# Scraps: Enabling Mobile Capture, Contextualization, and Use of Document Resources

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## ABSTRACT

People often capture photos or notes from their phones to integrate later into a document. But current mobile capture tools can make this hard, with the captured information ending up fragmented and decontextualized. This paper explores how to help document authors capture, contextualize, and use document-related information. A survey of 66 information workers reveals that document-focused information capture differs from other types of mobile information capture, and that while people capture a broad range of information types while mobile, most document-related capture comes in the form of photos, notes, and bookmarks. Based on this survey we built Scraps, which consists of two parts: 1) a mobile app that makes it easy for people to capture and add context to information from their phone, and 2) a Word sidebar that helps them later link that information to a document on their desktop. In a field study with 11 information workers, we find that Scraps streamlined the process of capturing and using document-related information, and enabled people to focus on writing over integrating captured information.

## CCS CONCEPTS

• **Human-centered computing** → **Interactive systems and tools**; **User studies**.

## KEYWORDS

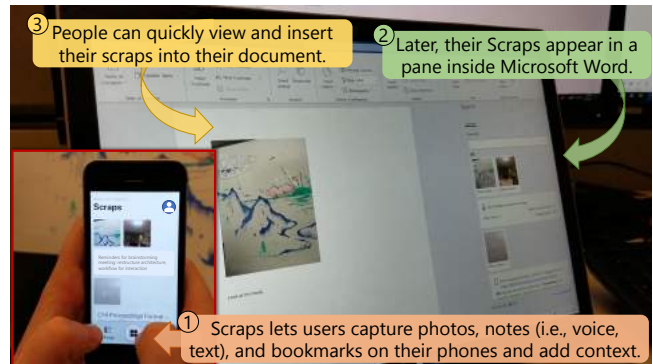mobile, microtask, writing, information scraps

Figure 1: Scraps users can: 1) capture scraps (e.g., photos, notes, bookmarks) and add context on the go. 2) When writing a document, their Scraps appear in a pane in Microsoft Word where they can quickly view and 3) insert them into the document.

## 1 INTRODUCTION

Smartphones make it easy for people to capture time and location-specific resources to later use in a task completed on a desktop environment. For example, an information worker may take a whiteboard photo on their phone during a meeting and use it later in a technical document created on a desktop [13, 46]. A student may take pictures and notes to use in a college application essay, or an interface designer might capture some inspirational images on-the-go to use later in a design mockup. The common underlying scene across these scenarios is that they require quick mobile *capture* (e.g., of photos or notes), organization and *contextualization* of information, and *use* of the information in a desktop environment.

Currently, when capturing information on mobile devices, people use a variety of apps (e.g., a built-in camera or notes app [32, 35]). However, the use of decentralized apps can result in information for a single task becoming fragmented across applications or forgotten about [35, 41]. People may need to make numerous data management decisions during capture to facilitate re-finding and use at a later time [41]. They can use commercial note-taking tools (e.g., Evernote [21], Apple Notes [30]), but such tools require linking the information with a specific note potentially making it difficult to find and reuse the information later in another document. Other

tools (e.g., Google Keep [27]) do not allow organization of and adding contextual details to captured information. Because of its universality, people may use email for capture (e.g., reminders, notes to self) [11], but this can lead to data fragmentation [7, 9, 34, 35] and an overloaded inbox [41].

To help contextualize captured information, especially if there is a delay between capture and use or if it will be used by others, people often also need to capture some context related to captured information to help with future recall. In this paper, we define context broadly to include metadata (e.g., project, tags, notes), information on the situation or context of capture, or future situations and contexts for information use. Past work has shown the value of capturing the how, what, and why a piece of information was captured [24, 50]; it can, for example, aid in task resumption [10]. But external interruptions may cause people to forget to capture context [36], and the design of most default capture apps (e.g., default camera, notes) make it difficult for people to add context.

Once captured and contextualized, people may need to transfer the information to a desktop application or other device for use. If captured information is fragmented across multiple apps on peoples' mobile devices, it may be hard to find. Once found, they can use a cloud service (e.g., OneDrive) to transfer it, but these services have limitations including integration with native applications and data fragmentation across storage providers [33]. People frequently resort to inefficient transfer methods like email [41] or use commercial capture and note-taking apps (e.g., Evernote [21]). However, most of these tools do not make captured information readily available for use in other applications (e.g., a document editor).

In this paper, we study how to help people overcome these challenges using document-authoring as the study domain where the design of current mobile capture practices can require people to switch back and forth between locating the captured information from their mobile devices, and reusing information in their documents. This can potentially disrupt their writing flow. Building on past research studying the capture of information "scraps" in a desktop environment, we conducted a survey of 66 information workers to understand their experiences with mobile information capture and use, finding that (1) document-focused mobile information capture differs from general information capture, and (2) most document resources can be captured by an interface supporting taking photos, capturing links, and writing open-ended text notes. From these findings, we created *Scraps* (Figure 1) which consists of two parts: a mobile app and Word sidebar. The mobile app lets people capture heterogeneous information *scraps* (e.g., photos, links, notes) and add context to organize them. Later, when people begin to write a document, the word sidebar displays the scraps in a pane beside their document for use and easy insertion. We evaluated Scraps with information workers in a document authoring task and found that compared to their current practices, participants found Scraps to be an effective way to capture, contextualize, and use document resources.

## 2 RELATED WORK

We contextualize Scraps by discussing past work on mobile information capture, cross-device information organization, and the

challenges and architectures to enable use of captured information in other applications. We also discuss how mobile information capture relates to more complex authoring tasks, survey current commercial tools for information capture and present the novelty of Scraps compared to existing tools.

### 2.1 Information Scraps

While people use many tools to manage information (e.g, email, calendar, notes apps), much of this information exists as information scraps [8] - individual pieces of information outside a person's primary information management tools (e.g., notes to self through email, notes in different text files). Past work has categorized information scrap contents [8, 12, 25, 45] (e.g., To-Dos, calendar events, lists). Others studied the roles of information scraps (e.g., reminding, archiving, temporary storage) [8, 16], and the method of their capture (e.g., sending a self-email, taking a picture, writing a note) [8, 11, 32, 35, 43]. Information scraps can also have lifecycles and exist in different stages of use (e.g., record, transfer, maintain, complete) [18, 38].

Prior work has also studied the use of information scraps in a variety of domains including knowledge work [8, 12, 16, 18], staff and students at universities [19, 25, 38, 51], IT and technology work [9, 11, 16] as well as general use [32, 35, 43]. However, we did not find any previous studies on information scrap use specifically for document authoring. With Scraps, we are motivated by previous information scraps literature to categorize and support mobile capturing and use of "scraps" for document authoring.

### 2.2 Mobile Information Capture

Most work on information scraps focused on desktop-centric environments before mobile devices became ubiquitous, and only a few have recently studied the capturing of information scraps on mobile devices. Thakur et. al. [43] characterized the methods people use to capture work information on their phones (e.g., recording audio & video, taking notes). Zhang and Liu [51] studied the information capture methods of Chinese college students (e.g., e-mails, phone screen captures). Jensen et al., [32] classified "acquisition strategies" like opening browser tabs, sending self-addressed texts, and bookmarking webpages. Capra [19] found six methods people used just to keep track of webpages. The range of capturing methods found by previous work demonstrates the diversity of information capture tools (e.g., notes apps, camera, mobile browser). In contrast to Scraps, many of these capture methods are *storage-centric* over *task-centric*, serving as a place to store information rather than enabling a person to use the captured information later for a task.

### 2.3 Information Contextualization and Use

Because of numerous capturing methods, information can easily become fragmented across applications [7, 9, 18, 41, 47]. Prior work on re-finding has focused on the challenge of finding information captured through photos in particular, [43, 52] as they are often captured in the same collection as personal photos [14]. Whittaker et. al. [48] also found automatic photo organization schemes can be a barrier to successful retrieval.

Once information is found, people face challenges transferring it to another device [41]. Joleka et. al. [33], found that cloud storage

solutions (e.g., iCloud, OneDrive) commonly led people to use more general communication tools like email to transfer information between devices (e.g., todos, reminders, files). When people send information in self-emails, it can become lost in an inbox where most content is centered around communication between people [35]. Even after transferring it to another device, information for the same task may still be fragmented [34].

Several prior systems with some similarities to Scraps have aimed to help users overcome these challenges. A few systems focus on supporting more structured and efficient note-taking and information scrap capture [12, 45], but do not support reuse in other applications. Other work presents new architectures to link captured information [34], tasks [20], notes [12, 23], and scientific document [40] across applications and devices. Other systems link specific information types to specific usage contexts, such as linking whiteboard photos [13] to web interfaces for information workers, sketches and diagrams to source code artifacts [6] for programmers, and photos and paper notes to spreadsheets for field biology workers [50]. In contrast to prior systems, Scraps aims to support capturing of information types for general document authoring, and supporting their use in a document editor in a desktop environment.

## 2.4 Interplay between Mobile Interactions and Complex Tasks

Inherent in mobile information management is the notion of interacting in short bursts, also known as *microproductivity* [42]. Mobile devices offer affordances for microproductivity, as these devices are typically used in limited attention, limited screen real-estate scenarios. However, smooth integration of workflows across mobile and desktop devices remains to be work in progress. Recent work has shown how mobile microproductivity can help programmers curate work-related knowledge while mobile [49], capture local knowledge through brief interactions with a phone's unlock screen [44] or make meeting scheduling more efficient [22]. Microproductivity has enabled people to better leverage mobile devices to support document editing by letting them add content or triage editing tasks from their phones [5, 31], collaboratively contribute to documents while co-located [42], and do edits from a smartwatch aided by crowdworkers [39]. Recent work has investigated embedding writing microtasks into a person's social media feed [28]. In this work, we address how a mobile device can be integrated as part of a broader document authoring experience – capturing information on a mobile device to later use when writing a document in a focused setting.

## 2.5 Commercial Information Capture Tools

There are a few popular commercial apps for mobile information capture (e.g., Evernote, Apple Notes). These tools have two key *storage-centric* behaviors that prevent a seamless transition between capture and use in a document or relevant application. First, these tools do not make captured information available to be used in a document editor or other application. As such, these tools require the user to switch back and forth between multiple applications to gather resources, a major source of task disruption while focusing on a single task. Second, these tools often require users to know

where the information will be stored when they capture it. In Evernote and Apple Notes, users need to link the information with a specific note, potentially making it hard to later find and use it in a different document or application.

A more similar tool to Scraps, Google Keep [27] does present information captured on a mobile phone in a sidebar adjacent to a document so that information (e.g. notes, photos) can be easily inserted into the document without having to switch to another application. However, Google Keep does not provide capabilities to associate captured information with a specific document, thereby making all information available for all documents. Moreover, the user cannot add additional information (i.e., project, status, tags) to organize the captured information other than in an unstructured note form. The user is also not provided any automatically inferred details (i.e., date and time of capture, location) to help them remember the context of their captures. Prior work has found context to be important to enable use of information scraps after a delay [10, 24, 50]. Unlike Google Keep, Scraps users can optionally link their scraps to a document to ease the retrieval of scraps needed for a specific document, or leave them unlinked for flexible use across multiple documents.

Another key challenge with commercial apps (e.g. Google Keep, Evernote, Apple Notes) for information capture is that they currently separate gathering web results (i.e., bookmarking) from the capture experience, which is then disconnected from the document or application where the information will be used. To overcome this challenge, people can copy URLs to these tools from the browser but to use the URLs later, they may have to open the browser to remind themselves of the contents of the link. Google Keep provides a browser extension to capture bookmarks to overcome this, however, this is not available on the mobile app for on-the-go research.

## 2.6 Summary

Identifying the gap in prior work in information scraps especially in mobile devices, and current commercial information capture tools, in this research we focus on 1) understanding what is needed to support observed behaviors for capturing and reusing information scraps, using document authoring as a test bed ; 2) presenting information (e.g., photos, notes, bookmarks) along with relevant and inferred context in a primary task (i.e., document authoring); 3) offering mobile *task-centric* over *storage-centric* support for capturing and reusing information; and 4) providing a centralized place for heterogeneous information types rather than segmenting by type. Contrasting Scraps to other commercial information capture tools, we see Scraps falling at a midpoint between more structured (e.g., Evernote) and more flexible (e.g., Google Keep) information capture tools, bring some of the benefits of each in a unified experience.

## 3 SURVEY OF MOBILE INFORMATION CAPTURE

While past research on information scraps [8, 12, 16, 45] has categorized the types, methods, and reasons for information capture, these studies have not studied *mobile phone* information capture and how it relates to *document creation* and *use* of captured information in a document. As a first step in our research, we wanted to understand what information scraps people currently capture

**Figure 2: Responses to the question "How frequently do you capture this type of information on your mobile device?"**

on their mobiles devices and their practices around use as well as where friction currently exists. These insights would help identify the gaps in current mobile information management frameworks, and motivate the design for Scraps - our proposed tool for mobile information capture, contextualization, and use in a document.

To gather insights for designing Scraps, we administered an online survey by randomly soliciting participation from employees at a large technology company using a complete distribution list. Participation was voluntary. Owning a mobile smartphone was the only participation requirement.

The survey contained 3 main sections: understanding the types, methods, frequency, and use of 1) general information captured via mobile devices, and 2) information captured for document creation, and 3) methods of organizing information (e.g., notes, photos). The survey consisted of multiple choice questions, some followed by open ended questions. The length of the survey ranged from 10 to 40 questions based on branches resulting from some responses and typically took 15 minutes to complete. We provide a copy of our survey questions in supplementary materials, and at the following link: https://doi.org/10.17605/OSF.IO/9D5KY.

The survey was available for three weeks. In all, 71 people responded to the survey (46 M, 19 F, 1 Not Specified), including 57 full and 14 partial responses. As participants needed to complete a full section to count a response and sections were not interdependent; we believe there is minimal impact on results, beyond having fewer data points. Participants' job roles ranged from Software Engineers (22), Researchers & Interns (9), Program Managers (6), Directors (4), Law (4), and a range of other roles. 91 percent of participants had at least a bachelor's degree, and 53 percent had 10 or more years of experience in their job.

### 3.1 Mobile Information Capture

First, we wanted to understand the types of information and frequency people currently capture them on their mobile devices. We had people report their capture frequency of 16 *information types*, shown in Figure 2. We gathered 13 types from previous information scraps literature [8, 12, 45], and added 3 additional types (i.e., whiteboard, task, and inspirational photos) from our own observations on types people may be more likely to capture on their mobile devices and from recent literature [43, 46, 51]. Figure 2 summarizes

the frequency people capture each information type on their mobile devices, arranged by the most responses for "Very Frequently" (top-left) to the least (bottom-right). Information types with the most responses for at least "Occasionally" are Events & Reminders, Contacts, Task Photos, and Whiteboard Photos. Our survey demonstrates that information captured while mobile is different than on a desktop; the information types with the highest frequencies from our survey are different than the top information types found by both Bernstein et al. (i.e., ToDos, Meeting Notes, Contacts, How-Tos) and Van Kleek [45] (i.e., ToDo, Bookmark, Thing, Contact), which both focused on a desktop environment. In contrast to information scraps that are captured in a desktop environment (e.g., meeting notes, How-Tos), mobile captured information types appear to be items that can be quickly captured (e.g., events, contacts, photos), reflecting more common on-the-go scenarios like capturing whiteboard photos or adding a contact.

We also had the respondents report the frequency of specific methods used to capture information on their mobile devices. Methods included taking a text or voice note, creating a calendar event, taking a photo, sending a self-addressed email, sending a self-addressed text, or bookmarking a webpage or URL. Over half the respondents reported taking a photo (37 out of 56) and creating a calendar event at least weekly (33 out of 56). The respondents also reported frequent sending of self-addressed email (29), taking notes (22), and bookmarking webpages (17). These results reflect the frequency of "Information Capture and Retention for Later Use" categories found by Jones et. al. [35]. Our respondents rarely or never capture voice recordings (44 out of 56) which is similar to the results found by Jones et. al. [35].

### 3.2 Document-Focused Mobile Information Capture

In order to design Scraps to better support mobile capturing for document creation, we had participants reflect on a recent time they captured information on their phone to use in creating a document. Previous literature on information scraps [8, 12, 16, 45] has not studied information capture for document creation tasks. For the reflections, we asked participants to recall a recent instance of information capture on their mobile, and select an information type from the 16 types in Figure 2. They then answered multiple
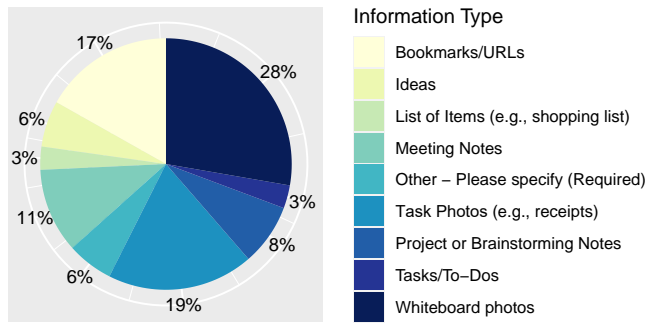
**Figure 3: The proportions of information types, from the list of 16 information types found in Figure 2, that survey respondents captured when reflecting on a recent time they captured information for a document.**

choice questions on when, how, and why they captured it. They also stated if and how they used the information later in their document. For this section, we defined documents broadly as written records composed in an editing program (e.g., Word), slideshow (e.g., Powerpoint), notes editor (e.g., OneNote), or an email editor. 71% of the respondents reported at least weekly creation of documents for their work.

**Capture**: The majority of our respondents (36) recalled a recent instance (i.e., within the last month) of capturing information on their phones for creating a document. Forty seven percent (17 out of 36) reported capturing photos (i.e., whiteboard photos, task photos), while 17% (6 out of 36) captured bookmarks (Figure 3). Nine of the remaining respondents captured unstructured text notes (i.e., ideas - 6%, meeting notes - 11%). Two respondents reported capturing screenshots of their phone screen (included under "Other").

Depending on the future task a person has in mind while capturing information, different capturing needs may arise. Examining the most frequently captured information types, compared to the proportions of information types participants recently used in a document, we see that general information types consist of contacts,

| | General Info. Capture | Document Info. Capture |
|---|---|---|
| 1 | Events & Reminders (47/60 = 78%) | Whiteboard Photos (28%) |
| 2 | Whiteboard Photos (30/60 = 50%) | Task Photos (19%) |
| 3 | Task Photos (27/60 = 45%) | Bookmarks (17%) |
| 4 | Contacts (26/60 = 43%) | Meeting Notes (11%) |
| 5 | List of Items (26/60 = 43%) | Project/Brainst. Notes (8%) |
| 6 | Tasks/To-Dos (25/60 = 42%) | Ideas (6%) |

**Table 1: The top 6 most frequently captured general (% of people capturing this information type at least weekly) and document-specific information types (Proportion of people reporting a recent capture of this information type). General information types contain document-specific information, along with general information like contacts and lists, while document information types contain document-specific resources.**

todo items (e.g., events & reminders, tasks/to-dos) and information items (e.g., whiteboard and task photos), while document-specific information types contain information for a document (summarized in Table 1). A general purpose interface to manage captured information might prioritize both to-do items and information items like those in Figure 2, while a document-specific interface (i.e., Scraps) can focus on information items for use in a document.

**Contextualization:** To gain insights for how to support organization and contextualization of captured information in Scraps, we asked our respondents how frequently they organize three captured information types (e.g., photos, notes, bookmarks). Half of our respondents never organize their photos (50%). These non-organizers reported relying on their devices' default organization, and either use search to find them later, remember where to find them, or do not need typically need to find them later. Alternatively, some respondents reported organizing their photos daily (8%), weekly (21%), or monthly (10%). Similar patterns followed for bookmarks and notes. For each information type, we found a large-group of non-organizers and more frequent organizers. Many document-focused scenarios require in-the-moment capture, and because many people do not organize their captured information, systems for information capture should provide lightweight and flexible organization & contextualization features as well as intelligence to automatically organize captured information for infrequent organizers.

**Use:** Our respondents reported both direct usage – e.g., copying a photo into the document (44%) and indirect usage—e.g., as an idea, or inspiration—(36%). They also reported using the information as reminders related to the document (8%). One respondent reported *"I captured a URL for the document by sending myself an email, adding the URL to the document, and also added a summary of the contents of the URL"*. Another respondent reported *I used the information in project planning and to follow up with a stakeholder*. Of the 36 respondents, 20 percent of them reported sending captured information through email to use it in a desktop environment.

### 3.3 Summary

The goal of our survey was to understand current practices in mobile information capture, and in particular understand mobile information capture and use in document authoring scenarios. Our survey revealed that people primarily capture a mix of reminders & communication (e.g., calendar events, to-dos, contacts) and information items (e.g., photos, notes) while mobile. For information capture related to document authoring scenarios, they primarily capture information items like photos, bookmarks, and notes, and use them directly (i.e., insert them into the document), or indirectly (i.e., as a reference or a reminder). Our survey also showed that only a fraction of people frequently organize captured information. Based on these findings, we designed Scraps to (1) support capturing bookmarks, photos, and notes - the three categories reported to be most commonly captured to supplement document authoring, (2) automatically link them back to a document editor for direct or indirect use, and (3) provide flexible and lightweight organization features. Based on prior literature [10, 24, 50], we include support for contextualization of scraps through enabling context notes that users can associate with a scrap and automatically inferring context (e.g., location, nearby landmarks).
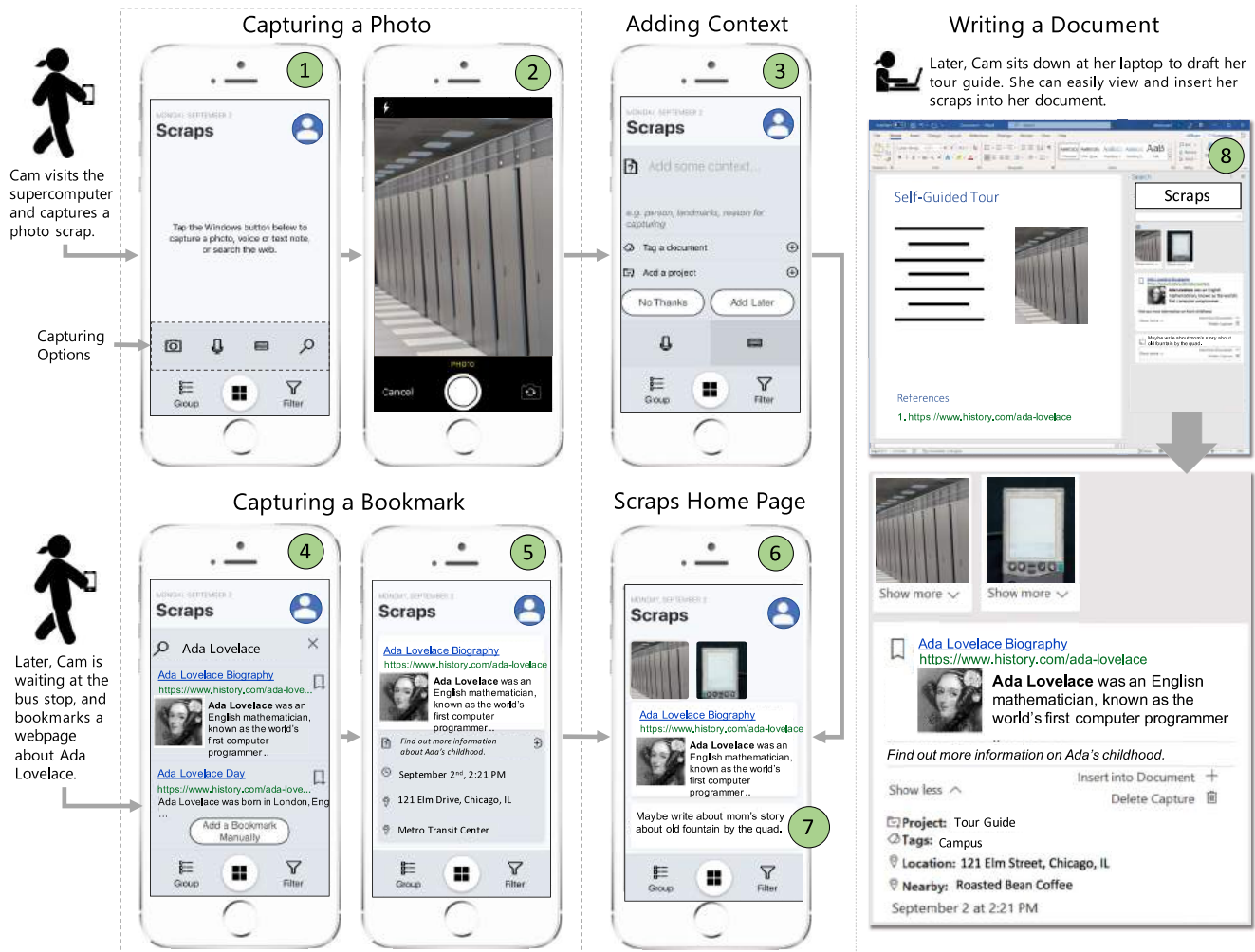
**Figure 4: Scraps users have four capturing options including photos, voice and text notes, and searching and bookmarking web results (1). Above, a Scraps user, Cam, captures a photo of a supercomputer and adds context to it (1-3). Later, she bookmarks a webpage while waiting at the bus stop (4-6). Later, she adds a text note reminder using the capturing options in (1) to include mom's story about a historical fountain on the campus quad (7). On the right (8), she later works at her laptop and sees her captured scraps in a side pane in Microsoft Word including context notes she has captured along with inferred context (e.g., location, landmarks) that Scraps has captured for her (9). She can quickly insert her scraps into the document to write about or reference them.**

## 4 SCRAPS: A TOOL TO CAPTURE, CONTEXTUALIZE, AND USE DOCUMENT RESOURCES

Based on the results of our survey and findings from prior literature, we designed Scraps (Figure 4)—a tool that enables people to capture heterogeneous information types, including notes, photos, and bookmarks, with a mobile app, organize them by adding additional context notes or organizational metadata (e.g., project, status) in a lightweight manner [8], and link them to relevant documents for use. Scraps provides a mobile app for capturing and contextualizing information, and a sidebar within Microsoft Word to enable

viewing scraps along with automatically-inferred contextual details and flexibly inserting them into the document for use.

### 4.1 A Motivating Scenario

To motivate Scraps, consider an example scenario. Cam is an admissions director at a local university, and due to COVID-19, the university will not be hosting in-person tours this year for prospective students. She wants to create a self-guided tour guide for visiting high school seniors to explore the campus on their own – or even virtually if they can't make it in person.

Cam is always on the go, allowing her to frequently collect notes and photos on her phone at different times from different locations

for her writing projects. She decides to use Scraps to capture some photos, notes, and research to use for writing her self-guided tour. While Cam is walking around the campus to brainstorm campus features to include in her tour guide, she passes the campus supercomputing facility. At a STEM university, Cam would like to emphasize that students can have access to campus computing resources. In Scraps, she taps the camera icon (Figure 4.1) which opens up her phone camera (Figure 4.2) to take a picture of the supercomputer. When she taps the circle icon to take a picture, Scraps displays a prompt for her to add a context note (Figure 4.3). She types a note of some information she sees on a sign outside the building "Send request to access resources to access@computing.university.edu." and taps "Done" to save the scrap.

A few days later, while waiting at the bus stop, Cam remembers a story she once heard about Ada Lovelace, for whom the computer science building on campus was named. She decides to include some biographical information about Ada in her tour guide. As she waits for the bus, she quickly opens Scraps on her phone and taps the search icon (Figure 4.1) to search for "Ada Lovelace" and opens a few webpages in her mobile browser to read them further. She bookmarks a webpage with biographical information on Ada (Figure 4.4), and captures an additional context note *"Find out more information about Ada's childhood".* Scraps shows her some context it has inferred automatically such as date, time, location, and nearby landmarks (Figure 4.5). In order to find this information quickly when she writes her tour guide, Cam links this scrap to a document she created on her desktop, *SelfGuidedTour.docx* (Figure 5.1). Using the grouping and filtering options in Scraps (Figure 5.2-3), Cam can group or filter her scraps by attributes like location, project name, and scrap type (e.g., photos, notes, bookmarks). On the Scraps homepage (Figure 4.6), Cam can see all of the scraps she has captured for her essay. Scraps also lets Cam capture open-ended voice and text notes by tapping the microphone and keyboard icons in the capture bar (Figure 4.1). Cam is later having dinner with her mother who attended the university where Cam works. Her mother tells her a story about how she would hang out with her friends by a historical fountain on campus which is no longer there. Without disrupting the conversation, Cam quickly captures a note in Scraps (Figure 4.7) as a reminder to include some historical information about the old campus fountain in her tour guide.

After a few days, Cam begins to write her self-guided tour on her laptop. She starts Microsoft Word and opens the Scraps pane (Figure 4.8). The pane has automatically synchronized all of her captured scraps while mobile, making them available for her to use. She can see all scraps she has collected, or filter scraps to those she has linked to her current document, *SelfGuidedTour.docx.* Cam inserts the supercomputer scrap into her document by clicking it in the pane, and writes a paragraph of information about the supercomputing facility and how students can utilize it. She writes a paragraph with some information about the computer science building named after Ada Lovelace and remembers that she has browsed some information on her mobile device a few days ago. She finds the scrap she captured about Ada, and inserts the webpage link from the scrap by clicking "Insert into Document" in the Scraps pane to add a references section. Cam can also group her scraps in the pane by project, linked document, or other attributes (e.g., location). Rather than having to go to different sources to collect the

different types of information she collected on her mobile device, with Scraps, Cam can quickly transition between writing about and integrating her captured resources without breaking her writing flow.

## 5 SCRAPS - WORKFLOW

Figure 6 shows the Scraps workflow—consisting of an iOS app for information capture, and a Word sidebar to facilitate use of captured information in a document. Scraps has three types of functionality—capturing a *scrap*, which can be a photo, voice note, text note or a bookmark, contextualizing the captured scraps with context notes and organizational metadata (e.g., project), and finally, making the scraps available and facilitating their use in a document editor.

### 5.1 Capturing a Scrap

A person captures a scrap with the Scraps app (Figure 6.1) using the provided input methods (Figure 6.2). Scraps creates a `scrap` object with the captured data (e.g., image data, text). A person can then update the scrap with optional context (Figure 4.3). The Scraps app captures several types of information when a user captures a scrap (Figure 6.3), including the scrap data (e.g., `ImageData`, `Text`), contextualization data including user captured context notes (e.g., `Note`), automatically inferred context (e.g., `Address`, `Nearby Landmarks`), and user captured organizational metadata (e.g., `Project`, `Document Links`, `Status`). Scraps converts this captured data into a JSON string and stores it in a cloud storage container (i.e., OneDrive), while it stores any image data in an Azure storage blob (Figure 6.6).

Scraps lets a person capture 4 kinds of input (Figure 6.2). First, Scraps users can capture voice input from their iPhone's internal microphone, which Scraps converts to text with a Speech-To-Text API. Second, Scraps users can capture text notes through their phone keyboard. Third, Scraps users can capture bookmarks through a searching and bookmarking interface in the app (Figure 4.4–5). The searching and bookmarking interface uses the Bing Search API [3] to retrieve search results for a person's query, and retrieves search suggestions using the Bing Autosuggest API [1]. Finally, a Scraps user can capture photos through their native phone camera, which they open by tapping the camera icon in the Scraps app (Figure 4.2). Scraps converts the photo scrap image data to a Base64 string for storage. A Scraps user can update their scraps at any time inside the app (e.g., deleting a scrap, adding projects, tags, or context notes to a scrap, changing the status of a scrap, or linking a scrap to a document in their OneDrive).

### 5.2 Contextualizing Scraps

For each scrap, Scraps automatically infers some context including a person's location, address, nearby landmarks (e.g., businesses), and the date and time the scrap was captured. Scraps also allows people to input context notes (Figure 4.3). Scraps captures the person's location using the iPhone's internal GPS sensor, which returns latitude and longitude coordinates. Scraps uses the Bing Maps Locations API [2] to convert the latitude and longitude into a formatted address string (e.g., 121 Elm Street, Chicago, IL, 12345) and to retrieve the names of nearby landmarks (e.g., businesses).

Scraps also captures some organizational metadata, which the person inputs through the "Add some context" pane (Figure 4.3).
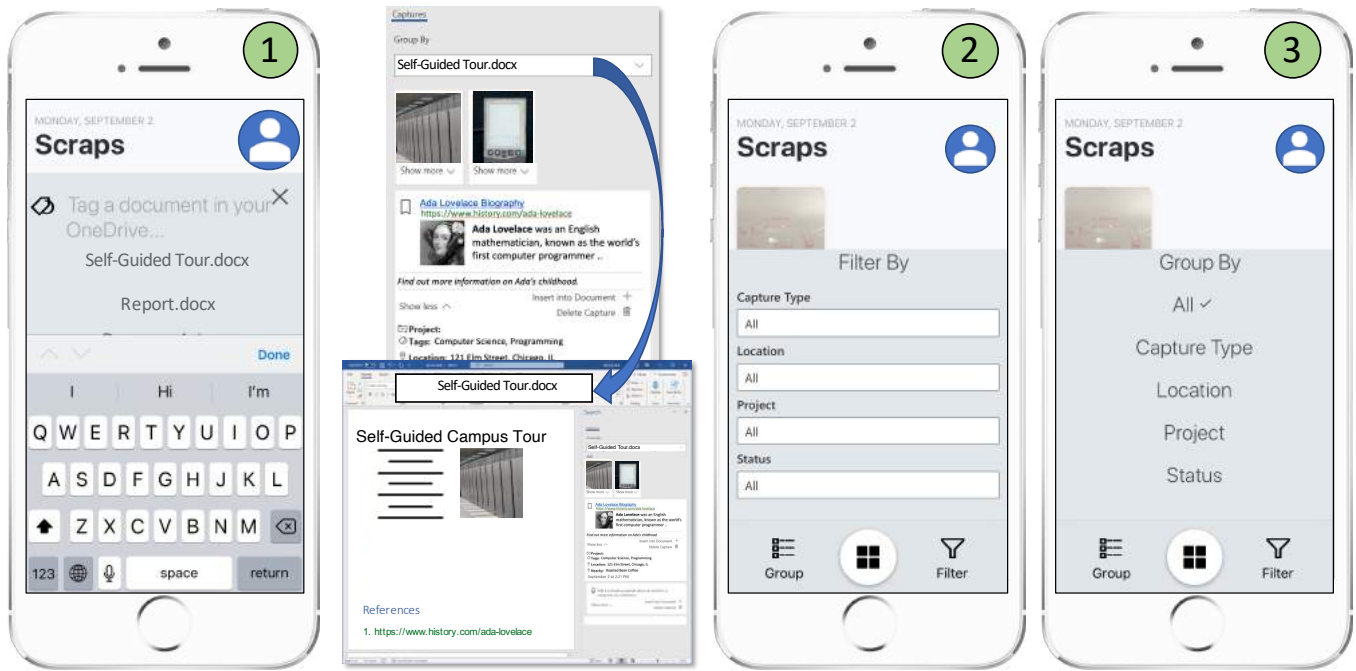
**Figure 5: Scraps lets users link scraps to a document during capture. In the sidebar, they can view scraps linked to their selected document, or see all scraps (1). In the mobile app, they can filter (2), and group (3) their scraps by type, location, project, and status.**
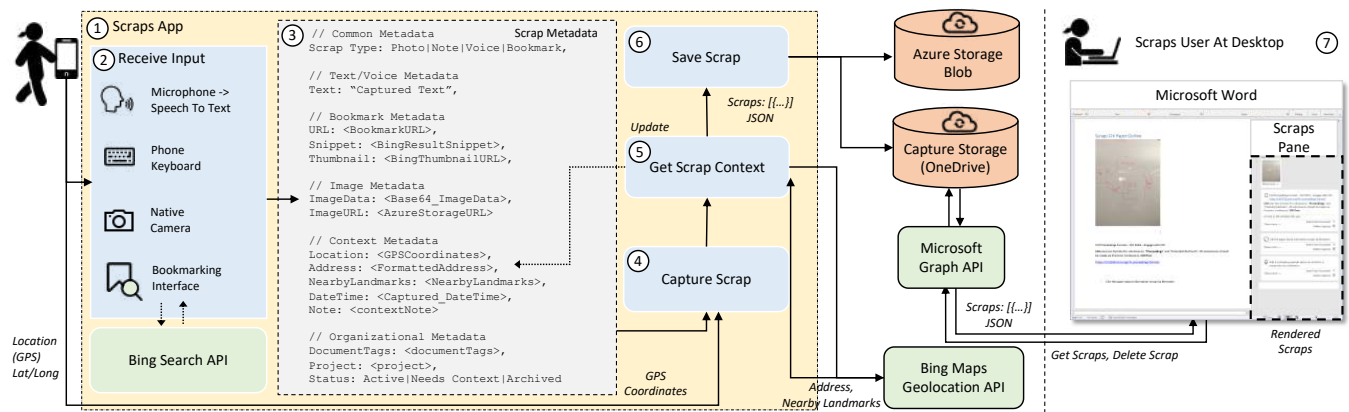


**Figure 6: Scraps tool workflow. People capture scraps through an app (1) using their microphone, keyboard, native camera, or a bookmarking interface (2). Scraps captures the scrap data, user added context notes, and inferred context (e.g., location) into a metadata object (3-5), which it stores into the person's OneDrive and an Azure storage blob (i.e., image data) (6). The desktop Scraps pane retrieves the person's scraps with a REST query to the Microsoft Graph API (7).**

Scraps includes an interface for adding projects and linking scraps to documents in the Scraps users' OneDrive. Scraps uses the Microsoft Graph API [4] to retrieve a list of the person's OneDrive documents, and provides a suggestion interface that lets them search their documents by name and add links (Figure 5.1). Each scrap also has a `Status` indicator indicating its current status (i.e., Active, Needs Context, or Archived). Scraps users can group and filter their scraps by capture type, location, project, or status as shown in Figure 5.

### 5.3 Using Scraps in a Document Editor

To use scraps in a document, a Scraps user opens Microsoft Word on their desktop and opens the Scraps sidebar (Figure 4.8). The sidebar queries their scraps, images, and metadata from the storage container and Azure blob using a JavaScript REST API. Scraps displays each scrap along with contextual details (e.g., time, location, nearby landmarks). People can insert the contents of scraps (e.g., text, images) directly into the document by clicking an "Insert into

Document" button. People can group and filter their scraps in the Word sidebar by capture type, location, project, status, or linked document. The sidebar is implemented as a JavaScript web add-in in Microsoft Word, and uses Word add-in capabilities to support insertion of scrap contents into the document.

## 5.4 Extensibility

Our broad goal is that tools like Scraps could support a variety of scenarios beyond document creation. When a person captures a scrap, Scraps creates an object with the captured data (e.g., image, text), automatically inferred and user captured context, and organizational metadata. In a generic interface, Scraps could be extended to capture other types of scraps (e.g., screenshots, tasks) by extending the Scraps metadata with additional properties specific to the added scrap type (e.g., image data, task metadata). Scraps also infers some context automatically (e.g., location, nearby landmarks); however, it should be possible to infer other types of context relevant to captured information. Scraps users can also link their scraps to a specific document for use. In a more generic interface, people could link their scraps to other document types (e.g., .ppt, .xls) to make them available to other applications. Finally, Scraps makes captured scraps available in a Microsoft Word pane. It should be possible in practice for other applications (e.g., slide editor, spreadsheet editor) to query and make the same scraps available for use as long as the application has an API to query and display scraps, and insert them when needed. Scraps could also be displayed in a separate application on a desktop outside a document editor from which they could be drag and dropped, using native APIs, into various editors. However, we believe that having scraps available in a pane inside a document editor, or other application, may enable more focus in document authoring without having to switch out of the document editing application.

## 6 EVALUATION

Our goal in evaluating Scraps was to both understand its usability and evaluate its impact on capturing, organizing, and reusing resources in a document authoring task. Therefore, we conducted an in-the-wild, first-use evaluation [29] based on current practices for evaluating cross-device interactions [17]. We investigated the following research questions:

- RQ1: What types of scraps do people **capture** with a specific writing task in mind?
- RQ2: How important is it to support **contextualization** of scraps?
- RQ3: How do people **use** scraps in their documents?

## 6.1 Participants

To evaluate Scraps, we recruited 11 information workers (7F, 4M) for a week-long study by posting flyers on our company's campus. Participants had a variety of job roles (e.g., software engineers, user researchers, managers), years in their current jobs (<1 year— 2; 1–2 years—1; 3–5 years—2; 5–10 years—3; 10 or more—3), and ages (18–64). These characteristics were coincidental based on who volunteered for the study from our company. 9 of 11 had at least a bachelor's degree. They reported regularly writing a variety of documents including: design documents (3), project descriptions (3),

research papers (2), tutorials (1), and documentation (1). As Scraps is an iPhone-only app, we required each participant to own and regularly use an iPhone. We compensated the participants with a $50 Amazon gift card upon study completion.

## 6.2 Procedure

For the study, we instructed the participants that they would be creating a one-page tour guide about a building of interest on their work campus. The guide was expected to contain descriptions of featured items in the building that visitors would find interest in. The study had two phases scheduled two days apart. In phase one, *capture*, our participants remotely installed Scraps. We instructed them to walk around inside or outside their work building and capture information with Scraps to use to create their tour guide during phase two. We told them the resources they captured would be available inside their Word document during phase two. These resources could include voice notes, text notes, bookmarks of web resources, or photos - anything that they felt could provide useful information while they authored the document later. We encouraged the participants to add contextual details if needed using the Scraps app. In phase one, they could return to the app multiple times to capture more scraps or add details to their scraps, up until phase two. In phase two, *writing*, the participants would come to the study room to use Scraps to create their tour guide document in a 30-minute writing session. To write the tour guide, we encouraged them to add detailed information for each feature of interest including a picture of each feature of interest, location, floor, statistics, facts, or other information about the feature. For context, we conducted our study prior to the 2020 COVID-19 pandemic.

## 6.3 Data Collection & Analysis

After phase two, the participants completed a 15 minute, online post-study questionnaire on their experiences and a usability evaluation using the System Usability Scale (SUS) [15]. In the questionnaire, each participant filled out an open-ended text field to describe their process using Scraps for each stage of the document-authoring task (i.e., *capture*, *contextualize*, and *use*). They then filled out a second field describing if and how that process differed from how they might have done that stage of the task without Scraps. We provide a copy of our post-study questionnaire in supplementary materials, and at the following link: https://doi.org/10.17605/OSF.IO/9D5KY.

To answer our research questions, we evaluate the types of scraps the participants captured, participants' use of context, and participants' usage of scraps in their documents (e.g., types, number, and direct or indirect usages). We qualitatively evaluated participants' open-ended responses on the process they followed for each stage of document writing using Scraps (i.e., capture, contextualize, and use), and hypothesized differences to how they might have done the task without Scraps.

## 6.4 Results

Overall, the participants gave positive feedback on Scraps and the idea of being able to easily capture, view, and insert document-related resources from a single location. Scraps also received above average usability (SUS) scores from the participants ($M = 73.86, IQR = $

| Question | S.A.(5) | A.(4) | N.(3) | D.(2) | S.D.(1) | Med. |
|---|---|---|---|---|---|---|
| I think that I would like to use this system frequently. | 3 | 4 | 3 | 1 | 0 | 4 |
| I found the system unnecessarily complex | 0 | 1 | 3 | 4 | 3 | 2 |
| I thought the system was easy to use | 2 | 6 | 2 | 1 | 0 | 4 |
| I think I would need the support of a technical person to be able to use this system. | 0 | 1 | 0 | 3 | 7 | 1 |
| I found the various functions in this system were well integrated. | 2 | 6 | 1 | 2 | 0 | 4 |
| I thought there was too much inconsistency in this system. | 1 | 1 | 3 | 2 | 4 | 2 |
| I would imagine that most people would learn to use this system very quickly | 6 | 3 | 2 | 0 | 0 | 5 |
| I found the system very cumbersome to use. | 0 | 3 | 1 | 4 | 3 | 2 |
| I felt very confident using the system. | 5 | 3 | 2 | 1 | 0 | 4 |
| I needed to learn a lot of things before I could get going with this system | 0 | 1 | 2 | 2 | 6 | 1 |

**Table 2: Number of responses for each question and median agreement score on the System Usability Scale (S.A. - Strongly Agree, A. - Agree, N. - Neither Agree or Disagree, D. - Disagree, S.D. - Strongly Disagree).**

32.5). Table 2 reports the number of responses and median agreement score for individual questions of the SUS scale.

### 6.4.1 RQ1: What types of scraps do people capture with a specific writing task in mind?

Our 11 participants captured 155 total scraps during the study, which consisted of photos (113), bookmarks (21), and notes (18). The participants only captured 2 voice notes during the study. The participants mainly captured their scraps within the first 2 hours after opening the app for the first time (103 scraps). This was likely influenced by our task prompt which instructed them to walk around and capture scraps for 30 minutes, as well as calendar invites we sent them to block off time for capturing. Three participants captured additional scraps midway through the study (around 30 hours after first opening the app).

Finally, two participants captured almost all of their scraps right before coming to the second study session as the Scraps app lost their initial scraps thus they had to capture them again right before the session. Although we did not formally study this, we hypothesize this could potentially impact these two participants' results for RQ2 by making them less likely to need to capture or use context for their Scraps. However, we don't forsee any significant impact on the results for RQ1 and RQ3.

***Capturing Without Scraps:*** We also had participants reflect on how they would have captured their scraps if they did not have the Scraps app available. Figure 7 shows the responses participants gave for the capturing methods they hypothesized using if they did not have Scraps to capture information for their documents. We let the participants select multiple answers. Our participants believe they would have used a range of different methods and applications (e.g., OneNote, Gmail, Slack - as listed in Figure 7) for capturing information for this task if they did not use Scraps. P11 mentions using built in iOS apps and a mobile browser, which may have resulted in them losing their links:

> *If I didn't use Scraps I would have taken photos with the default camera app, jot down notes in the default Notes app, open links that I wanted to keep (will probably lose them if I decided to close all tabs in the browser).*
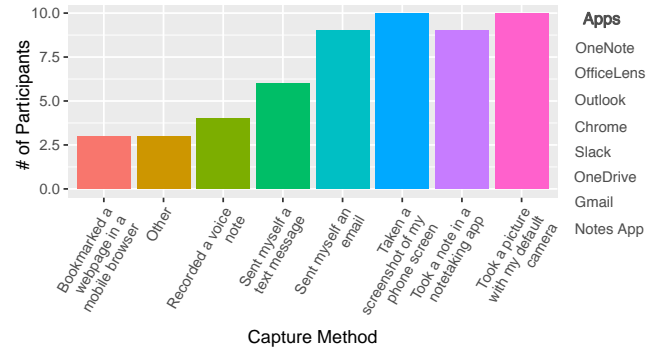


**Figure 7: Responses to the question "If you did not have Scraps, which of the following methods would you have used to capture information?", along with a list of apps (right) participants would have used to capture and synchronize information to their documents.**

### 6.4.2 RQ2: How important is it to support contextualization of scraps?

Fifty-five percent (86 out of 155) of the scraps our participants captured contained additional context notes. This was likely influenced by the Scraps app interface, which prompts people to add additional context notes to their scraps before continuing. Most people added context notes directly after capturing a scrap (80), however, a few people returned to their scraps later to capture context (6).

We also categorized the contents of each context note. These notes largely related to the participants' tour guide document task. We categorized the notes into 6 categories, summarized in Table 3. Feature names were the most common (63 notes), followed by wayfinding information (19 notes). We assigned a context note to multiple categories if it contained multiple types of information. Overall, we found that 78 percent of the scraps that contained context notes were used in the document compared with 75 percent of the scraps without context.

We also found that not only the scraps, but the context notes that were added later were also included in a document. 60 percent of context notes themselves were directly or indirectly used somewhere in the document, largely consisting of feature names (38),

descriptions of bookmark contents (7), and reminders of what to write about (4). Participants used context notes in different ways. For example, some photo scraps, rather than containing context notes, were used as context for writing about other photo scraps in the document (e.g., menu photos, cafe hours sign). P3 described using context notes as a reminder:

> *I created note reminders about what I was going to talk about, and added links in scraps which allowed me to look into the links and add more context to the resources I captured in scraps*

In the followup survey, five participants stated that adding context notes to their scraps was very important, while some thought adding context was important (4) or slightly important (2). However, when we asked them the importance of adding such notes if they were to use their scraps again in a month, nine participants thought that adding context was very important. While most participants thought capturing context was valuable, three participants mentioned they did not feel it was necessary for this task because they were familiar enough with the features of interest to remember the context (2 participants), or would have just looked up the additional details online later (1 participant).

***Context Without Scraps:*** Hypothesizing on the process they might have used without Scraps, not all participants would have captured context notes with their document-related resources. Without capturing such notes, this could mean relying on their memory to recall why they captured a resource, as described by P10:

> *I didn't [capture context]. If I was sitting in a conference talk or a seminar, I would've had the capacity to use a notetaking app. But if it was just taking photos or screenshots, I couldn't add any context. I would just hope for the best that I remember why I took the screenshot later in the day.*

Additionally, even if they did capture a context note, the context and the resource might have become disjoint. Seven participants noted that in other scenarios they would have captured context

| Description | Count |
|---|---|
| **Feature Name**—Name of a place, object, or feature with description (e.g., lobby, transit center) | 63 |
| **Wayfinding**—Information needed to locate the feature (e.g., entrance, corner of 34th and 14th) | 19 |
| **Related Notes**—Related information to the feature (e.g., you can find technical support here) | 11 |
| **Link Descriptions**—Describing the contents of a link (e.g., website for finding cafe menus) | 11 |
| **Reminders**—Reminder of something to write about (e.g., talk more about the cafes) | 5 |
| **Undetermined**—We were unable to determine the meaning of the content | 4 |

**Table 3: The categories, descriptions, and counts of the contents of additional context notes associated with scraps. A single context note can be included under multiple categories.**

notes in a separate application (e.g., notes) from the resources (e.g., photos), as described by P6.

> *Typically I would be capturing context in a separate application from the picture/resource itself. So the info/context would necessarily be disjoined from the resource. I think I would be systematic in the same way, though. I would probably still do it "linearly" and in sequence, as above. The info would just be captured in different places.*

A story mentioned by P10 also reflects how people may capture context notes disjoint from the information. While P10 was on vacation last year, a tour guide was pointing to wildlife and mentioning facts about them. She took pictures of the animals using her default phone camera and jotted down notes about the animals in a separate notes app. When she returned home, she wanted to write about the experience. However, the notes she took on the tour were mixed in her other vacation photos making it difficult for her to link her notes from the tour with her photos to write about them. She felt that Scraps would have been useful in this scenario to keep her context together with her captured photos.

*6.4.3 RQ3: How do people use scraps in their documents?*
Participants estimated they used 60 to 80 percent (4) or 80 to 100 percent (5) of their scraps in their documents. Examining their documents, their estimates reflected their actual usage (79 percent). They used 80 percent of scraps directly in the document (i.e., links, photos) while they used 20 percent indirectly (i.e, information mentioned in the scrap was in the document). Some users did not use photo scraps directly, instead using them as context for other scraps they used directly (e.g., menu photos, cafe hours). Note that indirect usages may not mean the participant used the scrap as we cannot know for sure whether the scrap reminded them of the information or they already remembered it. Participants mentioned not using some scraps because they were redundant (4), they were no longer relevant or necessary (5), or they didn't have enough time to use them (1).

As we did not have baseline data on documents written without Scraps, we did not evaluate the quality or comprehensiveness of the tour guide documents. Instead, we evaluated basic statistics on the contents of each document. The documents contained 394 words on average (SD = 162) while the largest and smallest word count a tour guide document contained were 776 words and 194 words, respectively. Participants mentioned an average of 6.1 landmarks (min: 3, max: 9, std: 2), inserted an average of 7 photos (min: 1, max: 12, std: 3), and 2 links (min: 0, max: 5, std: 1.6). A majority of the participants (5) inserted only photo scraps into their documents.

***Integrating Resources With Scraps:*** Seven participants mentioned it was useful to have the collected resources appear automatically next to their document. Most participants thought that Scraps made it very easy (4) or easy (4) to integrate these resources into their documents. Three participants noted the simplicity and ease of viewing and inserting their resources directly into their document from the Scraps sidebar, such as P2:

> *I was able to really easily add them into the document through the pane. The photos were most straightforward and I quickly figured out to just click on them to insert. I didn't quite realize the text memos could be added*

> *through the little + icon until a little later, but that was*
> *also helpful to use.*

**Integrating Resources Without Scraps:** When reflecting on the process participants might have used without Scraps, the responses were diverse. Seven participants hypothesized using a combination of apps (e.g., AirDrop, OneDrive, OfficeLens, Slack, email) to synchronize their resources to the computer where they writing the document. They described a process involving a series of manual steps including searching for captured resources, downloading them from multiple sources (e.g., email, OneDrive), and copying and pasting them into the document. P11 notes that this process might have even involved retyping captured notes.

> *Would involve me uploading all my photos onto a folder*
> *I created, and then importing the photos one by one as*
> *I need them. For notes, I would hold my phone on the*
> *side and type the exact same notes I had on my phone*
> *onto my computer again.*

Two participants mentioned that having the captured resources collected in different places could make it difficult to find the information when they need to use it. P10 reflects on how difficult it might have been to locate the photos they captured for this task had they used their default process.

> *Normally I would've had to remember where the picture*
> *was stored, or what it would look like in my phone,*
> *because I take millions of other photos related work,*
> *family, etc., AND I store a lot of photos that other people*
> *have sent me. Especially, I get pictures of my daughter*
> *from other people (grandparents, daycare, etc.).*

**Impact on Flow Without Scraps:** Four participants mentioned that if they didn't have Scraps available, their process during writing may have involved switching back and forth between different apps to integrate captured resources into their document. Some participants noted that this process may have made them lose their flow during writing, such as P3:

> *I would've taken pictures and memos in different apps,*
> *and having to switch back and forth would make me*
> *lose my train of thought*

Most participants found it very easy (5 participants) or easy (4 participants) to focus during the writing task. However, one participant (P6) found it difficult to focus. While they found it convenient to have their resources available next to the document, they were distracted by picture placement and formatting.

*6.4.4 Key Findings.* Our participants used Scraps to capture a variety of resources to use in their documents, largely consisting of photos. Without Scraps, participants believed they might have used several different apps to capture their document-related resources which may have caused them to become fragmented.

Participants added context notes to a little over half their scraps, mostly during capture. While they mostly described what they saw (i.e., feature names), they sometimes included reminders, related notes, and wayfinding info. Without Scraps, they likely would have captured context disjointly or not captured it.

Participants also found it beneficial to have their scraps automatically available for use beside their document. They used a majority

of their captured scraps in their documents either directly or indirectly. With Scraps, they could easily use the captured information without needing to consider where the information would be stored or synchronize the information to the desktop. Without Scraps, they would have potentially had to manually synchronize and integrate their scraps, potentially causing them to lose focus on their writing.

In addition, several participants mentioned that they often capture information for a document in different places along with other unrelated information (e.g., family or vacation photos). While participants in our study only worked on a single document, such scenarios indicate that Scraps' ability to link captured information to a single document or project can ease the process of retrieval and use of captured information for a specific task (e.g., a tour guide).

## 7 DISCUSSION

Our design of Scraps was motivated by the information types reported in previous literature and validated by our survey. Our survey showed that people capture many information types while mobile, with calendar events, contacts and photos being most common. However, peoples' capture of information for a document was limited to a few categories. Over 60% of all captured information was photos and bookmarks. This suggests that the design of information capture tools must account for the intended use of the information (e.g., in a document vs. in a to-do app) and should present the key capturing features accordingly. Scraps was designed for reusing the captured information in a document, and the design may need to be adapted to other scenarios (e.g., to-do apps).

Our broad goal is to provide a seamless transition between capturing information and reusing it later in a different context, which could be useful for tasks beyond document creation. We designed Scraps' architecture to be extensible, and our long-term vision is that people could use it to capture scraps for a variety of tasks across a range of applications. A sidebar could infer relevant scraps to the task or application and provide task-based ranking, smart suggestion, or support based on context to support use (e.g., showing slide creation resources next to a slide editor like PowerPoint). Follow up work should study and categorize these tasks, information types to support capturing, and how to support their use in relevant tools. Furthermore, our work and follow-up studies can inspire features for other notetaking tools (e.g., Google Keep) which could support tasks in a document editor (e.g., Google Docs) with in-app contextual presentation.

Even when people capture information for a specific task, linking it to a document is challenging as people often capture information disjointly and may need to gather information for a task from multiple sources. Commercial information capture tools currently do not effectively link captured information to the application where it will be used, or they require linking information with a specific note which may make it more difficult to locate and use the information later for a different task. Also, such tools currently separate searching and bookmarking web results from the capture experience. We believe that Scraps advances upon these tools by enabling people to capture and enhance heterogenous information in one place, and use it in a relevant application (i.e., document editor). People typically have to go through additional steps to gather captured information from multiple sources, which can be difficult as not all

captured information is relevant to a task. Scraps' ability to scope resource capture to a project, task, or document can potentially aid this process. Furthermore, linking captured information within a document reduces the need to switch applications, which is a major source of disruption in flow during focused work [26, 37].

## 8 LIMITATIONS

We conducted a first-use study of Scraps which is a common approach for similar tools [29, 49]. Such a study can help us to understand the overall usefulness and usability of Scraps. Our study did not compare directly with a control group for the same document creation task (i.e., without Scraps). While this would have let us directly compare outcomes, we found that having the participants retrospectively compare using Scraps with their default practices yielded useful insights (i.e., disjoint context, difficulty locating resources). Participants could express what they found useful about Scraps and how it could improve based on their current practices. Future work should compare with users' default approaches.

Our participants only added context notes for a little over half the scraps and in general did not feel adding such context benefited them for the study task. However, our users completed the capture and writing tasks 2 days apart in a familiar location, making them more likely to remember the context of captures. Past work has shown capturing context is important, especially with a lag between when information is captured and used [50]. Context is often lost over time, and sometimes people capture information without realizing the post-captured value. Our participants noted that if they used the scraps much later, the added context would likely be much more useful.

Additionally, our study evaluates the use of Scraps within a single document creation task (i.e., creating a tour guide). It is possible that other document creation tasks (e.g., project planning) or other types of information work (e.g., designing a personal website, writing a biography) that require proactive capture of information scraps could potentially reveal other potential use cases, benefits, and limitations of Scraps.

## 9 CONCLUSION

This paper explores how we can help authors capture, contextualize, and use collected information in a document. Our survey of 66 information workers reveals differences between document-focused mobile information capture and general information capture. To better support document authors in mobile capture of information for document authoring, we created Scraps, a mobile app and Word sidebar to capture, add contextualize, and use information in a document. Scraps streamlines capturing and integrating document information, and can potentially help people focus on their writing rather over integrating externally collected resources. We envision Scraps to be a valuable step forward in cross-device information management embracing mobile and focused productivity.

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