Capturing, Sharing, and Using Local Place Information

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ABSTRACT
With new technology, people can share information about everyday places they go; the resulting data helps others find and evaluate places. Recent applications like Dodgeball and Sharescape repurpose everyday place information: users create local place data for personal use, and the systems display it for public use. We explore both the opportunities -- new local knowledge, and concerns -- privacy risks, raised by this implicit information sharing. We conduct two empirical studies: subjects create place data when using PlaceMail, a location-based reminder system, and elect whether to share it on Sharescape, a community map-building system. We contribute by: (1) showing location-based reminders yield new local knowledge about a variety of places, (2) identifying heuristics people use when deciding what place-related information to share (and their prevalence), (3) detailing how these decision heuristics can inform local knowledge sharing system design, and (4) identifying new uses of shared place information, notably opportunistic errand planning.

Author Keywords
Local knowledge, map-based interface, location privacy, disclosure interface, location-based reminder, local search.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

The Internet can render space and location meaningless. You can pursue your passions – be they stamp collecting, obscure 1970s punk rock, the Gnostic Gospels, or one of thousands of other interests – with likeminded people from anywhere in the world. Yet we still live in the physical world, and our location still matters when fulfilling everyday tasks: you can't outsource your child's daycare to another continent, or warm up with a good cup of hot coffee brewed in a distant city. As evidence, a national US survey shows people spend over two and a half hours a day frequenting *everyday places* in their vicinity, including malls, stores, churches, auto-repair shops, health clubs, laundromats, and other public places [17]. While doing so, they develop varied knowledge about nearby places. For instance, ask a local resident and often they can tell you:

- which local places offer specific goods and services, or **candidate places**. Examples: where can I find yoga classes or Chicago-style pizza nearby?
- **distinctions between places**. Example: which nearby yoga classes offer the most rigorous workout?
- **place popularity**. E.g., which pizza places are always crowded?

Today's technology, however, offers few methods for capturing local knowledge and making it available to those who seek it. And indeed, people commonly need local place information: visitors ask hotel clerks where they can buy souvenirs, and new residents use "welcome packets" provided by neighborhood groups to find nearby places. Even longtime residents need local information when their lives change. For example, new parents suddenly must discover where they can find enriching children's activities, baby supplies, or other parents who want to socialize.

Our research targets technology that makes candidate place and popularity data available online; we do so because individuals increasingly use technology to find place information: a 2005 study showed 25% of search engine queries sought place-related information such as "hardware stores in Manhattan" [14]. But search engines cannot always identify relevant places [14], and the web does not offer varied resources for selecting among them. Sometimes customer reviews are available (and indeed valuable), but in the physical world, people make additional place distinctions. For instance, they observe which places are popular [28], or assess place reputations based on physical appearance [22]. Our research studies applications that support new local knowledge sharing and related privacy concerns. Broadly, we examine two key issues:

Can applications capture local knowledge of value? We gather local place information using location-based reminder (LBR) system called PlaceMail [19]. In brief, the system runs on a GPS-equipped cell phone, and people use it to create and receive personal task reminders, such as "pick up corn on the cob". A user might associate this reminder with their local Farmer's Market; PlaceMail uses

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the phone's location-sensing GPS to deliver the message when the user nears the place.

When people use LBRs, they generate local place data, including: (1) lists of places they go for everyday tasks (or place *bookmarks*), and (2) reminder messages related to the bookmarked locations. We repurpose this data by making it available on a map-centered local information sharing application, called *Sharescape*. Sharescape illustrates place popularity by displaying the number of bookmarks or reminder messages for places, and uses message contents to power 'search' for places.

Will people share local knowledge? Currently, little is known about people's attitudes towards sharing personal place data. Further, this type of information has historically been private. For instance, a person's credit card bill reveals where they go, but credit card companies do not ask customers to share their data with the public. We therefore study people's privacy concerns in this domain, focusing on heuristics they use to decide what to share, their prevalence, and how these heuristics can inform system design.

Our research takes an empirical approach; we conduct 2 user studies. Subjects employ an LBR and Sharescape in realistic settings to plan errands at local places. Our studies together address four research questions (RQs):

RQ 1: PLACE TYPES. *What types of places do LBR users generate information about?*

RQ 2: SHARING. *What place-related information will LBR users share with others?*

RQ 3: HEURISTICS. *What heuristics do people use to decide which place-related information to share?*

RQ 4: UTILITY. *Is the information LBR users share useful to others?*

Together, the answers explore the viability of LBR-produced place information and user-centered techniques for gathering it.

RELATED WORK

Sharing Place Information

People currently share place information online via a number of applications. Most similar to our experimental platform, Dodgeball [dodgeball.com] users share their social hangouts with the public on the web. A location-aware friend-finder, Dodgeball collects places where its users' "check in"-- meaning they have broadcast their presence there to buddies. A random selection of each user's "check-in" points appears on their profile, with profiles grouped by urban area. Like our model, Dodgeball features implicit knowledge acquisition: users "check in" to maintain social connections with friends, and the system reuses this information for another purpose—helping outsiders find local social hangouts. Unlike our approach, though, Dodgeball does not aggregate data across users: the system does not currently display what places are "checked-into" most frequently.

Individuals also share place information online via explicit authoring. For instance, PlaceOpedia [placeopedia.com] users connect Wikipedia articles with locations on a map. Sites such as TripAdvisor and Yahoo Maps allow people to write place reviews. Platial [www.platial.com], Google Earth (its community layer), and others sites let users associate tags with places. The Katrina Information Map [scipionus.com/katrina.html] lets people share the status of specific locations affected by the storm. In all of these cases, contributors expressly enter place information for public viewing. This complements and contrasts with our implicit knowledge acquisition approach. Our approach reuses information people enter for their own benefit, thus sidestepping the problem of motivating people to enter information for the benefit of others. On the other hand, repurposing information raises different privacy concerns.

Last, research teams have developed systems such as route maps for personal travel [4] and place recommenders based on dwell time [10]. While these systems must collect and store people's real-time location, none of these studies examine whether individuals will actually share data for the intended purpose, or their preferences for doing so.

Finding Place Information

Sites like Yahoo, Google, and MapQuest provide map-based local search. Users navigate to a target area (e.g., their city) on a map, and then search for a term such as 'restaurant'. The application displays icons on the map to represent each place satisfying the query. Commercial search engines obtain information about places either by crawling the web [6] or purchasing it from a data vendor [24]. We believe these engines deliver value, and that our approach complements theirs.

Privacy

Other research teams have reported on a host of electronic data privacy issues; their approaches range from theoretical to practical, and domains covered range from e-commerce to social networking.

First, Palen and Dourish [21] discuss how people maintain privacy in face-to-face situations and recommend comparable techniques for software interfaces. Similarly, Lederer et al. [18] offer privacy design guidelines. While these efforts inform our work, neither specifies how to apply design principles in a given application. We thus developed our own visual, map-based interface for managing personal information disclosure. Friedman and Howe [9] evaluate a visual disclosure interface, but for a problem different than ours: web browser cookie management. Thus, decision-making process and interface details vary considerably from their work to ours.

Gross and Acquisti [12] study Facebook [facebook.com], a social networking web site, and find that users freely reveal personal information such as their birth date, email address, and political beliefs online. Sometimes sharing online leads to regrettable consequences [8]. Currently, the majority of social networking software users are under age 25 [3, 12],

and Gross and Acquisti studied this demographic with 95.6% of their subjects aged 24 or less [12]. Our work differs in three ways. First, we take a task-oriented, not a social networking perspective. Second, we investigate people's willingness to share a specific type of information, places they go and activities they do there. Finally, we study individuals responsible for tasks central to maintaining a household, and 44 of 49 of them are over age 25. This last distinction is noteworthy: few others have studied personal information sharing among middle-aged adults. We therefore contribute by revealing preferences of individuals who have potentially different concerns resulting from relatively more life experience.

Other work [5, 7, 16] has examined people's willingness to share their current location with friends, family, and acquaintances. Among these, Consolvo et al. [7] is closest to ours. Yet our work differs because we focus on: (a) sharing the places one habitually visits rather than current location, (b) sharing information about the tasks one does at places, and (c) sharing information with the public – not social contacts – and doing so anonymously.

Social Navigation/Social Data Mining

Social navigation systems mine records of social activity to aid users browsing large, complex information spaces. These systems typically aggregate usage patterns and allow new users to view popular "paths" through information collections. For example, Edit Wear and Read Wear [13] show the parts of a document that others most often edit or read. Observations of the real world inspired social navigation: for example, a trail through the woods emerges from the decisions of many individuals, reflecting what they find to be a good path. Designers applied these observations as metaphors to aid virtual space traversal. Our research brings things back to the real world: we use information about the places people frequent and the tasks they do there to aid others in finding everyday places.

We next turn our attention to describing PlaceMail, the Location Based Reminder (LBR) system we leverage as a research instrument.

PLACEMAIL LOCATION BASED REMINDER SYSTEM

With PlaceMail, users create personal reminder messages, and the system delivers them at user-specified places on their cell phone. For example, Irene might create a message, "bring my database book to school tomorrow" and associate it with her home. PlaceMail uses the location-sensing equipment on her cell phone to determine her location, and delivers the message next time she nears home. People can leave messages anywhere, and can associate a single message with multiple places. Users can create, update, edit, and delete messages on either on their cell phone or using a graphical web-based interface.

PlaceMail users define the places where they will leave messages by entering place names and street addresses on the system's web interface. Behind the scenes, the application converts the street addresses to latitude, longitude pairs. The cell phone senses the user's location once a minute and compares the location with latitude/longitudes of places with outstanding messages. The user hears a tune on their cell phone when they near a place with a pending message. Additional details about PlaceMail's functionality are beyond the scope of this paper, and are available in our previous research [19].

As mentioned earlier, we explore harvesting two types of knowledge from LBRs: (1) place *bookmarks*: lists of places users go for everyday tasks, and (2) place *profiles*: all of the PlaceMail message contents associated with a place. In the aggregate, these data provide a consumer-centered picture of a community: the number of bookmarks suggests places' popularity with the user community, and its profile reflects what people do there. Importantly, profiles can reveal *secondary functions* of a place, that is, activities the place supports and that people often find useful [14], but that are not obvious from its name or primary description. For example, a University student center might contain a post office, but you wouldn't know it from the name. However, if the profile for the student center includes the message "pick up stamps at post office", this useful secondary function is revealed.

STUDY 1: DESIGN AND METHODS

In the summer of 2005, we conducted a field study where subjects used PlaceMail for four weeks, with initial results reported in Ludford et al. [19]. We report on new research here, however, we use previously unreported data from the field study to investigate our first two research questions:

RQ 1: PLACE TYPES. *What types of places do LBR users generate information about?*

RQ 2: SHARING. *What place-related information will LBR users share with others?*

Participants

We recruited subjects from urban-residential neighborhoods in southwest Minneapolis, MN USA. The locale contains a mix of single and multiple family housing, restaurants, shops, and other businesses-- many locally owned-- as well as schools and community centers. Many residents live within easy walking distance of retail districts. Area residents commonly use automobiles, buses, trains, and bicycles for transport.

We recruited only subjects responsible for essential everyday tasks such as grocery shopping, home repair, or scheduling family activities. We recruited via community newspapers, online area newsgroups, local organizations, and referrals. None of the subjects knew members of the research team prior to the study. 20 subjects participated, 8 men and 12 women, with ages ranging from mid-20s to 50s. This resulted in a set of subjects with diverse occupations, including office workers, stay-at-home parents, small business owners, managers/executives, marketing workers; 3 held Information Technology positions. As an incentive to participate, 2 random subjects received a $50 gift certificate at the end of the study.

Experimental Tasks

During the field study, subjects created reminder messages for themselves at whatever places they wished, with whatever contents they wanted. We asked them to participate at a minimum level, sending and receiving at least 2 messages per week. Most exceeded this requirement, they created a total of 344 messages (mean: 17; min: 4; max: 31; std: 7.42). Subjects said PlaceMail delivers value: other task management methods do not offer place-based opportunistic reminders, and they found these useful [19].

At the end of the field study, we conducted an in-depth interview with each subject, exploring their attitudes and concerns about sharing their place data. Prior to the interview, subjects did not know we would ask about this. We began the interviews by presenting subjects with a low-fidelity (lo-fi) prototype [23] of Sharescape (see Figure 1). The prototype was customized for each subject to depict the neighborhood near their home. It showed labeled icons representing places in their neighborhood, including some of their own places and ones where they had left messages during the field study. We also augmented the map with other subjects' bookmarked places.

We explained that numbers near the icons were fictitious, but on a functional display would illustrate the number of people who had bookmarked the place or the number of messages left there. We said this information would serve as an estimate of place popularity with the user community. We also told them that Sharescape users could search for local places by entering keywords such as "swimming lessons" or "volleyball". Sharescape then would retrieve places whose profiles – messages left at the places – matched the query. For example, if a subject searched for "swimming lessons" the map might show the name and location of a local park, along with the associated message, "sign up for **swimming lessons**".

Figure 1. Subjects saw a lo-fi prototype of Sharescape, which depicted the neighborhood near their home.
Google Maps image © Google Inc. and is used with permission.

Once subjects understood Sharescape and the related use concepts, we probed their preferences for sharing their own data with others via the application. We presented subjects with a printout of: (1) their bookmarked places, and (2) the messages they created during the field study. For each, we asked whether the subject would be willing to share it. We also explained what it meant to share. First, neither the contributor's name nor a pseudonym would appear with shared information, so contributions would be anonymous. We also explained how sharing decisions would become visible on Sharescape. If they were the first one to share a place, a new icon labeled with its name would be added to the map at the proper location. If the place had already been shared by someone else, the display would change in a different way: the number next to it (representing the number of shared bookmarks) would increment. Finally, if they shared a message, the associated place's message count would increment and the message would be added to the place's profile.

Results for RQ1: PLACE TYPES

To answer RQ1, we categorized subject bookmarks and the places where they left messages by place type. We used place classifications that we believed basic and descriptive, and conjecture that other categorization schemes would lead to conclusions similar to the ones that follow. In Figure 2, we illustrate the percentage of bookmarks and messages by category.

The results show that the LBR acquisition technique yields information about a variety of everyday places. The number of bookmarks and reminder messages are broadly distributed across categories: none of the groupings attracted more than 20% of the data.

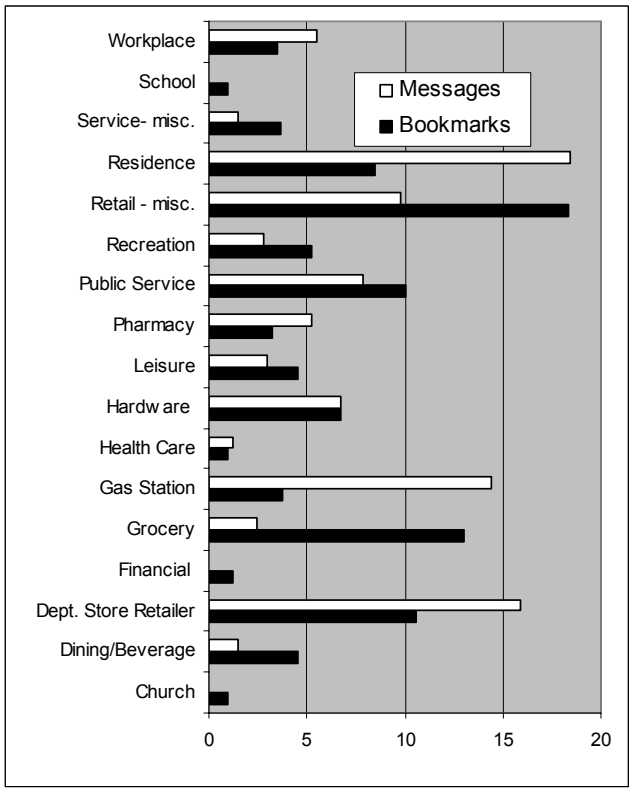

Figure 2: Categorization of Places / Messages.

In some categories, the number of bookmarks is higher than the number of messages. This is because subjects created place bookmarks at the onset of the study, and we asked

that they focus on creating a list of places they go for everyday tasks, rather than to anticipate where they might leave messages. By defining a (relatively) complete place list up front, creating reminder messages would be faster later: the system would already know place locations.

We will not systematically evaluate LBR message contents in this study; we anticipate measuring their usefulness with a group of area newcomers in the future. Message contents are briefly characterized in [19], but we share a few typical messages here for informational purposes. Shopping and to-do lists constituted the majority of messages, so we illustrate ones from those categories:

"*Buy Solid Gold Dry Food and use coupon"*. A user associated this message with 'Chuck and Don's', a pet supply store. 39% of messages were shopping lists.

"Return Xbox game, and check out a new one", was left at a video rental shop, while *"Remember to take out mp3 player from car and add music."* was associated with a subject's home. These typify the 31% of subject's to-do list messages.

Results for RQ2: SHARING

Recall that RQ2 examines what place-related information people will share with others. To answer it, we analyzed subjects' sharing preferences expressed in post-experiment interviews, discarding data from two subjects due to anomalies in their interviews. We examined sharing preferences for 3 types of PlaceMail data: (1) bookmarks, (2) message contents, and (3) dwell time at places, (the amount of time subjects spent at bookmarked places).

Sharing bookmarks. Subjects agreed to share the vast majority of their place bookmarks. Of the 332 non-residence/non-work bookmarks, subjects agreed to share 327, a 98% contribution rate. Understandably, no one wanted to share their home's location, the locations of other people's homes, or their workplace (unless it was a public venue, which we define as a place that primarily serves patrons, such as a bank or coffee shop). Many subjects worked in business offices, which fall outside the definition.

Sharing messages. Subjects were more selective when it came to sharing messages, but they still agreed to share many. We initially planned to ask which messages they would share one by one and why, however, some subjects had so many messages that this became impossible given time constraints. We instead asked if they were willing to share any in their message set. 72% of the subjects (13 of 18), said they would share some message contents provided they could decide on a case-by-case basis which ones. 5 subjects elected not to share any messages and provided various rationales their choice:

- *It's strange to see other people's message data: it feels like snooping.*
- *If a lot of people share message contents, the display will become too cluttered.*
- *I don't want to do the extra work needed to share.*
- *These particular messages wouldn't be useful to others. I would however, share in the future if I thought the contents were useful.*

Of those willing to share, many articulated a proviso: they would only share if the system had an "extremely fast" mechanism for designating shared messages.

Sharing dwell time. Although PlaceMail does not need to store a history of the user's location to function, we collected this data anyway during Study 1 so that we could study attitudes about sharing dwell time. We did so because others have proposed place-recommender systems using dwell time as a proxy for recommendations [10], and this data could conceivably appear on Sharescape. We explained to subjects that to compute dwell time, PlaceMail would have to store their real-time location history.

9 subjects said in the future, they would decline to share their personal location history with parties other than academic researchers. 2 were unsure about dwell time sharing and wanted more information about how data would be used. 4 subjects were willing to share data other than time spent at home, friends' homes, workplaces, and other private places. 3 said they would share dwell data if it could be anonymized; two of these pointed out, however, that they could not imagine a way to anonymize a person's location data in digital storage: the system would know who the user was, or data about the person's home and workplace would reveal their identity. Most subjects explained that allowing their location history to be stored electronically was a more contentious issue than sharing bookmarks or messages. For instance, one medical professional said it is unclear who owns the data, and that as a society she does not think we are ready for location data tracking and storage. More research about privacy concerns, data storage issues, and societal issues is needed before location history tracking can move forward innocuously.

Dwell time tracking aside, the bookmark and message sharing results encouraged us that our LBR technique had the potential to yield new and varied types of place information, and that many who produced the information would share it. On the other hand, the results raised new challenges: we needed to create a running version of Sharescape that made the sharing decision fast and easy. We address this challenge in Study 2, and next detail the updated Sharescape design.

SHARESCAPE DESIGN AND IMPLEMENTATION

We based Sharescape's functional design on the lo-fi prototype from Study 1 (see Figure 1) since subjects found it easy to understand. Sharescape is built on top of the Google Maps and Yahoo! Geocoding APIs and uses PostgresSQL for data storage. Users navigate with native Google Maps features, such as zooming and panning to adjacent regions. The Yahoo! Geocoding API provides address parsing and geocoding services; for example, it can map the two (equivalent) addresses, such as "123 Main

Street S., New York NY" and "123 Main St. South, New York, NY", to the same latitude, longitude pair.

The new Sharescape (see Figure 3) displays places as circles. The size of the circle is proportional to the popularity of the place, where popularity is measured either as the number of shared bookmarks or the number of shared messages. We impose a maximum circle size to prevent obscuring too much of the map. A sidebar displays a list of places currently displayed on the map, which updates as the user pans to adjacent mapped regions. Clicking on a place highlights it both on the map and the sidebar.

In addition to providing place browsing and search, we integrated Sharescape into the PlaceMail web interface: after creating a PlaceMail message or bookmarking a place, the user sees a screen with an embedded Sharescape display asking whether they are willing to share the bookmark or message contents on Sharescape (which we called 'local search' during the experiment). The display embodies a key design intuition: users preview how the bookmark or message will appear to others should they elect to share it.

Figure 3 illustrates a sharing scenario: A user has just bookmarked the place "Milios". On the map, the circle representing Milios has increased in size and is highlighted in red. Likewise, on the sidebar, Milios is highlighted, and the number of bookmarks for it increases. And, at the bottom of the screen, the user expresses whether she is willing to share her bookmark. If she says yes, the temporary changes become permanent; if she says no, the database and display are rolled back to their previous state.

The sharing interface also incorporates conformity theory [25], which predicts people seek to behave like others in public situations. The Sharescape map shows places and messages that others have previously shared, so users can consider this information when making a sharing decision.

Last, the interface supports case-by-case decision making: users decide whether or not to share each individual place they bookmark and message they create. An alternative would have been to allow users to state rules such as "keep all messages containing the word 'doctor' private". We implemented the case-by-case approach because Study 1 subjects found it difficult to articulate sharing rules, yet they resolved each sharing decision in a matter of seconds. We note that the utility of rule-based approaches for privacy management is an open issue. Some research has suggests people can state preferences [15]. But, as Ackerman [2] emphasizes, every rule has exceptions, and the consequences of these exceptions can be unpleasant. In addition, Lederer et al. [18] illustrate the complexities of rules-based systems from the user's standpoint. The conflicting evidence concerning rule-based approaches reinforced our decision to try a case-by-case approach.

STUDY 2

Using the running version of Sharescape, we conducted Study 2 in February 2006. In this study we address 3 research questions:

RQ 2: SHARING. *What place-related information will LBR users share with others?*

RQ 3: HEURISTICS. *What heuristics do people use to decide which place-related information to share?*

RQ 4: UTILITY. *Is the information users share useful to others*?

Design and Methods

We recruited from the same geographic area and using the same tactics as in Study 1. 29 subjects participated, and each received a $12 participation incentive. We led each subject through a series of tasks and semi-structured interview that lasted about an hour.

We began by describing PlaceMail and Sharescape. We then instructed subjects to make a list of places they go for everyday tasks and activities. The research team selected 7 places from the list; subjects then bookmarked each using the experimental software. We applied several constraints when selecting bookmarked places. First, we made sure that the places included the subject's home, some public places, and, when possible, potentially sensitive places such as a doctor's office, bank, or a private organization's meeting place. We also made sure that each subject would be the first to share at least one place on their list, and that at least one of their places had previously been shared by others. The latter condition allowed us to test a potentially negative effect of conformity theory: perhaps nobody would want to be the first to share a place, or the opposite: if someone else already had provided information about a place, maybe users would think their contribution wasn't necessary. We seeded Sharescape with data from Study 1 so that even the first subject could add a place previously bookmarked by others.

After bookmarking places, subjects created 5 messages, one for their home, and the rest for whatever places they chose. In order to assure messages had realistic content, we asked subjects to bring artifacts such as shopping lists and calendars to the session and to consult them as they created messages. The first time subjects saw the sharing interface, a member of the research team walked them through its functionality to assure they understood what it meant to share information with others on Sharescape (which at the time we simply called 'local search'). Our objective was not to evaluate the effectiveness of the disclosure interface as stand-alone tool, but rather to evaluate subject's sharing behaviors in a setting where they clearly understood the process. We also explained that if they chose to share data, the place or message would be visible to subsequent subjects. (This differs from Study 1, where decisions to share did not have immediate consequences.) We did not study dwell time in Study 2 because we did not collect subjects' location history. We ended each session with an interview where we probed issues related to our research questions.

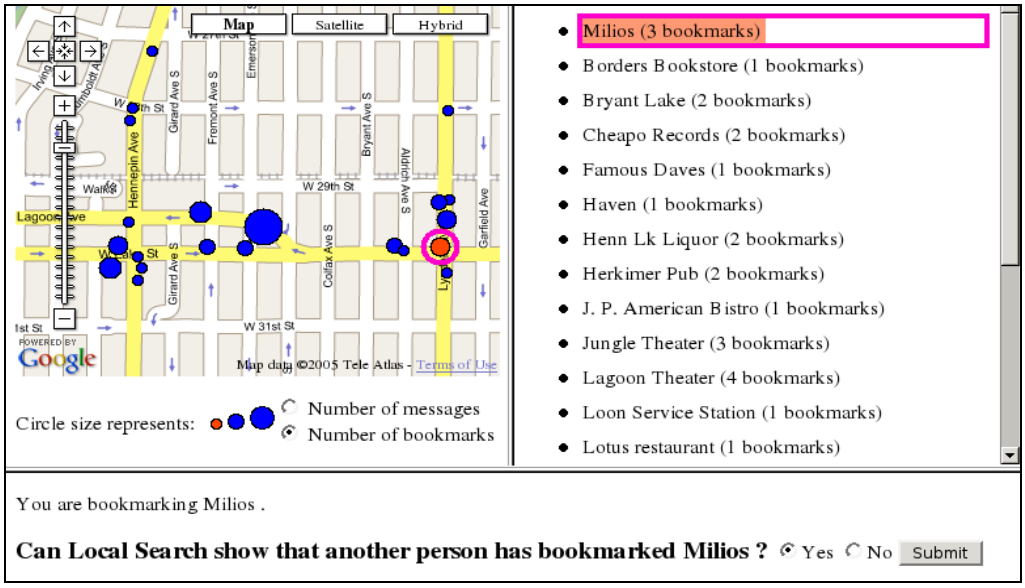

Figure 3: The Sharescape interface. Google Maps image © Google Inc. and is used with permission.

Results for RQ2: SHARING

Study 1 subjects told us what information they would share if they had a fast and easy tool for making their decisions. Since we had the tool in Study 2, we used it to confirm and quantify the Study 1 results. Other location privacy researchers recommend this tactic, suggesting following-up hypothetical sharing exercises with ones using functional software [5, 7]. While Study 2 has a hypothetical element in that subjects would not receive messages they created, it was realistic in that their bookmarks were for real places and contained realistic content. And as mentioned, other (unknown) people saw their shared messages.

Study 2 subjects shared a majority of both their places and messages. They bookmarked 175 non-residential/non-work places and shared all of them. Further, they shared 90 of 124 (73%) messages for non-residential/non-work places. These results are consistent with Study 1, where subjects said they would share most places and messages, but were more cautious about sharing messages.

Recall that the opportunity – and challenge – from Study 1 was to create an interface that made it fast and easy to decide whether to share place bookmarks and messages. We asked subjects whether it was tedious to make sharing decisions on a case-by-case basis with the interface. 26 of 29 users said no, although 4 of those wondered if it would become so over time. 2 of 29 subjects said yes, they found the process tedious. The last subject suggested a hybrid scheme for deciding whether to share data, whereby a person could elect to share for a place: 'always', 'never', or 'just this message'. In the future, custom or modified disclosure interface designs could increase these satisfaction numbers.

We asked subjects whether we should explore another sharing scheme, such as a rules-based system. Those who did not find the current process tedious said the current solution worked well as is. Many mentioned they like direct control over what was shared.

Results for RQ3: HEURISTICS

We now move on to RQ3, where we assess *how* people decide what to share; the results offer guidance for system design, and illustrate what subjects shared vs. what they kept private. We articulate the results as a set of decision-making heuristics derived from free-form responses to the question, "How did you decide what to share?" Subjects could look at their messages and bookmarks when answering, but we did not offer them a list of typical sharing heuristics to choose from. As we enumerate the results, we also supply quantitative data (actual sharing behavior) to support the heuristics.

1. I share public places, and messages about typical activities at them. 22/29 subjects said they shared bookmarks for places they considered public. Many subjects said that this poses little risk to themselves or others: public places serve everybody, so making their locations available on Sharescape poses little danger. Further, 13/29 subjects said they shared public place message contents reflecting (what they consider to be) typical place activities. Example: a shopping list for a grocery store. Subjects noted that the odds of being personally associated with this type of data are low, and in the unlikely event that they were linked to a message, the consequences would be minor.

2. I will not share messages that contain a name, especially if it is my child's name. Subjects marked 27/34 messages containing a person's name private, and 14 said they would not share messages containing people's names. 2 parents in the study created messages containing their child's first name, did not share them, and said they declined to do so for security reasons.

3. I share what I believe others will find useful. 12/29 subjects employed a 'usefulness heuristic' and provided examples of how they assess usefulness. Some did not share personal messages because they deemed them not useful to others. For instance, a man created the message, "talk to Beth about free shelving" at a non-profit organization office. He explained that Beth, an employee at the place, offered him some free shelving that the office was discarding. Sharing this message might imply that the place was giving away free shelving to the public, so he marked it private.

Some kept messages with (what they determined to be) cryptic abbreviations private, and this is important because in both Study 1 and 2, subjects occasionally used "personal shorthand" in messages. Their conscious efforts to screen these messages illustrates that case-by-case sharing may go a long ways towards preventing noisy data.

Last, 3 subjects did not share messages that they thought relayed obvious place information: for example, "pick up dry cleaning" left at a dry cleaners. Many subjects did not apply this "obviousness" assessment, however, as noted in heuristic 1.

4. I will not share residences, private workplaces, or messages left at these places. Several subjects said these places are not open to the general public, so there is no need for data about them to appear on a public web site. As with heuristic 3, the information was not shared because it was not considered useful. Subjects shared none of the 33 residence or private workplace places, and kept 22/28 messages for these places private. Of those they shared, all but 1 were for residences, and referenced typical home activities such as, "take out recycling".

We conjecture that subjects shared these messages because they reflect innocuous activities, and forgot that sharing would mean they would appear along with their home's location on a map. We anticipate updating Sharescape so that messages for places marked 'private' cannot be shared, or alternatively, so that messages are shared at a regional level rather than with a place. For instance, "take out recycling" mapped at the city block level could actually help others remember when neighborhood recycling day is.

5. I share places/information I want to recommend. 7/29 subjects mentioned this heuristic and explained this practice offers personal benefits. For instance, if nearby businesses do well, the neighborhood they live in generally benefits. Or, if people become aware of an obscure, yet worthwhile product offered at a place, sales may increase and the venue will be more likely to continue offering it.

6. I will not share if overcrowding will decrease the place's appeal. 3/29 subjects said overcrowding could lessen their enjoyment of certain places so they would not share them.

Additional Observations

We observed additional sharing behaviors of interest, but do not consider these heuristics due to inconclusive results. First, one subject kept all of her messages private; she did not want to make it easy for marketers to find out what people do at places. This practice may relate to movements in the United States where some oppose large retailer business practices and expansion [11]. If these movements grow or controversial retailers begin using personal place-sharing data, people may alter their sharing behaviors. Conversely, if place sharing helps small business, behaviors may also adapt accordingly. Many subjects also said they would not share if doing so led to location-based spam.

Second, to better understand information marked 'private', we scanned the set of places to identify those that might be "sensitive", including elementary schools, places of worship, banks, doctor's offices, and private organization meeting places. Subjects treated these messages more cautiously, marking 10/16 of them private. Shared sensitive place data, however, does include an Alcoholics Anonymous meeting, a gay organization's location, and a message for the latter. Subjects talked openly about sharing this data during the study, and explained making it available online could help others. This sharing indicates that system designs should not preclude sharing at sensitive places.

Finally, we note one heuristic that did *not* materialize. We earlier conjectured on the basis of conformity theory that other people's sharing behavior would affect subject's sharing decisions. However, this conjecture did not hold. Subjects did not hesitate if they were the first to share a place or message for it (as long as it wasn't a home or private workplace). And they weren't discouraged if others already had shared bookmarks or messages for a place[1]. Instead, they made decisions independently, weighing potential risks to themselves, friends and family (Heuristics 4-6) vs. perceived benefits to others (Heuristics 1-3).

We end by summarizing the quantitative sharing data:

	Places		**Messages**	
	Shared	*Private*	*Shared*	*Private*
Residence /Work	0	33	6	22
"Sensitive"places	28	0	6	10
All other places	147	0	84	24
Total	175	33	96	56

Table 1: Subject Sharing Decisions from Study 2.

We now move on to our final research question, assessing the utility of the information shared by our subjects.

Results for RQ4: UTILITY

The answer to RQ4 may vary depending on who you ask. We examined it with Study 2 subjects, and all except 1 were longtime area residents. In the future, we expect to study this question with newcomers and visitors, and expect different results. In this study, subjects unearthed a novel,

[1] We quantified these observations by running a t-test to see if there was a relationship between the number of messages already shared for a place and subjects' decisions whether to share a new message. There was no such relationship.

unanticipated use for local place information: *opportunistic errand planning*. They also valued Sharescape for collaborative place discovery and social matching.

These findings arose in post-exercise interviews when we asked subjects whether they valued various disclosure interface features, and why, in an open-ended format. It caught our attention when 11 of 29 subjects said the Sharescape map (see Figure 3) helped them plan errands. For instance, one subject said:

I forgot about this post office that's near the drug store. It would be easier to go there than to the one I usually go to downtown. ***I'm glad the map reminded me it's there.***

Another subject said:

When I created the message for Target and saw the liquor store near it on the map, ***it reminded me that I need to stop there****, too.*

Another subject explained it is valuable to see local places on the map while using the combined PlaceMail/Sharescape software. He can then quickly add PlaceMail reminders for errands he thinks of as he sees the map, and he values this because "*I need all the reminders I can get*".

We call this concept *opportunistic errand planning*. Some participants said they would also like to see items people commonly buy or do at places on the map: this could help when making shopping or to-do lists with PlaceMail.

Subjects also mentioned two more uses for Sharescape: collaborative place discovery and social matching. 10 subjects said Sharescape helped them learn about local places. For example, one who had lived in the neighborhood for over 40 years noticed a place two other people had bookmarked. Since he did not recognize the place, he wanted to find out what it was. Another said that if he saw that a restaurant was popular with others, he would create a message reminding himself to go there. He explained that often a person hears about good places, but then forgets to go to them. Both of these comments show the value of seeing a place's popularity, not just its location. Additionally, one subject wanted to meet others who have bookmarks for the same lesser-known places that he does. He took this as an indicator of shared interests, and he wanted to use this information for social matching [26, 27].

SHARING HEURISTICS: DESIGN IMPLICATIONS

We now discuss how sharing heuristics can inform system design. We articulate a set of design suggestions, based on subject sharing heuristics from Study 2.

Compute usefulness and display it to users. Nearly half the study subjects said they shared information when they deemed it useful to others. This requires a subjective judgment on the user's part: they must estimate usefulness. We suggest a simple automated technique to eliminate this guesswork. Recall that people use Sharescape to search for places in a locale by keyword. The system could retain these keywords, and tell LBR users when their message or place bookmark contains terms others have sought. For example, "*Please consider sharing this reminder message: 4 Sharescape users have searched for the term 'swimming lessons' in your area in the past year*".

Recognize names and offer to suppress them. We saw that most subjects would not share messages containing names. Systems could learn to detect them and offer to suppress names, displaying only the remainder of the message. Example: "Meet <name withheld> for happy hour".

Use common sharing heuristics to trigger confirmation dialogues. We base this guideline on real-world place sharing behavior. When we examined Dodgeball.com as background for this study, we found one subject's profile that included the location of his residence. It was labeled "Jerry and Amy's Place" (names changed to protect privacy). Amy, also a Dodgeball user, posted a comment expressing her discontent because "I live there too". This suggests that, like our subjects, she did not want to reveal her residence location to the public. At that point in time, Dodgeball apparently allowed anyone to share information about any place, including homes. While we did not formally study the extent to which this type of sharing occurred, we note that even a single instance can potentially be damaging.

This example suggests that systems could utilize common sharing heuristics to prevent careless or malicious behavior. Similar to the 'privacy critic' approach [1], if a system detects that a person is about to share a residence (this could be detected based on the place name or other criteria), it could present a confirmation dialogue such as, "*This place appears to be someone's home. Most people prefer not to share this information, are you sure you would like to make its location public?"*

Allow varied levels of sharing. Finally, additional levels of sharing may prove useful. In some applications such as Dodgeball, users might want to share private locations – such as their home – with buddies, while excluding them from public view. Each level of added sharing, however, adds complexity to the interface, and thus more research is needed to identify ways to maintain ease of use.

Open Issues. Several open issues remain in the place-sharing privacy domain, and we end by identifying several. As we noted earlier, subjects anticipated (and dreaded the idea of) location-based spam. Currently, there are no easy ways to prevent a shiller from opening a location-based reminder service account and creating self-serving, fictitious messages. Future research could investigate solutions for filtering such data from shared displays.

In Study 1, PlaceMail users sometimes created reminder message proxies. For instance, they associated, "go to restaurant after picking up book" with a bookstore. A term like "restaurant" might prove confusing if associated with a bookstore. In Study 2, none of the subjects created message proxies and it is unclear how they would handle sharing them. Future work could thus investigate this issue.

Finally, a field study using both functional PlaceMail and Sharescape could confirm real-world sharing behaviors and the value of widely- shared local knowledge as reported here.

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