Questions Not *Answers*: A Novel Mobile Search Technique

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ABSTRACT
Mobile search is becoming an increasingly important user activity. In this paper, instead of investigating the most efficient and effective ways of providing search results, the *answers*, we consider the value of giving access to previous queries, the *questions*, relating to a user's location. By exposing what other people have searched for, the aim is to provide useful insights into a *location's* character. To consider the value of the approach we deployed two mobile probes in a large-scale field study involving 391 participants. Our experiences suggest that presenting users with other people's in situ queries influences their information seeking interactions positively.

Author Keywords
Mobile search, social software, location.

ACM Classification Keywords
H.5.2. User Interfaces: Interaction styles, Evaluation.

1. INTRODUCTION
In the reception area of Google's headquarters in California, a large public display shows search terms being entered by users around the world in real-time. One visitor, a BBC journalist, awestruck, described it thus: "We are looking into the mind of the world."

Web users are already becoming used to giving and receiving information as a side-effect of their online activities: for example, the Froogle search service (www.froogle.com) displays items other people are shopping for online; and the BBC homepage (www.bbc.co.uk) lists searches being carried out on the site. Fifty years ago, C. S. Lewis wrote that, *"We read to know we are not alone"*; today, it seems, people go online to enhance their sense of being part of something bigger.

Our work extends the use of such incidental information to the mobile context where its utility is perhaps more potent. We argue for a complete re-envisioning of the mobile search problem. Mobile search – submitting queries and receiving results via mobile phones and other handheld devices – will become widespread in the next several years; already, search engines report millions of queries from such terminals [4]. Clearly there is an important role for research into appropriate ways of accessing search engine indexes while mobile [3][6]. However, rather than considering an approach aimed at providing the best match *answers* to specific queries, we explore an approach that allows a user to see a physical environment in terms of the *questions* others have posed in that place. The system, then, involves mapping other people's search engine queries to the physical locations they match (see Figure 1).

Consider then these two scenarios:

- *Rosie wanders into a busy part of town. She's looking for an interesting place to have lunch. She flips open her mobile phone and sees a series of words being collaged onto her screen. These are search terms that match things in her area. She sees there are lots of queries about dance shops and suppliers. Rosie is pleased – dance is one of her hobbies and she decides to explore the area after eating.*
- *James sits by the river bank. Behind him is a district of town full of fashion stores. He opens his smartphone and sees a birds-eye-view of his current location. Selecting the fashion district, he's amused at the latest terms for must-have clothing and accessories. He feels his age. Zooming out the display, other people's queries that map to an area over the river begin to appear – 'chill-out', 'avant-garde art', 'cultural events'. Just the kinds of thing he might say; just the sort of place he's looking for.*

In the first case, the user finds something without intentionally looking for it. In the second case, the user is making sense of their environment not by querying it but by picking up cues from the form of search terms relating to it: by seeing terms that draw on a vocabulary that resonates, this user feels attracted to those locations. Search here is not about focused, purposeful information-seeking; it is about seeing the patina of possibilities, a social process, playful and intriguing; presenting the intelligence in the environment.

Search terms, although often short, express far more than people's information needs; they distil intentions, aspirations and values: 'cheap hotel', 'luxury gifts', 'experimental theatre'. They show us what people are thinking, but also how they are thinking. Formal, official or considered descriptions of a place may not convey its character emphatically. Allowing a user to see other people's brief, informal queries in relation to the places they 'hit' - a shop, hotel, park or tourist attraction - may give them a richer sense of place.

Search queries relating to a place will be conditioned not just by the location itself but also by the changing populations that pass through it and the events that occur within it. Unlike static, authored content about a location, queries may reflect these dynamic transitions. A central city area, early in the morning, will seethe with workers on their daily commutes, their concerns and interests

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Figure 1. Initial design concept.

User flips open device and is presented with a glance-based interface showing queries made by other people in that location. Queries continuously updated automatically.

perhaps divergent to the tourists meandering through a couple of hours later, or the theatre-goers who arrive that evening. Transient circumstances – dramatic, serious security incidents, a cultural festival – could also impact on the stream of search terms.

Previous research has considered the explicit authoring of location-based content such as the use of virtual 'post-it' notes viewed via a mobile device [1]. In contrast, our approach takes artifacts from an existing activity (search); we seek to explore the engagement that occurs when this hidden intelligence is available in the environment whilst avoiding the overheads involved in interacting via devices with relatively impoverished interfaces. Our work has closer resonances in this respect with that of the HyCon system which allows users to browse the location-based link-trails left by others [2].

To explore this incidental use of other people's mobile activity, we carried out a two-phase field study over several weeks. In the rest of this paper we begin by describing the two probes built for the study and the method used during the trials. Our findings relating to the qualities of queries elicited and their subsequent impact on information seeking behaviour are then explored.

2. FIELD STUDY

To explore the benefits and characteristics of the "questions not answers" approach, we designed a two-phase field study: the first phase to elicit queries in situ, and the second to discover the reaction of users to a preliminary "questions not answers" interface. We were interested in finding out whether queries can give users a sense of place and the people who pass through a location; and, the different interaction strategies people used when presented with previous queries. Phase I took place during 3 weeks in June 2006, Phase II over 2 weeks in July.

Both phases were carried out in and around a city. A number of separate venues were chosen to run the studies at: a national industrial museum, the campus of the local university, a shopping mall, a cultural museum, a marina and coastal tracks, an arts centre and an archeology museum. Together, these provided a mix of site types: commercial, educational, cultural, sporting and historic.

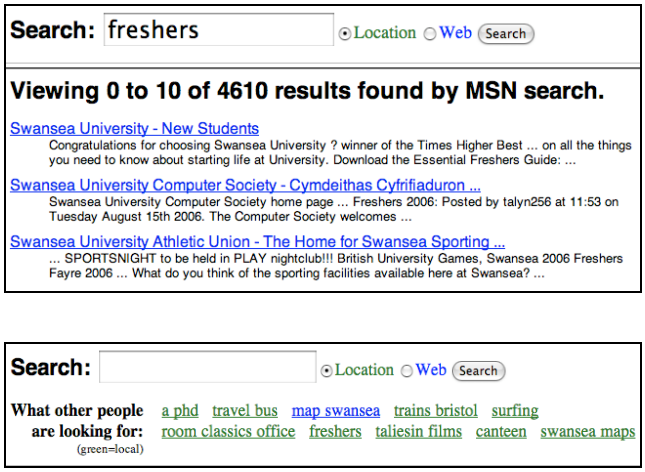

Figure 2. Probe interfaces.

Top: Phase I interface, user is performing a 'local' search at the campus; Bottom: Phase II interface, previous queries made from the location are displayed; all of the queries bar "map swansea" were made using the 'local' option.

Each study phase used the same equipment: tablet PCs fitted with 3G wireless data connections running at c. 300kbps. The use of a 3G phone network enabled us to use a wide range of sites without being tied to WiFi or wired traditional networks.

A simple search interface was developed for the first phase, built on the MSN search engine. Two modes were provided to the participant: first, the default mode for queries, a 'local' search option that restricted results to pages related to the location and the surrounding area (by adding additional query criteria which we pre-programmed); secondly, a 'web' search option that searched all pages on the web for the query they entered. Users could change mode via a simple control (see Figure 2, Top).

In the second probe, this interface was supplemented with ten randomly chosen queries (which we will term 'questions') made at the location and elicited from the first phase. The queries were displayed next to the normal search interface and were color-coded to show which queries related to a 'local' search and which to a 'web' search. Clicking on the text of a question would simply execute the displayed search (see Figure 2, Bottom).

In both cases, participants interacted with the prototypes using a stylus and an on-screen keyboard. The display area used to display the search interface and result was approximately the size of the larger-sized PDAs (the rest of the screen real estate displayed the keyboard).

Participants were recruited at each site and brief demographic details were taken (e.g. age, gender, whether local or visitor) through the tablet PC, before they progressed to using the test interface. No training was provided; users were simply requested to use the service to meet any of their information-needs. The participants were encouraged to enter any queries and as many queries as they desired. The system logged the queries that they executed and which pages they subsequently visited.

After they had completed their searching, the system then gathered basic subjective feedback on the user's experience. For this we used a questionnaire based on the NASA Task Load Index: users were asked to rate their experience on a five-point scale in relation to dimensions including performance, mental effort and enjoyability.

In addition, in Phase II, the participants were asked to complete a categorization task. They were shown ten random queries made by others, all of which related to a particular location. They were then asked to select one of six categories that they felt the words best belonged to.

3. FINDINGS

3.1 Phase I: Queries, places and people.

Phase I was designed to elicit queries in situ for later use in Phase II. Here we consider the data gathered in the light of previous reported mobile search and explore the value of such queries in giving a sense of place and populations. 277 participants took part in the study; their profiles were diverse.

Basic query statistics

The first scrutiny we applied to the data was to assess their consistency with previous studies. Three ready values to compare are the number of words per query (mean: 1.7, Std. Dev.: 0.9), the click-throughs given a result list (mean: 0.86; Std. Dev: 0.6) and the number of queries per participant session (mean: 1.73, Std. Dev: 0.93). There was no discernable variation as a result of age or other demographic factors.

The latter two are in-line with those reported from a large-scale mobile query analysis [4]. However, the mean query-length is smaller than those reported previously – in [4] PDA-based queries had a mean length of 2.7 words (Std. Dev: 1.5). Query lengths were shorter in our study due to the impact of the "local" search option: there is no need to enter additional terms – *"swansea campus films"* versus *"films"*, for instance – if users believe the system is context sensitive. 89% of queries were 'local searches', with a mean length of 1.64, with the remaining 12% (the 'web searches') the mean query length was 2.21.

Queries and places

As in [4], while there were query terms that occurred frequently (e.g. *"coal"* and *"mumbles"* at the industrial museum; and *"hotels"* and *"boats"* at the marina) there was a great deal of variation, with these top queries only accounting for a small proportion of searches. Within the 'long-tail' of other searches there were many intriguing examples such as, *"a safe n freindly place to take my child"* [sic] (coastal walk); and, *"media representation"* (campus).

The overlap of queries captured in the different locations was low. On average, after normalizing the data via stemming and other manipulations, 78% of queries were unique to the place they were generated.

Queries and populations

Figure 3 shows 'tag cloud' style visualizations of the queries captured in the campus location. The larger the size of the font, the greater the use of the query. The first cloud represents queries captured during several days towards the end of the examination period when the campus was full of students anxiously completing the academic year: their concerns are study resources (e.g. *"library"*) and other supports to survive the assessments (e.g. *"coffee"* and *"cinema"*); and, their future (e.g., *"career centre"*). Two weeks later, we carried out a further data gathering exercise during an 'open day' when the majority of participants were potential students and their parents; their queries reflect their different interests as the sought information on subject areas, support services and the lifestyle that the university might offer.

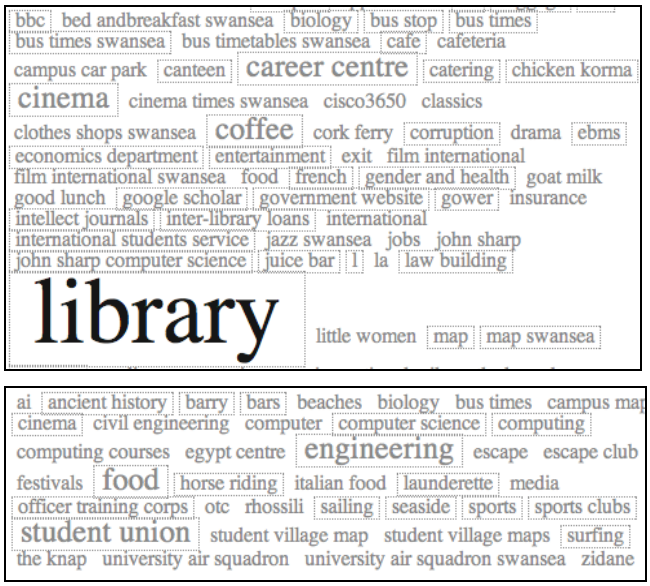

Figure 3. Campus query tag clouds. Top cloud generated from queries entered predominately by resident students. Bottom cloud from queries entered by potential students. Queries that led to a user clicking on one or more of the search results are emphasized with dotted boxing.

3.2 Phase II: Impact of other people's queries.

The focus of the second probe was on eliciting the different behaviors users display when interacting with the metadata-enriched search interface (see Figure 2) and the impact on their experience. 114 participants took part in this phase of the study; again their profiles were diverse.

Different types of interaction

As with the first probe, participants had the option to perform as many searches as they desired. They could choose either to enter a query or to click-through on a previous query made in the location. Consequently, some participants explored only one option, and some both. In total 114 people used the new interface, of whom 47 used the traditional search interaction only (the *Searchers*), 44 the novel click-through interaction only (the *Clickers*) and 23 used both systems. All three groups consisted of a similar mix of participant profile.

'Searchers' are influenced by previous queries

One immediate suggestion that may be made for the 47 'non-users' of the click-through previous queries was that they simply ignored the displayed metadata – i.e. that other people's queries had no effect on them. However, this hypothesis is readily discounted.

First, some query terms were entered that were verbatim copies of click-through queries, from brief items such as "gym" to longer items such as "student village maps". In total, 15% of queries were literal copies of click-through titles. Other searches included simplified versions of click-through titles; though these may be a consequence of the presence of titles this is hard to prove or disprove robustly. Secondly, the mean performance rating given by this group of users was statistically significantly higher (at the 5% level, t=2.43) than that for the first probe. No other significant distinctions between this group (age, gender etc) and the users in

Phase I was apparent: the modified interface appears to have improved the perception of the effectiveness of the interface.

'Clickers' actively engage through previous queries

In our initial design concept (Figure 1) users are able to view previous queries and click-through to view search results associated with them. One of the interesting questions posed by this scheme is whether users would see the approach as a way of 'searching' or 'browsing' their environment.

On face value, the 44 users who only used only used the click-through approach, exploring other people's search terms, were involved in a browse-like behaviour. Marchionini [5] and others note that browsing is perceived as less effective but less effort and more enjoyable than searching. We might anticipate, then, the *'Clickers'* would score the performance and mental effort elements in the questionnaire lower than the *'Searchers'*, and the enjoyability higher.

However, users rated the performance of the system at a level that was very similar to this group. The t score was very low (0.12) suggesting that, in fact, there is little evidence of any distinction to be made between the *'Searchers'* and *'Clickers'*. Mental effort was also rated similarly in both interfaces (t=0.0). *'Clickers'* did rate the experience as less enjoyable (t=2.21, sig. = 5%), though.

Queries give a sense of place

After using the probe and completing the evaluation, all participants carried out the location categorization task. Participants correctly identified the location category for the ten random queries they were shown in 42% of cases. If participants chose a category at random, the accuracy rate would be only 16.6%.

4. CONCLUSIONS AND FUTURE WORK

In this paper we began by presenting a new approach to giving people a sense of the places they encounter via a handheld, mobile device such as a cell phone. A first question we wished to address were the ways in which the character of locations might be communicated in the short queries entered by others. The majority of queries we gathered certainly related to the locations they were elicited within. Furthermore, participants in Phase II were able to identify a location's category over two-and-a-half times better than chance given a small set of randomly chosen queries. The diversity of queries seen at each location presents an interesting design issue: should the interface present the raw queries, the 'chatter' going on at the location, or is there also a need to aggregate and categorise other people's search behaviour? Further questions arise relating to the processing and presentation of past queries: for example, should 'successful' queries (ones that led to clicked-through search results) be more prominently displayed than the others?; and, how should the privacy issues be handled (e.g., by building in a time delay between capturing a query and making it public)?

Turning to a second area of interest, the role of the approach in representing population patterns in a location. The query sets at the campus locations with their differing emphases suggests potential in this respect. It will be interesting to study the dynamics in the in situ query patterns over an extended period with a system that presents ever changing, queries to mobile users.

Phase II highlighted different responses to the approach. It is clear that the initial design concept should be extended to allow people to directly search as well as to interact with previously captured queries. In the *'Searchers'* case, the evidence of both query terms and user rating coalesce to suggest that, in fact, the presence of descriptive metadata in the form of previous queries does change the experience of users engaging in local search. The *'Clickers'* engagement with the approach is encouraging: despite the limited set of previous queries being displayed, it appears that people are able to feel they can find out about a place in an active way.

In summary, our work provides evidence of the scheme's value. A range of further research questions have been identified and to explore these issues we are building smartphone and PDA prototypes.

5. ACKNOWLEDGMENTS

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