resulting information was shared amongst the group and how many different methods of sharing were employed in a given search session. We provided 4 default sharing modes for users to choose from: (1) Speaking aloud, (2) Showing the screen whilst holding the phone, (3) Handing over the phone, and (4) Sending electronically phone-to-phone (*e.g.* via email, SMS, Bluetooth, etc.). Users were also given the option of specifying *other* sharing means.

Table 5. Total number and percentage of social mobile searches along with how users chose to share the results with members of their group. Given that multiple share types could be present in a single social mobile search experience, the percentages extend beyond 100%.

Sharing Classification	Survey		Diary Study	
	# num	% perc	# num	% perc
Speaking aloud	134	69.4	94	76.4
Showing screen whilst holding	89	46.1	36	29.3
Handing over the phone	27	14.0	20	1.6
Sending electronically	20	10.4	6	4.9
Other	6	3.1	6	4.9
Total	276	143.0	162	117.1

Table 5 shows the results of this analysis. In the survey, 69% of search results were communicated by speaking aloud, 46% by the user showing the device screen to other members of the group, 14% handed the phone to another member of the group, whilst 10% of search results were sent electronically. In the diary study we found that speaking the results aloud was even more common with 76% of diary entries. We also found much lower occurrences of showing the device screen to group members (29%) and sending the search results electronically (5%). Interestingly < 2% of diary entries corresponded to users relinquishing control of their device to show the search results to someone else in the group.

It was common for more than one method of sharing to be used in a single search session. In the survey, 23% of searches involved two methods – most commonly (in 70% of these

cases) speaking and showing the screen; meanwhile 8% of all search episodes saw three different methods used. Similar results were found in the diary study: 28.5% of diary entries reported at least two sharing methods.

Although the 4 default modes of sharing account for the vast majority of recorded behaviours, users reported using other somewhat surprising means at times. The *other* category of sharing was reported in 3.1% of cases in the survey and almost 5% of cases in the diary study. These other means included: writing the information down on paper, using *Whatsapp* (which is related to sending the information electronically but somehow participants felt it required a separate category) and finally telephone calls. Phone calls were employed when users wanted to share the search results with people not physically present.

It is clear from these results that users generally share results by speaking aloud or showing their phone. Users rarely hand over their phone or send the results electronically. We will show in the discussion section that both the private nature of mobile phones and the type of content being shared have an impact on how information is shared and with whom.

What is the Impact on Future Plans?

In both the survey and diary study, participants were asked if the social mobile searches they conducted had an effect on the future plans or decisions of their group. 34% of survey responses and 25% of diary responses indicated that the reported social mobile search did have an impact on the future plans of the group. Across both studies, the information need type that most often had an impact on future plans was the *Finding* category (47% of the survey responses that impacted on plans and 23% of diary study entries that impacted on plans). *Guidance* and *Availability* needs also had a strong impact on future plans (12.9 vs. 13.7% and 7.6 vs 22.6% respectively).

When asked what effect the search had on their future plans, a diverse range of responses were provided by users. For example⁸: (1) Decisions: **P9D**: “We decided not to take the car”, **P16D**: “We decided our next stop”, (2) Plans: **P2S**: “We agreed on a plan”, **P7D**: “We will read the book”, (3) Actions: **P1S**: “We went to the cinema”, **P16S**: “We booked the travel” and (4) Purchases: **P2S**: “We had to buy an umbrella”, **P80S**: “We bought flight tickets”.

DISCUSSION

When compared to prior work on understanding general mobile search behaviour, our results show that social mobile search behaviour is *different* across a number of dimensions: it tends to occur in more unfamiliar and mobile-specific locations, it tends to happen among tightly knit social groups of mixed sizes, it is motivated mainly by curiosity or assisting an activity and it is dominated by trivia and finding information need types. Social mobile search is primarily sparked from conversations and is used primarily to engage or enrich those conversations. In this section we turn our attention to more qualitative data and delve into three insights related to social

⁸The ‘S’ and ‘D’ in the participant number listings refer to S: survey participants and D: diary study participants.

mobile search: (1) the pros and cons of social mobile search highlighting mixed feelings in using this technology, (2) the perceptions towards sharing search results with peers and (3) the role of time in the activity planning tasks derived from these social search scenarios.

The Pros and Cons of Social Mobile Search

Through the survey, diary study and follow-up interviews with participants, the general perception towards using mobile search in social settings was deemed to be a very positive experience by our users. One of the key goals of this study was to assess what value users gain from using social mobile search and what is lacking from their current experiences. In the survey, the 193 participants were asked to describe what they liked and disliked most about using mobile search in social environments. Based on their responses we identified 4 benefits and 6 drawbacks of using social mobile search⁹.

Perceived Benefits to the User

In terms of value, the first benefit was convenience. That is fast, easy access to a wealth of information anytime, anywhere. Some user comments related to this benefit include: **P3**: “Information is always at your fingertips”, **P5**: “It’s so easy and useful” and **P30**: “I can get a fast answer without opening/starting/moving to my computer”.

A second benefit was that it enhances conversations. Many users were able to learn something new, to provide new insights to conversations and to settle friendly bets and debates with friends. For example: **P39**: “It solves a lot of arguments in the group :)”, **P151**: “The possibility to answer a question that has arisen some discussion in the group. You can settle the discussion having learned something and knowing that it is true.”, and **P82**: “It complement interests and provides random tips that enrich conversation”.

A third advantage was the means to make well-informed decisions using accurate, real-time information, thus leaving nothing to chance. For example, **P182**: “You can take right decisions in realtime”, **P79**: “Allow groups take decisions all together every time.”, and **P71**: “It helps us make fast well informed decisions”.

Interestingly users also indicated that social mobile search enabled a form of *personal empowerment*, i.e, it helped them show initiative and made participants feel in control and independent. Users expressed feeling good when being the first to find the answer to a question and sharing that answer with their peers. For example **P37**: “Always getting the info gives me better visibility in the group and allows me to interact”, **P45**: “I like to be helpful”, **P175**: “Being the first to know the answer”, **P173**: “There’s a little phone pride and snobbery about it too when you race with someone to get the info first”, **P70**: “I like to feel Independent even if I am in a place that I don’t know well”, and **P80**: “To show initiative and technical ability to find information”.

Perceived Drawbacks to the User

The first downside to social mobile search is that it can be deemed rude and antisocial. For example, **P50**: “It’s very

⁹Note that all user comments quoted in this section are from the survey part of our study.

impersonal.”, **P67**: “It’s rude, just like making a call” and **P147**: “It can be deemed impolite”.

Other users expressed that while social mobile search is used as a conversation enhancer, the act of searching in such situations resulted in them feeling removed from the conversation, e.g. **P115**: “You stop talking and can be out of the conversation.”, **P97**: “It can make you feel removed socially as you are fully immersed in getting the information” and **P100**: “It can be a distraction of the natural flow in a group situation”.

Another negative aspect of social mobile search is that at times it ended conversations that might have continued if the search had not taken place, e.g. **P3**: “I also feel like it puts an end to fun and friendly debates”, **P105**: “Sometimes, it’s the end of a interesting discussion”, **P138**: “It can stop the flow of conversation as the focus is taken away from the conversation itself”.

Some users hinted that it creates a mobile dependency. For example, **P47**: “You get dependent. I feel that I’m using my memory less so I tend to easily forget simple concepts”.

Contradictory to the *personal empowerment* benefit mentioned earlier, other participants felt that the act of searching reflected poorly on them, leading to a negative reaction from the group, e.g. **P4**: “I feel like I’m acting like a know-it-all when I look things up.”, **P163**: “Some people do find it annoying and might roll their eyes, like ‘oh great, they’re searching for it on their phone to prove a point and be right’. You have to be conscious of this and sometimes not search for some thing.”, and **P56**: “You can be accused of pedantry”.

And finally, we were surprised to discover that some users thought that searching for answers in these social situations felt like cheating. For example, **P172**: “It kills the surprise”, **P192**: “Instead of more discussion we ‘cheat’ and find the answers”, and **P40**: “It removes the challenge”.

Along with the caveats mentioned above, common mobile device usability issues were reported by users — e.g. poor coverage, bad speeds, cumbersome input, etc. — however, surprisingly none of the aforementioned drawbacks were seen as a barrier towards using mobile search in social settings.

Sharing Mobile Search Experiences

One of the research questions we aimed to address in this work is how do people *share* mobile search experiences with their group. Our previous results show that users rarely handed over their phone (14% of survey responses and only 2% of diary entries). Sending the results electronically was also used infrequently (10% of survey responses and 5% of diary entries), mainly because it was too difficult for most users, e.g., **P1**: “It takes a while to do Bluetooth. You have to wait a few minutes to have an image which is ridiculous for something that’s not critical”. In the follow-up interviews with diary study participants, we probed these sharing behaviours in more detail¹⁰.

Sharing the Input

One of the first questions we asked interviewees was whether they shared the query input phase of the mobile search. While

¹⁰Note that all user comments quoted in this section are from the interview phase of our study.

one user pointed that a group-based search could lead to more engagement, **P15**: “If there was a way to actively group search the discussion would stay on the topic at hand”, socializing the search input process appears to be an undesirable feature in general. For example: **P4**: “I do not see any point in any social activity for something as simple as entering a search” and **P10**: “If everyone is looking for info at once it kind of defeats the purpose”.

Sharing the Results

In terms of sharing the results of the search process, the decision about how to share the results appears to be a consequence of multiple factors, e.g. who the recipient is, the type of information being shared, the task at hand, the physical environment and the personal, private nature of mobile handsets. All in all, the decision about how and what to share varies greatly based on personal feelings and preferences. As can be seen from the user comments below, there are contrasting attitudes in terms of what is shared and with whom.

P11: “If it’s short, small bits of information, maps or photos I show. For longer pieces of information I may speak”, **P13**: “If it’s something simple I can say aloud, if it’s difficult then I show the phone”, **P2**: “With family I show and maybe hand over the phone. With friends I generally just speak what’s on the screen. It depends how well you know them (i.e. the people you are with). I rarely hand over my phone due to privacy and practical/protective issues” and **P13**: “With friends I speak it aloud, with colleagues I usually show the phone to share the information”.

Furthermore, when the search results related to persistent, task-related information, sharing effectively becomes more complex. Maps or navigation type results in particular appear to create significant complications and overhead in terms of sharing. In these cases speaking a word/phrase aloud or showing the screen does not satisfy user needs. For example, **P10**: “In London on a college trip and I was the only person with an iPhone so I used Google maps a lot. I was constantly reading directions. A massive printout of Google maps would have been handy”.

Finally, the inherent usability issues of mobile phones also have an impact, e.g. **P2**: “The problem with giving them my phone is they tend to knock the search off” and **P9**: “Showing something to someone on a tiny screen on a mobile doesn’t make much sense. I don’t find it very practical”.

Group-based Activity Planning

We found that a significant proportion of searches had a real impact on the future plans of the group (34% of survey responses and 25% of diary entries). After exploring this effect in more detail we found that the resulting activity planning had a strong temporal component: *group plans* were spread across the *now+next*, *soon* and *later* time frames.

Most of the activity planning relates to immediate and near-term planning. A number of users mentioned that it was quite common with friends when making in-the-moment decisions about immediate activities, e.g. going to the cinema, deciding on a restaurant for lunch, etc. However, there were also cases of social mobile searches which led to plans in the coming

weeks or months ahead. Examples from the survey participants highlight this fact: **P109**: “We are going to that place in December”, **P155**: “Next weekend we decided to go to St Anton Market”, and **P117**: “We’ll probably go to Zurich next year”. When the interview participants were asked about their use of social mobile search for planning, they offered a range of responses that not only confirm the existence of these temporal elements but also showed the value of using mobile search in social settings for finding new activities or confirming group plans. For example: **P11**: “When it is related to activities/plans, it’s usually just to confirm places or find the way”, **P16**: “I have been using it a lot to find activities to do in the city where I am”, **P1**: “Most of the time it’s making plans to go out to restaurants, travel, etc” and **P15**: “My father has his 50th birthday next year so we’re thinking about going to Barcelona for the grand prix. So I looked up tickets, etc. I do use it a lot for planning”.

Interestingly based on feedback in the interviews it appears that certain roles within the group appear to influence this behavior. For example, the *organizers* within the group tend to conduct the majority of these types of searches, e.g. **P1**: “Generally with a group I’m always searching for something we’re going to do or thinking of doing.” and **P10**: “I am the organizer of the group so I do searches for these.”

IMPLICATIONS FOR DESIGN

Overall our findings imply that there are a number of caveats in terms of engagement, interaction and sharing during social mobile search usage. In this section we describe a number of open challenges and design opportunities for enriching shared, social mobile search.

Enhancing Sharing

As highlighted earlier, we found that personal preferences, information type, group relationships and privacy/trust concerns all have a role to play in who shares what and with whom. In both the survey and follow-up interviews we asked users what would improve their current experiences and many users pointed to wanting an *easier means of sharing results* with their peers. For example, **P2**: “If you could send, not so much a link, just a screenshot of what you’ve found. If you could just flick the info onto their phone”, **P15**: “A lot of people I hang around with are also smartphone users, if somehow they could see the results on their screen” and **P16**: “it would be nice to have a quick way to share results, so people can also look at them”.

However we also found that the private, personal nature of mobile phones makes the act of sharing through these devices a complex and sensitive task. For example one user commented. **P2**: “I wouldn’t like to share my phone or information from the phone. My phone is always used for work as well so I’m always paranoid that something can happen. Smartphones tend to be expensive, that is a factor”.

As such it appears that future social mobile search tools will benefit users if they can support easier sharing between devices. However, any future advances in this research space will need to consider user privacy and control as a top priority. And striking a balance between easy to use sharing modes and privacy/control will be a challenging task.

Group Creation & Engagement

Group identification and creation remains an open challenge in social environments, let alone in dynamic mobile environments. In order to increase sharing and engagement in social mobile search settings, users need an easy, fun and privacy-preserving means of identifying group members. While being physically close to a person might be some indication of participation in a group, it's unlikely to work successfully in crowded, public spaces such as bars and restaurants where such behaviors emerge quite frequently. Furthermore, there may be instances where users want to connect and engage with sub-groups rather than the entire group. For example, one participant commented that he wanted to allow his friends to see the search results he discovered, however, in certain circumstances he didn't want to share that information with everyone in the group. While interaction among sub-groups was not reported very often, it's likely that future social mobile search services will need to consider a complex set of group structures and dynamics, especially when facilitating group creation and interaction.

Finally, while all of our participants were smartphones users, a few users expressed a desire to share and engage with friends across a range of devices, *e.g. not specifically an iphone*. One user pointed to using blackberry messenger to share content quickly and at no cost but was restricted to sharing with colleagues that also had blackberry devices. Given the diverse range of mobile handsets on the market today, and the fact that within a given group it's likely that multiple handset types are present, any future applications aimed at engaging groups will need to be inclusive and cater for multiple device types.

As described earlier we found mixed user perceptions towards using mobile search in social settings. Users indicated that a fine line exists between appearing rude and showing-off versus using mobile search to facilitate a conversation and engage with the group. At times the act of mobile search in social settings was deemed annoying and anti-social to group members. Sometimes the act of executing the search was distracting and left the searcher isolated and withdrawn from the conversation. We believe that some of the negative connotations associated with social mobile search could subside by developing inclusive services that engage the entire group during the social mobile search activity.

Beyond Co-location

In both the survey and diary study we focused on exploring the use of mobile search in *co-located* group settings to satisfy a shared information need, that is where all group members were physically located in the same place. While the majority of recorded social mobile search instances focused on co-located group members, we did find that some users opted to share search results with group members not physically present either via WhatsApp or via phone calls. While these modes of sharing account for a low percentage of overall usage (3.1% and 4.9% for the survey and diary study respectively), future social mobile search applications may need to facilitate group interaction across multiple locations. Extending location boundaries in this manner is likely to make group creation, interaction and sharing more challenging.

Overall, these qualitative insights suggest that a more engaging, shared mobile search experience *aimed at the entire group* might help in waining the negative aspects and in turn enrich user experiences. There is definite scope to support richer, more collaborative mobile search experiences among groups of mobile users. As pointed out in the related work section, there have been some initial attempts by researchers to support collaborative mobile search for group activity planning tasks [16, 17]. However, given that curiosity motivations and trivia information needs were prominent in our study, it is likely that alternative techniques will need to be explored to support a range of social mobile search behaviours. Furthermore, as outlined in this section, developing richer, shared mobile search experiences is a non-trivial task which we believe will lead to new interaction and design challenges for mobile researchers. We hope that the challenges outlined in this paper inspire other researchers in their future endeavors and that our findings can help inform improvements in future social mobile search services.

STUDY LIMITATIONS

While significant effort was spent to ensure validity of our user study and our results, there are three limitations to our current approach which we would like to discuss. Firstly, the study was conducted in November 2011 and as such there may be seasonal effects in terms of the behaviours that emerged. For example, perhaps users would engage/search differently in summer months. Secondly, while we tried to ensure a balanced sample, we received more responses from male participants for the survey portion of the study. This may also have an impact on findings. Finally, both the survey and diary study relied on self-reported data from users, which could be incomplete or contain inaccuracies. In designing the study, we took these limitation into consideration and decided to combine the survey with a more longitudinal diary study so that we could capture a diverse range of behaviours that may have not emerged in the survey alone. We sent daily reminders to users via SMS to limit missing entries and we conducted in-depth interviews with each of the diary study participants so that we could augment the quantitative findings with more subjective responses. We feel that this combination resulted in a rich dataset which has allowed us to draw a number of insights into how and why mobile users engage in social mobile search.

CONCLUSIONS

In this paper we have presented the results of a survey and diary study investigating why and how people use mobile search in co-located social groups to satisfy a shared need for information. Our results highlight significant differences when compared to prior work on understanding mobile search behaviour. Mostly sparked by random conversations, we have found that social mobile search is more likely to occur in unfamiliar and mobile-specific locations (56.5 % and 47.1 % for survey and diary study respectively), it happens among tightly knit social groups, it is motivated by curiosity or assisting an activity or task and it is dominated by trivia and finding information need types. We have also discovered that a non-negligible proportion of social mobile searches have an impact on the future plans and activities of the groups in question.

In addition to characterizing social mobile search behaviour, we have highlighted key user perceptions towards using mobile search in social settings. Our findings point to a number of open research challenges and opportunities to enrich the future experiences of mobile Web users, in particular related to improving content sharing and group interaction. In terms of future work, we would like to explore social mobile search behaviour *in-situ* through both log analysis and field studies to validate our findings and determine if new trends emerge in-the-wild. There might also be opportunities to explore if demographic, seasonal and cultural differences exist in social mobile search behaviour.

ACKNOWLEDGMENTS

This work is funded as part of a Marie Curie Intra European Fellowship for Career Development (FMIA, PIEF-GA-2009-255625) award held by Karen Church. Thanks to the reviewers for their useful comments and valuable feedback.

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