“I thought she would like to read it”: Exploring Sharing Behaviors in the Context of Declining Mobile Web Use

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ABSTRACT
The use of applications on mobile devices has changed dramatically over the past few years. While web browsing was once a common activity, it’s now reported that 86% of time on mobile phones is in apps other than the browser. We set out to understand how the mobile web was currently fitting into people’s lives and what web sessions looked like. Finding a dramatic reduction in mobile web revisitation rates compared to previous work and that a large number of sessions comprised single page views, we then studied how web content was shared with others in mobile messaging, the source of many single page sessions. The HCI community has not heavily studied this sharing activity that many people perform daily. We conclude with design implications for new mobile applications from our two studies with a combined 287 participants where we studied actual logs of mobile web use and link sharing behavior.

Author Keywords
Mobile Web; Mobile Browsing; Mobile Search; Link Sharing; User Research; MTurk

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

INTRODUCTION
Since the introduction of the iPhone in 2007, the use of mobile devices has changed markedly. While the initial iPhone did not support third party applications, and expected all developers to utilize the mobile web, currently most smartphone users spend the majority of their time in applications other than the web browser. According to a report from Flurry [14], mobile web use represented just 14% of total time spent on mobile devices in 2014, with apps representing the other 86%. This compares to the mobile web representing 20% of overall mobile device time just the year before. This rapid trend of decreasing mobile web use has been apparent in industry, but has not been explored in great detail in the academic community. How are people utilizing the mobile web in 2015 and how does this compare to previous research? Which sites do they browse, for how long and, in an increasingly app focused world, what exactly are they doing on the mobile web?

While studying the mobile web use, we observed that many sessions start with a content page. We became interested in how mobile web content was used in conversation. While many research studies have examined specific mobile communications patterns – in particular text messaging practices, such as image sharing [6], coordination [24], or learning to text [25], one area that has been hinted at in the literature but only been peripherally explored is how people share web content, in particular links to websites, in messaging apps. This is interesting to us not only for its academic merits of understanding how multimedia (especially video) links are used and shared in everyday communication, but also commercially as companies add sharing and messaging components to a variety of products from news apps, to live events, to search applications. Specifically, we are interested in understanding more about which web links mobile users share with each other as well as how this behavior fits into tasks in daily life.

We set out to answer both sets of questions through two mid-scale research studies: one analyzing actual logs of website visits from 187 participants to understanding what mobile web usage looks like in 2015 and a second study investigating recently shared links through mobile messaging of 100 additional participants.

In the remainder of this paper, we will present related work in studying web browsing and mobile messaging behaviors, present our two related studies, review our findings, and discuss the implications for the design of future mobile applications.

RELATED WORK
There are two main areas of research related to our current interests. Research of web browsing behaviors, originally on the desktop web and later on mobile devices has sought to quantify people’s behavior online over time. A variety of studies dating back more than a decade have explored factors related to the amount of time people spend on the web and the pages that they visit. In parallel, other studies have explored mobile messaging practices and a few have touched on the sharing of multimedia and links.
We build on this existing research by showing marked differences in mobile web use from those reported just a few years ago as well as provide the first in-depth analysis of a large number of links shared in mobile messaging applications from both a quantitative and qualitative perspective.

**Understanding Mobile Web Usage**

As mobile device use has grown considerably in the past 10 years, so too has the range of research studies aimed at understanding how and why people access and consume online information via their mobile phones. Early work focused on emerging mobile Internet behaviors e.g. [10, 15], while more recent work sheds light on modern device use, e.g. iPhones [3]. There have been extensive qualitative studies using techniques such as interviews, surveys and diary studies focusing in particular on the motivations and perceptions of mobile Web use. These studies have shown that most mobile Web usage occurs when people are at home or work [8, 17] and is primarily motivated by a user’s desire to stay aware and up-to-date [22]. Other researchers have explored both mobile Web and mobile search behaviors, highlighting that mobile search is often a social act, sparked by conversations and a desire or need to share information found online [8].

While these works have helped the community understand the key motivators behind mobile Web usage, one thing lacking from these studies is their reliance only on qualitative insights. As such there has been a range of studies that log and report on actual mobile Web patterns using real world datasets from mobile operators [9, 26] as well as commercial mobile search engines like Google and Yahoo [13, 27]. The more recent of these log-based studies show significant signs of evolving mobile Internet patterns. For example, Song et al. [21] compare mobile search behaviors across desktops, mobile phones and tablets and highlight that the average query length on mobile continues to grow; both mobile and tablet users issue significantly less navigational queries than desktop users; usage time across three platforms is different, with mobile and tablet use peaking in the evenings; and finally location of usage is different between mobile and tablet. Specifically, mobile users travel more than their tablet counterparts and thus issued queries across a larger variety of locations.

Again, while these quantitative studies have helped shape our understanding of how mobile users access and seek online information, they lack insights about why certain behaviors have emerged. To fill this gap there have been a handful of studies that use mixed-method approaches, combining qualitative and quantitative insights to get a more rounded, complete picture of how and why mobile Web usage is evolving. For example, Tossell et al. [23] conducted a year long study with 24 iPhone users in which a custom logger collected and tracked both browser usage as well as usage of other native applications (e.g. Maps, Weather, Facebook). In addition to logging actual usage the authors had periodic meetings with participants to help interpret the data. The goal of this work was to characterize web interactions, in particular exploring web revisitation on mobile phones. The authors found that page revisitation rates were much lower than previous PC-based studies [18]. Related work by Carrascal & Church explicitly explored the interaction between mobile search and mobile app usage, highlighting that as native mobile app usage has gained momentum, the relationship between web/search usage and app usage has changed. Specifically web and search usage has become uniquely interlinked with native apps like Messengers, IMs and Email, often used to share interesting content found on the mobile Web [5]. Combined, these works have shown just how rapidly mobile usage and mobile behaviors have changed. Combined with the data from Flurry [14] mentioned above, we saw the opportunity to study new practices in this rapidly changing domain. In this paper we aim to study this shift in more detail by revisiting mobile Web usage patterns to see what exactly has changed in the past few years.

**Messaging & Sharing of Content**

Over the past fifteen years, there has also been a wealth of research studies published which aim to shed light on the various nuances of mobile communication practices, in particular text messaging. Research of this nature has been conducted across various countries [12, 24] and in particular among teenagers [11, 16] to understand how, why and when SMS is used in daily life.

One of the first quantitative studies of text messaging use was conducted by Battestini et al. [1] in which a corpus of almost 60,000 actual SMS messages were collected over a 4 month period from participants in the US. They found that their participants, in this case all students, communicated with a large number of contacts and engaged in many simultaneous text message conversations at once.

Most recently, Bentley and Chen [2] conducted a mixed-method study of 200 diverse participants from across the United States in which they analyzed phonebook entries, call log data, and SMS history metadata for their 65,940 contacts. The authors found that on average, over 80% of all calls and SMS messages are with the top 5 contacts in participants’ phonebooks.

With the recent rise in popularity of Mobile Instant Messaging Applications (MIM), attention has turned to understanding communication practices within apps like iMessage, WhatsApp and Line. For example, a study by Church & Oliveira [7] explored the motivations and perceptions of using WhatsApp compared to more traditional SMS. The authors reveal that factors including cost, sense of community, and immediacy all play a role. In similar spirit, O’Hara et al. [19] conducted an interview-based study with 20 participants to understand the use of WhatsApp in relationships, exploring notions of togetherness, intimacy and dwelling and how these feelings
are supported through messaging apps like WhatsApp. Both of these studies highlight the prevalence of sharing media including photos, video clips, and URLs for web pages of interest, in particular amongst groups.

Chen et al. [6] set out to explicitly understand the conversations that occur around shared mobile media by looking at the photos and links shared within almost 3,000 messages collected via a custom mobile instant messaging application. Their study compared the conversions people had around mobile media among 20 participants in both the US and Taiwan. Their findings reveal that mobile media is used in messaging to experience the moment together, to fill in the visual details, to provide background context, and to support information exchange.

Finally, in their study exploring the interaction between mobile search and mobile apps, Carrascal & Church [5] found that many users shared results of their mobile searches via communications apps like SMS. This “sharing” could be in the form of a screenshot, URL or simple textual info but was often done to help complete an overarching task or make joint decisions on day to day things, for example where to eat for dinner?

However, all of the above studies were conducted in relatively small-scale settings, without the data to show larger patterns of use. Thus while existing literature has revealed insights into mobile communication practices and more recently the sharing (and discussing) of media via mobile phones, link sharing within messaging apps is not something that researchers have investigated explicitly at a larger scale to identify larger patterns of use. We set out to study this behavior through a mid-scale user study and to derive compelling design implications for new systems that support link sharing.

**MOBILE WEB USE STUDY**
In order to answer our research questions around the current use of the mobile web, we conducted an online study in May 2015 to collect multi-month mobile web histories.

**Method**
The study was conducted through an online crowdsourcing platform, with 187 diverse participants from around the United States taking part. After agreeing to a consent form approved by our institution, which included specific examples of the data that we were collecting, participants downloaded a small Android application to their phone. This application retrieved the user’s full browser history, their browser bookmarks, and a list of their installed apps along with some metadata about their device (e.g. device manufacturer, model, Android version). The history included any activity in Chrome or the Android browser, including links from Twitter, email, and SMS. All information was sent to our server via HTTPS with an anonymous ID, and each participant was given a code when this upload completed that they could enter into the web-based survey to continue.

After uploading their data, we checked its validity and directed participants to a final screen where they provided general demographic information and received a completion code so that they could be paid for their time. The survey took an average of ten minutes to complete, and participants were compensated for their time at a rate roughly twice the federal minimum wage.

**Participants Demographics**
Our 187 participants comprised a diverse and fairly representative sample of the Android-owning adult American population. Full demographic detail was provided by 170 participants. They ranged in age from 18-65+ (28% between 18-25, 45% 25-34, 21% 36-45, 5% 46-64, and 1% 65+), 58% were male, and 25% had completed college (compared to a US average of 23.1%). They resided in 39 different states across the country with 23% living in rural areas (compared to a US average of 19%).

**Results**
A total of 99,415 URLs or web page visits were collected from the browser history of our 187 participants (avg: 531.6, median: 244, sd: 921.13 per user). We found that 92.6% (or 92,107) of these were unique URLs. We collected an average of 102 days mobile web browsing data per participant (sd: 131.7, median: 81).

**Browser Visits**
Using a 30 minute session delimiter (which is in line with recent work exploring mobile search behaviors [21]), we extracted 15,137 web browsing sessions from the data. We found that most participants appeared not to rely on their browser as a primary means of accessing information. Users averaged just 1.70 web-browsing sessions per day (Median = 0.98, SD = 1.90). Almost 70% of our users (128) launched their browsers less than three times per day. The highest volume user averaged 10 browser sessions per day, however, we only had 3 days of mobile web browser history for this participant. This is in an era where Android users typically interact with applications 100 times per day.

Interestingly, 22% of all sessions involved only viewing a single web page. These are likely to be sessions where the browser is launched by another application to view a specific piece of content, such as a link from an email or text message, or a news story linked in a social platform such as Facebook or Twitter. This is an interesting category that we will discuss in more detail with our second study below.

We found that search was consistently used by our participants with over 28% of mobile web sessions (4,280) involving at least one search query. In other worse, almost one third of web browsing sessions were in fact search sessions. This is lower than previous findings by Tossell et

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1 Yahoo Aviate Infographic, See: http://yahooaviate.tumblr.com/post/95795838933
al. who report a query rate (volume of search sessions) of 56% among their iPhone participants [23]. Our participants issued a total of 14,559 search queries in their web histories (9,066 of which were unique). We identified four search engines in our participants’ mobile browsing logs (Google, Bing, Yahoo & DuckDuckGo), with the majority of queries (> 82%) being issued via Google (the default search engine on Android devices). Data for other search engines can be seen in Table 1.

However, search sessions are generally more than a single query. Users often reformulate their queries to find the information that they are looking for. We found an average of 3.4 queries per search session (Median: 2, SD: 5.64) in our data. Figure 1 shows the distribution of queries across search sessions and highlights that the majority of search sessions contained 4 or fewer queries (84%). This is in line with prior work. For example, Tossell et al. [23] found that 85% of sessions contained 4 or fewer queries.

<table>
<thead>
<tr>
<th>Search Engine</th>
<th># Queries</th>
<th>% Queries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google</td>
<td>11,972</td>
<td>82.23</td>
</tr>
<tr>
<td>Bing</td>
<td>2,568</td>
<td>17.64</td>
</tr>
<tr>
<td>Yahoo</td>
<td>18</td>
<td>0.12</td>
</tr>
<tr>
<td>Duckduckgo</td>
<td>1</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Table 1. Distribution of search queries across search engines

We were interested in the time that participants spent in their browser in each session. While the mean length of a browsing session was just less than 9 minutes (514 seconds), the median was much shorter, at 50 seconds due to some very long sessions (SD= 1126.3 seconds). When we compare search sessions (sessions in which the user executes at least one search query) and non-search, browsing-only sessions we see some interesting differences. Specifically, search sessions are almost three times longer in terms of duration, (15.1 minutes on average, compared to 5.9 minutes on average for browsing-only sessions). While this is in line with prior work which shows that web sessions involving search tend to be longer in terms of duration, we see that overall time per session has increased. For example, prior work by Tossell et al shows an average mobile browsing session duration of under 2 minutes [23]. More recent work by Song et al. highlights a mobile search session length of session duration of 7.62 minutes, under half of what we found in our current study. Some of this increase may be due to shorter tasks now being a part of frequently used apps, which have much shorter average durations of use. Searching for an address in a Maps application, or taking a quick peek at your Facebook newsfeed are now much more easily done in applications.

We also explored the types of webpages our participants visited by looking at the top domains. The table below lists the top 20 domains visited, which account for greater than 44% of all browsed webpages. Ignoring the MTurk related sites, seven of the top ten domains match top mobile websites from the general US public, showing that this data set is not wildly dissimilar from the general US mobile browsing trends.

<table>
<thead>
<tr>
<th>No</th>
<th>Domain</th>
<th># Freq</th>
<th>% URLs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><a href="http://www.google.com">www.google.com</a></td>
<td>12876</td>
<td>13.0</td>
</tr>
<tr>
<td>2</td>
<td><a href="http://www.mturk.com">www.mturk.com</a></td>
<td>8143</td>
<td>8.2</td>
</tr>
<tr>
<td>3</td>
<td>m.facebook.com</td>
<td>4106</td>
<td>4.1</td>
</tr>
<tr>
<td>4</td>
<td><a href="http://www.amazon.com">www.amazon.com</a></td>
<td>3096</td>
<td>3.1</td>
</tr>
<tr>
<td>5</td>
<td><a href="http://www.bing.com">www.bing.com</a></td>
<td>2779</td>
<td>2.8</td>
</tr>
<tr>
<td>6</td>
<td><a href="http://www.pogocheats.net">www.pogocheats.net</a></td>
<td>1603</td>
<td>1.6</td>
</tr>
<tr>
<td>7</td>
<td>en.m.wikipedia.org</td>
<td>1345</td>
<td>1.4</td>
</tr>
<tr>
<td>8</td>
<td>mail.google.com</td>
<td>1338</td>
<td>1.3</td>
</tr>
<tr>
<td>9</td>
<td><a href="http://www.reddit.com">www.reddit.com</a></td>
<td>1284</td>
<td>1.3</td>
</tr>
<tr>
<td>10</td>
<td>m.imdb.com</td>
<td>990</td>
<td>1.0</td>
</tr>
<tr>
<td>11</td>
<td>mturkforum.com</td>
<td>989</td>
<td>1.0</td>
</tr>
<tr>
<td>12</td>
<td>m.xhamster.com</td>
<td>840</td>
<td>0.8</td>
</tr>
<tr>
<td>13</td>
<td>m.liketwice.com</td>
<td>697</td>
<td>0.7</td>
</tr>
<tr>
<td>14</td>
<td>t.co</td>
<td>674</td>
<td>0.7</td>
</tr>
<tr>
<td>15</td>
<td>m.mysanantonio.com</td>
<td>610</td>
<td>0.6</td>
</tr>
<tr>
<td>16</td>
<td>m.youtube.com</td>
<td>572</td>
<td>0.6</td>
</tr>
<tr>
<td>17</td>
<td>yoyoexpert.com</td>
<td>544</td>
<td>0.5</td>
</tr>
<tr>
<td>18</td>
<td><a href="http://www.inboxdollars.com">www.inboxdollars.com</a></td>
<td>511</td>
<td>0.5</td>
</tr>
<tr>
<td>19</td>
<td><a href="http://www.facebook.com">www.facebook.com</a></td>
<td>418</td>
<td>0.4</td>
</tr>
<tr>
<td>20</td>
<td><a href="http://www.pornhub.com">www.pornhub.com</a></td>
<td>397</td>
<td>0.4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>43,812</td>
<td>44.1%</td>
</tr>
</tbody>
</table>

Table 2. Top 20 Domains in terms of number of visits.
Revisitation Behaviors
Prior work has analyzed web page revisitation behaviors on both desktop [18] and mobile [23]. These papers have computed and compared so called revisitation rates across web pages (i.e. URLs) as well as sites (or domains, such as visits to any page on google.com). Revisitation rates are defined as follows:

\[
\text{Revisitation rate} = \frac{\text{total visits} - \text{unique visits}}{\text{total visits}} \times 100\%
\]

Where, total visits can refer to total number of web pages or total number of distinct domains and unique visits is the total number of distinct web pages visited or in the case of domains, the total number of distinct domains visited. Using this formula we find a web page revisitation rate of < 0.6% (averaged across all participants). In fact we find that web page revisitations rates were all < 32% for a given participant. Domain revisitation rates were higher, averaging 70% across all participants. Thus the revisitations rates found in our study are significantly lower than the rates found in prior work. See the details in Table 3 for a full comparison.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Device Type</td>
<td>Android</td>
<td>iPhone</td>
<td>PC</td>
</tr>
<tr>
<td>Web page</td>
<td>0.56% (0%-31%)</td>
<td>25.3% (13%-41%)</td>
<td>45.6%</td>
</tr>
<tr>
<td>revisitation rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domain</td>
<td>69.4% (0%-95%)</td>
<td>90.3% (86%-97%)</td>
<td>70%</td>
</tr>
<tr>
<td>revisitation rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>URLs/Visits</td>
<td>99,415</td>
<td>112,083</td>
<td>137,272</td>
</tr>
<tr>
<td>Unique URLs</td>
<td>92,107</td>
<td>7,672</td>
<td>65,643</td>
</tr>
<tr>
<td>Users</td>
<td>187</td>
<td>24</td>
<td>25</td>
</tr>
</tbody>
</table>

Table 3. Comparing web page revisitation rates across studies

Discussion
The overall drop in mobile web use and revisitations can likely be attributed to the rise of app use, and an overall reduction of mobile browser use as reported by Flurry [14]. Users are increasingly turning to applications such as Yelp for restaurant recommendations and reviews, Google Maps for finding businesses and navigation, and Facebook for sharing photos and updates. While these activities might have traditionally been done on the mobile web, the rich interactions afforded in native applications have moved much repetitive behavior into purpose-built applications.

The drastic changes not only in total amount of use, but in revisitation patterns is the most interesting to us. The older “portal” model of the mobile web has decreased drastically since Tossell et al.’s work just four years ago [23], however people are still visiting the mobile web many times per week. The shorter non-search sessions to unique pages likely represent news articles and other web links from applications such as Facebook or Twitter, since users are unlikely to directly type in a long content URL.

However, one other source of links in people’s lives is mobile messaging. In a variety of studies over the past few years, we have heard participants frequently discuss sharing links to yelp pages, map directions, videos, and news content with others on their mobile phones. These shared links, over older mobile browsing behaviors, are becoming a main platform for people to learn about online content. However, as mentioned above, there is relatively little work studying them in detail. To further explore the links people share, and their role in mobile web use today, we conducted a second study.

LINK SHARING STUDY
While we observed a steep decline in mobile web use compared to previous work, anecdotally we were seeing people repeatedly talking about sharing links via SMS in other studies that we have been conducting. We were quite interested in the content of these messages as well as the purposes for sharing links in the context of this declining mobile web usage.

To explore research questions around the content, purpose, and frequency of sharing web links in mobile messaging, we conducted a separate study with 100 diverse participants from throughout the United States.

Method
The study was conducted online with 100 participants through a popular crowdsourcing platform, Amazon Mechanical Turk. Participants ranged in age from 18 to 65+ years old. We had a mix of genders (66 Male, 34 Female), geographic locations (representing 33 states in the U.S.), and device usage (46% iOS devices, 54% Android devices). Previous work [4] has shown that MTurk can provide samples as diverse as many much more expensive professional survey platforms and is suitable for research of this type.

In order to capture actual past behavior, uninfluenced by our study, we asked study participants to search for “http” in their messaging apps and to find the last three links that they shared. Participants were then instructed to upload screenshots with the shared links in focus. Figure 2 shows some examples of the screenshots collected and uploaded by the participants. Specific instructions were included for the default text messaging apps on iOS and Android, as these remain the most frequently used messaging apps in America, far ahead of other messaging apps that might be popular in other countries, such as WhatsApp [5]. After uploading the three screenshots, participants reflected on each of these shared links by answering the following questions for each:
When did this conversation occur?
Where were you when it happened?
What type of link was shared?
Who did you share it with? What is their relationship to you?
Why did you share this specific information? Tell us the story of the event
How did your friend respond to the information being shared? Please summarize the conversation
Was there any follow up (for example choosing a venue to go to, buying something, etc.)? What did you do?

These questions were designed to get as much qualitative detail as we could from an online study, similar to questions that we would have asked when probing about specific incidents in an in-person interview. At the end of the survey, participants were asked about the types and frequency of messaging applications they use, supplied demographic details, and were given a completion code to enter into the Mechanical Turk website to get paid.

Participants uploaded and reflected on 306 links they had shared on their mobile devices. Figure 1 shows three examples of the screenshots that we collected in the study. Participants took an average of 15 minutes to complete the survey and were compensated $3, well above the average wage on Mechanical Turk for survey-based tasks.

We gathered all qualitative responses for the seven questions asked and printed them as post-its to use in our analysis. We grouped similar notes together to form subgroups and themes under each of our main research questions. The qualitative sections below will highlight each of these themes by combining both the quantitative and qualitative data to support each research question.

**FINDINGS**

In this section we will discuss people’s use of mobile devices to share links focusing on three main themes. First, we address the types of links that people share on their mobile devices and the types of people with whom they share. We then explore the reasons for sharing these links and finally report on the follow-up actions that are triggered by this link sharing. A summary of all of the categories of links that were shared can be found in Table 4, along with example quotes from each category.

**What types of links do people share on their mobile devices and with whom?** We found that video represented the most common category (28%) of links shared on participants’ mobile devices. This was followed by coupon/shopping (17%), articles (17%) and humor (9%). Table 5 explored the complete list of types of links people shared on their mobile phones. Among the various types of links shared, the top domains were YouTube (24%), imgur (6%) and Facebook (5%). We found that people shared similar number of links with friends (49%) and family (46%).

**Why do people share links on their mobile phones?** People had a variety of reasons to share links with others from their mobile devices. Some of the key reasons include sharing because certain topics/content reminded them about certain people (28%), for example: “Shakespeare's Pizza in our college town is temporarily closed and being demolished...
<table>
<thead>
<tr>
<th>Category</th>
<th>Description/Example</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
</table>
| 1. I saw this and thought of you / I know you’re a fan of… | “She is a royals fan so I thought she would like to read it”  
“I wanted her to see this idea for a terrarium because I am becoming very interested in making them”  
“To show her this guy’s crazy video game room renovation since she likes to play Skyrim” | 86 | 28% |
| 2. We were talking about this topic, and I came across something related | “She was talking about being hungry, the image went along with it as a joke”  
“We were talking about KH3 before and I linked him a topic showing some of the gameplay and art”  
“We were talking about how the NY Rangers were in the nhl playoffs and I came across a funny video of one of their fans so I thought I’d send it since jane would think its funny” | 40 | 13% |
| 3. I wanted to improve your mood / make you laugh | “She knew I was having a bad day, so she sent me something happy”  
“I sent this as a funny way to tell her I was ready to see her”  
“It was shared because of it’s humor” | 39 | 13% |
| 4. I want to do something with you | “A drawing parodying the Jurassic World, which we are planning to go see together”  
“I originally sent her the link, and this is the updated search she sent me back with different prices for a hotel in orlando. we are thinking of planning a trip to disney for new years next year”  
“We were looking for a place to eat. We wanted sushi. The place I sent had good reviews and I wanted to try it” | 35 | 11% |
| 5. People asking for specific information or to do a specific thing | “He wanted to see where I bought the shirt that I had just ordered”  
“I needed her to pay my hospital co pay from when I got shot”  
“She had asked for a link to the churches podcast page” | 24 | 8% |
| 6. I found this content to be interesting/exciting | “I wanted them to see a weird duck ad I found”  
“I thought it was an interesting and amusing story. I'm always interested in how different celebrities react to political campaigns”  
“It's an interesting story of how they got out of the prison with power tools” | 15 | 5% |
| 7. You’re in the market for | “He's been looking for guitars for Rock Band so I sent him a link to a relatively cheap one”  
“She is looking at apartments and we're comparing how close together we'd be if she moved there”  
“She is in the market for a kayak and we just purchased one” | 14 | 5% |
| 8. Reciprocal sharing | “I shared with her a buzzfeed article about things to do in your 20s and she sent me the follow up for books to read in your twenties”  
“I showed him a disturbing picture, and he sent me another one back. Then we shared banter about how much we disliked it”  
“She asked me what I thought of a song and I responded by sharing a like to a song I thought sounded similar” | 10 | 3% |
| 9. Coupons / Prizes | “The link to the coupon was to win a free pizza. It was a flash promotion which I knew would go quickly and so I texted my sister as this would be the fastest way to get her the information”  
“They wanted my referral code so I sent them the link”  
“Special offer from them [restaurant]” | 9 | 3% |
| 10. I want your opinion | “Wanted his opinion on a fishing kayak for my husband. Brian has a fishing kayak and we have not purchased this type of boat before so we were looking for his thoughts / opinions”  
“He started a company up and wanted me to check it out”  
“I wanted to get his opinion on a city pass for our vacation” | 9 | 3% |
| 11. Something about my life/personal news/personal events | “Was bored and wanted her to see new art prints I bought for my house”  
“To show them my dogs instagram and to get them following, they were curious about my new pup”  
“It was a video of my son dancing and watching tv [sent to grandparents]” | 7 | 2% |
| 12. Here’s something related to an inside joke we have | “We always had an inside joke between us about ‘Dingo ate my baby’”  
“It was a link for a disgusting cheeto recipe, it's an inside joke”  
“I had walked out to my roommate's room and he yelled 'Go away! Batin'” | 6 | 2% |
| 13. People sending links to themselves | “I did not share the message with anyone else”  
“I didn’t share” | 5 | 2% |
| 14. Others | “it was a spam link” | 4 | 1% |
| 15. I made this for you | “It was a playlist I made for her” | 2 | 1% |
| 16. Businesses sharing with their customers | “They [phone carrier] shared it with me. I ran out of streaming” | 1 | 0% |

**Table 4: Categories of reasons for sharing links, with examples, from the study.**
for a renovation. Iconic place," or a conversation in the physical world triggered them to share specific links (13%), example: “We were talking about this silly billboard we saw and how it made no sense, I found an article/blog about it making absolutely no sense," or simply sharing to improve the mood of the recipient (13%), example: “She knew I was having a bad day, so she sent me something happy.” Sharing links also happened as a way to propose activities that people could do together (11%), “We were in the process of looking for movies to watch later in the week. So I shared a movie I thought was hilarious.” In other cases, participants were asking for specific information or asking someone to do a specific thing (8%), “My mom wanted to see the Cabela’s ad and look for a good deal. She just asked me if I could forward the link.” Further examples can be found in Table 4.

Where were people when they shared the links? Although smartphones are mobile devices, we found that most people shared the links when they were at a stationary location such as home (79%) or work (16%). This is similar to other studies addressing the places of more general mobile device use. [17] Very few people (2%) reported sending messages while they were in transit, walking or driving.

What kind of follow up actions are triggered by shared links? Consumption of the content was often the only action that took place after sharing a link. A majority (67%) of the time these links did not trigger any follow-up actions. When these links triggered actions, they often (18%) took place in the real world, as one participant said “We decided to go to the bar afterwards.” Only 13% of the time, they resulted in an online transaction or an action in the virtual world, “He started playing on the site that I gave him so I guess that counts.”

**Table 5. The categories of information that were shared via links in the messages capture as a part of our study.**

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video</td>
<td>83</td>
<td>28%</td>
</tr>
<tr>
<td>Coupon/Shopping</td>
<td>52</td>
<td>17%</td>
</tr>
<tr>
<td>Articles</td>
<td>51</td>
<td>17%</td>
</tr>
<tr>
<td>Humor</td>
<td>27</td>
<td>9%</td>
</tr>
<tr>
<td>Blogs/Social</td>
<td>21</td>
<td>7%</td>
</tr>
<tr>
<td>Local/Venues/Maps</td>
<td>14</td>
<td>5%</td>
</tr>
<tr>
<td>Jobs</td>
<td>12</td>
<td>4%</td>
</tr>
<tr>
<td>Travel</td>
<td>8</td>
<td>3%</td>
</tr>
<tr>
<td>Recipes</td>
<td>8</td>
<td>3%</td>
</tr>
<tr>
<td>Gaming</td>
<td>8</td>
<td>3%</td>
</tr>
<tr>
<td>Facts/Health</td>
<td>6</td>
<td>2%</td>
</tr>
<tr>
<td>Charity/Church</td>
<td>4</td>
<td>1%</td>
</tr>
<tr>
<td>Sports</td>
<td>3</td>
<td>1%</td>
</tr>
<tr>
<td>Search Results</td>
<td>2</td>
<td>&lt; 1%</td>
</tr>
</tbody>
</table>

**Table 6. Actions taken after receiving a link.**

<table>
<thead>
<tr>
<th>Action</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Followup</td>
<td>204</td>
<td>67%</td>
</tr>
<tr>
<td>Real World</td>
<td>56</td>
<td>18%</td>
</tr>
<tr>
<td>Online/Virtual</td>
<td>41</td>
<td>13%</td>
</tr>
<tr>
<td>Not Reported</td>
<td>4</td>
<td>1%</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Our findings highlight mobile link sharing as a common activity and point to the categories of video, articles, and deals/shopping as the main type of links that are shared. Sharing links is a common way to converse around topics of shared interest, and often spark topics for further conversation or action in-person.

However, the current link sharing experience is fairly arduous. Often, to get a link into a mobile messaging app one must copy and paste a URL from a website or app, and then switch tasks to the messaging app, find the person that they want to share with, and then paste the link. The fact that we observed the volume of mobile messaging that we did speaks to the large value seen in sharing links.

When a recipient receives a link, the experience is also jarring. There is no context as to the content of the destination page, and clicking the link launches a new application, the browser, from which it can be difficult to navigate back to the message. It is difficult to continue the conversation and browse the content of the page at the same time. This highlights several design implications for mobile messaging apps and browsers.

**Sharing Beyond the Blue Link**

Blue links can only tell the recipient so much information. And in SMS, that is all that gets shared. Newer messaging applications that are more common in Europe and Asia such as WhatsApp or Line share a bit more context such as the title of the page and a thumbnail. However this is often not enough to be able to view and fully appreciate the content. Jumping out of the messaging app to the browser is generally required.

However, we envision a system where the actionable information is shared directly in the “link” message itself. For a restaurant, Yelp information such as the address, rating, and reviews might be shared. For a video, the playable video might be included. For an article, perhaps the first few paragraphs of the lead which convey the essence of the entire piece could be automatically shared. We see an increase in the number of people sharing screenshots, in studies such as Chen et al. [6] and other work in our lab. We would like to avoid this complex behavior, which requires a good deal of technical savvy, and allow for the most relevant content to directly appear when sharing a “link.”
Simultaneous Browsing and Messaging
With the growing screen size of mobile devices, the entire screen is often not needed to view a video or webpage. We envision mobile messaging applications or browsers that allow content consumption and communication to occur simultaneously. Shamma et al’s Zync [20] was an early example of this type of system on the desktop, however later messaging systems lost this functionality. On a modern smartphone, the top half of the screen can easily hold the content from a link, which is playable, scrollable and fully functional. The bottom half of the screen could carry on the messaging. Alternately, messaging could occur on top of the shared content, similar to Yahoo’s LiveText application, which shares selfie video while text messaging. This is not a concept we have seen for non-video content and could allow for explicit positioning of content on a shared screen while communicating via text (or voice) in the same view on a mobile device.

LIMITATIONS
While these findings have allowed us to gain a very deep level of insight into the daily practices of mobile web use and link sharing from hundreds of individuals, there are a few key limitations that we would like to highlight.

For the mobile web history study, our participants were all Mechanical Turk users. This represented a portion of their mobile web use that would not be present in a typical dataset of US consumers. However, we would argue that most people have their hobbies and unique set of webpages that they might visit for their interests. Also, seven of the top ten non-Turk websites that our participants visited were also in the top ten from ComScore, highlighting the generalizability of much of the browsing behavior that we captured. Along other demographics, our participants were typical Americans in terms of education and urban/rural split.

A main hypothesis that drove our work – that users were moving to Apps and away from the mobile web could not be directly quantified with our data for our participants. Because we used a one-time data collection technique, we were not able to directly measure app use over time. This is not something for which the Android operating system logs historical data. However, work such as that from Flurry [14] validates this hypothesis from hundreds of millions of users.

Finally, while our mobile web study captured hundreds of days of data, the link sharing study only asked participants for the most recent three links that they had shared. Therefore, there may be temporal patterns in our data that would not be present at other times of year. The study was conducted in the late spring/early summer, so travel-related links may be over-represented. It was also the height of summer movie season, so links to movie trailers might also be over-represented while links to shopping and school-related tasks, such as viewing children’s grades, might be under-represented. Regardless, we find this snapshot to be incredibly interesting, and the largest collection of mobile web links that we have seen published to date.

CONCLUSION AND FUTURE WORK
The findings from these two studies highlight the importance of conducting HCI field work repeatedly as practices change over time. The mobile web usage observed by Tossell et al [23] just three years ago bares little resemblance to today’s mobile web use behaviors due to the rapid rise of mobile apps and declining mobile web use. Link sharing in mobile messaging, now a major activity employed regularly in daily life, is a relatively new practice that had not previously been studied in detail, mostly small-scale messaging studies.

Our link sharing study also raises further questions for future work on understanding the use of shared media as a part of larger conversations in messaging applications - what does a typical SMS or messaging network look like? How does the number of messages change from family to friends to significant other? What entities (like restaurants, venues, train/flight information etc) are present in these messages? How are these entities shared and discussed? How is media consumed in parallel with the conversations that emerge?
These questions, and data from this study, suggest there is value in exploring conversation-based media consumption experiences, especially as current messaging applications do not support this functionality without resorting to painful copy and paste and task switching between browsers and messengers. Our work has provided clear design implications and opportunities to make mobile messaging applications better fit into the lives of our users.

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REFERENCES


