Insights into Co-located Shared Mobile Search

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Abstract
Recently, the use of mobile search among co-located groups to satisfy casual, shared information needs has grown in popularity. In this paper we describe a proof-of-concept research prototype, which is designed to enhance such social experiences by providing an easy means of interacting with and sharing mobile Web content among co-located groups. We present initial results of an exploratory field study of our prototype and outline a number of design implications that could enhance next-generation social mobile services.

Author Keywords
Mobile search, mobile internet, mobile web, social mobile search, shared search, collaborative search.

ACM Classification Keywords
H.5.2 [Information Systems]: Information Interfaces and Presentation – User Interfaces. H.3.3 [Information Systems]: Information Storage and Retrieval – Information Search and Retrieval.

Introduction
Recent work highlights that mobile search is often a social act, sparked by conversations, motivated by curiosity [2] and in lots of cases (>65%), it's carried out in the presence of others [2, 5]. A 2012 study by Church et al. [3] focused explicitly on understanding

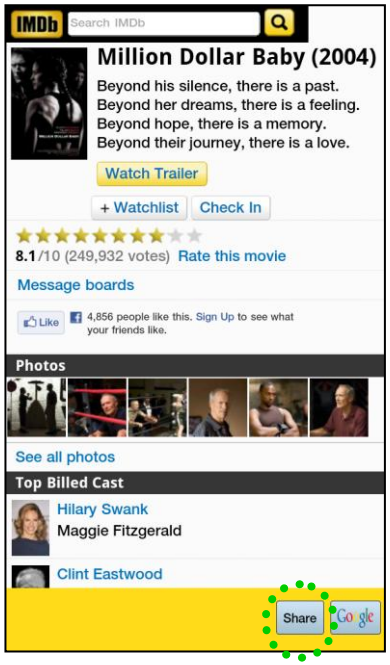

Figure 1. WaggleBee app with "Share" button highlighted by a green circle.

Figure 2. Request received by session receiver to start a sharing session.

status-quo co-located mobile search practices shows that mobile users often stumble upon interesting search results that they would like to share with their friends. At present, sharing is done by speaking aloud or showing the mobile device. Users rarely relinquish control of their handset to share such content due to various privacy concerns and issues related to control [3]. And while mobile Web content can be shared electronically, e.g. emailing, sharing via social networks, these mechanisms are seldom used due to their cumbersome nature [3]. All in all attempts to share Web content often lead to frustrations because mobile search engines are designed primarily for solitary use and provide limited support for sharing content with other people.

While progress has been made in terms of enriching collaboration in the general Web search space [1, 6], tools to facilitate collaboration in the mobile search space have been rather limited to date [4]. We believe that there is scope to support richer, more collaborative mobile search experiences among groups of mobile users. Thus we developed a proof-of-concept mobile prototype designed to support easy and explicit sharing of mobile Web content among co-located groups of users. We conducted a preliminary field study to assess if the proposed prototype enriches shared mobile search experiences. Our initial findings point to a number of implications for designing next-generation mobile search tools that can support collaboration.

The WaggleBee Prototype

The software architecture of WaggleBee consists of an Android application and a server that synchronizes and stores all queries, interactions, group sessions and shared pages. The main interface of the WaggleBee application displays the standard Google search page along with a toolbar at the bottom of the screen with two buttons: (1) a "Share" button to share Web content with group members and (2) a "Google" button for returning to the Google search page (see Figure 1). When a user wants to share a webpage with group members he/she presses the "Share" button. We define this user as the *session initiator*. After clicking the "Share" button, the session initiator's device ID and current physical location (latitude / longitude) are forwarded to the server and a unique session ID is created.

Each WaggleBee application or client runs a thread that periodically queries the server to find out if a *nearby* session was identified, i.e. within the same physical location based on latitude, longitude. In this case, all WaggleBee clients within close proximity to the session initiator will identify a new session and display a message indicating that a sharing request has been made by the session initiator (Figure 2). We define these WaggleBee clients as *session receivers*. After the session receiver accepts, i.e. chooses to join the sharing session, the session initiator is shown a list of all people who have chosen to join the sharing session (Figure 3). The session initiator can review the list of group members and approve the session. Once approved, a *sharing session* is established and sharing of Web content can commence. Note that all WaggleBee clients within a sharing session can share content with all other members of that session.

Once part of a sharing session, WaggleBee clients constantly check the server to see if new Web content has been shared within their group. If a new shared page is found, WaggleBee notifies each group member

Figure 3. List of session members for review by session initiator.

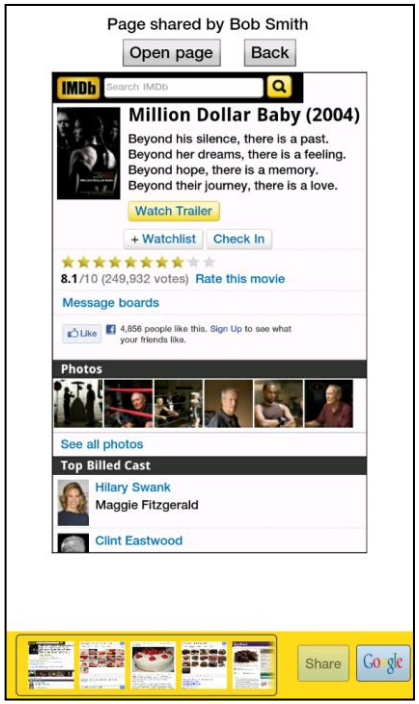

Figure 4. Shared page notification showing screenshot. Users can click the open page button to interact with the webpage. Horizontally scrollable thumbnails of the shared web pages are displayed on the bottom.

of that page by displaying a screenshot of the shared page (Figure 4). Users can choose to interact with the webpage in question by selecting the "Open page" button. Users can also choose to close the screenshot and return to the webpage they visited previously.

All webpages shared within a sharing session are displayed as thumbnails on the toolbar at the bottom of the application (Figure 4). Users interact with these thumbnails by scrolling horizontally. Users can choose to revisit past shared pages by pressing on the thumbnail in question. These thumbnails are displayed on a per session basis, that is, once the current sharing session is closed, these thumbnails are no longer shown. A sharing session is closed automatically if there has been no activity from any group members within a 15 minute period. Users can also close a session explicitly via the application.

The goal of this approach was to provide mobile users with an explicit and easy means of sharing Web content with one another. However, it is important to note, that our use of physical location to identify group members and establish sharing sessions would not function correctly if deployed in the real world. We chose this implementation as a simple starting point to explore more fundamental research questions related to (1) does the application enhance social mobile search experiences, (2) what are the benefits and limitations of our approach and (3) what can we learn and apply to the design of future social, mobile applications?

Study Methodology

In April 2012 we carried out a 2-week exploratory field study of WaggleBee. 17 Android users (13 male, 4 female) were recruited via online mailing lists and social networks. Participants ranged in age between 19 and 42 (avg:30, stdev 6.4) and had a diverse set of occupations. Participants were split, according to their social relationships, across 6 groups of friends (See Table 1), 5 of which were based in Spain and 1 in the UK. The 5 groups based in Spain lived in different cities across Spain. Most participants owned a Samsung Galaxy II or HTC handset (16 users). The majority of participants accessed the Internet via their smartphone multiple times per day (13 users).

Participants installed WaggleBee on their mobile phones and were given time to execute some test queries and to ask any questions they had before the study began. Participants had access to a website with details on the study, a list of FAQs and an instructional video for using WaggleBee. Participants were asked to use WaggleBee when co-located with group members to carry out mobile Web searches and to share any content that they find interesting or relevant to the groups needs or conversations. Users were sent a daily reminder via email or SMS. At the end of the 2-weeks, participants were asked to complete a survey to gather subjective information on their experiences with the application. Finally, we conducted semi-structured interviews, where we gathered insights to help inform the design of next-generation social mobile services of this nature. 16 participants completed the post-study survey, while 13 took part in the interviews. Participants were given a 30 Euro Amazon voucher for taking part in the study. We also raffled 3 prizes of 100 Euros Amazon vouchers to 3 participants at the end of the study.

Results

Participants executed 85 unique queries (avg:5, min:1, max:12, stdev: 3.5) and shared 165 webpages

Group	Users	Males	Females
1	3	2	1
2	2	1	1
3	5	3	2
4	3	3	0
5	2	2	0
6	2	2	0
Total	**17**	**13**	**4**

Table 1. The total number of participants per group and the number of males and females for each group.

Category	#	%
Photo/Image	29	17.6
Google	27	16.4
WaggleBee	24	14.5
Entertainment	14	8.5
Unknown	13	7.9
Search results	12	7.3
News	11	6.7
Forums & Blogs	6	3.6
Sport	6	3.6
Bar/Restaurant	5	3.0
Wikipedia	5	3.0
Automotive	3	1.8
Computers & Technology	3	1.8
Youtube	3	1.8
Telecomms	2	1.2
Shopping	2	1.2
Total	**165**	**100**

Table 2. The number (#) and percentage (%) of shared pages per category.

(avg:9.7, min:1, max:20, stdev: 6.2) over the 2-week period. Each user entered, on average, 5 unique queries (min:1, max:12, stdev:3.6). A diverse range of queries related to sports, entertainment (e.g. celebrities, movies, gossip), autos, banking, bars, restaurants, artists, etc were submitted. Most of these were informational in nature, driven by trivia related information needs and motivated by curiosity and chance conversations. This finding is in line with past work in this space [2].

To understand the type of content shared with WaggleBee, the authors manually classified the 165 shared pages into a set of categories listed in Table 2. *Note the screenshots on page 1 of this paper highlight some of the actual webpages shared with WaggleBee*. The categories were generated through an inductive analysis of the dataset in question, using an initial list of categories from related literature on mobile search behavior [2]. The most popular type of content shared with WaggleBee were photos or images. The majority of these images are individual image search results accessed via Google's standard mobile image search. Shared pages classified in the Google category relate to screenshots of the Google mobile search homepage. Likewise, a significant number of shared pages (14.5%) relate to the WaggleBee application and include users sharing the WaggleBee help page, home page, etc. These types of shares most likely relate to users initially testing the sharing feature.

Of the 165 shared pages, we found only 29 cases of opening the dynamic webpage (17.6%), that is where users clicked the "open page" button (Figure 4). This implies that in most cases, providing a screenshot or image of the shared content is sufficient for conveying the desired information to the group. Similarly we only found 46 interactions with past shared pages, that is only 28% of shared pages are re-accessed.

Overall the concept of sharing mobile Web content among the groups in our study was deemed positively. 14 of the 16 questionnaire respondents indicated that they liked sharing Web content using WaggleBee. Highly rated sharing experiences were described as fun, interesting, useful and entertaining (See Table 3). And in terms of what users liked most about WaggleBee, 9 of the 16 respondents expressed opinions related to the simplicity of the sharing supported by the application once a session is established.

Some issues were found regarding the intuitiveness, reliability and ease of use of the application (Table 3). In terms of what users like least about WaggleBee we received a mix set of responses related to the speed of the application and the restriction of sharing content with people in the same physical location. In the interview part of the study, we probed participants on these and other issues in more detail. Our findings highlight 2 benefits and 3 limitations to WaggleBee's current sharing and interaction capabilities (See Table 4) and suggest a number of implications for designing more enriching, shared social mobile services.

Design Implications

1. Think beyond physical location

Currently WaggleBee restricts sharing to co-located groups. While this design decision was motivated by past work [3], the requirement for co-location was seen as too restrictive, e.g. "*I think this feature [sharing beyond co-location] is essential for the application. Otherwise, it has a very closed use*". 12 participants

Question	Mean	Median	Mode
Fun	3.5	4	4
Interesting	3.7	4	4
Useful	3.4	4	4
Entertaining	3.5	4	4
Intuitive	2.6	2.5	2
Reliable	2.8	3	3
Easy	3	3	3

Table 3. Questionnaire results highlighting users experiences with sharing Web content with friends using WaggleBee. Responses based on a 5-point Likert scale (1=strongly disagree, 5=strongly agree and 3=neutral)

Benefits	Limitations
Supports denial of content	Sharing limited by physical location
Supports user privacy and control	Group creation isn't flexible
	Limited to a single mobile platform and therefore isn't socially inclusive

Table 4. Overall benefits and limitations of the WaggleBee approach to sharing mobile search experiences

indicated that they would like to be able to share Web content with people outside of their current physical location. In today's world, our social ties and social behaviors are not limited by location. Social networks like Facebook allow us to share and interact no matter where we are in the world. While supporting a simple means of remote and co-located sharing in the mobile space is a challenging feat, it appears that in order for mobile tools of this nature to support natural, intuitive sharing behaviors, sharing beyond a single physical location needs to be supported.

2. Support flexible & dynamic group creation

After a sharing session is established in WaggleBee, the only way to share content with a new user (i.e. a user not part of the current sharing group), is to terminate the current session and create a new one where that person is included. When designing WaggleBee we made a mistake in assuming that all group members would be present at the beginning of the session and didn't consider fully the dynamic nature of groups. Participants expressed explicitly that this restriction takes away from the social, shared aspect of the application. For example, 4 participants mentioned it would be useful to allow more people to enter a session after that session is already created. In real life, social groups are highly dynamic. When meeting friends for a drink in a bar for example, it's not uncommon for some group members to arrive earlier than others. Overall we needed to be more flexible in our approach to creating sharing groups and establishing sharing sessions. Our results highlight that future social mobile applications need to fully consider the dynamic behaviors of groups and to provide flexible, intuitive means of connection and interaction among those groups.

3. *Support inclusiveness*

While one participant affirmed that using WaggleBee was antisocial, most users felt that WaggleBee added to the conversation because the search for online information became a common shared activity. Nevertheless, we received comments that, for WaggleBee to really contribute to the group's social dynamic, all members of that group must have it installed. We designed the application for Android, and in some cases participants were involved in social activities with friends that did not have an Android handset and therefore did not have WaggleBee installed. This lead to feelings of exclusion, e.g. "*when we use WaggleBee in a large group, the other two friends who had no application complained about it…*". WaggleBee was designed to enhance sharing and social search behaviors among groups. However, in order to support such social behaviors we need to reach more people to ensure inclusivity. As a first step to this end, when designing social mobile services, we need to accommodate multiple mobile platforms.

4. Support Denial

Once a webpage is shared, WaggleBee displays a screenshot of the shared page by default, with an option for users to open the dynamic webpage. Participants expressed mixed preferences in terms of whether they preferred the screenshot or opening the dynamic webpage. For example, 6 users indicated that they preferred to open the page because they liked to interact directly with the content or because the information shown on the screenshot was insufficient. The remaining users expressed a preference for the screenshot as it saves on data and time and sometimes they're not interested in the content that has been shared within their group. By providing both features,

WaggleBee supports both denial of shared pages as well as enhanced interaction with shared pages. Our results imply that both options were needed. One option for future versions of WaggleBee or related social applications is to customize this feature, allowing users to specify their desired default or to personalize this action based on users past interactions with either the screenshot or dynamic webpage.

5. Support privacy and control
Users didn't report any privacy concerns with WaggleBee. Given users were free to decide *what to share with their chosen group*, they felt there was no breach of privacy. This feature was deemed very positively by participants. As such, enabling and providing privacy and control to end-users appears to be crucial in designing social, mobile services.

Conclusions and Future Work

We have described a proof-of-concept research prototype called WaggleBee, which is designed to enhance social mobile search experiences by providing an easy means of sharing Web content among co-located groups of users. Our initial results highlight definite promise in our approach and suggest a number of important implications for the design of social mobile applications like WaggleBee.

As part of future work we plan to take on board these design implications and address the 3 main limitations of WaggleBee. That is, we will extend sharing beyond co-location, provide a more flexible and dynamic means of establishing groups and we will enhance inclusiveness by developing for multiple mobile platforms, e.g. Apple iOS. While the majority of usage uncovered from our results relates to trivia related information needs and tasks, we believe there is scope to support collaboration in mobile environments for activity planning and would like to explore this research domain in more depth in the future. As well as conducting a longitudinal study of a new, enhanced version of WaggleBee, we also see great potential in evaluating WaggleBee in a more controlled environment where we can compare the sharing and collaborative capabilities of our prototype with de-facto standards of sharing content among mobile devices. We hope that the lessons we have learned and shared through this work provide fruitful food for thought for researchers working in the field of social mobile computing.

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