SearchMessenger: Exploring the Use of Search and Card Sharing in a Messaging Application

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ABSTRACT

Previous work creating systems for collaborative search has mainly focused on solutions for the desktop. However, as the majority of web use moves to mobile phones, few systems have been created on this platform to support collaboration around search results. Mobile search is often a collaborative activity where the input of a group is sought before making a decision to purchase something, visit a venue, or book a ticket. However, currently search and messaging applications are separate, creating frustrating copy-and-paste interactions and uninformative blue links or OpenGraph cards in messages. We built the Search Messenger system to support both finding and sharing search results, in the form of rich, interactive cards, directly within a mobile messaging system. After building the system, we conducted a two-week field study exploring how 14 participants used the system in their daily lives. We report on our findings and implications for future mobile applications that embed functionality in messaging.

Author Keywords

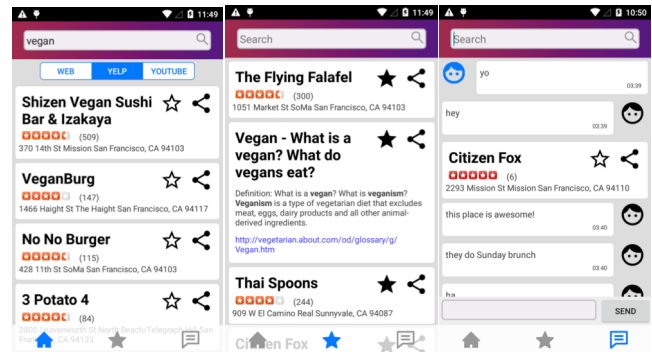Mobile; Search; Messaging; Cards; Sharing

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; H.4.3 Communications Applications

INTRODUCTION

Search on mobile phones is frequently a social and collaborative activity [8], with search and messaging apps often used back to back within a phone use session. Frequently, when searching for particular information or content, the opinion of others is sought, or the searcher wants to share the content that they find directly with another person. This can range from sharing venue information from a Yelp search to sharing videos, articles, and web pages that are relevant to that other person [1].

Figure 1: SearchMessenger with search, saved cards, and messaging screens. Users can search directly from any screen and results can be added directly to the conversation as rich, interactive cards. Any card can be saved, and accessed through the "star" tab at the bottom at any time.

However, sharing search results on mobile phones is currently quite difficult. People use many workarounds when trying to share content, such as taking a screenshot of a results page or copying and pasting a URL to a result, which previous study participants have frequently referred to as "tedious" or one of the most frustrating parts of using a mobile phone today [9].

With these difficulties comes a great opportunity for design. Inspired by a rich history of CSCW work on desktop-based collaborative search (e.g. [1, 19, 22]), findings from [8] on the co-occurrence between search and messaging app use, and design implications from [2] regarding sharing rich, interactive results from mobile searches, we created SearchMessenger, an Android application that allows users to conduct searches, share search results, and message friends directly from within a single application. Beyond basic messaging features, users could conduct queries and see results in the form of rich graphical cards with key details from the landing page presented visually. These cards each contain action buttons to share directly into a conversation in the app or to save for later. Both of these buttons are visible to both the sender and recipient, and cards can be easily forwarded on to other users.

In order to understand how this system would be used in people's daily lives, we conducted a 14-day field study with 14 participants (7 pairs). Participants used the application on their smartphones, created periodic voicemail diaries, and took part in a final interview after the 14 days.

This paper will discuss the system itself, the study and its findings, as well as implications for the design of future search and messaging systems. Our contributions lie both in the design of the novel interactions made possible by the system and in understanding the ways that the features fit into the daily lives of our participants. We close with implications for future content sharing systems, including better ways to design for recipient experiences as well as the role of embedded features in mobile social systems.

RELATED WORK

Collaborative web search has been extensively studied in fixed contexts, such as on computers and tabletops [1, 16, 19], with current practices as well as the use of new systems being explored. Existing mobile web search behavior has also been a frequently studied activity, with research studying the types of queries issued [10,11,25], temporal patterns of use [12], and the social context of search [13]. In addition, researchers have studied mobile information needs [13,16] and the interplay between search and messaging apps in existing mobile sessions [8]. Together, these studies highlight opportunities for applications that combine search and messaging on mobile devices, yet mobile collaborative search systems have been largely unexplored in the existing literature.

Collaborative Web Search

There has been a research focus in the CSCW and UIST communities on collaborative web search for at least the past ten years. This focus has largely explored opportunities for collaborative search on larger screen desktop and laptop computers or tabletops, yet teaches us useful lessons to apply to a mobile collaborative search system.

Early work, such as Morris et al.'s Search Together [16], provided the sharing of query strings, the ability to see the search results from the other user, and a separate instant messaging window, that as far as we can tell had no interaction with the search results themselves other than being associated with a search session. CoSearch [1], focused on multiple people sharing a computer in a public place, and their needs in information seeking. WeSearch [20] took this work even farther to the large screen of a tabletop, and introduced the idea of clipping relevant parts of the target pages.

All three of these interfaces required a large screen or a computer to work effectively, yet provide inspiration for components that might be integrated into a mobile search solution. CoSearch provided a mobile application to download the results list from the web for access on the go, and Search Together's desktop web-based chat proved interesting given research described below that shows the interplay between SMS and search on mobile devices today. WeSearch's clipping highlighted that often there are specific aspects of pages that are useful to share, and often the entire page does not need to be viewed for the necessary information to be conveyed, something we were quite interested in when designing our actionable cards.

One interesting aspect that these systems share is that they were designed for more traditional information seeking tasks: SearchTogether was created by studying information workers and its motivating scenario is investigating a disease. CoSearch was created for environments such as libraries, offices, and schools and its motivating scenario comes from researching global warming. Part of this reflects the historical research focus of the CSCW community, but we are now interested in modern mobile information seeking, which frequently includes topics such as finding restaurants, travel planning, or finding movies and GIFs.

Kelly and Payne [16] studied a variety of collaborative search tools, finding interesting themes around shortlisting results and the desire to immediately share results with others. Participants in their studies would often call or message each other to tell each other to check their shared searches. Clearly, there is an opportunity for messaging and notifications to coexist with collaborate searching.

Mobile Search

Several researchers have studied mobile information needs and existing mobile search behaviors. Sohn et al. [15] explored needs that people had for information while on the go, to see how newly created smartphones could address these needs. They found that 27% of information needs were prompted by conversation, highlighting the possible utility of an app that integrated communication and search.

Church et al. [12] explored the types of content that people searched for on their mobile phones as well as temporal patterns of search. They found spikes in mobile search activity in the early evening as well as found that searches for venues, movies, news, and weather were common.

Kamvar et al. [15] further explored mobile search queries and compared searches performed on different types of devices. They found that mobile queries are generally shorter than desktop queries, and that tasks are more focused – highlighting opportunities for specifically crafted mobile search interfaces for specific search verticals.

Teevan et al. [25] explored co-located mobile searching with an interface that allowed users to rotate the phone to collaboratively search with those physically around them. This system included features to save results for the group and featured a restaurant searching task, but was not studied over time in everyday use, leaving us curious to explore collaborative search in more natural settings over time.

And Kotani et al. [17] explored a mobile search application that modified the mobile search results page of a user to show sites that others had rated highly as well as allowed for sharing of search terms with others.

These studies have shown the variety of information needs that people have while using their mobile phones and that many of these situations involve specific types of structured data such as venues and movies. They have also highlighted

the social nature of mobile web search that is not well supported with existing mobile search applications.

Messaging with Search Results

Specifically addressing the search results that are shared with others, researchers have investigated the other types of apps that are used within search sessions as well as the types of links that are shared in mobile messaging.

Morris [21] conducted a survey of existing collaborative search behaviors, finding that most often specialized tools are not used and the results are frequently shared in messaging applications or email. She points to the need for "glue" solutions that connect search and messaging instead of building purpose-built complex systems for saving, organizing and sharing results.

Carrascal and Church [8] analyzed the applications most frequently used in mobile search sessions. They found that communications applications such as Facebook (which included Messenger at the time of their study), SMS, and email made up 27% of app launches in sessions that contained searches. Their qualitative data showed that often the result of the search was shared over phone calls, messages, or email for further comment or approval from someone else.

Bentley et al. [1] explored the types of links to websites that were sent over mobile messaging. They found that videos were the most common type of link shared, and that many of these videos were a result of searching. Five percent of shared links were to venues or maps, also frequently the result of a web search.

Chen et al. [9] also explored links that were shared in messaging applications. They found that screenshots were often shared when users wanted to share the results of a query such as a restaurant, movie booking, or other structured data. However, the screenshot that came through was not clickable, and thus the recipient had to perform their own query for any additional information.

Commercially available applications such as Facebook Messenger will cardify a pasted link from a search conducted in another application, using the Open Graph data of the title, description, and image. Using this requires that the user copies the link from a browser and pastes it into Facebook Messenger, and the resulting card does not show actionable information about the venue, nor can it have multiple interactive components (e.g., jumping straight to reviews, sharing or saving the result, etc.).

Through reviewing all of this related work, we see a need for creating an application that embeds search and sharing functionalities within a messaging platform. It should provide simple and easy sharing of rich, interactive search results in the form of cards that can be added directly to existing messaging conversations without the need to launch other applications or copy and paste links. To meet this need, we created the SearchMessenger system.

THE SYSTEM

The SearchMessenger system consists of a mobile application, written for the Android platform, and a server. The system was built on top of the messaging platform created for the PairApp study [3] and added search and rich card sharing functionalities.

The system was designed for three main tasks. Users could conduct searches and view results, they could save results for themselves by pressing the star button on any search result card, and they could share a search result directly into a messaging conversation where it would appear as a card. The recipient could click on the card to view the web page or to get directions to a venue, could save it for themselves, or could reply directly to the sender. The interface had three tabs at the bottom as shown in Figure 1, one to conduct new searches and view result cards, one to access saved cards, and one to access conversations. We were interested in how people would save results for themselves, but were much more curious to see how cards would be used in conversations with others.

In the system, users could issue queries for general web content (found using the Yahoo Search BOSS API), venues (found via the Yelp API), or videos (found via the YouTube API), and tabs for these three categories were available on the search results page. We had seen in previous research [1] that links to videos and venues were often shared in messaging apps, so we chose high quality data sources for these queries and created custom card formats for each source that contained actionable information such as star ratings and addresses for restaurants. Individual search results were presented as cards as shown in Figure 2, which acted as a form of automatic clipping [20] of the results pages. Each search result card had two buttons, one to share the result card, and one to save it locally to a dedicated tab.
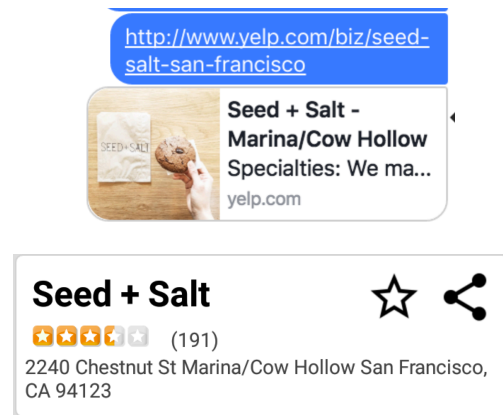
Figure 2: A web card in Facebook Messenger showing OpenGraph data (top) and a card from Search Messenger (bottom). In FBM, two messages are sent with every link - the actual blue link and a card with basic OpenGraph data. We include clipped information that goes beyond OpenGraph, such as the Yelp rating, number of reviews, and address of a restaurant, as well as star and share buttons to save the result or to insert it directly into a conversation.

Our system uses phone numbers for authentication and users could access their device address book from within our application when finding new recipients for cards. The application was fully instrumented to capture all screen taps and other user interactions for the duration of the study.

FIELD STUDY
Our main research question was to discover if this tight integration of search and messaging provided value to users over their existing search and messaging behaviors. Additionally, we wanted to understand in detail how and why search cards would be shared and how they would be used in everyday scenarios. In order to understand how the system would be used in daily life, and to explore the usefulness of this embedded application, we performed a 14-day field study of the app in use in natural contexts.

We recruited 14 diverse participants from the greater San Francisco Bay area. We made sure to recruit broadly and outside of the tech community. Participants ranged in age from 21-53 and were recruited in pairs. Five sets of participants were mixed gender couples and two sets were groups of male friends. Participants came from a wide range of occupational backgrounds, from real estate agents, to finance professionals, to students, and a participant who worked odd jobs. All were active users of a variety of existing messaging applications. As is still common in the US for Android users, most relied on standard SMS for most of their messaging needs [22], but all participants also used Facebook Messenger and some were using WhatsApp, Google Hangouts, and Snapchat for some conversations.

Participants visited our offices for an initial interview about their current search and messaging behaviors and then were given the SearchMessenger app on their smartphones. They were instructed that no use of the application was necessary, and that if they did not find it useful, there was no need to use it at all. Participants were paid for their time as long as they returned to the office for a final interview 14 days later. We have used these instructions in a variety of other projects (e.g. [3,4]) and have evaluated other systems with very high or very low usage as a result. While still likely higher than usage completely in the wild, we feel that these instructions get us the closest possible use to natural conditions while still participating in a research study and providing us with other qualitative data on use. Participants were not given any tasks or scenarios of use and were free to use or not use the system for any purpose they saw fit.

During the 14 days of the field study, we issued four voicemail diary prompts that appeared as a calendar reminder on participant's phones. The prompt stated that they should call only if they had used the application since the last call, reminded participants that there was no need to use the application, and asked them to summarize any usage that they did have.

In the final interviews, we asked followup questions based on the voicemails and also had participants walk us through their chat history individually to understand how it was used. After individual interviews were completed, we brought the pair of participants together for a joint debrief about how they used the system and what worked and what did not work for them during the 14 days of the study.
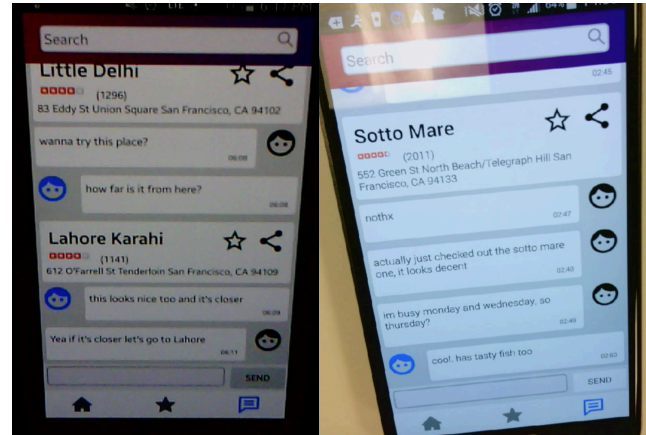
Figure 3: Screenshots of SearchMessenger from real world use of our participants. On the left, a couple discusses a few different Indian restaurants to go to, and settle on one that is closer. On the right, two participants discuss a restaurant and after clicking through to view the menu, decide to go there.

All quantitative log data was analyzed from captured logs in Flurry[1], a mobile analytics platform. All qualitative data was transcribed and analyzed in a grounded theory-based affinity analysis, with leaf notes comprised of exact quotes from participants, and themes emerging as the team reached consensus. This analysis method is the same as used in over 30 academic papers including [4, 6, 8, 18] and the particular details of how it was used are more fully described in [8]. The themes will be discussed below with illustrative quotes and examples given for each section.

FINDINGS
We will now discuss overall findings related to the use of the SearchMessenger application. Where possible, we combine both quantitative and qualitative data to explore a theme both from what participants said and what they did.

Overall Usage
Use of the system remained high for the 14 days of the study. Participants shared a total of 161 cards during the study (mean 23 per pair) out of a total of 343 searches performed. For every card that was sent, participants sent 2.7 text-based messages. Usage of the top features can be seen in Table 1. Overall, each participant averaged 50 sessions with the application during the study, totaling an average of 28 minutes of usage over the two weeks of the study. Sessions averaged 34 seconds, similar to the use of other messaging apps [4] but less than is typical for search sessions [1], given the addition of non-search sessions for just responding to messages. Of the cards that were shared,

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[1] http://www.flurry.com

Feature	Avg. Use Per Pair
Send Message	61
Search	49
Open Search Result	43.5
Share a Card	23
Add a Star	9.5

Table 1: Average use of the features of the app per participant pair. One card was sent for nearly one in every other search that was performed and participants sent an average of 2.7 textual messages per card that was shared.

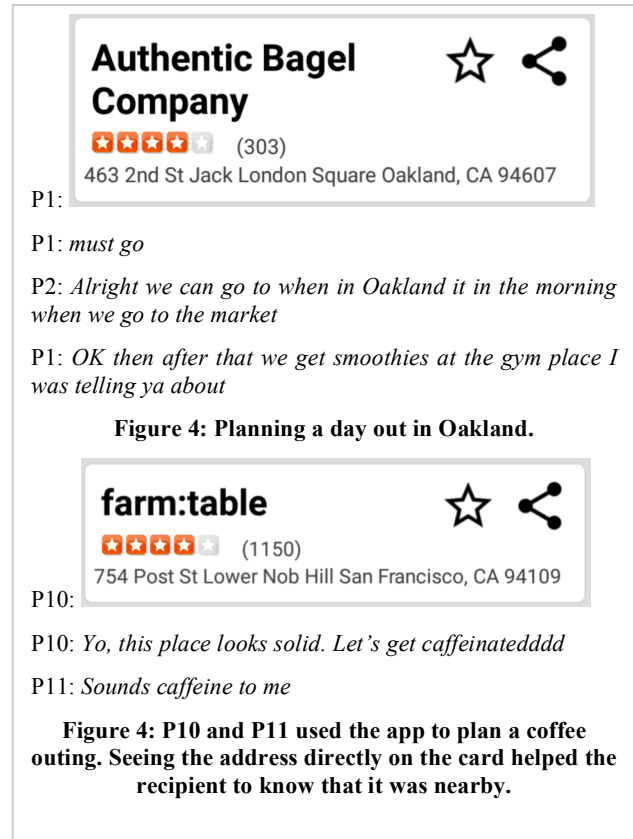48% were to general web results, 35% were to Yelp venues, and 17% were to videos.

Everyday Use

Participants found many uses in their lives for an application that embeds search activities into messaging. We saw examples of the app being used to pick a restaurant for dinner, to share funny videos to brighten a friend's day, choosing a bar to go to on the weekend, and planning a day in Oakland including breakfast, a farmer's market, and events (see Figure 4). P2: *"We used the app on a Saturday to plan out our day. It kind of turned into a planning app with food and events."*

Cards became a natural part of the conversation, and participants often shared a few cards back and forth with each other as a part of a conversation to provide further explanation to their points or to give details about venues that they wanted to visit. Looking at the image on the right in Figure 3, you can see two participants trying to pick a venue for dinner. One shares an initial idea, but the other person thinks that it's too far away. This person then provides a new suggestion and states that it's closer. Both then agree on the second suggestion. P3: *"I knew he wanted pizza and he suggested Round Table, but I really wanted to sit down someplace and eat. So Italian could be a compromise. This was one of the first places that popped up and because it had such a high rating I clicked through and read some of the reviews. And it impressed me so I decided I'd go ahead and share it."*

Sharing venues in this manner accounted for 56 of the total cards shared during the two weeks of the study. We noticed that even in the initial interview when trying out the system for the first time, participants found it quite natural to include a card in the conversation and did not need any explanation of the feature to figure it out.

In another example, P7's sister was in town for a long weekend. He and his girlfriend used the app throughout the weekend to send ideas back and forth and to share their current location when trying to meet up. P8: *"It was very convenient, because not only were we having the conversation through this app but I was able to see like the*

P1:

P1: *must go*

P2: *Alright we can go to when in Oakland it in the morning when we go to the market*

P1: *OK then after that we get smoothies at the gym place I was telling ya about*

Figure 4: Planning a day out in Oakland.

P10:

P10: *Yo, this place looks solid. Let's get caffeinatedddd*

P11: *Sounds caffeine to me*

Figure 4: P10 and P11 used the app to plan a coffee outing. Seeing the address directly on the card helped the recipient to know that it was nearby.

location [venue] right there in the same app. Instead of having like a separate texting and sending a link separately it was all right there in front of me."

Other participants were excited by the video sharing features, accounting for 28 of the cards shared during the study. P8 shared a movie trailer: *"I was bored one day and I wanted to see what was coming out in the theaters in the next few months. So I looked up movie trailers and the search was so fast and I went through all of the trailers that came up. And I watched The Martian trailer and then I just sent it right there with the sharing button. And it was so much easier than like going and copying and pasting it into the text message box."*

Some participants shared music videos with each other. P9: *"So we like sharing music [videos]. Mostly like just sharing stuff from YouTube, like cool music stuff."* P9 and P10 were friends at a party and looking for music to play: *"We both went to this party last Saturday and we were in separate parts of this house. We needed some recommendations for music to play and we were sharing songs [as YouTube videos]."* P13 appreciated the easy sharing capabilities directly from a music video: *"This is just like a rapper and I was looking at some of the weird bit that he does. And I wanted to talk to her about it, and I was just able to pop it through here for her to see."*

P13 and his wife also shared many videos of Corgis with each other, an example of which is shown in Figure 5. He

35 Corgis To Get You Through Your Day

Little stubby legs all day erry day! Check out more awesome videos at BuzzFeedVideo! http://bit.ly/YTbuzzfeedvideo MUSIC Sunny Side Licensed via Warner ...

P13:

P14: that is very true

P14: and corgi!!!!! 😍😍😍😍😍😍

Figure 5: P13 and P14 sharing videos of corgis.

told us: *"The YouTube sharing is the biggest thing that happened with it. The corgis."* P4 talked about his girlfriend *"sending me raccoon videos. And they were really funny. And then I want to forward them to my family. The raccoon videos were pretty great."*

At other times a recent conversation would prompt a search and sharing of a card. P7 had been *"watching the TV Show Narcos about Pablo Escobar and the next day I used the app to look up his Wikipedia page and send that to her and like continue the conversation."* P10, a college student, told us that he and his friend *"were looking up recipes for JELL-O shots and we found something and shared it and talked about what we were going to do."* In these cases, the cards shared in the app helped to continue a conversation and visually give details about the results. These examples follow from the 27% of search queries prompted by social interactions found by Sohn et al. [16].

There were many instances in daily life where the app became useful. By having an embedded search functionality in the application, and a share button directly on each search result, it became easy to send along anything from a random video of a corgi dog, to a movie trailer, to a restaurant for dinner. The cards fit into the conversations and provided the relevant information alongside the text of the messages so that users could get on with their planning or enjoying content without switching back and forth between several applications. We will return to benefits of this embedded nature of the system in the discussion.

Planning Ahead

Beyond just sharing to plan activities that were about to occur, or in sharing media quickly, we observed many participants using the application to plan ahead for future activities. In these cases, they would often share lists of places or activities that they could do on an upcoming trip. This planning moved beyond previous work that allowed for saving shortlists or query terms [16, 25], as participants could easily discuss the relevant results right where they were shared and quickly come to a shared understanding and consensus. Action could be taken directly instead of having a separate chat that might call attention to a result in another part of the interface such as in SearchTogether [19].

P5 had an upcoming birthday and started sharing a few places that she wanted to go with her husband: *"I was saving some places for my birthday. Because there's a couple of night clubs, a couple of strip clubs that I want to go to."*

P1 and P2 shared several cards in planning with each other. The planner in the relationship, P1, sent a message about planning for the weekend, followed by cards for a movie as well as showtimes and a brewery that was nearby: *"I sent him the movies because I knew we were going to be up in San Francisco in that area."* P2 agreed to the plans and watched the movie trailer directly in the shared card, decided it was worth seeing, and directly messaged her back from the same screen.

Before P7's sister was in town, he used the app with his girlfriend to plan all of the places to take her ahead of time, as shown in Figure 6. P7 told us, *"My younger sister visited us this previous week and it was her first time in San Francisco. So we wanted to show her everything. So a lot of*

P6: *Phew! I've been so busy with this video edit today. thank you for coming up with good suggestions for chill things to do my doll.*

P6: *YES! I'm excited to show [sister] around downtown. Let's check out the ferry building then show her union square too!*

P6: *we haven't had Thai food in forever. I love the inner Richmond*

Saigon BBQ
★★★☆☆ (90)
2623 San Bruno Ave Excelsior San Francisco, CA 94134

P6:

P7: *First pho for [sister]*

5 Tea House
★★★☆☆ (116)
2527 San Bruno Ave Excelsior San Francisco, CA 94134

P7:

P7: *She's gotta experience Boba too*

Figure 6: Planning for a sister's first visit to San Francisco. Here the cards fit right into the conversation and provided quick links to return to when visiting these venues.

it was finding places that we wanted to show her. Ideas to fill out 6 days of adventure." They sent venues back and forth while they were at work to share ideas of things to do and created a saved itinerary that they could return to.

P13 and P14 were planning an upcoming vacation to Japan and shared places that they could visit in the conversation. P13: "We're headed to Japan next week and we were bouncing travel videos and stuff back and forth." In addition to the videos, they shared Wikipedia pages for various landmarks as well as "top attractions" pages from the web for various cities in Japan.

P9 and P10, the college students, used the app to find "good bars to go to in SF." They shared a few venues back and forth to plan for a weekend in the city, and then ended up sharing a web card to "The top 5 parties to attend in SF this weekend." They were able to discuss each venue right inline in the conversation and had a record of the places that they might want to go to saved right in their conversation.

P5 was planning in advance as she "was looking up things to go see in Oregon. I'm going to see my best friend from middle school. And I've never been to Oregon so I started looking up some places." Then she starred places she wanted to go to: a dinner at the Cheesecake factory, an aquarium, and a movie theater. She planned to go back to these once she got there, and if her friend was using the application she said that she had wanted to share them with her to see if they were worth checking out.

Cards were used to plan for the future, not only to coordinate in real time. Often in these cases several options were shared, allowing the recipient to check them out and decide which seemed the most promising. Frequently this type of use involved upcoming trips and vacations, but as we discussed in this section, we also saw sharing cards around preparing weekend plans a few days in advance and sharing possible options of things to do, movies to watch, or places to go.

Starring as Shortlisting and a Gateway to Sharing
The application also allowed for starring results to save locally on the phone. When designing this system, we saw starring results as a feature for individual use, to save cards that were personally relevant to the user, but that they did not need to share with others. While we did see some of this behavior, the larger use of the stars was to create a shortlist [16] of items that were "at the ready" for sharing if a particular circumstance came up in the future.

P1 "went through and starred off a bunch of places that I'd like to try. [P2]'s Brazilian and I love Brazilian food so I pretty much starred off any place that served Brazilian food. It's a good list to have so if we're ever in that area I can bring it up and say, hey, let's go here!" She said that this feature "helped me organize myself too. Like the next time someone asks me where I want to go eat, I can just go on and open the [starred] list and send it to them." P4 shared a similar use: "You can share the starred thing. So if

I'm trying to lure someone else to go to a place that I like, I could send the starred thing to them."

P2 discussed using the starred items for quick retrieval at a later time, either to get directions to a place, check its hours, or just refer to additional information when needed. "We saved a place so that when we're out on the road we could bring it up and do the GPS to there. So that was really handy and we didn't have to go look it up while on the road." Here, having the direct action to launch Maps from the card afforded this unexpected use.

Having the entire card saved, and not just the venue name that one might write down, made it more convenient to look at later on. P1 told us that "some friends at work were talking about a place. Usually I'd just take a note, but it's nice to have it all in one place here, and with a link to Yelp so I can see if it's going to be good or not, when it's open, stuff like that."

P9 had saved some music videos to watch later: "Some music videos that I found interesting, like Nirvana. I love Nirvana. And like Thirsty Bear Brewing company. I saved that like I might want to go there later." He later ended up sharing both a music video and the bar with his friend in two different situations. One was shared while at a party and the other was shared when trying to make weekend plans.

Stars helped users to keep track of items that they found interesting, until the moment was right to use them. Sometimes this involved sharing the card to someone else in the app, while other times it was brought up in person to get details for a venue or to access the information linked directly from the card, such as the map for navigation.

Cards Embedded in the Conversation
One of the most interesting themes was about the ease of use that the integration of search and messaging provides. All users commented, without prompting, on how much they disliked copy and paste today, and how this application removed these barriers to blend the two functions together. This embedded nature allowed for search to be more easily accessed and used compared to current systems.

P1 told us that sharing links was something that used to only occur for her on a computer: "Before, I had to do this kind of thing on the desktop and not so much on the phone. Because copy pasting links never really works for me. It's doable, but it just doesn't really work." She continued, saying that SearchMessenger "makes it easier to plan with friends. Like you don't want to send a mass email, you can just do it on your phone. Without having to copy paste links it definitely made it a lot easier."

P14 appreciated the removal of the extra screens when sharing a link: "I do love the messaging because it makes it so much easier. Instead of being like, copy the link, email it. Like sharing a video to Facebook, to a message, that takes a couple of extra steps, so it was easy to just drop it in. Like

there was that thing I was looking for and I could search and send it right away. So that was the most useful especially as we were planning for [a trip to] Japan."

By adding search to messaging, we not only removed the barriers of copying and pasting, but we removed the need to use multiple applications. Participants found this ability to search for cards right in the app to be much simpler than switching back and forth. The following examples highlight the benefits of embedding search and cards with rich data directly into a conversation. P2 said, *"Sharing in the app is really good **because it's already in the conversation itself**. I can reply right there to that specific place. And I can suggest something else. If I did this in Facebook [Messenger] I'd have to go into the browser, search for a new place, copy and paste the address in there, and the fact that I can do all that right there, just say oh, I don't like this place how about this one? That cuts a lot of the pain."*

P5 liked that in addition to a link, the details of the venue, or the actual video was right in the message: *"It's great because you can share the details of the place you looked for. Instead of having to ask 1,001 questions about it, it's like - this is the place we're going to go, here you can look and find out yourselves."* P8 also enjoyed that the cards linked directly into the relevant content sites for more details: *"And there was a Yelp button right there, so I didn't even have to get out of that window. It was just right there in front of me. Really convenient."* P11 said, *"If I search for a burrito, I want to see that picture of that burrito and be like I want **that** burrito."*

P1 said that having the Yelp details directly in the message made the app *"so much more functional in real life. All the other apps are either about reviewing the food, the place, or just announcing that you're there, just saying that you're there. So it's nice that this actually makes it functional to coordinate with people. Everyone is so flakey in San Francisco, so you can be like guys, we're going here, here's the address."* Having details of the venue from Yelp, or the video ready to play helped participants to get the information that they needed at a glance, often without having to tap at all.

Thinking about the recipient's experience, and wanting them to have the information they need at a glace is a form of recipient design [14]. P11 told us that the sending a card *"is pretty great because then he can just go open it right away in Yelp."* Giving the recipient the data and links that they need to more fully explore a venue or link helped the sender in providing relevant information while limiting the burden of having to look up and copy and paste a variety of facts about a place (opening hours, ratings, if it has wifi, etc.).

Seeing these details on the cards allowed for increased sensemaking [22] in the conversation, without the need for a communication partner to explain every detail. Because the card went beyond simple OpenGraph data to show actionable information about the venue, or controls to directly play a movie, participants were able to quickly get the information that they needed to make a decision about a venue or watch a video without any additional interaction. This sped the conversation along as additional pages did not need to be visited, as in [22], and participants did not need to tell the recipient where to focus attention on a landing page.

By having search and messaging capabilities in the same app, participants were able to easily add new content to the conversation as well as read relevant information about the venues without switching back and forth between different applications. The simplicity of removing copy and paste, or complex Share Sheets, made it much easier to jump between search and messaging and insert a large number of cards into conversations where in existing apps there might have been many messages back and forth to share the relevant details and come to a shared understanding.

DISCUSSION

We have explored a new type of search and messaging application for mobile devices that can ease burdens of copy and paste or Share Sheets as well as promote the sharing of rich, interactive search results in the form of actionable cards directly into conversations. Through a 14-day field evaluation we have seen how this system was used in daily life by 14 diverse participants.

Beyond the specific use cases that we have seen emerge through everyday use of the system, this work points to the benefits of *embeddedness*. Participants repeatedly discussed their current frustrations of both going to another app on the device to search, and needing to visit a resulting page away from the conversation to interpret the results. This integration of applications can be seen in the growing capabilities of messaging applications in Asia where you can order a car or buy nearly anything from a conversation. Not having to switch applications is more than just a trivial interface detail, as we have shown it leads to fundamentally different usage behaviors, with dozens of cards shared over a two-week period where participants reported existing behaviors of sharing 1-2 links per week with their partner. Existing communications applications should support the both sharing of interactive HTML objects as well as the ability to launch a search from directly within the conversation view.

This extends previous work on the desktop that contained conversation views and search result views. From early systems that left the views almost completely disconnected [19] to later systems that allowed for clicking an individual message to open the page the sender was viewing at the time [22], it is increasingly important on small screens to embed views together and to give users all of the necessary context on one screen within the conversation itself.

By building a fully integrated application, we have shown the benefit of having search functionality and interactive

cards in a messaging experience and how it can help people to easily share multiple options and come to a mutual understanding while staying within a consistent experience.

Promoting sharing and saving as high-level, visible actions on each result made it easy for people to take action directly from the results. Participants did not have to navigate complex sharing menus to select applications and recipients. With one touch they were shown a list of people that they had previously shared with in our application and with one tap, the card was added to that conversation. While this may seem like a trivial enhancement, it solves a major pain point of mobile phone usage today as copy and paste remains difficult and frustrating for many users, and totally undiscovered for others.

This work extends previous design implications, e.g. from Carracal and Church [8], showing that search and messaging are frequently used together. We have shown that by combining them together into a single application, search result cards become a part of the conversation, reducing the need to describe venues or copy and paste blue links, which are received without the relevant information and require launching a browser to consume. This led to easier sensemaking and informed decision making, where multiple options could be easily shared and discussed when planning. Search and messaging in the same application also reduced barriers to going to the homescreen, launching the browser, entering a search, and then getting that result back into the messaging application. Other opportunities to combine applications like this can also be explored.

IMPLICATIONS FOR DESIGN
We see a large opportunity for more applications to be integrated into messaging and the value of rich, interactive cards within conversations. With more functionality being built into messaging apps, including bots who can be summoned to find information, it is important to step back and think about what the user is trying to accomplish.

Through this work, we have explored our participants' mobile information needs and how these led to sharing search result information with others for a wide variety of tasks. Extending early research on mobile search, which showed that mobile queries are often in specific domains [15], we have shown the value of having specific Yelp and video searching within a messaging experience. Messaging applications should support *embedded* within them a variety of vertical-based searches, which can all insert cards showing meaningful, and interactive information. Sharing train schedules, flights, shopping items, and other rich cards can increase the use cases for a new messaging application like SearchMessenger.

Beyond the interface, mobile communications applications should consider Recipient Design [14] to a greater extent. Current applications either share blue links via copy and paste, or share Open Graph information (typically a title and 1-2 sentence description of the page). But having

details like the address of a restaurant, its ratings, and even pictures of the food served there allows for the recipient to act without having to navigate to yet another page or guess what type of (possibly malicious) content is behind the blue link. Newly released smart keyboards insert a static image card that is not clickable. This makes it difficult to get to the relevant information such as reviews or a map.

Further exploring recipient design, having actions to re-share or save the received card, allowed for the recipient to hold on to that piece of information or send it along to someone else. Considering actions that the receiver might want to make should be important to any type of sharing/messaging system. Allowing recipients to easily search for other related cards and insert these back into the application allowed for rich back and forth sharing instances in our study. Received cards could also have their own search functionality to find related content, saving the need for the recipient to even need to enter a query. Entire result sets could also be shared and voted upon by the recipient to further empower them in selecting a final venue, movie, or other type of content.

These designs would allow for easier sharing of web content in messaging experiences, without the need to switch between multiple applications and fumble around with text selection and copy-paste interactions on a mobile device. We see the market entering a post copy-and-paste paradigm, originally led by companies such as Facebook on the desktop web with ubiquitous Share and Like buttons, but now moving into new hybrid applications on the mobile device. While removing copy and paste actions might seem like a trivial change, it significantly altered the way our participants communicated during the study and led to some of the most positive comments from any field evaluation we have run. We see new hybrid applications and ties to messaging as a large growth area for new mobile systems.

In this paper we have described the SearchMessenger system, including its motivation from related work showing the frequent co-occurrence of search and messaging behaviors. We also described our 14-day evaluation with 14 diverse participants, including findings on how they used the application in-the-moment for short term planning, how it was used in longer term planning and list-making, and how the integration of search and messaging within one application allowed for easy sharing of venues and a back and forth of sharing related cards to arrive at a shared decision. Finally, we concluded with implications for designing new messaging applications, with a focus on embeddedness and Recipient Design [14] in designing the information that is shared and the actions available from the shared object. We hope that this will lead to the creation of new messaging systems that incorporate domain-specific search and rich card sharing so that users can stay in a single experience instead of having to use complicated copy-paste or Share Sheet interactions to get content from search to messaging experiences.

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