DESIGNING COMPUTER MEDIATED COMMUNICATION THROUGH ALTERNATIVES: DIGITAL EPHEMERALITY, CONTENT DE-EMPHASIS AND THEIR IMPLICATIONS

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DESIGNING COMPUTER MEDIATED COMMUNICATION THROUGH ALTERNATIVES: DIGITAL EPHEMERALITY, CONTENT DE-EMPHASIS AND THEIR IMPLICATIONS

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Computer-mediated communication (CMC) has long been a key theme in computer-supported collaborative work, human-computer interaction, communication, psychology, linguistics, and other fields. Much CMC design research has focused on recreating features of face-to-face interaction or in capturing and transmitting rich information. In this thesis, I argue that a focus on rich interaction and rich information transmission overlooks many interesting situations and design choices when rich information is not necessarily beneficial.

More specifically, I explore how ephemeral media, which illuminate the alternative dimension of temporal preservation, particularly on the question of how long to retain content, and how a medium that de-emphasizes content, which highlights interaction rather than information, respectively influence the ways people interact with these tools. These explorations help inform a design space that includes other interesting dimensions such as the message materiality, interaction flow and system fidelity for CMC tools that designers have yet to fully explore.

My approach to exploring this alternative design space is three-pronged. First, I think critically about the normative designs of CMC tools and consider alternatives to these designs, particularly digital ephemerality and content de-emphasis, as valuable sources for highlighting alternative purposes and goals users aim to achieve. Second, I conduct qualitative studies of users of a conventional CMC tool (Snapchat) and research prototype I have built (BubbleQ) to

understand how these designs influence users' communicative practices. Third, I do iterative designs and evaluation of the prototype I built to advance designs from both my critical thinking and my study findings.

The first study showed that Snapchat's ephemerality benefited communication by encouraging mundane interactions that support relationship maintenance between closer relations, reduce consciousness in self-presentation, and mitigate privacy violation issues in content saving and sharing. The second study shows that BubbleQ's content de-emphasis design highlighted interaction rather than contents in messaging, leading to an alternative conversational flow that encouraged mundane and lightweight talk for social connection and helped highlight meanings in messages without explicit contents.

I use my findings to explore my two focal dimensions (temporal preservation and the focus on interaction rather than contents) more deeply. I also discuss the implications of formatively designing alternatives by assessing the materiality of digital messages, interaction flows that define the rhythm and speed of communication processes, and alternative levels of fidelity that violate the conventional emphasis on accuracy and genuineness of contents.

BIOGRAPHICAL SKETCH

Bin Xu conducted his PhD study in the Department of Information Science at Cornell University between 2012 and 2017. At Cornell, he worked in the Re-Imagination Lab led by Professor Dan Cosley, the Intercultural Communication Lab led by Professor Susan R. Fussell and the Social Media Lab led by Professor Natalie Bazarova. Prior to Cornell, he received a Bachelor of Science Degree in Electronic Engineering from Dalian University of Technology in China and a Master of Science Degree in Electronic Engineering from Tsinghua University in China. He also had internships at the IBM Thomas J. Watson Research Center, IBM Almaden Research Center, and Nokia Research Asia.

致我的父母，

是你们让我一直努力做更好的自己。

[To my dear mother and father]

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LIST OF ABBREVIATIONS

CMC   Computer-mediated communication

CSCW   Computer-supported cooperative work

IM   Instant messaging

MT   Machine translation

CHAPTER 1

INTRODUCTION

Computer-mediated communication (CMC) has long been a key theme in computer-supported collaborative work (e.g., Bannon, 1992; Schmidt, 2009), human computer interaction (e.g., Ess, 2004), communication (e.g., Konijn, 2008), psychology (e.g., Kiesler et al., 1984), and linguistics (e.g., Herring, 1996). Design efforts for CMC tools have been done in different contexts such as collaboration (e.g., Erickson, 1999), online learning (e.g., Chou, 2001), social support (e.g., Han & Belcher, 2016), and general daily conversations (e.g., Sayago et al., 2011; Zhang & Leung, 2015).

Much CMC design research has focused on recreating features of face-to-face interaction in media (e.g., Kiesler, Siegel & McGuire, 1984; Culnan & Markus, 1987). For example, consistent with the view that visual and audio contents are critical for conveying affective and interpersonal information (see Whittaker, 2003 for a review), there have been many technical efforts in the development of multimedia conferencing tools (e.g., Suh, 1999) and video tools for online learning (e.g., Balaji & Chakrabarti, 2010), in the hope to make the media as "rich" as face-to-face communication. More recently, as the value of lean text-based media has become more apparent, a multitude of synchronous chat platforms have been developed (see Herring, 2004 for a review).

In addition to efforts to replicate features of face-to-face communication, some CMC design work has focused on what else can be captured and transmitted, presumably to benefit the mediated communication. For example, some CMC tools provide features such as a visualized network (Fisher & Dourish, 2004), information about what others know (e.g., Ogata et al., 1996), information about the user's social network (e.g., Wolf et al., 2009), and visualizations of events

(e.g., Rittenbruch & McEwan, 2009). The underlying assumption of much of this work is that more is better: CMC tools should strive to provide maximum information via text, audio, video, emoticons, presence indicators, network visualizations, and so on.

While the work of Walther and colleagues (e.g., Walther, 1992; Walther & Parks, 2002) has helped advance the area of CMC research and design by showing that many interpersonal processes can be supported via text alone, the focus of this thesis is on exploring other ways beside text to support these processes without rich information. Specifically, I point out that in addition to the dimension of information richness (e.g., text vs. audio/video), there are also interesting design choices around the extent to which CMC tools aim to convey and preserve information. While Walther has shown that lean format media like text can support interpersonal processes, I ask whether a focus on less rather than more in other dimensions, such as temporal preservation and a focus on interaction vs. content, might similarly serve important communication functions.

My approach to exploring this alternative design space is three-pronged. First, I think critically about the normative designs of CMC tools and consider alternatives to these designs as valuable sources for highlighting alternative purposes and goals users aim to achieve. Second, I conduct qualitative studies of users of both conventional CMC tools and research prototypes I have built, to understand how these designs influence users' communicative practices. Third, I do iterative designs and evaluation to advance designs from both the critical thinking and the study findings.

More specifically, I explore how an ephemeral medium called Snapchat, which illuminates the alternative dimension of temporal preservation, and how a content de-emphasizing medium called BubbleQ, which highlights interaction rather than content, influence the ways people

communicate with each other. These explorations help to understand the benefits and costs of these designs and form new designs in these alternative dimensions.

The remainder of the dissertation is structured as follows. In Chapter 2 I give an overview of my two focal topics, digital ephemerality and content de-emphasis. With respect to digital ephemerality, I first explain that digital permanence versus digital ephemerality is a design choice that should be associated with people's use in retaining information versus other practices, then review related work to illustrate how digital permanence and digital ephemerality differ from each other and the benefits and costs of each in particular contexts. Finally, I discuss the limitations of one manifestation of digital permanence in CMC tools—the persistent design of conversations—and question the normative designs that automatically retain conversation history. With respect to content de-emphasis, I critically analyze traditional instant messaging tools' emphasis on content in both message composition and conversation flow, and assess potential costs and benefits of emphasizing content in CMC tool design. I argue for exploring content de-emphasis designs that also support interaction beyond passing message content.

In Chapters 3 and 4 I present studies of two systems called Snapchat (http://www.snapchat.com) and BubbleQ (http://bubbleq.com) to provide further empirical understanding on the two topics. In Chapter 3, I first explain how Snapchat (at the time of the study, Spring 2015) provided an ephemeral messaging feature through its automatic deletion of received message content, in contrast to the persistent conversation found in most other messaging tools. I then present an interview study of 25 college students who were Snapchat users, and present my findings on participants' communicative practices in Snapchat and their reflections on how the ephemeral design influenced these practices. Finally, I extend the discussion by summarizing insights from the study on how to construct ephemerality in other ways besides content deletion.

In Chapter 4, I first present the BubbleQ tool I designed to explore content de-emphasis as a feature of CMC tools. I describe several iterations of the design of BubbleQ, ranging from total removal of content to foregrounding interaction rather than content. I then present a field study (December 2016) of BubbleQ with 81 users, 28 of whom were interviewed, and describe my findings on how they reacted to BubbleQ's design features. I also present an overview of content de-emphasis' benefits in general.

In Chapter 5, I summarize the findings from the previous chapters on the benefits in serving alternative purposes and processes in communication, particularly in the two focal dimensions (i.e., temporal preservation and the focus on interaction rather than content). I then discuss other alternative dimensions that can formatively inspire designs for CMC, with design examples and their hypothetical benefits, by assessing the materiality of digital messages, interaction flows that define the rhythm and speed of communication processes, and alternative levels of fidelity that violate the conventional emphasis on accuracy and genuineness of content.

In Chapter 6, I conclude with a summary of the basic contributions of the work. These include:

- I provide an in-depth review and discussion of the concepts of ephemerality and content de-emphasis and their benefits and costs for CMC.
- I present a detailed study of how users engage with one tool design with ephemerality that shows that Snapchat's ephemerality foregrounds users' less-informational communicative goals such as relationship maintenance and entertainment, with reduced concerns in self-presentation and privacy.
- I design a new tool called BubbleQ as a prototype with iterations, illustrating different ways that content de-emphasis can be designed and presenting a

qualitative investigation based on a field trial of BubbleQ that shows how its alternative flow foregrounds mundane lightweight conversations for connection, its empty bubble design in the flow reduces costs such as pressure in content generation, and its bubble presentation of messages embeds meanings beyond its message content.

- Based on my findings and design explorations, I provide a detailed discussion of the different ways ephemerality and content de-emphasis might be incorporated into design. I also provide an extended discussion of other dimensions in the CMC tool design space that might be valuable to explore, such as message materiality, interaction flow, and fidelity, in order to provoke designers' thinking about choosing these alternatives or their own ones, to foreground latent values that could be neglected in conventional designs for CMC tools.

CHAPTER 2

BACKGROUND: DIGITAL EPHEMERALITY AND CONTENT DE-EMPAHSIS

In this chapter I present background on *digital ephemerality* and *content de-emphasis* as two design moves that depart from the common focus on preservation and richness of information in CMC tools. I consider digital ephemerality as a contrast to digital permanence, which aims at preserving information and data, and consider content de-emphasis as a contrast to designs that depend more on message content than interaction. Both of these concepts are not new, but lack systematic review and clear definitions. In this chapter I aim to present their background to ground the studies and discussion in subsequent chapters.

I start with a portrait of what ephemerality as a concept and a practice means in a digital era, consider ephemerality versus permanence as a temporal property that digital artifacts generally possess, and highlight potential issues with making digital permanence as the default in system design. I then discuss information preservation in CMC tools, focusing on conversation persistence as one example. This discussion frames my qualitative study of Snapchat presented in Chapter 3.

Next, I consider content de-emphasis as a design move that violates the common dependence on content exchange in mediated conversations. Interpersonal messaging is aimed at achieving various goals rather than just exchanging content. I discuss the differences between content and meanings in an interpersonal communication context, in order to surface the potential risks in narrowing the multiplicity and expressiveness of communication in designs that emphasize content. This discussion will frame the building my prototype that de-emphasizes content and a study upon it, presented in chapter 4.

Digital Ephemerality vs. Digital Permanence

With the development of digital storage technologies and cloud technologies, preserving digital artifacts is an easy choice for individuals. For example, it is easy for people to put all the digital content they create, copy, receive, or share in a digital library that is designed to last as long as possible. Users might use Apple's cloud service for online storage called "iCloud" which lets users upload files, notes, photos, and so on to preserve them even when they change between devices. Blogging websites, wiki websites, and online personal homepages are also examples users have as their online archives (Lindley et al., 2013). In addition to these systems designated for personal archives, online social systems also empower users to preserve their own digital traces, for example group photos on Facebook, chats with others in Apple iMessages, or voice messages in WeChat. These media, conversations, and messages are saved as digital artifacts and stored by the system unless the user deletes them.

These digital permanence solutions for individuals offer great benefits: assuming they are still using these systems (and they still exist) decades later, they can still access the pictures they took today and see others' comments on photos posted to social media sites. More importantly, they do not need to buy hard disks, nor to print the picture to preserve it, as all of this is automatically done by Facebook.

However, the ease of saving all this data also has costs in terms of managing the saved digital content. For example, Whittaker and Sidner (1996) found that although email was primarily designed for communication, it was also used for personal archiving; this created problems for personal information management such as filtering important previous messages from their cluttered in-boxes containing accumulated massive content. Users were also found abandoning and forgetting their online archives in these online systems that they ceased to use, which required

effort (like resetting passwords they did not remember) to regain access (Lindley et al., 2013). Moreover, for these digital archives that are also presented to others, like the Facebook Timeline, their values were perceived to be realized through intentional curation (e.g., Lindley et al., 2013; Zhao et al., 2013). These management tasks of filtering/finding, maintaining, and curating pose costs in users' effort as well as risks in loss of valuable artifacts that they would appreciate in the future (e.g., Whittaker & Sidner, 1996), and misrepresentation of self across time (e.g., Zhao et al., 2013)

There are ways to reduce the costs of managing large digital archives. Many systems themselves work as curators on behalf of users to filter, order, and search digital artifacts for users (e.g., Hogan, 2010). Facebook's Newsfeed uses algorithms to selectively present users' posts to their Facebook friends, without clearly telling users how its algorithms work. System curators have benefits in saving users effort in considering who should see their posts and when, but also result in risks around misperception of audiences (Bernstein et al., 2013), failure of content delivery to the right friends (Eslami et al., 2015), and biased impressions of others (Ananny, 2016).

Some other systems reduce this cost by not automatically accumulating contents in archives, but letting users decide what to save. For example, an ephemeral messaging application Snapchat gained popularity, where pictures and video messages (called "snaps") last less than 10 seconds unless explicitly saved during that time. In this case, photos are not saved by default. The fact that users send a similarly large number of pictures through Snapchat compared to persistent media like Facebook and Instagram ("Snapchat photos sent per second", 2015) suggests that ephemeral messaging supports certain communication purposes well. (As I show later in Chapter 3, Snapchat's ephemerality by default deletion design facilitates mundane everyday talk, eases pressures concerning self-presentation, and helps people manage their privacy.)

These different strategies in saving and disposing digital artifacts for users—automatic saving and later curating in persistent media versus automatic disposing with selective saving in ephemeral media—have both benefits and costs in their use contexts. Focusing on understanding how digital ephemerality instead of digital permanence benefits interpersonal communication processes, I will first present my definition of ephemerality, which emphasizes it as an intentional design choice rather than a system limitation. Then I review background on how digital permanence instead of ephemerality became widely accepted in system designs, and discuss the benefits and costs of digital permanence. Finally, I focus on CMC systems that use persistent conversation as a representative digital permanence design that also manifests the default emphasis on information preservation.

Definition of ephemerality

While there are several ways to define ephemerality, I borrow one from the Cambridge Dictionary that illustrates what I have in mind: ephemera are "objects that, when they were produced, were not intended to last a long time or were specially produced for one occasion" ("Ephemera Meaning in the Cambridge English Dictionary," 2017). This definition emphasizes two key notions: 1) the objects only last with their original states for a short time; and 2) their ephemerality is associated with certain purposes or intentions. For example, flowers die after their reproductive purposes to save nutrients for the plants. In the case of flowers, ephemerality is built into the system. This is not always the case: for instance, 3D printed plastic prototypes are often used to illustrate design ideas and are meant to be thrown away, but can last a long time unless explicitly disposed of.

When physical objects are captured as digital artifacts, the system provides the possibility of making them long-lasting: digital photos or videos of flowers can stay in the system for a long

period until intentional deletion (or until accidental data corruption or digital obsolescence "where a digital resource is no longer readable because of its archaic format: the physical media, the reader (required to read the media), the hardware, or the software that runs on it is no longer available" ("Digital obsolescence," 2017)). Digital preservation is much easier and cheaper than other means; in prior decades and centuries, people also preserved flower images though cave painting, artworks, or dried flowers as specimens, which required more skill or effort than simply snapping a photo with a mobile phone.

However, historically preservation normally has associated purposes. An artwork of flowers could serve aesthetic goals, and a dried flower specimen could serve as a research sample. A digital photo of the flower could serve the same purposes, but often not—especially when the photo is shared for social purposes for the moment (Van Dijck, 2008; Bayer et al., 2016).

In this sense, being persistent or ephemeral is a design choice that should be associated with people's purposes in their capture, saving, and disposing of the artifacts. To reveal this association, the next section will discuss digital permanence versus ephemerality.

Digital permanence as a contrast to ephemerality

Although there has been some work on ephemerality in arts (e.g., Haskell, 2000) and policy (e.g., Clarida et al., 1999), they do not offer direct insights to understand ephemerality in digital systems. Since the choice of being ephemeral or persistent is often associated with how a digital system handles artifacts (messages, data, contents, connections, and so on), I focus below on topics that either shape or represent this handling to form a picture on how persistence and ephemerality differ from each other, and what benefits and issues they both can have.

Total capture. Bell and Gemmell (2009) described a world in which people's daily lives could be totally captured, including users' digital traces in systems, their physical activity, their

locations and physical context (e.g., weather, temperature), psychological status, and so on. And *total capture* as a life-logging technology was argued to allow people to retrieve all information about themselves, to help users' *recollecting*, *reminiscing*, *retrieving,* and *reflecting* of their past (Sellen & Whittaker, 2010). Besides life logging systems like Fitbit, digital systems also capture user activities through the systems like online browsing history, our conversations, messages with others, and so on. In most systems, the captured content is permanently saved for various purposes like system learning, usability, and security (e.g., Cao & Yang, 2015).

However, capturing does not always mean preserving the captured content forever. First, the values to save the artifact at the time of capture could be reduced after time. The SenseCam prototype (Sellen et al., 2007) used light and heat in the environment as triggers for taking a picture; this helped users to re-visit past experiences, but their usefulness strongly weakened after a longer time (Sellen et al., 2007; Sellen & Whittaker, 2010). Secondly, not every experience is worth capturing. *Situation-specific capture* proposed that "system designers should channel their efforts more fruitfully by identifying the situations where human memory is poor or targeting the things users most want to remember (Sellen & Whittaker, 2010, p. 77)". However, this pre-filtering does not always work because it is hard for people to decide what they want to remember in a current context (Sellen et al., 2007). Thirdly, saving information forever also poses concerns and risks in privacy, civil surveillance, and data rights. Laws have been passed regulating what should not be captured regarding privacy and civil rights (e.g., Carr & Bellia, 1977; Citron & Gray, 2013). The legal practice of "right to forget" in Europe empowered users to protect their data ownership rights from abuses by organizations and companies. Privacy issues were also highlighted because persistent content can violate privacy when it negatively impacts the current online image users

aim to build (e.g., Shein, 2013), or shared to future audiences who are not meant to see it (Nissenbaum, 2009).

Personal archives. Different from total capture, personal archiving emphasizes saving content that has value to the individual worth taking the effort to save them in a collection. Personal archives can be collections of digital artifacts in devices like computers and mobile phones, online services like iCloud and Dropbox, and persistent social media like Facebook (Zhao et al., 2013). Personal archiving is not only about retaining content for later retrieval, but also for supporting values including building digital legacy, sharing, preventing loss, and constructing personal identity (Kaye et al., 2006). However, data permanence is not always necessary for a meaningful personal archive. Gulotta et al. (2013) found users considered digital artifacts had an appropriate lifespan, and only some of them had enough values to be retained or even passed to next generation.

Digital forgetting. One of the goals in capturing and archiving is using these artifacts to serve remembering (Browne et al., 2011), but forgetting is also an important process for people in memorization, reminiscence, and reflection (Schacter, 2002). The emphasis on data permanence to serve remembering could neglect forgetting. For example, permanently preserved digital content from users' passed away loved ones could trigger mixed feelings when forgetting should be considered (e.g., Massimi et al., 2010; Odom et al., 2012, May). In such contexts, an ephemerality solution of data disposal, deletion, or hiding might be a better design. Moreover, persistent saving by default at the beginning also raises costs in later disposal with emotional investment (e.g., Sas & Whittaker, 2013) and efforts of organizing (e.g., Odom et al., 2012, May).

Besides situations where people intentionally or preferably forget, people having permanently accessible personal records could bias their perception of their past and their self-

narratives (Burkell et al., 2016) as well as their social relationships (e.g., Schwanda Sosik et al., 2012).

Digital forgetting is a valuable alternative design space to explore. Human memory is not similar to computer memories that can be erased, retrieved, and addressed (Bannon, 2006), but instead has a more constructionist nature in which "condensation, elaboration and invention are common features of ordinary remembering and forgetting helps in this process (Bartlett & Burt, 1933, p. 205)". Memory should be augmented by digital forgetting; for example, technologies such as *ephemeral data* can support users to experience "being-here-now" and "in the moment" (Bannon, 2006).

Total capture, *personal archive*, and *digital forgetting* are different kinds of schemes to address the technological possibilities in preserving versus disposing digital artifacts that highlight individuals' needs. However, when users interact with others in CMC tools, they generate digital artifacts like emails, messages, comments on Instagram, tagging on Facebook, and so on, which also associated with communicative goals (Burleson, 2010). In the next section I assess digital permanence in CMC on whether it can fully re-access or re-produce the meanings and needs people have in interpersonal communication.

Digital permanence in CMC

CMC tools with a persistent conversation design afford users the ability to search, browse, replay, annotate, visualize, restructure, and re-contextualize the saved conversations (Erickson & Kellogg, 2000), offering benefits such as promoting common ground in task-focused conversations (e.g., Gergle et al., 2004) and reflection on conversational interaction in groups (e.g., Donath et al., 1999). Besides message content, persistent conversation also preserves behavioral patterns such as conversation duration, frequency, pauses, and turn-taking. For instance, systems like the Chat

Circles prototype (Donath et al., 1999) visualized the temporal distribution of the conversation turns across the whole discussion, while Smith and Fiore (2001) designed several visualizations presenting temporal connections between threads of conversation and the interaction histories.

However, persistent conversation does not fully recreate the episode of communication originally captured and saved. As a complex and situated social process, interpersonal communication is defined by not only the conversation content, but also other constructing elements in the episode such as its situation and context that influence the process of the communication by defining what roles interactants should play, as well as communication strategies like scripts, prototypes, turn-taking, and repairing (see Burleson, 2010 for a review).

But some dimensions of situations and contexts are virtually impossible to be captured and digitalized, or too implicit to be de-coded from a saved conversation. Applegate and Delia (1980) presented five dimensions of these contextual settings: *physical* settings like location, space, weather, and physical characteristics of the communication channel used; *social/relational* settings such as the social relationship between the interactants; *institutional* settings such as the place where communications occur like home, school, and workplace; *functional* settings including primary goals and secondary goals; and *cultural* settings including ethnicity, value, nationality, social class, and other cultural separations.

The physical and institutional settings could be captured though sensing technologies and be presented as contextual information for mediated communication (e.g., Bowskill et al., 1999), but the capturing remains hard in other dimensions. In many cases the communicative relationships are more complex than the social relationships across different situations of the communication: a Facebook friend can be an information-provider in an information seeking episode (e.g., Ellison et al., 2011) or a support provider when giving social support (e.g., Ellison et al., 2011; Nabi et al.,

2013). But the dimensions of relations are often reduced to binary digital labels of "friends" (Facebook) or "followers/followees" (Twitter), posing a risk that the persistent representation of the relationship could lead to misinterpretation of the dynamic relationship (e.g., Schwanda Sosik et al., 2012). Also, only some functional properties can be easily digitalized. Communication can have functions such as to show compliance and to exchange empathy (reviewed in e.g., Hallsten, 2004; Miller, 1990), to provide social support (e.g., Burleson et al., 1994), or amuse (e.g., Zillmann, 2013), and these less-informational functions are, many times, implicit and play as secondary goals which occur spontaneously and automatically (e.g., Kellermann, 1992). Certain aspects of these functions can be inferred from conversation content and the interaction metadata (e.g., Hutchby & Wooffitt, 2008), but these inferences are not always accurate and can bias people to focus on the explicit meanings presented by content excluding other internal meanings (e.g. Schwanda Sosik et al., 2012). Moreover, explicit representation of implicit functions such as intentions loses ambiguity in the interpretation of meanings that opens space for positive attribution (e.g., Boehner & Hancock, 2006).

The limitations of persistent conversation question the necessity of making every conversation persistently retained. Daily face-to-face conversations are mostly ephemeral except when explicitly recorded, but still serve communicative functions, and ephemeral media like Snapchat also suggest that digital ephemeral conversations can fulfill certain user needs, suggesting potential values to consider the alterative design of digital ephemerality in media. In chapter 3, I will investigate the values users have from ephemeral conversations and how Snapchat's design plays a role.

Content De-emphasis: Highlighting Interaction Rather Than Content

Another dimension in assessing a CMC design is its focus on interaction versus content; here I use Instant Messaging (IM) design as a common CMC domain to illustrate the point.
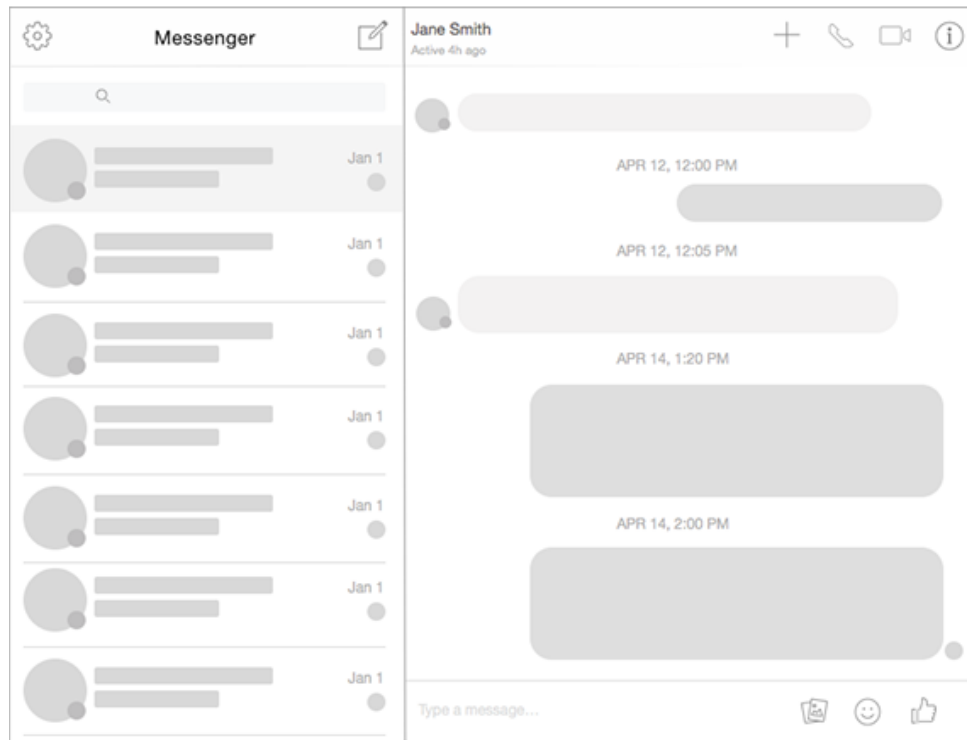
Figure 1. A wireframe of a common instant messaging application interface.

A message is more than its content: information vs. meaning

Traditional Instant Messaging (IM) tools tend to emphasize the role of content in conversations. This emphasis is reflected in several common design conventions: a message is composed of explicit contents like texts, pictures, videos, or even locations, while conversations are conducted through exchanging this content. Further, the representations are quite literal: the message is simply the content, usually with an included timestamp; the conversation is simply a chronological series of messages, with some indicator of the sender such as left or right justification in a window, as shown in Figure 1. Such a convention can be traced back to the early

development of communication systems based on Shannon's information theory (Shannon, 2001) where a *message* was considered as a piece of information represented by a set of semantic symbols (like a sequence of letters *a b a c a c a c a b* in Shannon's original paper).

Such a design reflects an implicit assumption that the message is equivalent to its content, and mediated communication via a conversation in an IM tool is equivalent to exchanging the content. If we only care about the information exchange, this equivalence helps the system developers and designers to narrow their efforts on reducing errors during the exchange, on increasing transmission speed, and on maintaining system stability.

However, in our use of IM tools, especially in our daily communicative activities, messaging is not limited to passing information. Regarding interpersonal communication as a way to accomplish social goals, Burleson (2010) conceptualized messages as behavior expressions to exchange meanings, "the internal states (thoughts, ideas, beliefs, feelings, etc.) that communicators seek to express or convey in a message and interpret a message as expressing or conveying. (Burleson, 2010, p. 150)". In this notion, "a message is more than symbols that compose words and sentences; a message is fundamentally a speech act—the performance of an action through the expression of words and gestures (Burleson, 2010, p. 151)". In a way, the act of messaging itself is a performance that has meanings, and people do interact without explicit content in face-to-face settings naturally. We sometimes do not communicate through words: we may just nod heads at each other when we pass in the hallway, or have eye contact when we sit nearby.

Some systems have explored ways to interact while minimizing the role of content. An example of such a system is the Yo messaging app (Bereznak, 2014). In Yo, the only message content is the string "yo", a message that in the Shannon sense has zero information content, but Yo users still exchanged meanings like greeting and connecting to fulfill relationship maintenance

goals (e.g., "Yo app: what is it and why is it popular?", 2014). Similarly, Kaye et al. (2005) developed a Virtual Intimate Object (VIO) that only allowed a user to send their partner a one-bit message by offering a virtual circle they could tap; the partner's corresponding circle would become bright red and fade over time. Users thought this communication without explicit content offered value in connecting to remote partners and maintaining intimacy. In both cases, the meanings exchanged were achieved not from the content of the message, but rather from their mutual interpretation of the fact of receiving a message.

Further, sharing meanings through content can require effort to either generate or capture the appropriate content to convey the expected meanings. A simple "yo" that took seconds to send might be at least as good for keeping in touch with people as explicitly conducting a conversation starting with "how are you". Moreover, in the Snapchat study later presented in Chapter 3, participants noted that "*Just one or two Snapchats back and forth, you see their face, you exchange a laugh even though it's not like personally ... A little with just keeping connected but like I said before it's I think it's kind of on superficial level…, not much meaningful stuffs happen on Snapchat*. (Snapchat Participant #17)". Here the generating of the content was not considered as the primary goal, versus the goal of staying connected.

In short, the perspective that messages do not always need content leads to questions about IM applications' focus on providing affordances to let users generate or compose content, as not being sufficient to convey—and perhaps hindering the conveyance of—important meanings that are not strictly from the content itself. Inspired by this, I developed a prototype called BubbleQ that uses a design of empty messages, which will be presented in detail in chapter 4.

Messaging flow: dependence on content versus interaction

The second design convention is that conversations are both initiated and continued via messages with explicit content. Taking an interactional perspective, the process of conversation is established by a structure constituted through reciprocal expression and interpretation of intentions of the interactants (Burleson, 2010). In some cases, the intention does not require the exchange of explicit content. For example, in face-to-face situations, sometimes we do not need words to start a conversation; instead, being approached by another person raises awareness that that person might want to talk to you, and vice versa (e.g., Dillard, 2008). Likewise, conversations often end implicitly rather than through explicit goodbyes: others walk by, bodies shift, we glance at a clock or attend to the external environment, and so on.

The typical IM representation of conversations as a chronologically ordered sequence of content-ful messages does not support managing intentions around conversation very well. When available, people do employ a wide variety of tools—some provided by the system such as away messages, availability indicators, and typing indicators, some by the social-technical context such as network glitches whether real or made up (e.g., Hancock et al., 2009)—to help negotiate intentions around interaction and attention management. However, these tools are not always available, and I see opportunities for representing conversation and structuring interaction in ways that smooth these transitions into and out of conversation.

Meaning through interaction, not just content

Therefore, seeing the goal of messaging as to achieve shared meanings constituted by a set of acts initiated and ended with intentions, I point out that default IM system designs emphasizing content risk narrowing the multiplicity and expressiveness of communication through the interactions. In particular, I argue that design conventions like messaging with required content

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and the flow of interaction based on exchanging content shape the kinds of meaning that can be easily and naturally made. People have a wide variety of instrumental goals in communication: entertaining, connecting, supporting, informing, persuading. Content in messages supports some goals well, and others less so. For instance, although participants using the VIO's one bit intimacy message (Kaye et al., 2005) could also use much 'richer' channels like SMS and Email, participants reported that the simple one-bit tapping interaction without content was better for maintaining intimacy than using these tools that afforded 'rich' content. This suggests that designing only with content exchange in mind probably misses opportunities to support communicative interactions that are not well suited to exchanging symbols.

To explore the role that interaction plays in supporting meaning making in mediated communication, I propose a world where contents are less afforded in both the generation and transmission process, to create a situation where users rely more on interactions rather than symbolic contents, in order to highlight the potential values of an interaction-emphasizing messaging experience. In chapter 4 I will present a prototypical design that illustrates this propose, and the study using this design, to illuminate my points.

CHAPTER 3

WHAT SNAPCHAT TELLS US ABOUT DIGITAL EPHEMERALITY IN DESIGN

Snapchat is a good example of, and the first mainstream social media system to adopt, an ephemerality design. Specifically, Snapchat automatically deletes the message content after a short amount of time. In this chapter, I report a study of how this kind of conversation ephemerality influences users' communication practices and how people react to the design. My goal is to both increase our understanding of ephemeral communication in the particular Snapchat context and to suggest implications for a wider design space of ephemeral communication. I begin by describing how the design of Snapchat (as of March 2015, when my data were collected) achieved conversation ephemerality. Then I describe my study's method, findings, and interpretations, as well as an extended discussion on other possible ephemerality designs. I also published findings in the chapter in a CSCW paper (Xu et al., 2016).

Introduction to Snapchat Features

Snapchat is an application for iOS and Android phones; there is no web or desktop version. Its core feature is that it allows users to send pictures to other Snapchat users that they have added as friends. Users can only add friends by entering their Snapchat username or by searching through their mobile phone contacts for other Snapchat users. This design limits people's ability to add acquaintances, leading to smaller networks of closer friends than most other social media (Bayer et al., 2016).

When a user wants to send a picture (a *snap*) to a friend, they use their phone camera to take a picture from inside the app. Pictures stored on the phone can't be sent as a snap. Senders then choose a receiver, and can optionally customize the snap by adding a brief caption or drawing (Figure 2a). They can also set the lifespan of a snap, which is how long the receiver has after

opening it before it is automatically deleted, to between 1 and 10 seconds; the default is 10. Senders can also send a short video, although this is less common. In addition to snaps sent to individuals, Snapchat provides a *Story* function that allows users to send snaps to their whole network. Story snaps last for 24 hours—similar to the default expirations proposed by Mayer-Schönberger (2011)—and any friend of the user can view the snap during that time period. Stories, and notifications of Stories, live in a separate part of the app from person-to-person snaps.

Receivers are notified when they receive a snap individually or when someone posts a snap to a Story they follow (Figure 2b). To see the snap, the receiver must press the notification icon and hold the screen for the duration of the snap (Figure 2c). After the sender-set time expires, the snap is deleted from the receiver's view and cannot be retrieved, much as in the "burn memory away" idea that Chi et al. (2009) sketched in their match-burning prototype, which used a match metaphor of a video recorder that only played the recorded video once. However, this ephemerality is not absolute. Mobile phones can take screenshots, and although in Snapchat this is not easy because receivers must also hold the screen, it is possible (Figure 2d). In addition to being physically awkward, it can be socially awkward, because Snapchat detects the screenshot and notifies the sender (Figure 2e); thus the system allows users to selectively save received contents but reports this saving action to the original sender.
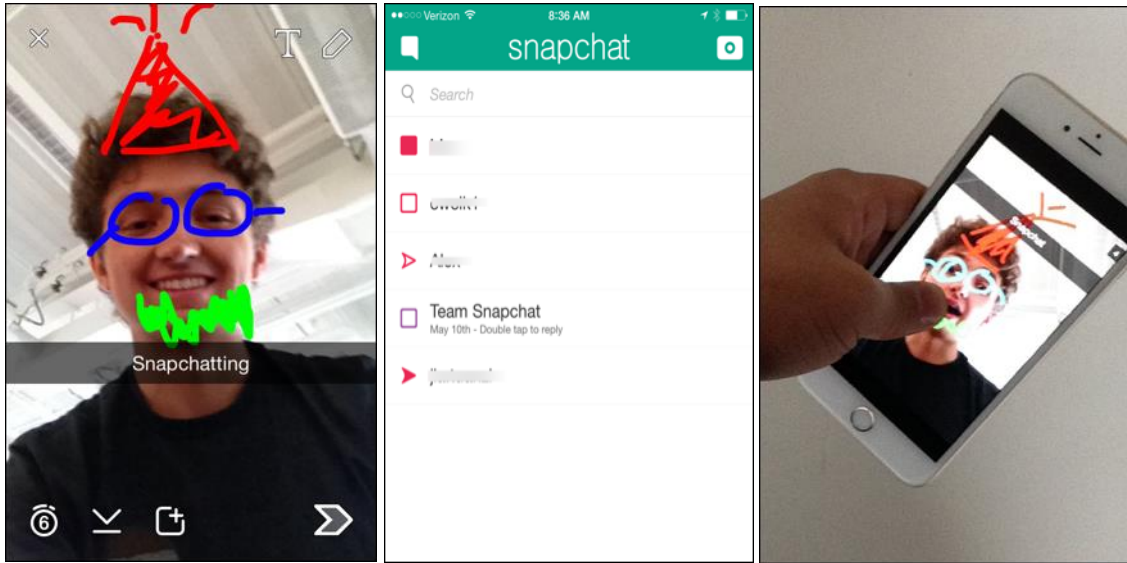
-a-   -b-   **-c-**
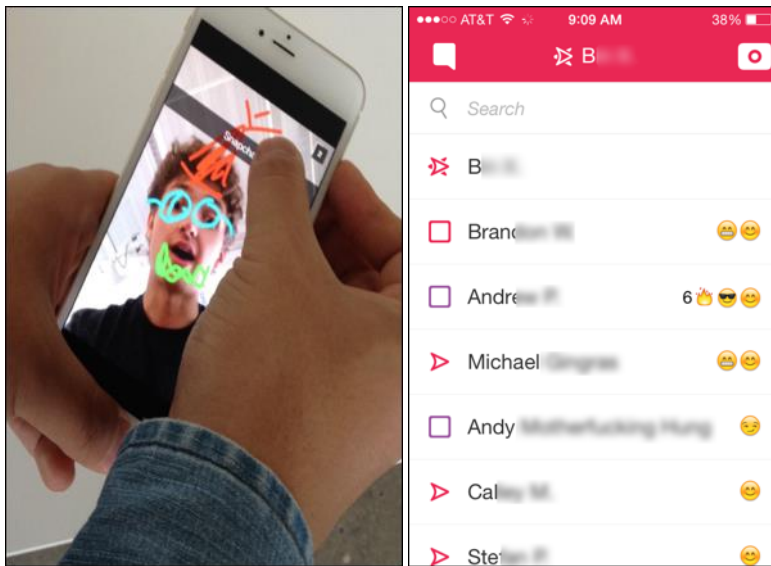
-d-   -e-

Figure 2. Key Snapchat interface elements. (a) users can take photos and draw on them or add captions. Further, they can set an expiration time in seconds, save a copy of the photo to the phone, or add the Snap to their Story. (b) Receivers get notifications from his snap list, which shows unopened snaps, opened snaps, and sent snaps. (c) Receivers must hold the screen to view the Snap; a countdown on the upper right corner shows when then Snap will be deleted. (d) Receivers can also take a screenshot while viewing the Snap; here, by pressing the power button and home buttons of an iPhone. (e) When a screenshot is taken, senders are notified via their contact list (the arrow with three dots next to "B" at the top).

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In short, Snapchat incorporates an ephemeral message design because all messages are *by default deleted* from both the receiver's and sender's interfaces, with an affordance of *selective saving with notification*. To align with the discussion in Chapter 2, the design of Snapchat did not follow a persistent conversation design that many CMC tools adopt and highlighted that conversation content could stay ephemeral as our face-to-face conversations mostly do, although Snapchat still automatically saved information about who users messaged to recently (as shown in Figure 2e). I expected that Snapchat's lack of persistence would lead people to use it differently than they use other more persistent forms of CMC. Specifically, I expected that users would use Snapchat to "share the moments" with close relationships (Bayer et al., 2016). I also expected that an ephemerality design would influence users' goals, as well as how they managed received message content (i.e.., what they chose to save and why).

Method

A qualitative investigation of Snapchat was conducted to examine these hypotheses about the effects of ephemerality design on communication. My colleague and I recruited 25 college students to participate in semi-structured interviews asking about their use patterns and motivations for using Snapchat vs. other types of CMC. We then conducted a qualitative analysis with mixed measures on the collected interview data to surface main themes reflecting the research questions on how Snapchat's ephemerality design influenced people's interaction processes.

Participants

Participants were recruited in Spring 2015 from Cornell University through an online research recruiting system. This study recruited college students as participants because they are the most frequent Snapchat users. In all, we recruited 25 Snapchat users, 8 males and 17 females, all between 18–24 years old. Demographically, the sample was 15 Caucasian, 4 Asian, 3 South or

Central American, 2 European, and 1 African-American. Participants received either two experimental participation credits or $10 as compensation for their time.

Procedure

I chose an interview method in part because Snapchat's ephemeral form of messages makes it difficult to collect actual message content and in part because I wanted to focus on users' perceptions of message ephemerality independent of any specific message content. Based on pilot interviews, an interview guide was developed (see Appendix A) with general questions about Snapchat use, characteristics of their contacts on Snapchat, communication content and goals in Snapchat, comparisons of Snapchat to other tools and social media, and reflections on why and how they use Snapchat. Interviews lasted from 28–54 minutes. Interviews were audio-recorded, transcribed verbatim, and edited to remove identifiers and other references that may identify the participants and/or anyone they mentioned during the interview. Each transcript was then numbered, and quotes are reported as (SPn) in the sections below.

Data Analysis

A grounded theory-inspired method (Strauss, 1987) was used to analyze the data. After reading the transcripts multiple times to become acquainted with the data, transcripts were imported into the Dedoose.com qualitative data analysis tool and divided into meaningful units based on the segments of talk upon a single topic or a single system feature. Another collaborator and I then did a close reading of the transcripts and memos during all phases of analyses to highlight key themes about relationships in the data, to help refine categories as a part of an open-coding process to code distinct concepts and categories in the data (Corbin & Strauss, 1990; Glaser, 1965). One of the co-authors and I met several times to discuss and reconcile these codes and an initial codebook was developed. Two coders then independently coded a random subsample of the

data, with good interrater reliability (Cohen's kappa = .81); then a full coding of the whole data was conducted. After open-coding, the two authors iterated both through the codes and the codebook as an axial coding process (Corbin & Strauss, 1990). Lastly, selective coding (Corbin & Strauss, 1990) was conducted to illuminate themes and categorize the results.

Results and Discussion

Four main themes were identified that were both connected to Snapchat's ephemerality and frequently mentioned by participants: the presence of more intimate networks; the prevalence of mundane communication using these ephemeral conversations; the reduction in self-consciousness in such communication; and the negotiation around saving messages that are normally ephemeral.

The relational context: smaller, more intimate networks

Participants reported that they normally only added people who they already knew in Snapchat. Participants mentioned it was because people must have a screen name or phone number of another Snapchat user in order to be able to add this person as their contact, and also because Snapchat did not help users import their connections on other social systems like Facebook:

"Facebook is a lot more acquaintances. Mostly people in my sorority that I'm not trying to be friends with, I think...Snapchat is more close friends and romantic interests. (SP10)"

Snapchat contact networks are also much smaller in size:

"I only have 50 friends on Snapchat but on Facebook I have over 1,100 "friends," acquaintances... I use that as more of a networking site. (SP1)"

These differences in tie closeness also helped shape the way participants saw Snapchat versus other channels, perceiving it to be more appropriate for certain closer ties:

"E-mails are for professors. E-mails are for presidents, vice presidents, or an e-board member that I do need to reach out to. E-mails are for a kid in the library or something. Text messages are for my family or my best friend who I can always reach out to. Text messages or calls you expect them to get back to you within hours, you know?...Snapchat is definitely for just my age group, especially ones who are close to me and who know me very well. Facebook is just for everyone else. (SP16)"

Overall, participants reported using Snapchat to interact with a select group of people, those with whom they were closely connected. As the above quote suggests, Snapchat was not the only way close relations connected, but it was a common way: participants considered Snapchat to be one of their most frequently used social applications on their mobile phones, along with Facebook, messaging tools like WhatsApp, and other social media like Instagram.

Ephemeral conversations influence functions: Mundane talk for daily connection

Compared to other CMC tools that made conversations persistent, participants saw Snapchat as particularly well-suited for everyday talk. The idea of everyday talk is closely related to "the mundane, everyday interaction between two partners (Duck et al., 1991, p. 229)" that constitutes the majority of offline conversations in daily life. Such talk takes many forms, but can be broadly classified into superficial talk, informal talk, task talk, and deep talk (Duck et al., 1991).

Participants were much less likely to use Snapchat for the kinds of talk that require more intense coordination or communication, such as task talk and deep talk. Task talk refers to conversation regarding decision-making and instructions for accomplishing a task. Interviewees reported engaging in such talk less on Snapchat than on text-messaging platforms like iMessage or GroupMe:

"I don't plan through Snapchat. I definitely do more plans through text, or GroupMe. Or, if I have a funny comment to say, I'll post it to the group. Mostly plans. (SP18)"

Participants also highlighted the lack of deep talk on Snapchat. Deep talk refers to conversations involving sharing problems, complaining, and having serious conversations about personal and important topics. Participants reported they tended to have deep talk in other systems like SMS:

"If something was actually wrong, someone would like, you would text someone about it versus snapchatting them about it. (SP6)"

Participants explained why they did not conduct many task and deep talks in Snapchat: Ephemerality acts as a *constraint* to achieving certain goals and meanings that involve continuous and informational conversations. The automatic deletion of messages restricts archiving and reviewability, thereby removing an important support for reference and grounding activities that are important to task talk and deep talk:

"I feel like, if I'm going to have like, a real conversation over text with someone, or like a more, a relatively more serious conversation or like, even organize or plan something. I'd rather do it over text, just because like, it's there to like, look back at. Or reference. (SP6)"

This is consistent with the benefits of persistent conversation including its support for informational goals in collaboration and information exchange (e.g., Erickson & Kellogg, 2000).

At the same time participants also reported using Snapchat for superficial and informal types of talk, types of talk that are associated with close relationships, more than they did on other media. Superficial talk refers to conversations focused on the discussion of topics of limited depth

with the purpose of passing time, mostly between less familiar people (Duck et al., 1991). Examples of superficial talk include short conversations between strangers or acquaintances talking about current events, the weather, or a kind of chitchat to avoid silence. Informal talk is also common in Snapchat. Informal talk refers to conversation devoted to topics such as catching up on daily events, joking, and other light conversations between friends or known social relations.

"[Snapchat interactions are mostly] just one or two snaps back and forth, you see their face, you exchange a laugh even though it's not like personally ... A little with just keeping connected but like I said before it's I think it's kind of on superficial level. (SP11)"

"I don't know. I feel like texting is a bit more formal, where Snapchat ... is a lot less formal like, "Oh, I sent you this." (SP17)"

Participants' choices of an ephemeral CMC tool for casual, less-informational talks suggests that when the system by default deletes content, it influences users' choices of communicative practices using the system, and my participants explained why, as presented next.

Ephemeral conversation makes space for the mundane. One reason for the prevalence of everyday, informal communication in Snapchat is that default ephemeral conversation supports sharing mundane things. First, participants felt that the digital contents of these mundane talks primarily serve the interaction at the moment:

"I won't look back at someone's old photos. I don't do that frequently. I'm just interested in the moment and I don't care about it after I see it, so Facebook, I'm not going to look back on someone's old photos. A Snap story will go away. I don't really want to see it again. In a week from now I don't really care what someone did last weekend, but in the moment, it's nice to see what they're doing. (SP23)"

Because the digital content is only for short-term purposes, participants did not expect the tool to support long-term functions and goals such as reviewability and retrievability, and they saw limited value to automatically saving this content.

Moreover, automatically saving the message content in these less-informational talks has costs. Persistent messages take up both device space and mental resources. Respondents did not want to accumulate meaningless message contents in their own digital collections, and the fact that Snapchat automatically disposes of these contents while still allowing users to save select meaningful content (as the sender) or create screenshots (as the receiver) helps users to populate their digital collections only with these contents they perceive to be meaningful:

"Snaps only last for around ten seconds and then you can choose. If you found something really funny, you can choose to screenshot it and save it but for a Facebook post or a message, it lasts forever pretty much. It's always on the list of all the posts so it just can get a little overwhelming with the long list of posts. (SP22)"

In short, the reasoning participants gave suggested that digital ephemerality drives an alternative process of managing digital collections—to pick and save the meaningful among the mundane, rather than to pick and delete the mundane among the meaningful.

Ephemerality foregrounds relationship maintenance goals

Ephemerality makes space for mundane talk, but this alone does not explain participants' heavy use of Snapchat in these daily communication activities: they must also achieve certain goals from their mundane talk. Participants' responses showed that ephemerality as an alternative design highlights certain goals and functions by supporting these less-informational talks.

First, mundane talk helps to create a feeling of interactional co-presence, even when partners are not physically co-present, which was also found in another study of Snapchat (Bayer

et al., 2016). This type of talk enables people to implicitly participate in one another's lives and keep relational continuity. The very occurrence of such talk, not only its content, can create a sense of connection and closeness, which can lead to deeper interpersonal relationships. Participants described using Snapchat for these connection functions:

> *"To inform others who you're with, where you are. To share information. To make someone laugh. Reconnect with somebody. It's easy for long distance to keep in touch with my friends from other schools, to keep them updated with what's going on without me having to take a lot of time out of my and explain what's new. (SP23)"*

Other goals are also foregrounded in participants' ephemeral conversations, such as those around entertaining. Participants often described wanting to share fun, humor, or creativity, to make people laugh and "*smile throughout the day (SP3)*". Sharing enjoyable content has value for both self and others, especially in close relationship contexts. In Snapchat, mundane content like a funny face becomes a powerful vehicle to deliver these positive emotions:

> *"We have a thing where we send each other really ugly faces and we'll do it a couple of minutes at a time, send each other time photos. That's really fun. (SP8)"*

Through the feeling of interactional co-presence by sharing mundane content and the efforts in building mutual joy through sharing funny everyday moments, these conversations support relational continuity, acting as "symbolic forces for creating, sustaining, and manifesting relationships (Duck et al., 1991, p. 234)". Ephemerality's support of mundane interaction and the friend adding interface that encourages people to articulate mainly close relationships work together to meet user goals of relationship maintenance:

"Snapchat is more like a convenient easy way to tell your really good friends what you're doing right now, quickly, easy, because they're your friends you care about it. (SP14)"

Ephemerality influences self-presentational functions: Performance with less self-consciousness

Besides foregrounding relationship maintenance goals, ephemerality also influenced self-presentation functions around the visual communications conducted though photo and video messages in Snapchat. For example, sending ugly faces is an example of a more general theme that emerged, that Snapchat allows people to "*let [their] guard down (SP2)*". Concerns over self-presentation were less salient than in other communication tools:

"There are definitely things on Snapchat that people will video or take a picture of me that I wouldn't want on Instagram or Facebook. ... Especially Facebook, I want to take cute photos to make them think that I'm somewhat put together… (SP10)"

Goffman's dramaturgical "front stage/back stage" metaphor (Goffman, 1978) can be used to help explain the benefits that ephemeral sharing poses by contrasting the self-presentation and image management practices in Snapchat versus in other persistent social media that participants mentioned. In the metaphor, Goffman conceptualizes self-presentation as a "front stage" performance for audiences where people selectively present themselves based on social norms, expectations, and audience preferences. In contrast, the "back stage" refers to a behavioral setting in which people rehearse what goes on a front stage and are comfortable lowering their guard. Developed for face-to-face interactions, the metaphor has been applied in social media with friends and followers playing the role of audience.

First, Snapchat's audience control process contributed to reduced concerns around self-presentation. Snapchat's friending mechanism pre-defined that a user's self-presentation is mainly in front of familiar audiences: as discussed earlier, audiences in Snapchat are typically people they know well and who are specifically targeted for particular snaps. This composition of a closer network influences participants' lowered concern of self-presentation in Snapchat:

> *"I feel a lot of self-presentation on Snapchat is like it's not as much a priority when you're just sending individual snaps to people just because the people I usually send to are people I'm really comfortable with talking to and also the stuff I send is going to be gone after a while. (SP8)"*

In other media, audiences are much broader, leading to self-presentation concerns:

> *"Yeah, there's definitely things you put on Snapchat ...and you might be a little drunk or something or just you wouldn't want that to be on Facebook for employers and family members. (SP2)"*

Moreover, on the temporal dimension, ephemerality also mitigates long-term impression management concerns by setting the content accessible for a short time by default. In a persistent social system, the typical default of automatic archiving means that communication actions, such as sending a selfie photo, talking about some sensitive topics, or uploading a picture on Instagram, will leave records in the system unless users intentionally delete them. Hogan (2010) distinguishes between ephemeral acts and recorded acts, and argues that digital traces also have presentation functions. He uses an exhibition metaphor to make an ontological distinction: a performance in a strict sense is a real-time synchronous presentation of behaviors, while an exhibition is an asynchronous presentation of digital artifacts. The metaphor highlights that that system is usually

in charge of the presentation situation, which incites fear of permanent display that leads to self-censorship at the performance phase:

"Comparing it to Snapchat, I would say you need to be much more careful about how you use Facebook messenger than Snapchat, because, like, [on] Facebook stories, you can scroll through the log with everyone you ever talked to on Facebook, and look what was said. (SP7)"

Second, the message's content ephemerality makes Snapchat unlike most digital systems where users' content persists and other users might access it or the system might re-present it. Instead, the user has control of the display duration of the exhibition; the system enforces the user's decisions. This combination of short-term display and enhanced control is another factor that reduces self-consciousness:

"If it's for let's a boy you like, you don't want to send just a picture [through text messaging], because he's gonna have it and he's like oh, girl, if I look at it for a longer time, she doesn't look that—whatever, you know, but if it's Snapchat, you can even put like oh three seconds only and then they're oh and it's already gone. (SP14)"

In this sense, its ephemerality design makes Snapchat communication more similar to an ephemeral act rather than a recorded one, and this expands people's range of potential performances. People described being at liberty to do things they might not do in other situations, even face to face:

"When I'm Snapchatting my friends, I would just make silly faces and break out of my own shell. Outside of my comfort zone. Whereas when I go out in regular clothes, interacting with regular people, I would keep it together. (SP16)"

People would do this even at their own expense, such as with the quote about sending "ugly faces". This level of freedom provides additional support for the kinds of everyday talk and relationally oriented communication described earlier.

In short, Snapchat illuminates the boundary between performance and exhibition and how system design can affect perceptions of this boundary. Moreover, its content ephemerality, which limits the duration and access of the content, along with the locus of control over presentation and audience, all help in shaping people's understanding of their self-presentational outcomes across time, particularly mitigating their long-term exhibition concerns and encouraging sharing contents considered risky to self-presentation on persistent media.

Ephemerality shapes privacy management: Balancing default deletion and selective saving

Ephemerality also impacted how participants handle their exchanged contents together. Content generated in CMC is often shared and co-owned by parties in the communication rather than by individuals. One problem with making these artifacts persistent is that each party has an interest in mutual management of saved artifacts, and conflicts can happen if the ownership or control does not agree between parties. Although the automatic deletion design in Snapchat reduces these concerns about mutual management by not giving any ownership or further access of the content to the message receivers as the content is forced to be gone, Snapchat still supports automatic deletion, not absolute deletion: as shown in Figure 2d, the potential message screenshotting in Snapchat clearly violates the promise of ephemeral content and the sender's ownership and control over the interaction. Yet, participants still recognize the benefits of ephemerality and practices described in above sections, and consider that the default norm is to

not screenshot, a norm driven by Snapchat ephemerality design's emphasis on the default handling of messages:

"Snapchat is to send things that get deleted, disappear after five, eight seconds. If you screenshot it then you defeat the purpose of it. (SP24)"

Violation of the default norm could lead to explicit negotiation or argument. For example, when a receiver saves the content without the sender wanting them to, participants often reported that they confronted the violator:

"I would confront the person, either text them or in person, just in a mature way say, 'It's really important to me that you delete that photo,' and hope that they delete it. (SP23)"

Still, the default norm left space for selective saving. In many cases screenshotting is allowed or even expected:

"If [the snap] is of some funny contents I took a snap of a funny poster, that's completely fine, or if it's something else that's funny or something's name, there's nothing they can do with that to cause any kind of harm or anything bad to the sender but as soon as it involves any kind of information that you wouldn't want someone else to have saved, then it's bad. ...And then it also depends who does the snapshot. If it's one of your best friends and snapshots one of that, you're not really worried. But then if it's someone random, that's—by random I mean a friend that you're close with but not that close with, it doesn't, or someone that you're not even that friendly with, it doesn't make sense for them to Snapchat something personal to the sender. So then it's, it would mostly require you to text them like yo, why'd

you—you'll delete that, or why'd you snapshot that? Why'd you snapshot that?

(SP12)"

To interpret this allowance of breaking the default norm of deletion, I use Nissenbaum's framework of contextual integrity (Nissenbaum, 2009; Nissenbaum, 2011) to unpack how a violation to default deletion can be justified and accepted. Nissenbaum posits that norms are highly context-specific and that individuals move in and out of distinct contexts that pose different norms for information sharing (Nissenbaum, 2009). "Distribution," which refers to the movement or transfer of information between parties, is a key concern of these norms, influenced by three main forces: "actors (subject, sender, recipient), attributes (types of information), and transmission principles (constraints under which information flows) (Nissenbaum, 2011, p. 33)". So far, the transmission principles—messages should be ephemeral—have primarily defined the default norm not to screenshot, but the other two factors also shape the norm.

First, the force of the actors plays here: screenshots can be for closer friends. The main actors around screenshotting norms are senders and recipients, and the nature of their relationship helps determine whether the no-screenshotting norm applies. Participants reported that for the same snap, it would be okay for some contacts to take a screenshot but not others. Relationship closeness was the main criterion, because although on average Snapchat friends are close, not of all them are:

"I wouldn't screenshot if it was someone I was not close with. That's reserved for

close friends. (SP10)"

Other actors' factors, such as the gender of the sender and receiver, could also affect these norms:

"I would never screenshot something a boy sent me. That's weird, they're going to think I'm weird because I screenshotted it. (SP10)"

Secondly, the content attributes also play a role: selective saving is for outstanding, appropriate content. In general, saving mundane content was inappropriate, even for close friends:

"If they're boring, just saying 'hello,' then I wouldn't have any use for screenshotting that. (SP15)"

Instead, saved content should be "*out of the ordinary. Not just a picture of someone's face and hello. Either like a funny message or a cool picture... Something that you want to look at in the future (SP15)*".

More generally, content with archival value was more likely to be fair game. This might include fun or creative content:

"I would [screenshot] a personal message if I thought it was funny, assuming that it's not super personal. (SP1)"

or content that needed to be remembered later:

"if there's some information that probably should have been sent as an iMessage like a location or something then I would screenshot it just to remember it. (SP22)"

Overall, these norms around screenshotting are generally aimed at balancing the benefits of saving with the potential harm to the sender. When the potential for harm is high, as with personally revealing content, the norm is clearly not to share:

"If anyone sent me anything of them naked or something, I would never [screenshot]. (SP2)"

Otherwise, as with P1 mentioned above, people weighed the benefits of the content with the concerns of the sender:

"another case is when someone sends ... something you'd want to have at a later

date, but not necessarily something that was unflattering to the person that was

sending it, or anyone else. (SP7)"

The fact that information could, in principle, be saved was in the back of people's minds:

"I feel like a lot of people will do that. Like send gross pictures because it's funny

which I wouldn't do otherwise. So I guess that's kind of fun and you can send

whatever. But you can also screenshot it so it's not that reassuring that they go

away. (SP25)"

Still, Snapchat users walk this line and usually succeed, and it is the default ephemerality nature of Snapchat messages that helps people negotiate around sharing more seamlessly than in most systems. For example, the contextual integrity framework (Nissenbaum, 2009; Nissenbaum, 2011) was used to analyze how Facebook's interface and access control features lead to privacy management issues (Hull et al., 2011). There, violations of norms happen most often in joint contexts, such as when a user shares a photo that also has her friends in it. In this case, privacy concerns are not just with the person who shared the photo, but also with her friends, especially if they have been tagged by the photo owner. From the perspective of contextual integrity, distribution norms indicate that it is generally acceptable to share photos of one's social life with one's friends. However, tagging her friends and putting the photo on her newsfeed results in much wider revealing of information than the friends may expect. The problem is that although this could be perceived as a violation of expectancy, it is not clearly a violation of the norm of the system (Hull et al., 2011)—and this is hard to disentangle in a system like Facebook with design goals around sharing in social networks.

Sharing third parties' content is also a conscious process in Snapchat: photos may contain third parties—and, in fact, the distribution norms of Snapchat suggest these sometimes *should* be shared if those third parties would get value out of it:

"I think that's okay, in a basis that the person who screenshots that is showing the third person in order to prove something good about this person. (SP16)"

But the norms that arise from default deletion mean that information about third parties disappears quickly unless there are real reasons to keep the photos and keeping them is unlikely to harm others.

These norms, combined with the directedness of snaps and the smaller networks in Snapchat versus Facebook, make the effects of information sharing much more transparent in Snapchat than Facebook. Ephemerality defines the default information flow, where sharing does not imply co-ownership, with the default of not to screenshot. If a receiver assumes ownership, which opens a possibility of transmitting it to others, the original owner is notified. In this sense, sharing and information flows are similar to face-to-face because of shared awareness around shared content: everyone knows who knows what. This translucence around ownership and transmission, plus its relatively direct mapping to the way people negotiate sharing information in face-to-face settings, helps explain why many people have adopted Snapchat to have frequent informal but personal communication with friends they have offline.

Summary of findings

In this section, I present the findings on communicative practices in Snapchat and how they are influenced by the ephemerality design: the co-existence of default deletion by the system and intentional archiving by users shapes social interaction, affecting users' motivation, self-consciousness, and privacy management behavior. Snapchat's ephemerality is perceived as less

effective for formal conversations, so participants tend to share everyday, mundane talk for maintaining relationships. Default deletion is perceived to avoid unintended audiences and long-term exhibition of content, encouraging kinds of sharing rare in other social media. The automatic deletion design with the option to selectively save content forms a default norm of not taking ownership unless with justified goals and benefits.

However, it is not safe to suppose all the influence on these perceptions and behaviors comes from ephemerality alone. It may be because Snapchat's friending mechanism that only allowed users to add each other through their user id and phone number, users had a smaller network, with closer ties such as close friends, family members, partners and other people they knew well. And in their feedback on their mundane talk with others, the primary goal they had was to maintain connections to these close ties. Therefore, factors such as the network and anticipated communicative goals work with ephemerality to shape the effect we see.

Extended Discussion: Constructing Other Mechanisms of Ephemerality

The success of ephemerality in Snapchat does not mean this kind of ephemerality is the only way to achieve digital ephemerality. Here I extend the discussion to offer constructive suggestions on other ways in constructing ephemerality based on previous related systems, with their potential benefits and costs.

As a preview of my discussion, Figure 3 presents ephemerality as a nuanced concept the can be realized in a number of ways, including the mechanism of ephemerality such as data ephemerality versus interface ephemerality, the dimension of ephemerality such as content versus contacts, and the degree of ephemerality. I will unpack them with design examples and their potential benefits and concerns.
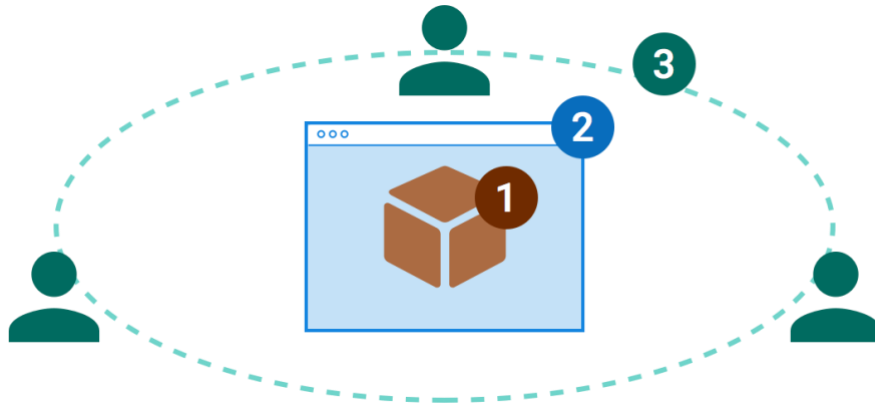
Figure 3. Ephemerality as a nuanced concept can be realized in different dimensions, including (1) data ephemerality, (2) interface ephemerality, and (3) contact/network ephemerality.

Mechanisms of ephemerality: interfaces vs. data. Even without explicit deletion, many systems given content essentially an ephemeral form through aspects of their interface design. For example, the reverse chronological scrolling of the Facebook Newsfeed interface makes it hard to retrieve old content, while other parts of the Facebook interface are viewed less ephemeral: Graph Search and Timelines both provide more access to past data (Kaun & Stiernstedt, 2014). However, because the newsfeed is the primary interface element, its *temporal limitation*-based ephemerality encourages people to perceive data that crosses beyond the recent feed as "the past" and less interesting (Zhao et al., 2013). Temporal restrictions can also play a role in increasing appreciation of artifacts (Odom et al., 2012, May).

Another natural way to implement ephemerality besides total deletion is partial degrading. For example, Gulotta et al. designed a series of prototypes that presented digital data as decaying over time, with portions fading out or being literally replaced by their constituent bits (Gulotta et al., 2013). Such data-degrading designs are sometimes proposed as a privacy-preserving mechanism in the database domain (e.g., Fung et al., 2010); Gulotta et al.'s exploration of the lifespan of digital artifacts also suggested that the design made participants experience digital data

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more like they perceive older physical content which often naturally degrades over time (Gulotta et al., 2013). Similarly, Snapchat could choose to highly blur expired snaps rather than delete them entirely, as shown in Figure 4. This might better support the conveyance of connection and positive emotion that make everyday talk powerful for maintaining relationships as Snapchat's deletion design does, while still being a safe platform for performative communication that minimizes long-term worry about information leakage (e.g., Besmer & Richter Lipford, 2010).
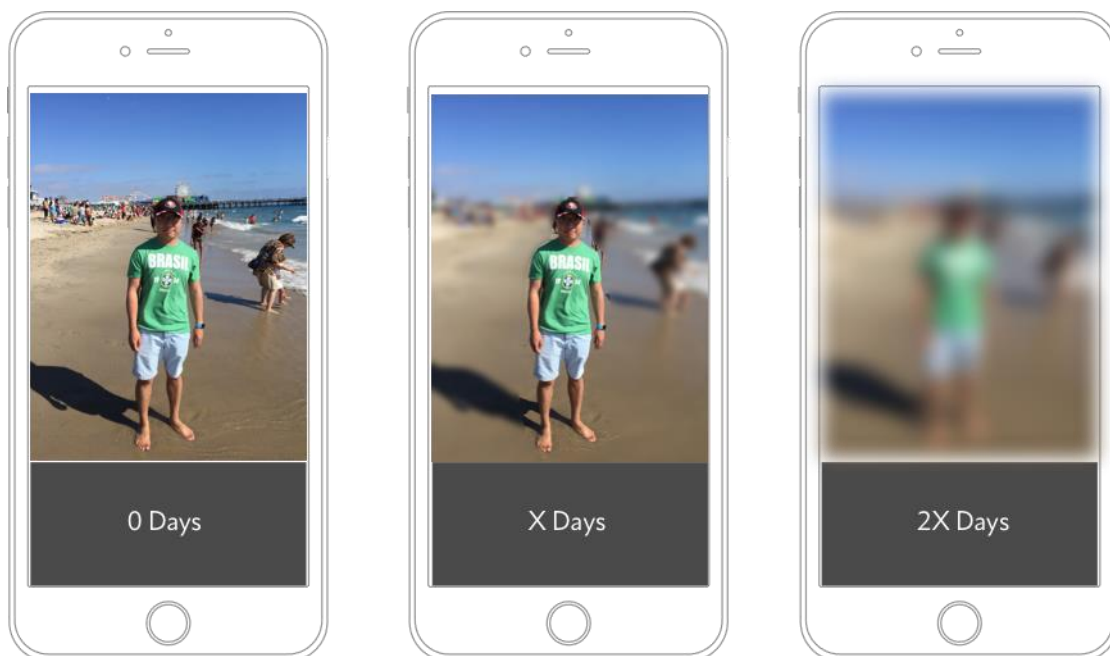
Figure 4. A sketch of how decay can be implemented: users or the system can pre-define what area to be decayed according to time and the speed of decaying.

Dimensions of ephemerality: content versus contact. Snapchat's ephemerality is primarily achieved by the automatic deletion of content. I propose that digital contacts can also be ephemeral, which is normal in our daily life: for example, people might talk to some strangers in social events like conferences, parties, and workplaces and build an acquaintance—but not interact with them until next they meet. Many people articulate these connections in digital social networks like Facebook, Twitter, or LinkedIn. However, for all the reasons described earlier around exhibition

and risks of unwanted information distribution, this can negatively affect people's ability to communicate on these networks. Further, this can lead to unwanted or inappropriate communication: imagine that a person you meet in a conference keeps sending you pictures about what she is doing—which Facebook actually affords.

Ephemerality can offer a new dimension to how people manage digital connections as well as digital content. Systems might automatically create ephemeral networks, or ephemeral connections to networks, based on certain physical or temporal contexts. Fully location-based networks such as YikYak grouped users who were geo-located together and let them anonymously share contents. When a user moved to another location, she/he would be grouped in the group based on the new location. YikYak groups were reported as a valuable design in offering users a location-based ephemeral online community with a strong sense of community ("Yik Yak: the anonymous app taking US college campuses by storm", 2014). Similarly, imagine a context-based social networking system where a digital connection (following, friending) only exists in the current context where the connection has meaning and disappears outside of the context.

I propose that ephemeral connections and networks can provide several benefits, by clearly identifying contexts, by making the interactions in those contexts more salient, and by reducing collapse between contexts that helps people manage their audience and disclosure. Snapchat limits interactions to close audiences and the temporal now; the automatic creation of networks or groups specific to locations, times, or events (in some ways, a combination of location and time) might also provide an easily handled context like Snapchat. This might support people's needs to both separate and communicate with audiences: more than just creating an event as in Facebook and people posting to it, it might be interesting to have a "newsfeed view" of the people in a group, or

at an event, that gave members a glimpse into the lives of other members during and perhaps shortly before and after the event or task the group was created for.

Degrees of ephemerality. Finally, ephemerality can come in different degrees. In Snapchat, where ephemerality is accomplished through deletion, the range is fairly wide: person-to-person Snaps last less than 10 seconds, while Snaps on stories last 24 hours. Even in Snaps' range of 1 to 10 seconds, people perceived differences; 10 seconds was seen as a long time:

> *"If you're putting a picture, don't make it 10 seconds long. I think that's annoying.*
>
> *I used to do 5 but now I'm down to 3 because even 3 seconds, that's a long time.*
>
> *No one's going to look at my picture for 3 seconds. (SP25)"*

Participants also reported setting very short times for particular Snaps to indicate that they were not for screenshotting.

This raises the question of the effect of ranges of time (or, for other mechanisms, what levels and rates of blur) would mean to users. As discussed in chapter 2, the capture and archiving of content should be aligned with goals such as serving remembering or forgetting. Designing the content to be deleted, decayed, or hidden at different speeds might impact differently on remembering or forgetting: slowly decayed photos in Gulotta et al.'s DataFade prototype (Gulotta et al., 2013) encouraged users to have a sense of legacy, while the quickly deleted photos in Snapchat encouraged users to conduct mundane visual disclosure. Designers should be aware of the potential effects of this difference and select the appropriate range to align with the design's mission.

In short, the mechanism, dimensions, and degree of ephemerality are possible design spaces that a designer can consider constructing an ephemerality design rather than a simple binary decision about content deletion or permanence.

Summary

In this chapter, I used Snapchat as an example to demonstrate a conversation ephemerality design and conducted a qualitative investigation to explore the design's role in influencing user practices and perceptions around it. Findings show that Snapchat's ephemerality, achieved by automatic deletion of the message content, foregrounds less-informational communicative goals such as relationship maintaining and entertaining while reducing concerns around self-presentation and privacy. These findings justify exploring ephemerality as an alternative to be considered in CMC designs, and I further discuss how to construct an ephemerality design in dimensions of mechanisms, content types, and degrees. Together this chapter offers an integrated look at designing ephemerality for CMC.

CHAPTER 4

BUBBLEQ: DE-EMPHASIZING CONTENT TO HIGHLIGHT MEANING AND

INTERACTION RATHER THAN CONTENT IN IM SYSTEMS

In this chapter, I explore content de-emphasis as a design strategy for CMC tools. Chapter 2 outlined some of the potential risks in adopting design conventions that emphasize content rather than interaction, in particular, designs in which conversations are composed of explicit contents, and also initiated with contents. These risks include neglecting interaction that can also serve goals without content and raising pressures in generating content to start conversations.

To illustrate a design that highlights interaction rather than content, I iteratively designed a prototype called BubbleQ, using a different design for content de-emphasis for each iteration. I then conducted a field trial based on BubbleQ's final design to explore how its content de-emphasis design influenced users' communicative practices, perceptions of the message, and reflections on CMC tool designs. Finally, I discuss the implications of content de-emphasis for CMC design. I also published findings in the chapter in an ACM DIS paper (Xu et al., 2017).

The BubbleQ Prototype

BubbleQ was created as one design example to demonstrate what a content de-emphasis design might look like, and to offer a context for investigating how people react to content de-emphasis designs. The creation of BubbleQ had 3 design iterations, which are presented next.

The first design: total removal of content

As a bold exploration, BubbleQ's first design totally removed all the content of the message. I chose this total removal strategy because first, it was the absolute opposite to content emphasis and thus the most obvious counter example to conventional CMC tool design, and second, it could serve as a platform for exploring my hypothesis that content is not always needed

for communicating. If this design works, it is a strong justification of these hypotheses. Therefore, similar to the Yo app that only allowed users to send two characters "Yo" to others, in this iteration of BubbleQ the messaging interaction was limited to sending empty messages (no "yo"). The design is shown in Figure 5. The interaction was as follows: by pressing the "+" button in the middle of the homepage (Figure 5a), users could send a message to one of their contacts (Figure 5b); the contact then received a circle ("bubble") with the sender's username on it.

The bubble representation offered an interface in which messages could be visually present but without chronological order, thereby breaking the conventional chronologically ordered message interface in most IM systems. Considering a metaphor as an instrumental tool in design (e.g., Blackwell, 2006), I used the metaphor of *bubbles* by giving more ways to interact with the bubbles besides reading the messages, hoping to provoke meaning making on the messages themselves rather than just the message content. After "given" bubbles were presented on the homepage, users could interact with them by dragging them around; bubbles were given a physical collision simulation so that they could bump but not overlap. The bubbles also had a simulated magnetic force to the center of the homepage as well as to each other to gather them around. Similarly, to simulate the fragile nature of a physical bubble and to further make the metaphor salient to users, I also designed the empty bubble to be deleted when double-tapped. I named this prototype BubbleQ to illuminate this metaphor.

A pilot study showed that users had mixed reactions to this design. The design was presented to 8 pilot participants who tested it for a week in June 2016. Pilot participants found the bubble to be an interesting format, and considered "bubbling" to be like "tickling" each other. However, they quickly lost interest as they found it supported few ways of communicating. One of their explanations was that a messaging without content did not justify a long-term and repeated

"tickling" of each other. Yo, which is similar to this design, also declined in usage after a while ("What's happened to ~$7 million app 'Yo', 2014). The decline in user engagement found with both BubbleQ and Yo's total content removal designs suggests that this content de-emphasis solution lacks support for long-term communicative purposes and thus encouraged me to consider other solutions.
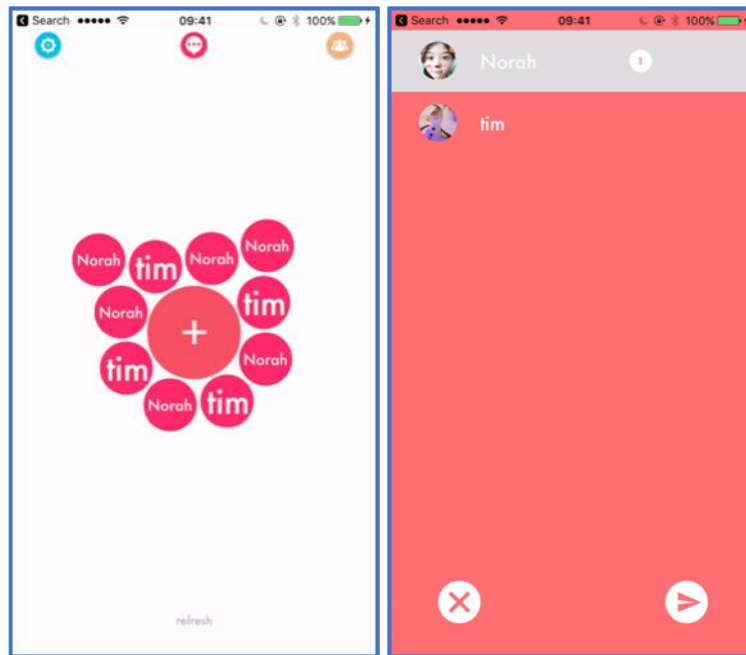
-a-   -b-

Figure 5. The first design of BubbleQ. Bubbles had no messages (empty bubbles), making it a completely content-less app. By pressing the "+" button in the middle of the homepage –a- users could send a message to one of their contacts –b-. The contact then received a circle ("bubble") with only its sender's username on it. Users could interact with bubbles by dragging them around the homepage or double-tap to delete a bubble.

The second design: content de-emphasis as an option

To address the lack of engagement found in our first totally contentless iteration, the second design of BubbleQ added some affordances for exchanging content. Specifically, the second iteration offered users the option of sending either empty bubbles or bubbles with content. The

second iteration of BubbleQ worked as follows: after tapping the "+" button on the homepage in Figure 6a, another window popped up (Figure 6b) with the instruction to "*input something or leave it blank.*" Users could decide whether to fill in the bubble with text or leave it blank and then send it. Then they chose the recipient by tapping the bottom left button in Figure 3, which opened the recipients window (Figure 6c). After the bubble was sent, the receiver's homepage (same as Figure 5a) showed either a filled bubble (i.e., one that included a message) with the sender's profile image and username or an empty bubble with only the username. Filled bubbles could be read by tapping, while empty bubbles do not respond to tapping. Read filled bubbles were shown in washed-out colors to distinguish them from bubbles that hadn't been read yet. In keeping with my focus on ephemerality, the filled bubbles could only be opened once; bubbles, regardless of whether they were empty or filled, could be deleted by double-tapping.

The same group of people used the new version for several days. They reported that although they had the option to send either empty or filled bubbles, they felt obliged to send filled ones because it was perceived as inappropriate to "tickle" people without saying anything. I found it interesting that the affordance of sending content appeared to create a norm that it *should* be sent, defying my assumption that offering alternatives was enough. It was also frustrating because this meant I couldn't learn about the effects of empty bubbles. This also suggests that people prefer to create meanings through messages than to send empty ones, making us wonder whether content de-emphasis of content was valuable for CMC tool design when the option was binary. Therefore, I came up with a design that let emptiness and content have a dependent relationship to one another rather than a competing one, as presented next.
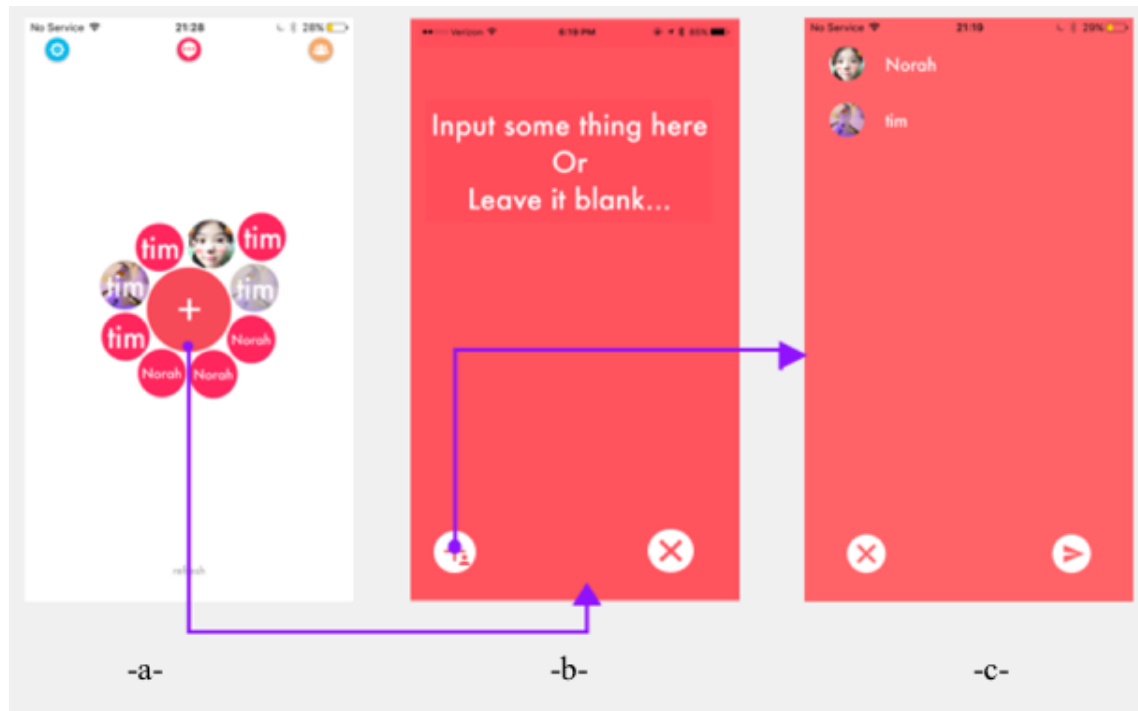
Figure 6. How to send a bubble to someone in the second design of BubbleQ. The second design allowed users to either send empty bubbles or filled bubbles that have a short text. By clicking "+" button at the homepage a, an editor page (b) pops up to let sender choose to put a short text or leave it blank. By clicking the selecting receiver button on the left bottom of page b, sender chooses who are the receivers in page c.

The final design: a content de-emphasized messaging flow

The feedback on the second design of BubbleQ led us to consider designs where users were required to use empty bubbles. Considering two choices of bubbles (empty vs. filled) and two places to create bubbles and content (conversation initiation vs. reply), I came upon a design in which senders could only send empty bubbles, which recipients could then fill with content in reply. Users can always send empty bubbles but can only send content by filling an empty bubble they received. When User A sends an empty bubble to User B, User B will receive it, and User B can choose to fill the bubble with content, or leave it there. This flow was appealing as there hadn't been other applications that incorporated this idea. Figure 7 shows the different messaging flows among the three iterations.
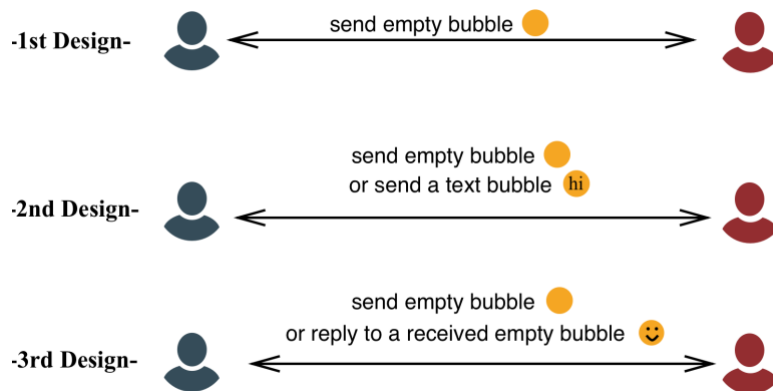
Figure 7. BubbleQ interaction flow in each design iteration.

In order to make this alternative flow of filling rather than sending content more salient to users, and to better probe this flow's effect on users' perceptions of the conversation, empty bubbles could not be deleted. This design feature could have potential costs as it might cause spamming; therefore, the app allowed users to block others if they spammed, and blocked users could not search for, re-add, or message the people blocking them.

The interaction of replying is different than other IM systems. If B chooses to fill the empty bubble with content, this bubble will be sent back to its original sender (i.e., user A). User A will receive the reply-filled bubble, which is presented as a full colored bubble with user B's profile image. Note that neither the opened content (Figure 8e shows the screenshot of a filled bubble with video) nor the homepage shows when a bubble was filled or the order of messages; this choice was made to address the chronological sequencing aspect of standard IM interfaces. User A can open this filled bubble anytime he or she would like to read it, but can only open it once. The reason for this ephemeral design was to explicitly resist the convention of a thread of messages and further limit the focus on information transmission by making it hard for users to form a long

contentful conversation. Those read bubbles were not removed from the homepage automatically after being opened; users could delete them by double tapping.
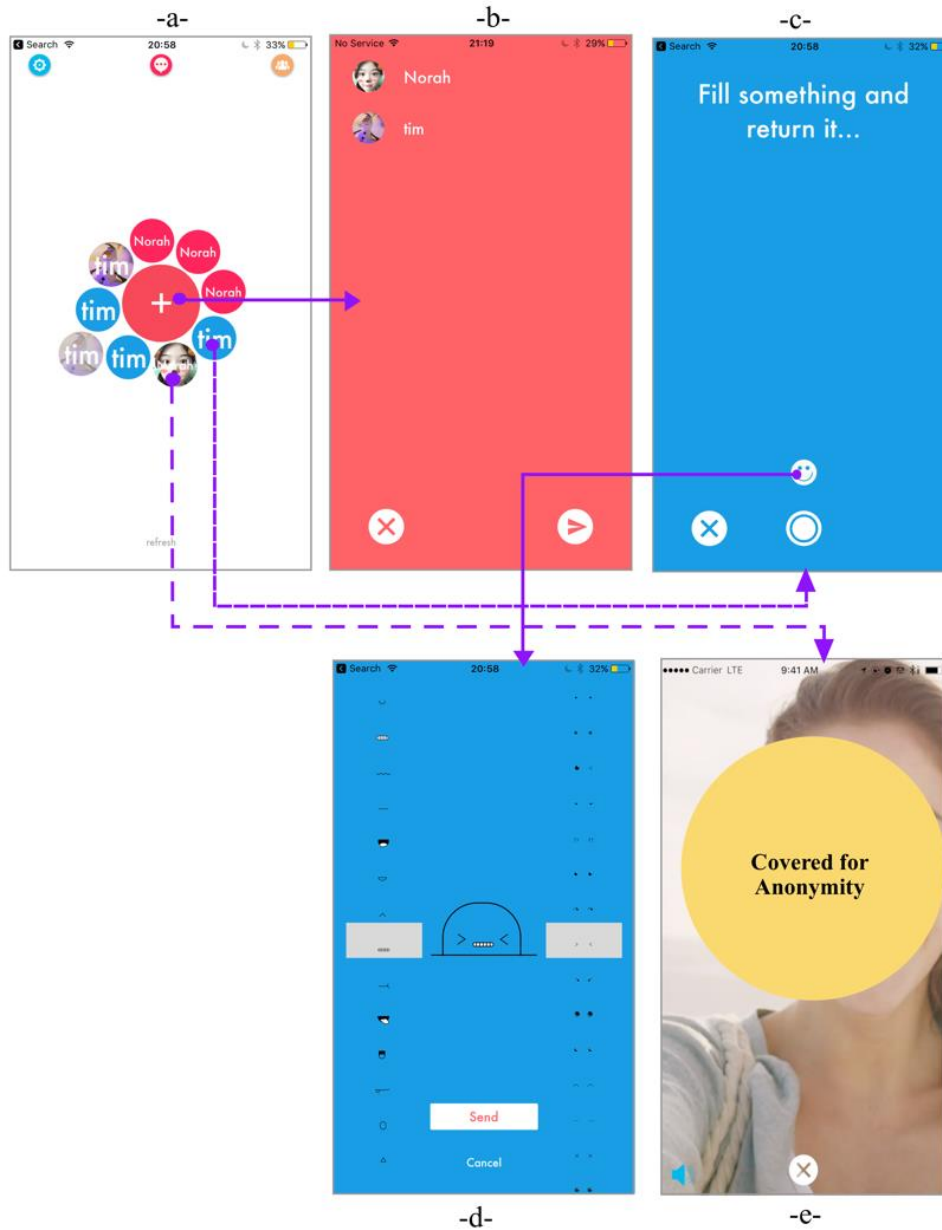
Figure 8. Main interface elements in the BubbleQ final design. Homepage (a): bubbles with only senders' usernames are empty bubbles, and others with user pictures are filled bubbles with contents, among which color-decayed filled bubbles are read ones. By tapping the "+" button users go to (b) to select to whom they want to send an empty bubble, and then by tapping the send button at the right bottom of (b) an empty bubble will appear on the recipient's homepage. Tapping an empty bubble opens the message composing window (c). After composing a text or emoji (d), or capturing a video, tapping the send button will send back the filled bubble that will appear on receiver's homepage (a) and can be read by tapping on it (e).

Furthermore, unlike the first and second BubbleQ designs, which limited users' capability to generate message content in both the sending and replying processes, this design attempted to de-emphasize content in the sending process for the conversation initiator but make it more salient in the replying process. I did this to shape a process that content is not always needed although can be afforded so that I can evaluate whether this process still constrains communication as the first design did. That is, it introduced difficulties in sending content directly to others by limiting it to filling and sending back empty bubbles. However, when replying with a filled bubble, this design offered users more choices so that content de-emphasis can be tested on the original sender's side rather than both sides as the first design did. These choices included text as in the previous design, short videos with optional filters inspired by Snapchat and Instagram, and a new emoji construction interface. The emoji interface allows users to create simple custom emoji by choosing a combination of eyes (from 30 given shapes) and mouth (from 30 more shapes) as shown in Figure 8d. I choose 30 items for each category as research showed humans can make more than 20 distinct facial expressions (Jack et al., 2012). The first motivation to build this feature is to offer users a non-verbal message feature that helps users to generate some less-informational but perhaps playful contents. The second reason is based on my fear that users might not have much to share through BubbleQ especially if BubbleQ was perceived as a prototype rather than a commercial application. I hoped this feature might help them start messaging.

In addition to de-emphasizing content, another theme that emerged from pilot studies of the first two designs was that users expected the app to be fun and playful even though this was not one of my initial design goals. Pilot participants liked the way bubbles could be moved by dragging them and thus felt like physical bubbles. To enhance this sense of playfulness, I made bubbles in this third iteration move when users shook their phones and added animations of

opening and closing when users interacted with specific bubbles. The design also allowed users to assign vivid colors to their contacts that would be displayed with their bubbles, both for playfulness and to help people distinguish bubbles from different senders (compare Figure 8a to Figure 5a).

In summary, unlike most IM designs that represent messages as a threaded conversation, BubbleQ uses a metaphor of free-moving bubbles to represent two kinds of messages: empty bubbles are blank messages without any content and filled bubbles are messages with text, video, or emoji content. Users could send their contacts empty bubbles or fill empty bubbles they had received, but they could not send content directly to others. Content could only be added in replies, and conversations had to be initiated with an empty bubble.

Technical details

The BubbleQ mobile client was developed as an iOS native app using Swift 2.3. BubbleQ had a Node server and a Mango database. The server and database were hosted on the cloud deployment service Heroku.com. The connections between client and server were SSL-encrypted.

As an iOS messaging application, BubbleQ also supported mobile push notifications: when users received a bubble (both empty and filled), they received a push notification delivered to their iPhone notification center, just like when they receive an SMS. A red circled badge number also appeared on the BubbleQ app icon showing whether users had unread filled bubbles and if yes how many.

Field Study

To evaluate the third design iteration, I conducted a two-week field study in which I asked people to use BubbleQ in their daily communication with others who they invited to use the application. In this section I present the field study's procedure, data collection and analysis process.

Procedure and participants

The field study had several phases: participant recruitment, a field trial, and interviews at Cornell University in December 2016. My colleagues and I recruited participants from the SONA system at Cornell University. We explained that participants would need to download and use a mobile messaging application for two weeks, then participate in a semi-structured interview. After signing up, participants were invited to the lab to meet the research team and to be introduced to BubbleQ and the study. We showed them the app and explained how to use it, and (if willing) they signed the consent form and agreed to BubbleQ's terms of use.

After consenting, we asked participants to download the app from the App Store and create an account. Each participant was asked to find at least two people they could use BubbleQ with. Some participants signed up as pairs or groups, and they were encouraged to add each other as contacts on BubbleQ. We asked them to use it in ways that made sense to them, and did not require them to use it instead of other messaging applications. However, we did ask them to use it frequently with the other BubbleQ users they found, aiming for at least 15 bubbles between them and each contact every day to encourage them to experience BubbleQ's messaging design on a daily basis. We also sent them reminders to use the app every three days. These reminders and usage levels were set with the goal of increasing the chance participants would have a solid experience of the interaction and interface, trying to balance ecological validity with forced use.

After two weeks, participants returned to the lab for a follow-up one-on-one interview. Through pilot interviews, my colleagues and I developed an interview guide (see Appendix 2) with questions about their general use frequency; their thoughts on the interface and interaction; their messaging patterns such as when and to whom they sent empty bubbles; when, to whom, and with what they replied to empty bubbles; and the goals or motivations they both had and inferred about

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others when using BubbleQ. We also asked them to compare it to other messaging applications, to reflect on the values and disadvantages of using BubbleQ, and to offer any other suggestions they had.

Participants who finished the two-week trial and the interview were given either 7 participation credits or $35. A total of 28 people participated, all U.S. citizens, aged between 18 and 26 (average 20), with 6 males and 22 females.

In addition to the 28 recruited participants, another 53 users used BubbleQ either because they were invited by the participants when we asked them to add BubbleQ contacts or because they happened to find BubbleQ on the App Store. We did not advertise the app publicly, so we expect that most were friends of participants. When they registered their BubbleQ accounts, these users also agreed to the terms of use, which explained that they were participating in a research project and what data we would collect and use later.

Data collection and analysis

Data collected included the 28 participants' interview data and all 81 users' message metadata logged by the system, which was later anonymized by removing user ids. Interviews were audio recorded, transcribed to text, and anonymized (referenced below as BP1 through BP28). Transcripts were imported into the Dedoose.com qualitative data analysis tool and divided into units based on segments of participants' feedback on a single or related topic or their comments on a specific system design feature. Similar to the method used in analyzing Snapchat study data, here we used a grounded theory method (Strauss, 1987) to analyze BubbleQ study data. I first wrote memos at the initial reading of all transcripts and created memos consistently during all phases of analyses to highlight key themes about relationships in the data, to help refine categories as a part of an open-coding process to code distinct concepts and categories in the data (Corbin &

Strauss, 1990; Glaser, 1965). An initial codebook of categories was developed, and a full coding of the interviews was conducted, iterating both through the codes and the codebook as an axial coding process (Corbin & Strauss, 1990). Lastly, selective coding (Corbin & Strauss, 1990) was conducted to illuminate themes and categorize the results.

Findings

A quick analysis of the server log was conducted for an overview of how many messages/bubbles of different kinds were exchanged by all the users in the field study. Across the 81 users, 9548 empty bubbles were sent during the first two weeks. Of these, 7269 were filled with content: 874 (12%) with videos, 1830 (25%) with customized emoji, and 4565 (63%) with texts. Texts ranged from 1 to 493 characters, with a mean of 32 and a median of 18 (SD = 35).

Because we did not ask participants for consent to look into their messages' actual contents to reduce potential concerns about privacy and security, we did not conduct content analysis on video, emoji, or the text messages. Instead, the findings are based on participants' recall and reflection on their communicative practices and their perception of the benefits and costs in content de-emphasis.

Alternative interaction flow leads to alterative practices

BubbleQ's alternative interaction flow led users to different practices from traditional messaging applications. BubbleQ forced users not to send content directly, but to reply to empty bubbles they received, and at the beginning of use, some participants experienced this flow had "*a learning curve (BP6)*" to understand and get used to; though it could be "*pretty fun, um, because it's just like this kind of explore. And then like once you figure out, I think it's like easy to use (BP2)*". To help make sense of it, they made parallels how they would communicate with paper:

"It's as if you're giving me a blank piece of paper and then I have to fill it out, and

then I could send it back to you. (BP7)"

Or more succinctly, "*like passing notes in class (BP19)*".

This new interaction flow still required effort and raised potential frustrations in starting and continuing the conversation. Participants sometimes asked for more empty bubbles during conversation, reminding the other person to send empties to keep the conversation flowing. When this failed and conversations lapsed because one party forgot to send empty bubbles, they would sometimes repair through other channels: "*it happened a few times where I didn't know when she ran out of bubbles for me and she messaged me (on my phone): hey send me more bubbles (BP12)*". To solve this problem, people often "stored" bubbles, or sent stores of bubbles to others, even though they were not looking to talk at that moment:

"To make sure my friend could respond cause then that's how, she can't respond

to me if I don't have, if she doesn't have any bubbles. So I just made sure to send a

few (empty bubbles) every day. (BP9)"

This suggested that some participants perceived empty bubbles as resources for future interaction, and as a way to get around the need to negotiate if they wanted to let their receivers just chat at will. However, this action did not address times when a sender wanted to initiate a conversation; in those cases, people sent more than one bubble at a time so that "*hopefully they see it and then they'll like reply to (BP2)*".

The necessity of having empty bubbles to send content also altered the way conversations ended. In many messaging applications, participants reported using explicit endings such as "butler lies" (Hancock et al., 2009) to terminate a conversation. In BubbleQ participants felt the conversation did "*keep going and there is no need to end to it (BP4)*" as they saw not sending new

empty bubbles as an implicit way to end conversations rather than explicitly terminating them. Unless one of the parties explicitly asked for more empty bubbles, participants reported that they could mutually sense this implicit intention to end conversation and agree on that.

Participants also saw the need to have empty bubbles to chat and the ability to ignore them as a way to prevent unwanted interaction:

"With Snapchat and the way other messaging apps work is that a lot of people get unwarranted messages. I feel like this happened in middle school and high school at times. You are friend with a guy and suddenly he just wants to like talk to you all the time. He just keeps texting you, texting you, texting you, keep messaging you. And like with this app, it definitely doesn't allow that. You have to want to talk to them. You have to ask, 'Hey, come talk to me' before they talk to you. So you wouldn't really get any of that (spamming). (BP7)"

And although sending many empty bubbles to other people could be spam in its own right, and the design choice to not allow users to delete the empty bubbles could lead to accumulated empty bubbles on the homepage, users did not spontaneously reflect on this possibility (maybe because users could block others who were spamming them).

Filling rather than sending foregrounds lightweight and mundane connection

Participants reported that BubbleQ's alterative process was more suitable to conduct light conversations rather than intense and in-depth conservations:

"Before cellphones, people would just like pass notes in class or whatever to talk to people. So I'm just saying like, not necessarily in class but something like small like that, like little things that you might want to say, and those are kind of just fun. (BP19)"

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Following Duck's categorization of communication into superficial talk, informal talk, task talk, and deep talk (Duck et al., 1991), the conversations in BubbleQ mostly fell into the category of superficial talk, covering topics of limited depth with the purpose of passing time:

"I feel like I pretty much just used to like tell them like something funny that happened during the day or like what I'm doing right now. Not really informational stuff, not really stuff they like necessarily need to know or not really stuff that they would need to write down somewhere or they would need to like look back on. Just like a funny picture or I was walking through the quad and I saw a dog and I would send them a picture of it. Or be like, 'Hey, look who I just saw'. (BP17)"

Similar to Snapchat, one main motivation of such superficial talk was to greet or quickly catch up:

"just like saying, 'Hi, how's it going?' And then like talking maybe for a little, and then going on with your day. Um, just like something casual, nothing like super in-depth that you would talk about. Something just short and friendly. (BP2)"

Another was entertainment; besides "funny" short texts and visual messages, 1/4 of filled bubbles were filled with customized emojis that served not just to communicate emotion but also as a playful, fun act:

"I kind of thought of the little like emojis as like little like Mr. Potato heads that you could like change them up and you're always trying to like make them look funny. So my friends and I would try to send real ones, but sometimes we'd like try to find like the best combination of like funny ones I guess. (BP7)"

Presenting messages as bubbles without timestamp information and chronological threading also led participants to use BubbleQ less for deeper talk because the lack of order affected grounding:

"Some of my friends have sent me (back) three or four (filled bubbles) at a time. I would have to go through them and sometimes I'd pick the third bubble at first, and the first bubble last. And then I'd have to think about it, so I cannot follow that conversation easily. (BP12)"

This focus on light content was perceived to potentially reduce users' pressure in capturing appropriate content for their communicative goals:

"I would use BubbleQ if I'm just trying to be playful (then I) send a cute little emoji or just say hey or something. With Snapchat, ... I'll send my friends like a picture of something that I saw somewhere else that I thought that they would like; or they were looking for something and I found it so I just send them, oh my gosh look I found what you were, what you were talking about. (BP19)"

Overall, this process in BubbleQ which twisted the initiation of conversations through requiring content to be sent as a reply to an empty bubble introduced some cognitive costs and occasionally induced frustration when the bubbles ran out unintentionally. However, this filling rather than sending mechanism made conversation easier to end and reduced unwanted interaction. Participants also tended to use this type of interaction for superficial talk in daily communication with a goal of quick sharing of mundane events in life to stay connected and entertain each other.

Content is not always needed: empty bubbles, full meanings

The empty bubbles were perceived by participants with different meanings, and the meanings were made because they serve purposes in BubbleQ's alternative interaction flow.

Emptiness itself alone was not sufficient for meaning, as expressed in this comparison to Facebook pokes (people can poke their friends or friends of friends on Facebook, who only get a notification saying they are being poked):

> *"The difference with the poke is when you poke someone, there's no room for interpretation, that's like 'Oh,' or 'you poked me,' and that's about it. But, for an empty bubble, if you sent me an empty bubble, then I can respond, like, 'want to grab pizza?' There could be an explicit thing that I ask, or I might just reply with something really minimal like 'Hi,' or something really dumb. But if you poked me, the only thing I can do back is either be like, 'Okay,' or poke you back, and nothing else. (BP6)"*

In principle, the recipient of a poke could switch to other Facebook communication tools, but in practice, BubbleQ's provision of both lightweight, empty bubbles and ways to follow them up and add content to them led participants to attach a number of meanings to the interactions around empty bubbles, depending on their history and relationship with a given person. These meanings include:

Negotiating attention and interaction. Sending an empty bubble was generally seen as a way to request attention, and the expected urgency of attention could be presented by the amount of empty bubbles sent:

> *"Sending bubbles is … really easy to get a person's attention. Especially because you can send, literally 20 bubbles at one time. So if someone did send me 20 bubbles, I would know that they're trying to get my attention. (BP4)"*

It was seen as a lightweight mechanism that reduced the effort needed to get attention, "*a little bit more conservative than writing a message (BP18)*", because it eliminated the need to create content:

> *"It's easier (to get attention) because you just press the button, you send them a bunch of bubbles, and then, they just pop up. But, like pictures you have to actually physically take the picture (BP4)".*

The main goal of this way of requesting attention was to invite the empty bubble's recipient to reply and start a conversation:

> *"It's kind of, like, poking someone, like, 'Hey, I want you to talk to me.' (BP6)".*

This is straightforward, as the process of replying to an empty bubble defined that the default response to empty bubbles was to fill them with messages to conduct conversations, even though it did not explicitly tell when, how, and why to do this.

The negotiation of intention also included the ways to interpret the sender's intention, and whether recipients should reply right away. Recipients interpreted partly based on the number of empty bubbles that were sent:

> *"If I had like, a couple empty bubbles around it (the center button), then you're like, 'Okay, like whatever, she sent me two or three.' But if you see that it takes up like half the screen, you're like, 'Oh, like I should look at it'. (BP7)"*

And the interpretation of intention was in part based on a particular partner's practices:

> *"If my cousin or my friend back home sent it to me, I would have to respond if they sent me empty bubbles, they were for a response, but my friend here, if she sent me empty bubbles, it was just like I could bubble her back whenever I wanted. (BP7)"*

A good interaction for building intimacy. As described earlier, BubbleQ's interaction style (as with Snapchat) was seen as effective for supporting superficial talk between people who already have a close relationship. Participants also saw potential for BubbleQ to help in developing new relationships.

Sending empty bubbles was seen as a subtle way to express interest in someone, especially if they "*were acquaintances and wanted to become a better friend or maybe someone that you kind of have like a crush on and you wanted to get to know better (BP19)*". Sending empty bubbles, as a lightweight and somewhat playful invitation, was a comfortable way to ask to talk:

> *"For developing friendships, relationships, I think it's kind of hard to, or people are nervous about maybe starting a conversation or with and, they are unsure what to do, I think BubbleQ was helpful cause it was fun, it (sending empty bubbles) lightened up the situation if you wanted to get to know someone better and have like, a way to prompt them to let you know that you wanted to talk to them. So I think it was just easier. (BP9)"*

As with the earlier quote from BP4 about not having to find a picture to take, the sending of empty bubbles reduced the cost and concern for senders, especially in newer relationships with less history.

This passed both power and responsibility on to recipients. Power, because as described earlier, it's easier to ignore empty bubbles than unwanted interactions:

> *"It works in the dating applications. Basically, it's a dating website, and you don't want unknown people to be messaging you a lot. So, BubbleQ would work out in that situation because, well they're only sending you an empty message, if you don't want to talk to them you don't have to talk to them. (BP12)"*

Responsibility, because the cost of knowing what to say could be passed to receivers:

"I feel like if someone text me, say I have like a crush on someone, or me and my boyfriend first start dating, if he texts me something saying, 'Hey,' with a smiley face, I feel like I would feel more confident that he wants to talk to me, versus, if he just sends me a bubble, because then that, then I would feel like, I don't know exactly what he wants me to say. (BP18)"

In summary, enabled in part by the ability to reply to them and conduct conversations, as the designed interaction flow required, sending empty messages was useful to negotiate intentions and meanings, as well as to support common relational goals. And this suggested that content, even though it should not be totally removed or eliminated in the system, might be designed to be absent in certain communication contexts and processes, to foreground purposes that do not fully depend on content.

The bubble as a physical body of messages

Besides the design of empty bubbles being filled later that poses an alternative conversation flow de-emphasizing content, BubbleQ's homepage presented both kinds (filled and empty) of message bubbles as an aggregated collection. It was different from the common IM interface shown in Figure 1, and participants noted this kind of interface, especially the bubble presentation of messages, offered them some benefits that were beyond the content of the messages.

First, the ability to interact with bubbles gave people a different experience of messages beyond just reading them. Some participants reported they played with the bubbles by dragging them around the homepage or shaking their phone to see bubbles bumping when they were waiting for others to respond, seeing this as "*aesthetically pleasing (BP11)*" and "*kind of cool to play with (BP4)*". This led them to see bubbles as a physical, embodied representation of the messages:

"I felt like it gave it more of like a physical aspect. It felt like I was holding a bunch

of things in my hand, like holding like a box of letters or something like papers that

you could just like move around. (BP7)"

This interaction also fostered a feeling of playfulness:

"The form in BubbleQ is kind of more playful. ... where you fill it, um, as opposed

to just like maybe a square of text, in regular messaging. (BP20)"

First found in the pilot of the second design, giving messages a body of "bubble" with some materialized physical sense led people to see messages not just as exchanged content but as interactive virtual objects with a certain playfulness. Many recent IM applications including Apple iMessage and Facebook Messenger have similar designs that use the appearance of messages to provoke playfulness. For example, Facebook messenger has a feature that when people type in certain words, or press and hold a message, decorations like flowers will be put on the messages as shown in Figure 9 ("Facebook Messenger is decorating your chats", 2016).

Figure 9. Facebook Messenger's Flower. (Photo from "Mothers' day: Facebook lets you send flowers to your mom via Messenger", 2016.)

Secondly, the homepage containing these bubbles was perceived as a visualization of historical conversation and impacted users' perception and reflection on their interactions with others as well as their own communicative performance. Similar to CrystalChat's representation of conversation history that used a circle to represent a message with each contact (Tat & Carpendale 2006), the physicality of bubbles and their occupation of space also emphasized the aggregation of messaging beyond individual messages or conversations:

"Having the bubbles kind of made you realize how many messages you actually got, because it would fill up, like, space, instead of just having a number, it would fill up a space. (BP4)"

This interface feature encouraged participants to think about their overall interaction patterns with others in a way that other messaging interfaces don't:

"In Snapchat, it just shows up as Joe sent you a bunch of messages, but it's just like that red square. You don't know how many they sent you. But then with this (BubbleQ homepage), you could be like, 'Wow, they sent me this one and this one and this one.' And it is like the spatial relation of it versus this person sent me a message. For example, my cousin would have sent me two (bubbles), but then my friend here would have sent me like six of them. So it just looks so much bigger in comparison and like makes it feel more important I guess. (BP7)"

It let users "*see who you talk to the most (BP2)*" and view "*a web of people and like how often you talk to them, like how often they want to talk to you (BP8)*". This could also have negative effects, however:

"Having a good amount of bubbles is good to keep conversation going, and it looks nice. Having too few bubbles is kind of sad, because they're mostly empty. (BP11)"

BubbleQ breaks the inherited IM conventions of emphasizing content by using empty bubbles both as a message and to initiate conversation, and also highlights alternative message forms by using a physically interactable bubble metaphor to present the message, and a filling-rather-than-sending messaging flow. Participants found that BubbleQ's alternative design in content de-emphasis introduced frustration at the beginning of their use, but they shortly adopted the alternative flow. The filling rather than sending flow also encouraged participants to conduct lightweight mundane talks with a goal to keep connection with other close contacts. In part influenced by this flow, empty bubbles were perceived to have functions in sharing and negotiating users' intention for communicating. The bubble representation of aggregated messages was also perceived with meanings in playfulness and reflection. Next, I will discuss what a content de-emphasizing design generally is, and what benefits it could have.

Discussion: What BubbleQ Tells About Content De-emphasis

These findings showed that BubbleQ's design of content de-emphasis foregrounded goals (here similar to Snapchat, mundane talks for connection) and meanings (sending empty bubbles also has meanings), justifying that content de-emphasis is a valuable alternative worthy to explore. Here I summarize the benefits that content de-emphasis can provide.

Content de-emphasis gives space for interaction

The reduced engagement in BubbleQ's first design suggests that content de-emphasis does not always mean limiting the affordance of content across all the interactions. BubbleQ was not designed only to let users share less content, but also to give users a space to interact without total dependence of content. And the lesson from its second design where content de-emphasis became an option but soon discouraged content-less interaction suggested the design should leave spaces that encourage users to try out content de-emphasizing messages.

The benefit in highlighting the differences between content and message is to offer chances for users to achieve meaningful communication through interaction rather than only through content. As Burleson (2010) pointed out, the content is to serve the message's meanings and goals. When messages need semantic content, the content should be easy to generate, as BubbleQ's final design did in supporting more formats of content. However, in cases that content is not needed, there should be alternatives such as empty bubbles or message representations that don't emphasize the content, as on the homepage.

Content de-emphasis induces ambiguity and gives space in interpretation of meanings

In BubbleQ, the empty bubbles also introduced a situation with ambiguity where empty bubbles were interpreted to have several different meanings: a desire for attention, a way to express interest, an invitation (or demand) to talk, an opportunity for future interaction, or a mechanical requirement to continue a conversation in the *BubbleQ* interaction flow. These intentions might also be achieved with explicit content such as "I want to talk to you" or "Let me know if you'd like to chat later?" or "How are you doing?" or even BP18's "Hey :)". However, in daily and social conversation, ambiguity has a value in subtle, negotiated meanings that support interpretation of social interaction like plausible deniability (e.g., Salovaara et al., 2011) and butler lies (Hancock et al., 2009)—and de-emphasizing content is one way to enable this negotiation. Like Yo and the Virtual Intimate Object, BubbleQ users were able to make space and make sense for their conversation needs with relatively little semantic content compared to most IM tools.

The ambiguity can offer a benefit in avoiding embarrassment. Aoki and Woodruff presented two design cases that intentionally make the system unstable for phone calls and thus introduce an ambiguity on the attribution to unresponsiveness to phone calls (Aoki & Woodruff,

2005). Similarly, BubbleQ participants talked about using empty bubbles to express interest, but felt more comfortable to do so rather than an explicit message showing interest, because they could also excuse themselves that they aimed at for example granting the interesting person chances to talk. I argue that this disguise should not be considered as a deception, but a "buffer zone" that helps people to probe a potentially aggressive intention with a possibility to withdraw and with a preservation of face work (e.g., Goffman, 1955).

Therefore, in cases where the design serves situations where ambiguity is welcomed, such as intimacy building, new connections and romantic relationships, it is useful to offer ways for users to subtly express their underlying intentions and de-emphasizing content can be a good way to do this. Snapchat user might keep sending each other several interesting photos to make a longer conversation; a Facebook user might click to like others' posts (e.g., Tong et al, 2008); yet a BubbleQ user might just need to send some empty bubbles. Having explicit contents can also achieve these goals, but has costs in appropriate content generation as well as risks in misinterpretation and fixed interpretation; while alternatives that de-emphasize content can cause ambiguity which offers space for interpretation in intentions, meanings, and goals that positively avoid these risks.

Content de-emphasis also has potential costs in certain communication processes: such an ambiguity in interpreting the messages is considered to be harmful for building grounding for effective communication, particularly in in a collaboration setting (e.g., Clark & Brennan, 1991). Therefore, the adoption of content de-emphasis should be considered along with the use context and the system's main use purpose.

Note that the discussion so far is focused on IM systems, but some findings can also be applied to other CMC tools beside IM. For example, is there a connection between sending an

empty bubble and making a phone call as they both can be ways to start conversation with an intentional action rather than content? How can we design for phone calls to provide such an ambiguity, for example, designing a similar alternative flow that the caller makes a phone call which cannot be answered but only be called back, and what values it offers? For example, since sending empty bubbles has more possible interpretations on the sender's intentions besides starting the conversation, would this alternative phone call flow offer values in giving space as discussed, and encourage users to make more phone calls even though they do not have information needs, and turn out to help maintain the connections between people? These are future directions that content de-emphasis designs can be explored and tested in CMC tools.

Summary

In this chapter I present the evolution of my own application BubbleQ to illustrate how content de-emphasis can be designed, with its design iterations from total removal of content, optional content versus empty messages, and an alternative interaction flow that highlighted interaction rather than content. A two-week field trial was then conducted, followed by qualitative interviews with the participants asking their practices, perceived goals, benefits and concerns on BubbleQ use. I summarized potential benefits and costs of content de-emphasis. Besides highlighting interaction rather than content in making meanings, the ambiguity from removal of content in certain processes has costs in building grounding in conversation, but benefits in leaving space to avoid negative attributions to each other and to possibly build intimacy.

So far, the discussion about BubbleQ and the previous discussion on Snapchat ephemerality showed both ephemerality and content de-emphasis to be valuable to foreground and serve certain communicative goals better than the widely accepted designs of persistent conversation and content dependence. However, there are other dimensions besides these two focal

ones that CMC designers can consider. The next chapter will give integrated design implications

on what other alternative dimensions there are to explore with proposed designs and their benefits

and costs.

CHAPTER 5

DESIGNING ALTERNATIVES IN MESSAGE MATERIALITY, INTERACTION FLOW, AND FIDELITY

The two main themes of this dissertation, as pointed out in Chapter 1, are to critique the conventional design focus on information in CMC tools and to provide implications for designing beyond information. The first theme revolves around concerns, issues and costs associated with focusing on information. In Chapter 2, I discuss costs and limitations associated with digital permanence, and propose that digital ephemerality may have benefits in terms of digital forgetting and digital artifacts research. In Chapter 3, I provide a study of Snapchat users that supports the value of ephemerality in CMC tool design and in Chapter 4, I discuss how ephemerality is included in BubbleQ.

The second theme questions the conventional focus on transmitting information in CMC tools. In Chapter 2 I provide some of the motivation for exploring design spaces that focus less heavily on information content, and in Chapter 4 I describe three iterations of BubbleQ that consider different ways that information content might be de-emphasized in CMC tools.

In this chapter, I integrate my thinking and findings across the previous chapters to draw out shared connections and insights and to explore design implications beyond those I have considered thus far. For example, Chapter 3 proposed that ephemerality can be designed through decay rather than full deletion, as a way to give content a temporal aspect; while Chapter 4 highlighted that the bubble as a body spatially represented on the interface triggered meanings beyond the content itself. Both these implications suggest the designs can give temporal or spatial materiality to content, with potential impacts on meaning making and communication.

In the remainder of this chapter, I first revisit the question of why designers might want to design beyond information. I then discuss *how* designers might design beyond information.

Why Design Beyond Information

Combing the insights from theories, previous design research, and findings from Chapters 3 and 4, I will summarize my recommendations for why to design beyond information into two main themes: focusing on information marginalizes some goals, while there are costs to emphasizing message content.

Focusing on information marginalizes some goals

People communicate with each other for multiple purposes: "Interpersonal communication is a complex, situated social process in which people who have established a communicative relationship exchange messages in an effort to generate shared meanings and accomplish social goals (Burleson, 2010, p. 151)". In a single communication episode, goals are often combined (Dillard, 2008), and the process of achieving these mixed goals can be complex (Kellermann, 1992). The design of CMC tools should also include this complexity because people need to trade off between primary and other goals, and because some goals might never even rise to the level of conscious choice/consideration under certain designs.

For example, persistence in conversation is helpful for information sharing and conversational grounding (Erickson, 2000; Gergle et al., 2004). Persistent content on social media is also helpful for self-presentation and self-reflection (Zhao et al., 2013). However, in achieving these benefits other goals become marginalized. Snapchat participants in Chapter 3 reported that persistent media like Facebook were appropriate for posting content that helped them construct a long-term online image, but less appropriate for posting self-deprecating content like ugly faces. When they wanted to use these ugly faces to entertain others, they chose Snapchat, because

Snapchat's ephemerality eased their long-term self-presentational concerns. This suggests that the focus on information in designs for persistent conversation and persistent social media can marginalize goals that do not rely on the information.

Emphasizing message content poses costs

As Burleson (2010) noted, people communicate to exchange meanings, including both informational meanings and less-informational ones like internal states. In most CMC designs, this exchange of meanings is based on the exchange of message contents. Even though some research shows that through content like texts people are able to exchange feelings and affiliation (e.g., Darics, 2010), build impression (O'Sullivan et al., 2000), and achieve playfulness (e.g., Danet, 2001), there are costs in using content to deliver these meanings. For example, using content to exchange these meanings requires effort to find the right words (e.g., Darics, 2010; Herring, 2001) or to get the right picture (e.g., Hu, 2014), and thus increases the cognitive load of communication. The fact that BubbleQ users in Chapter 4 were able to make meanings from sending an empty bubble suggests that there is a value to freeing users from the pressure of content generation. Moreover, as argued in Chapter 2, an information focused design such as digital permanence also increases the costs of space to save message contents, the effort required to filter the meaningful content from all saved content to form a digital legacy, and concerns about privacy, security, and power inequality.

Secondly, explicit content also has weaknesses in delivering implicit meanings. In cases when explicitness is appreciated, such as collaboration and information sharing, a design with such a focus is appropriate. However, people also need room for ambiguity in daily communication. For example, research on communication deception (Hancock et al., 2009) suggested people are reluctant to directly express the desire to end a conversation, instead using "butler lies" to leave it

ambiguous as to why they have to leave. Similarly, my BubbleQ participants in Chapter 4 reported that sending empty bubbles could mean many different things: a desire for attention, a way to express interest, an invitation (or demand) to talk, an opportunity for future interaction, or a mechanical requirement to continue a conversation in the interaction flow. BubbleQ users also valued the ambiguity of the intentions behind their bubbles, and it helped them flexibly express and interpret conversational intentions and meanings such as plausible deniability (Bradner & Mark, 2001), rather than stating these intentions in explicit ways.

Likewise, if the meaning/goal of a message is not so much the content itself but the act of messaging to show connection or support, focusing on the explicit content doesn't necessarily help (and can hurt) the implicit meaning. For example, participants in the Snapchat study in Chapter 3 noted that they sent ugly face photos to entertain and connect with others, without explicitly saying something like, "let us keep connected," which can be seen as a utilitarian move.

In short, the information focus of CMC designs can marginalize goals that are not information-driven, and its emphasis on content also increases the costs of generating and interpreting content to express and receive meanings. Recognizing these limitations, it is valuable to think about what kinds of alternatives can be designed, and what outcomes to expect from these alternative designs (at least hypothetically), which will be discussed in next section.

Designing Alternatives with Information De-emphasis in Mind

In prior chapters, I have suggested specific examples of alternative designs that emphasize information less; here, I will give a larger discussion of ways one might generate such alternatives, organized around message materiality, interaction flow, and content fidelity.

Designing alternative materiality

I discussed how BubbleQ's representation of messages as bubbles reflected meanings and values, and how Snapchat's ephemerality as a temporal characteristic of messages influenced communication practices and goals. This discussion pointed out some alternatives that can be explored in designing messages to have characteristics based on visual appearance, interactivity, and more. I consider these characteristics as the materiality of a message based on the view that a message is a quasi-object (Latour 2005) that possesses its own material characteristic when people interact with it (Ekbia 2009) besides the information or content inside. I also use metaphor as a method to help designers think about alternative materiality for messages.

Visual appearance and interactivity. The first and most obvious material characteristic of a message that users experience when they interact with it is its visual appearance, or how it looks on the interface, such as its color, size, font, and other aspects of its visual representation. Many CMC tools take a similar approach in visually representing messages as illustrated in Figure 1: messages are shown as a conversation that consists of saved message content organized by turns that are chronologically ordered and grouped by conversational partner. This is a fine representation for many communication goals that involve exchanging information, and people routinely appropriate the format for other goals as well.

However, in previous findings and discussions I see potential benefits in alternatives that foreground alternate communicative purposes. Fonts have been long recognized to influence perceptions of emotions, semantic meanings, and personality (discussed in Candello et al., 2017) that are not fully defined by content. As another example, colors are associated with our emotions (e.g., Hemphill, 1996; Naz et al., 2004), thus in design colors can be used as an instrument to influence how people experience the objects (e.g., Minolta, 1998). BubbleQ's vivid color was

perceived by participants as encouraging playfulness and this likely shaped their communicative goals towards sharing playfulness and fun.

The spatial representation of messages is also an example that can provoke different values. Chat Circles (Donath & Viégas, 2002) spatially embedded conversations in circles that changed colors, sizes, and proximities on the interface based on the conversation activities; user studies found that this interface helped users manage their conversation topics and reflect on their historical interactions. Besides static visual representations, dynamic animations such as the animated texts used in the Kinetic Instant Messenger (Bodine & Pignol, 2003) are also ways for users to convey meanings such as emotions. Similarly, in my own BubbleQ application, participants saw value in the aggregation and spatial embedding of messages that provided overviews that support meaning-making above the level of individual messages and conversations.

Interactivity is the second obvious material characteristic that users can experience directly with the design. For example, the normal interactivity of messages in most information-focused CMC tool design limits this interaction to acts related to message content: reading, copying, deleting, or hiding this content. This serves informational goals such as information access, sharing and management well.

However, users could interact with messages in more ways, and these additional interactivities might add or foreground additional values. For example, BubbleQ users could play with the bubbles which were also the "interactive" bodies of messages, and participants in my study noted that this interactivity offered them a way to "kill time" while waiting for responses. BubbleQ users also had to tap their read bubbles in order to delete them from the home screen; I deliberately designed this interactivity to make message deletion more salient, hoping that users could reflect on whose messages were being deleted and how often they had interacted with these

people. Because my focus was on content de-emphasis, I did not ask participants in the BubbleQ study explicitly about how they felt about this deletion, but we got reflections from users later talking about how they perceived this feature as a "review" of their histories with other people.

Ephemerality, space, decay, openness, values, costs, and more. Metaphor has been considered as a way to form design inspiration and to help users build mental models of the system (Blackwell, 2006). In practice, alternative message materiality can take metaphors from the materials people experience in our daily interaction with each other and the world. BubbleQ's bubble "metaphor" suggests physical objects that can move and touch each other. This metaphor inspired the homepage interface where message bubbles move and collide, and helped create an interactivity with the message's materiality that encouraged playfulness. Physical bubbles are also fragile and can be broken by a touch, and to simulate this, I designed BubbleQ message bubbles to be deleted only by the user tapping them, by which I aimed to offer message a temporal materiality of *ephemerality* that is slightly different from Snapchat's: for a message, not only its content, but its whole body can also be ephemeral.

There can be other interesting metaphors of physical objects that can inform the design of messages. For example, the traditional IM interface's representation of conversation turns as balloons (Figure 1, right column) can be seen as a simulation of passing paper notes to each other in the physical world, and this representation of messages embeds some aspects of the materiality of a physical paper note. Next, I will use paper as an example to illuminate how metaphors from physical objects can be valuable formative resources in designing alternative features for CMC tools.

Re-examining the materiality of a physical paper, we can see that it can decay and even decompose over time. Gulotta et al. (2013) designed their prototype PhotoBox that decayed digital

photos by deliberately deleting certain parts of the data, which provoked users to build a sense of lifespan of their digital contents. Similarly, if we design messages to have a decaying representation such as darker colors, lost words, and so on, would users also perceive the message to have a lifespan? Would this offer benefits, such as helping users perceive time without accessing the timestamp of a message, helping them reflect on past interactions with others, or helping them build a sense of the temporal scope of their message archive? Depending on how fast the decay and decomposition occurs in the system, would these perceptions and benefits vary? For example, can the Snapchat ephemeral message be interpreted as a metaphor of a quickly decomposing paper, and its decomposing speed (10 seconds or less) make it more appropriate for certain contents and goals than others in comparison to more durable but not permanent "paper notes"?

Contents on physical paper can also be erased and corrected; a digital message could also be designed like this. Normally, we cannot directly edit a sent digital message, and we normally send another one to complement or correct the sent one if needed. But what about a design where the content of a sent message can be changed by either the sender or the receiver? I consider this materiality as *openness,* which is also used to refer to the extent digital objects can be accessible and modifiable/reprogrammable (Manovich, 2001; Kallinikos et al., 2010). What are the values this modifiability might provide? For example, Google Waves (shut down in 2012) was designed to be open because any participant of a wave (conversation thread) can reply anywhere within the message, edit any part of the wave, and add participants at any point in the process ("Google Wave: A Complete Guide - Mashable", 2009). This type of openness design was considered beneficial for use cases such as collaborative learning, complex coordination, collaborative writing and storytelling, real-time translating, and so on ("Google Wave's Best Use Cases", 2009). Allowing openness to the message at the sender side could also be beneficial. For example, Facebook

initially did not allow users to edit their posts after publishing them, but later let users do that almost invisibly ("Facebook no longer clearly labels edited posts", 2017); would this design of openness help solve issues like regrets on Facebook (Wang et al., 2011) because of its modifiability? Alternatively, could it lead to confusion or anger if people change important things?

Besides the openness of content, the representations, the interactivity, and other material characteristics of messages can also be open to changes based on aspects of context such as relationships, topics, or other personal preferences. For example, besides letting users choose their own fonts and colors of messages, should the messages also be set by the system or the users to be more ephemeral as two people grow to be closer with more interactions, which might encourage more mundane talk as my Snapchat study suggested? Should the bubble bodies of messages in BubbleQ start to flash with colors when the conversation is emotionally vivid, as detected by the system through linguistic analytical methods (e.g., Pennebaker et al., 2001)?

Paper itself, without the content, can have meanings, and this can also inspire designs for digital messaging. In the physical world, having more paper potentially means having more chances to compose messages in the future. This is also reflected in BubbleQ study's findings: just like people need paper to write down some words, BubbleQ users had to have empty bubbles to fill in some contents, and users reported that they "saved" empty bubbles for future interactions in case their contacts forgot to send empty bubbles. If a new design of BubbleQ limits the number of empty bubbles being sent daily, would this strengthen users' appreciation of the empty bubbles because of their scarcity?

Additionally, a physical paper has value because of its economic cost that is reflected by its composition (recycled paper versus silk for example). A digital message can also be designed to have this economic characteristic—do you still remember the days when each SMS cost money?

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If BubbleQ gives the user some special empty bubbles with rare colors, unique textures, or additional features, would these empty bubbles be considered more valuable? Would receiving these empty bubbles thus become a sign of appreciation from the sender and encourage receivers to fill in more meaningful contents? Furthermore, if the generation of these special bubbles was connected to, for example, the physical activities of the user by giving more special bubbles for walking more steps, could it also increase people's fitness and health, at the same time connecting these benefits to communication purposes?

Physical paper might have other material characteristics that I have not mentioned but are also valuable metaphors for the alternative materiality of digital messages. In short, based on how a physical paper looks, feels, lasts, and affords, designers of digital messages can use these metaphors accordingly to generate ideas about their visual appearance, interactivities, ephemerality, space, decay, openness, values, and costs as a quasi-object, to highlight certain meanings beyond information contents.

Designing alternative flows

The message-centered definition of interpersonal communication also highlights the role of the communication process in delivering and shaping shared meanings. And the process of mediated communication is heavily influenced by the interaction flows that the system defines, such as the rhythm of starting and continuing a conversation, or the timing and speed of the delivery and the reading of messages. This subsection will discuss alternative flows regarding these interactions and the possible outcomes they could lead to.

The rhythm. Face-to-face conversation flows are mostly automatic and spontaneous (Kellermann, 1992): conversations start from the intention of one of the interactants, and keep going through reception of and response to that intention (e.g., Berger, 2005). This process is also

adopted by most CMC tools: a source sends a message with content to a recipient and the recipient interprets this content to infer what the source intended to communicate, then forms her/his response also in the form of a message with content.

But digital conversation flows can be altered by changing the rhythm of who sends what when. BubbleQ's design explicitly forces users to conduct their conversations in an almost opposite rhythm: the receivers create content rather than the conversation initiator, and this alternative flow proved to be a factor driving the mundane talk and playfulness. Note even though BubbleQ's interaction flow is new among current CMC tools, this process stems from some aspects of face-to-face conversation. Users perceived sending empty bubbles as a way to get attention without explicitly saying words; similarly, in face-to-face conversation, cues like gaze also support attention management (Goodwin, 1983). In traditional IM, this can also be achieved by sending a "hey" or an emoticon (e.g., Dresner & Herring, 2010), but the benefit of a flow like BubbleQ is that it frees users from the pressure of generating or composing content, and provides other benefits including ambiguity as discussed in Chapter 4.

More alternative designs can be made by manipulating the flow differently. Findings in my BubbleQ study showed that sending empty bubbles could present an intention to talk, and a new design (let us call it Bubble2) might define a new flow where users have to initiate their conversations by mutually sending each other empty bubbles. Imagine a flow like this: if user A sends user B an empty bubble, and B sends back another empty bubble within X minutes, then A and B can have a conversation for $10/(X+1)$ minutes during which they can freely send each other contents without sending empty bubbles to each other again. After $10/(X+1)$ minutes, if they want to continue the conversation, they have to go through the step of sending each other empty bubbles again. In this design, the starting process of sending each other empty bubbles can be considered

a way of negotiating explicit mutual intention to chat. Normally, many CMC tools provide awareness of others' availability, which helps users to decide if and when to initiate conversations, but the other person does not explicitly agree to chat before a message is received (e.g., Herring, 1999). A hypothetical benefit of this explicit intention matching design prior to the exchange of content should be similar to BubbleQ's design: it would save users the pressure of generating a starting message in sharing an intention to start conversation and agreeing to the intention, with potential costs of difficulties in demanding quick responses from a delayed conversation.

In addition to providing a different way to start a conversation, this design could also alter the rhythm of ending conversations: A conversation will be shut down after a time inversely related to the response lag of the second empty bubble to the first one. Therefore, the quicker the second person initially responded, the longer the two will be able to chat, and this might influence user perception and negotiation of the other person's intentions as the conversation duration is one important piece of timing information for interpreting others' willingness and intentionality to talk (e.g., Walther, 2002). Making the timing more salient by the system could be beneficial as a way for empty bubble receivers to control the conversation duration without needing to express their intentions to end it, working as a "butler lie" (Hancock et al., 2009).

The speed. The speed of digital messages, in particular, how fast they can be delivered and presented, is another dimension to explore. First, speed of delivery can be manipulated. To match the synchronous nature of face-to-face conversation, many CMC systems are developed to reduce system-caused lags between conversation turns in both asynchronous and synchronous media (e.g., Herring, 1999), meaning the system tries to deliver the message from one party to another instantly.

However, instant delivery may not always be beneficial. The slow movement critiques the default welcoming of fast speed in aspects of life and advocates a culture of slowing down (e.g.,

Fuad-Luke, 2005). This movement in the HCI community is presented as a call for slow designs (e.g., Hallnäs & Redströmm, 2001) that focus on people's well-being rather than efficiency (e.g., Fuad-Luke, 2005). For example, King and Forlizzi (2007) created design prototypes with slow messaging features such as intentional delay of message to wait for events like being in a particular location; this design helped long-distance partners feel a sense of shared place and build emotional resonance. Similarly, Odom et al.'s FutureMe prototype allowed participants to send a message to themselves at a future time, which was found to help users build reminiscence and unsettling encounters with themselves (Odom et al., 2015). These findings suggest a slowly delivered message, at a meaningful moment defined by the context (e.g., King & Forlizzi, 2007) or by time (e.g., Odom et al., 2015) can provoke meanings beyond the content of the message.

Speed can also be slowed in the presentation of the received messages. One key point in slow technology is to provide a slowness in the processes of learning, understanding and presence, to offer time for users to think and reflect (Hallnäs & Redström, 2001). Odom et al.'s PhotoBox prototype gave users printed photos at a low speed and was found to support anticipation of future artifacts, reflection on past life events, and renewed interest in their historical digital collections (Odom et al., 2012, June). Gulotta et al.'s DataFade prototype took another direction—it slowly deleted digital photos—and was found to provoke participants' attention on the archiving values of their digital possessions (Gulotta et al., 2013). These studies, although mainly focused on digital collections in family settings, suggest that slowness in presentation can be an interesting design alternative for digital messages.

BubbleQ could use this kind of slowness in delivery by changing the speed a bubble is opened. Right now, when users tap an empty or filled bubble, a 0.5-second opening animation is shown before presenting the content. In the study, we did not receive feedback regarding whether

this presentation was too slow or fast, but what would happen if the duration of the opening animation were extend to 5 seconds, 30 seconds, or even longer? Would users lose patience and feel annoyed by this, especially when the content inside turns out to be less interesting? Could a norm develop that people have to send meaningful contents worth the wait to see them? And practically, would the potential benefits in reflection it provokes exceed the cost in time so users appreciate it rather than giving up? One hypothesis is that the longer the waiting time for content, the more time and effort people would put into in finding meanings in the messages because of the sunk cost effect which is "manifested in a greater tendency to continue an endeavor once an investment in money, effort, or time has been made (Arkes & Blumer, 1985, p. 124)". Designers need to balance the benefits of these features with the costs to make sure the costs do not prevent people from exploring these alternative benefits.

Designing alternative fidelity

So far, I discussed alternatives in designing alternative message representations and interaction flows to give messages meanings beyond their content and foreground alternative values. Here I will focus on the content itself, by pointing out the alternative choice that content can be deliberately inaccurate or fake.

Accuracy. One default system effort in mediating communication is the pursuit of *error-freeness and robustness*, by avoiding technical mistakes in both the recording and transmitting of message content (Ziemer & Peterson, 2001), both of which are easy to achieve today with the development of data transfer and mobile network technologies (Le Bodic, 2005). Preventing the system from making technical mistakes has benefits such as guaranteeing that our communications do not suffer noise from the channel (Hamming, 1980) or are interpreted by the system's instability (Shannon, 2001).

However, I am curious whether a system that makes mistakes or does not work occasionally might provide benefits that an error-free system cannot. Few systems and little design research deliberately consider a system's technical mistakes as a valuable feature, but there are some hypothetical justifications why this might be the case. For instance, when a system makes errors and users are aware of it, users might not use this system for some purposes where errors and instability can be harmful, such as for collaboration, coordination, and information sharing. And for some purposes, errors and instability are fine or even welcomed, such as garbled mundane messages that need repair in second language learning, where recipients might have fun guessing what the right message would be (Cekaite & Aronsson, 2005). Intentional system-caused loss of messages might also be interesting. Similar to the internal delay of message delivery, this instability could create another kind of ambiguity for message recipients: were the errors due to the sender or to the system? This is a valuable kind of ambiguity in cases where attribution of negative aspects of the communication to the system can maintain a positive emotional valence between users (e.g., Burgoon, 1993).

Meanwhile, the mistake-making can be strategic such that the mistakes can have meanings. For example, an email system that strategically makes more mistakes after work hours might encourage its users to reflect on their boundary and rhythm and appropriate balance between work and life. Besides designing systems to make strategic mistakes, revealing the system's inevitable mistakes might also have value by influencing attribution management. For example, machine translation (MT) algorithms make mistakes in translating one language to another. The focus of most MT services aims at reducing these mistakes by improving the algorithm accuracy. However, revealing that the system *could* make mistakes (Gao et al., 2014), and showing what possible mistakes could be, as Xu et al.'s TwoTrans prototype did (Xu et al., 2014), provided benefits in

collaborative settings by leading to more positive attribution between collaborators, better grounding, and more actions to repair mistakes. Therefore, designing with the transparency of mistakes can also provide value.

Genuineness. The second alternative is that the content does not have to be real or genuinely created or curated. BubbleQ's particular content de-emphasis design demonstrated and justified that meaning making does not always need content, and here I propose that meanings and values do not always need the content to be real. Being "real" means that the content is a real photo, text, or other format that is generated by a real person. In this sense, Snapchat and BubbleQ also have real content. Communicating with real content helps users share their life moments with each other, but there is a possibility that fake content could be sufficient to fulfill certain goals. Binky (http://www.binky.rocks) is a mobile app that has a similar social media interface to Facebook, but contents there are generated by the system's algorithm and thus fake. Binky users do not need to friend each other or post anything to see these fake posts, but they can still like or comment on them. Reviews of Binky on its Apple app page were positive and users explained that interacting with these fake contents still gave them the gratification of participating in online social lives without the pressure to interact with real persons. This phenomenon, although it has not been empirically investigated, suggests that interaction with content, real or fake, could be equally or even more meaningful than the content itself. Binky also frees users from the effort of generating contents and dealing with social pressures from other persons, which might be valuable to certain persons with social anxiety (Caplan, 2006).

Although Binky doesn't actually help people have interpersonal interactions since the interactions aren't between people, it inspired ideas on whether system-created content can also provide value in interpersonal communication. For example, suppose there is a new BubbleQ

design in which users can only send empty bubbles to each other, and the system fills in some content in the empty bubbles before it delivers them to the receivers. What benefits could this design offer? I hypothesize that since the content is generated and curated by the system, this design would also free users from the pressure of content generation. Further, because users can blame the system for sending inappropriate or less meaningful content, it might help form positive attribution valence between people; and the uncertainty about the message content might also encourage curiosity (Bar-Anan et al., 2009) and foster playfulness (Guitard et al., 2005). Again, this opens an opportunity for system creators to strategically decide what kinds of content the system should generate and curate. For example, certain sexually sensitive contents can help maintain or develop intimacy in romantic relationships as these contents have been found in communications between these relationships (e.g., Drouin & Landgraff, 2012) while avoiding security and privacy concerns around users making genuine, personal disclosures.

Overall, in this subsection, I explore two alternatives to another manifestation of the information focus of most CMC tools, namely the conventional emphasis on preventing systems from making mistakes and the dependence on real, user-created and user-curated content. I propose designs that intentionally plan errors and instability in the system, transparently reveal the system's mistakes to users, or interject fake content in communication. Possible values from these designs could include positive attributions between users, reduced pressures or anxiety about getting a response, better repair of common ground in communication, and playfulness.

Summary

As noted at the beginning of this chapter, my goal is to outline a design space of alternatives to conventional CMC tools that might open alternatives to the default features of these tools. I discuss three categories of alternative design strategies: designing alternative materiality,

designing alternative interaction flows, and designing alternative content fidelity, and provide examples of hypothetical designs and their potential benefits. Although there are many more design instances and possible categories of features than those presented here, my goal is to illuminate the value of exploring alternatives in different dimensions beyond information, as a practical toolbox for designers to critically examine their current designs and constructively explore new designs for CMC.

CHAPTER 6

CONCLUSION

This dissertation attempts to illuminate alternatives that go beyond the common CMC aim of information richness, and to achieve this goal, two alternative dimensions were explored: the temporal retention of information and the focus on interaction versus content. A qualitative study on Snapchat users was conducted to understand how ephemerality as a contrast to persistent conversation in the temporal dimension influenced interaction processes. A prototype called BubbleQ was built to illustrate designs that highlight interaction rather than content, followed by a qualitative study based on a field trial on the prototype to investigate the benefits and costs of such a design.

Findings of the studies justified these alternatives are valuable to further explore. Snapchat's ephemerality benefited communication by encouraging mundane interactions that support relationship maintenance between close relations, reducing consciousness in self-presentation, and mitigating privacy violation issues in content saving and sharing. BubbleQ's final content de-emphasis design highlighted interaction rather than content in messaging, leading to an alternative flow which encouraged mundane and lightweight talk for social connection purposes and helped to highlight meanings in messages without explicit contents, with benefits in reducing needs and pressures in content generation and opening spaces for intention interpretation.

Based on the findings in the two studies, I also discuss implications on formatively designing alternatives, by assessing the materiality of digital messages, interaction flows that define the rhythm and speed of communication processes, and alternatives to fidelity that violated the conventional emphasis on accuracy and genuineness of content. I hope these implications

encourage designers to explore more dimensions beyond the default assumptions around information focus and beyond the two design examples that Snapchat and BubbleQ adopted.

REFERENCES

Ananny, M. (2016). Toward an ethics of algorithms: Convening, observation, probability, and timeliness. *Science, Technology, & Human Values*, *41*(1), 93–117.

Aoki, P. M., & Woodruff, A. (2005). Making space for stories: ambiguity in the design of personal communication systems. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 181–190). ACM.

Applegate, J. L., & Delia, J. G. (1980). Person-centered speech, psychological development, and the contexts of language usage. *The social and psychological contexts of language*, 245–282.

Arkes, H. R., & Blumer, C. (1985). The psychology of sunk cost. *Organizational behavior and human decision processes*, *35*(1), 124–140.

Balaji, M. S., & Chakrabarti, D. (2010). Student interactions in online discussion forum: Empirical research from "media richness theory" perspective. *Journal of Interactive Online Learning*, *9*(1).

Bannon, L. J. (1992). Perspectives on CSCW: From HCI and CMC to CSCW. In *International Conference on Human-Computer Interaction (EW-HCI'92)*. St. Petersburg: BCS HICOM electronic conference system (pp. 148–158).

Bannon, L. J. (2006). Forgetting as a feature, not a bug: the duality of memory and implications for ubiquitous computing. *CoDesign*, *2*(01), 3–15.

Bartlett, F. C., & Burt, C. (1933). Remembering: A study in experimental and social psychology. *British Journal of Educational Psychology*, *3*(2), 187–192

Bayer, J. B., Ellison, N. B., Schoenebeck, S. Y., & Falk, E. B. (2016). Sharing the small moments: ephemeral social interaction on Snapchat. *Information, Communication & Society*, *19*(7), 956–977.

Baym, N. K. (2015). *Personal connections in the digital age*. John Wiley & Sons.

Begole, J. B., Tang, J. C., Smith, R. B., & Yankelovich, N. (2002). Work rhythms: analyzing visualizations of awareness histories of distributed groups. In *Proceedings of the 2002 ACM conference on Computer supported cooperative work* (pp. 334–343). ACM.

Bell, C. G., Gemmell, J., & Gates, B. (2009). *Total recall: How the e-memory revolution will change everything* (p. 18). New York: Dutton.

Bereznak, A. (19 June 2014). "Developers Have Hit a Yo Point with This Terrible New App". *Yahoo! Tech*. Retrieved 2 January 2017.

Berger, C. R. (2005). Interpersonal communication: Theoretical perspectives, future prospects. *Journal of Communication*, *55*(3), 415–447.

Bernstein, M. S., Bakshy, E., Burke, M., & Karrer, B. (2013, April). Quantifying the invisible audience in social networks. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 21–30). ACM.

Besmer, A., & Richter Lipford, H. (2010, April). Moving beyond untagging: photo privacy in a tagged world. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1563–1572). ACM.

Boehner, K., & Hancock, J. T. (2006, April). Advancing ambiguity. In *Proceedings of the SIGCHI conference on Human Factors in computing systems* (pp. 103–106). ACM.

Blackwell, A. F. (2006). The reification of metaphor as a design tool. *ACM Transactions on Computer-Human Interaction (TOCHI)*, *13*(4), 490–530.

Bodine, K., & Pignol, M. (2003, April). Kinetic typography-based instant messaging. In *CHI'03 extended abstracts on Human factors in computing systems* (pp. 914–915). ACM.

Bowskill, J., Billinghurst, M., Crabtree, B., Dyer, N., & Loffler, A. (1999, October). Wearable location mediated telecommunications; a first step towards contextual communication. In *Wearable Computers, 1999. Digest of Papers. The Third International Symposium on* (pp. 159–166). IEEE.

Bradner, E., & Mark, G. (2001, September). Social presence with video and application sharing. In *Proceedings of the 2001 international ACM SIGGROUP conference on supporting group work* (pp. 154–161). ACM.

Browne, G., Berry, E., Kapur, N., Hodges, S., Smyth, G., Watson, P., & Wood, K. (2011). SenseCam improves memory for recent events and quality of life in a patient with memory retrieval difficulties. *Memory*, *19*(7), 713–722.

Burkell, J. A. (2016). Remembering me: big data, individual identity, and the psychological necessity of forgetting. *Ethics and Information Technology*, *18*(1), 17–23.

Burgoon, J. K. (1993). Interpersonal expectations, expectancy violations, and emotional communication. *Journal of Language and Social Psychology*, *12*(1–2), 30–48.

Burleson, B. R., Albrecht, T. L., & Sarason, I. G. (1994). *Communication of social support: Messages, interactions, relationships, and community.* Sage Publications, Inc.

Burleson, B. (2010). The nature of interpersonal communication: A message-centered approach. In C. R. Berger, M. E. Roloff & D. R. Roskos-Ewoldsen (Eds.), *The handbook of communication science*, 145–163. Sage Publications, Inc.

Candello, H., Pinhanez, C., & Figueiredo, F. (2017, May). Typefaces and the Perception of Humanness in Natural Language Chatbots. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (pp. 3476–3487). ACM.

Cao, Y., & Yang, J. (2015, May). Towards making systems forget with machine unlearning. In *IEEE Symposium on Security and Privacy* (pp. 463–480). IEEE.

Caplan, S. E. (2006). Relations among loneliness, social anxiety, and problematic Internet use. *CyberPsychology & Behavior*, *10*(2), 234–242.

Carr, J. G., & Bellia, P. L. (1977). *The Law of Electronic Surveillance*. C. Boardman Company.

Cekaite, A., & Aronsson, K. (2005). Language play, a collaborative resource in children's L2 learning. *Applied Linguistics*, *26*(2), 169–191.

Chi, P. Y., Xiao, X., Chung, K., & Chiu, C. (2009, April). Burn your memory away: one-time use video capture and storage device to encourage memory appreciation. In *CHI'09 Extended Abstracts on Human Factors in Computing Systems* (pp. 2397–2406). ACM.

Chou, C. C. (2001). Formative evaluation of synchronous CMC systems for a learner-centered online course. *Journal of interactive learning research*, *12*(2), 173.

Citron, D. K., & Gray, D. C. (2013, June). Addressing the Harm of Total Surveillance: A Reply to Professor Neil Richards. In *Harvard Law Review Forum* (Vol. 126, p. 262).

Clark, H. H., & Brennan, S. E. (1991). Grounding in communication. *Perspectives on socially shared cognition*, *13*(1991), 127–149.

Clarida, R., Gali, J., & Gertler, M. (1999). The science of monetary policy: a new Keynesian perspective. *Journal of Economic Literature*, *37*(4), 1661–1707.

Corbin, J., & Strauss, A. (1990). Grounded theory research: Procedures, canons and evaluative criteria. *Zeitschrift für Soziologie*, *19*(6), 418–427.

Culnan, M. J., & Markus, M. L. (1987). Information technologies. In F. M. Jablin, L. L. Putnam, K. H. Roberts, & L. W. Porter (Eds.), *Handbook of organizational communication: An interdisciplinary perspective* (pp. 420-443). Thousand Oaks, CA: Sage Publications.

Danet, B. (2001). *Cyberpl@ y: Communicating online*. Bloomsbury Academic.

Darics, E. (2010). Relational work in synchronous text-based CMC of virtual teams. In *Handbook of research on discourse behavior and digital communication: Language structures and social interaction* (pp. 830–851). IGI Global.

Digital obsolescence. (2017, August). Retrieved from https://en.wikipedia.org/wiki/Digital_obsolescence.

Dillard, J. P. (2008). Goals-plans-action theory of message production. *Engaging theories in interpersonal communication: Multiple perspectives*, 65–76.

Donath, J., Karahalios, K., & Viegas, F. (1999). Visualizing conversation. *Journal of Computer-Mediated Communication*, *4*(4).

Donath, J., & Viégas, F. B. (2002, June). The chat circles series: explorations in designing abstract graphical communication interfaces. In *Proceedings of the 4th conference on Designing interactive systems: processes, practices, methods, and techniques* (pp. 359–369). ACM.

Drouin, M., & Landgraff, C. (2012). Texting, sexting, and attachment in college students' romantic relationships. *Computers in Human Behavior*, *28*(2), 444–449.

Duck, S., Rutt, D. J., Hoy, M., & Sreejc, H. H. (1991). Some evident truths about conversations in everyday relationships all communications are not created equal. *Human communication research*, *18*(2), 228–267.

Ekbia, H. R. (2009). Digital artifacts as quasi-objects: Qualification, mediation, and materiality. *Journal of the Association for Information Science and Technology*, *60*(12), 2554–2566.

Ellison, N. B., Steinfield, C., & Lampe, C. (2011). Connection strategies: Social capital implications of Facebook-enabled communication practices. *New media & society*, *13*(6), 873–892.

Ephemera meaning in the Cambridge English dictionary. (2017, August). Retrieved from http://dictionary.cambridge.org/dictionary/english/ephemera

Erickson, T. (1999, January). Persistent conversation: discourse as document. In *Proceedings of the Thirty-Second Annual Hawaii International Conference on System Sciences-Volume 2-Volume 2* (p. 2021). IEEE Computer Society.

Erickson, T., & Kellogg, W. A. (2000). Social translucence: an approach to designing systems that support social processes. *ACM transactions on computer-human interaction (TOCHI)*, *7*(1), 59–83.

Esbjörnsson, M., Juhlin, O., & Östergen, M. (2003, November). Motorcycling and social interaction: design for the enjoyment of brief traffic encounters. In *Proceedings of the 2003 international ACM SIGGROUP conference on Supporting group work* (pp. 85–94). ACM.

Eslami, M., Rickman, A., Vaccaro, K., Aleyasen, A., Vuong, A., Karahalios, K., ... & Sandvig, C. (2015, April). I always assumed that I wasn't really that close to [her]: Reasoning about Invisible Algorithms in News Feeds. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 153–162). ACM.

Facebook no longer clearly labels edited posts. (2017, January). Retrieved from https://www.theverge.com/2017/1/13/14266134/facebook-no-longer-labels-edited-post-update

Facebook's Instagram Stories crushes Snapchat with 250 million daily active users. Facebook Stories Help. (2017, August). Retrieved from http://www.cnbc.com/2017/06/20/instagram-crushes-snapchats-daily-active-users-rate.html.

Facebook Stories Help. (2017, August). Retrieved from https://www.facebook.com/help/1825407747718430?helpref=search&sr=8&query=story.

Fang, L., & LeFevre, K. (2010, April). Privacy wizards for social networking sites. In *Proceedings of the 19th international conference on World wide web* (pp. 351–360). ACM.

Fisher, D., & Dourish, P. (2004, April). Social and temporal structures in everyday collaboration. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 551–558). ACM.

Fuad-Luke, A. (2005). Slow theory: A paradigm for living sustainably. Retrieved November 16, 2017, from http://www.slowdesign.org/pdf/Slow%20design.pdf.

Fung, B., Wang, K., Chen, R., & Yu, P. S. (2010). Privacy-preserving data publishing: A survey of recent developments. *ACM Computing Surveys (CSUR)*, *42*(4), 14.

Gao, G., Xu, B., Cosley, D., & Fussell, S. R. (2014, February). How beliefs about the presence of machine translation impact multilingual collaborations. In *Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing* (pp. 1549–1560). ACM.

Gergle, D., Millen, D. R., Kraut, R. E., & Fussell, S. R. (2004, April). Persistence matters: Making the most of chat in tightly-coupled work. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 431–438). ACM.

Glaser, B. G. (1965). The constant comparative method of qualitative analysis. *Social problems*, *12*(4), 436–445.

Goffman, E. (1955). On face-work: An analysis of ritual elements in social interaction. *Psychiatry*, *18*(3), 213–231.

Goffman, E. (1978). *The presentation of self in everyday life*. London: Harmondsworth.

Goodwin, M. H. (1983). Searching for a word as an interactive activity. In *Semiotics 1981* (pp. 129–137). Springer US.

Google Wave: A Complete Guide. (2010, January). Retrieved August 2017 from http://mashable.com/2009/05/28/google-wave-guide/#DyRZafXLNqq7

Google Wave's Best Use Cases. (October 2009). Retrieved August 2017 from http://lifehacker.com/5381219/google-waves-best-use-cases

Guitard, P., Ferland, F., & Dutil, É. (2005). Toward a better understanding of playfulness in adults. *OTJR: Occupation, Participation and Health*, *25*(1), 9–22.

Gulotta, R., Odom, W., Forlizzi, J., & Faste, H. (2013, April). Digital artifacts as legacy: exploring the lifespan and value of digital data. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1813–1822). ACM.

Hallnäs, L., & Redström, J. (2001). Slow technology–designing for reflection. *Personal and ubiquitous computing*, *5*(3), 201–212.

Hallsten, J. (2004). Theories of interpersonal communication. In J. R. Baldwin, S. D. Perry, & M.
A. Moffitt (Eds.), *Communication theories for everyday life* (pp. 106–121). Boston: Allyn
& Bacon.

Hamming, R. W. (1980). *Coding and Theory*. Prentice-Hall.

Hand, M. (2014). Persistent traces, potential memories: Smartphones and the negotiation of visual,
locative, and textual data in personal life. *Convergence: The International Journal of
Research into New Media Technologies*, *22*(3), 269-286.

Hancock, J., Birnholtz, J., Bazarova, N., Guillory, J., Perlin, J., & Amos, B. (2009, April). Butler
lies: awareness, deception and design. In *Proceedings of the SIGCHI Conference on
Human Factors in Computing Systems* (pp. 517–526). ACM.

Haskell, F. (2000). *The ephemeral museum: old master paintings and the rise of the art exhibition*.
Yale University Press.

Hemphill, M. (1996). A note on adults' color–emotion associations. *The Journal of genetic
psychology*, *157*(3), 275–280.

Herring, S. C. (Ed.). (1996). *Computer-mediated communication: Linguistic, social, and cross-
cultural perspectives*. John Benjamins Publishing.

Herring, S. (1999). Interactional coherence in CMC. *Journal of Computer-Mediated
Communication*, *4*(4).

Herring, S. C., Barab, S., Kling, R., & Gray, J. (2004). An approach to researching online
behavior. *Designing for virtual communities in the service of learning*, *338*.

Herring, S. C. (2004). Slouching toward the ordinary: Current trends in computer-mediated
communication. *New media & society*, *6*(1), 26–36.

Hogan, B. (2010). The presentation of self in the age of social media: Distinguishing performances and exhibitions online. *Bulletin of Science, Technology & Society, 30(6), 377-386.*

Hu, Y., Manikonda, L., & Kambhampati, S. (2014, June). What We Instagram: A First Analysis of Instagram Photo Content and User Types. In *Proceedings of AAAI International Conference on Web and Social Media* (pp. 595–598). *AAAI*

Hull, G., Lipford, H. R., & Latulipe, C. (2011). Contextual gaps: privacy issues on Facebook. *Ethics and information technology*, *13*(4), 289–302.

Hutchby, I., & Wooffitt, R. (2008). *Conversation analysis*. Polity.

Instagram Stories Help. (2017, August). Retrieved from https://help.instagram.com/1660923094227526/.

Jack, R. E., Caldara, R., & Schyns, P. G. (2012). Internal representations reveal cultural diversity in expectations of facial expressions of emotion. *Journal of Experimental Psychology: General*, *141*(1), 19.

Kallinikos, J., Aaltonen, A., & Marton, A. (2010). A theory of digital objects. *First Monday*, *15*(6).

Kaun, A., & Stiernstedt, F. (2014). Facebook time: Technological and institutional affordances for media memories. *New Media & Society*, *16*(7), 1154–1168.

Kaye, J. J., Levitt, M. K., Nevins, J., Golden, J., & Schmidt, V. (2005, April). Communicating intimacy one bit at a time. In *CHI'05 extended abstracts on Human factors in computing systems* (pp. 1529–1532). ACM.

Kaye, J. J., Vertesi, J., Avery, S., Dafoe, A., David, S., Onaga, L., ... & Pinch, T. (2006, April). To have and to hold: exploring the personal archive. In *Proceedings of the SIGCHI conference on Human Factors in computing systems* (pp. 275–284). ACM.

Kellermann, K. (1992). Communication: Inherently strategic and primarily automatic. *Communications Monographs*, *59*(3), 288–300.

Kiesler, S., Siegel, J., & McGuire, T. W. (1984). Social psychological aspects of computer-mediated communication. *American psychologist*, *39*(10), 1123.

King, S., & Forlizzi, J. (2007, August). Slow messaging: intimate communication for couples living at a distance. In *Proceedings of the 2007 conference on Designing pleasurable products and interfaces* (pp. 451–454). ACM.

Konijn, E. A., Utz, S., Tanis, M., & Barnes, S. B. (Eds.). (2008). *Mediated interpersonal communication*. Routledge.

Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford university press.

Le Bodic, G. (2005). *Mobile messaging technologies and services: SMS, EMS and MMS*. John Wiley & Sons.

Leonardi, P. M. (2010). Digital materiality? How artifacts without matter, matter. *First monday*, *15*(6).

Lindley, S. E., Marshall, C. C., Banks, R., Sellen, A., & Regan, T. (2013, May). Rethinking the web as a personal archive. In *Proceedings of the 22nd international conference on World Wide Web* (pp. 749–760). ACM.

Manovich, L. (2001). *The language of new media*. MIT press.

Massimi, M., & Baecker, R. M. (2010, April). A death in the family: opportunities for designing technologies for the bereaved. In *Proceedings of the SIGCHI conference on Human Factors in computing systems* (pp. 1821–1830). ACM.

Mayer-Schönberger, V. (2011). *Delete: The virtue of forgetting in the digital age*. Princeton University Press.

Mother's Day: Facebook lets you send flowers to your mom via Messenger. (2016, May). Retrieved from http://indianexpress.com/article/technology/social/facebook-messenger-mothers-day-flower-reaction-2788952/.

Miller, G. R. (1990). Interpersonal communication. In G. L. Dahnke & G. W. Clatterbuck (Eds.), *Human communication: Theory and research* (pp. 91–122). Belmont, CA: Wadsworth.

Minolta, K. (1998). *Precise color communication*. Mahwah, NJ: Konica Minolta Sensing, Inc.

Nabi, R. L., Prestin, A., & So, J. (2013). Facebook friends with (health) benefits? Exploring social network site use and perceptions of social support, stress, and well-being. *Cyberpsychology, Behavior, and Social Networking*, *16*(10), 721–727.

Naz, K., & Epps, H. (2004). Relationship between color and emotion: A study of college students. *College Student J*, *38*(3), 396.

Nissenbaum, H. (2001). How computer systems embody values. *Computer*, *34*(3), 119–120.

Nissenbaum, H. (2009). *Privacy in context: Technology, policy, and the integrity of social life.* Stanford University Press.

Nissenbaum, H. (2011). A contextual approach to privacy online. *Daedalus*, *140*(4), 32–48.

No one is using Facebook stories, so it turned your friends into ghosts. (2017, August). Retrieved from https://www.theverge.com/2017/4/5/15189148/facebook-stories-friends-ghosts-news-feed-snapchat

Odom, W., Banks, R., Kirk, D., Harper, R., Lindley, S., & Sellen, A. (2012, May). Technology heirlooms?: considerations for passing down and inheriting digital materials.

In *Proceedings of the SIGCHI Conference on Human Factors in computing systems* (pp. 337–346). ACM.

Odom, W., Selby, M., Sellen, A., Kirk, D., Banks, R., & Regan, T. (2012, June). Photobox: on the design of a slow technology. In *Proceedings of the Designing Interactive Systems Conference* (pp. 665–668). ACM.

Odom, W. (2015, April). Understanding long-term interactions with a slow technology: An investigation of experiences with FutureMe. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (pp. 575–584). ACM.

Ogata, H., Matsuura, K., & Yano, Y. (1996). Knowledge awareness: Bridging between shared knowledge and collaboration in sharlok. *Proceedings of Educational Telecommunications*, 232–237.

O'sullivan, B. (2000). What you don't know won't hurt me. *Human Communication Research*, *26*(3), 403–431.

Richter, H., Miller, C., Abowd, G., and Funk, H. Tagging knowledge acquisition to facilitate knowledge traceability. *International Journal on Software Engineering and Knowledge Engineering 14*, 1 (Feb. 2004), 3–19.

Rittenbruch, M., & McEwan, G. (2009). An historical reflection of awareness in collaboration. In *Awareness Systems* (pp. 3–48). Springer London.

Pennebaker, J. W., Francis, M. E., & Booth, R. J. (2001). Linguistic inquiry and word count: LIWC 2001. *Mahway: Lawrence Erlbaum Associates*, *71*, 2001.

Salovaara, A., Lindqvist, A., Hasu, T., & Häkkilä, J. (2011, August). The phone rings but the user doesn't answer: unavailability in mobile communication. In *Proceedings of the 13th*

International Conference on Human Computer Interaction with Mobile Devices and Services (pp. 503–512). ACM.

Sas, C., & Whittaker, S. (2013, April). Design for forgetting: disposing of digital possessions after a breakup. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1823–1832). ACM.

Sayago, S., Sloan, D., & Blat, J. (2011). Everyday use of computer-mediated communication tools and its evolution over time: An ethnographical study with older people. *Interacting with computers*, *23*(5), 543–554.

Schacter, D. L. (2002). *The seven sins of memory: How the mind forgets and remembers.* Houghton Mifflin Harcourt.

Schmidt, K. (2009). Divided by a common acronym: On the fragmentation of CSCW. In *ECSCW 2009* (pp. 223–242). Springer, London.

Schwanda Sosik, V., Zhao, X., & Cosley, D. (2012, February). See friendship, sort of: How conversation and digital traces might support reflection on friendships. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work* (pp. 1145–1154). ACM.

Sellen, A., Fogg, A., Hodges, S., Rother, C., and Wood, K. (2007) Do lifelogging technologies support memory for the past? An experimental study using SenseCam. In *Proceedings of the Conference on Human Factors in Computing Systems* (San Jose, CA, Apr.–May). ACM Press, New York, 2007, 81–90.

Sellen, A. J., & Whittaker, S. (2010). Beyond total capture: a constructive critique of lifelogging. *Communications of the ACM*, *53*(5), 70–77.

Shannon, C. E. (2001). A mathematical theory of communication. *ACM SIGMOBILE Mobile Computing and Communications Review*, *5*(1), 3–55.

Shein, E. (2013). Ephemeral data. *Communications of the ACM*, *56*(9), 20–22.

Smith, M. A., & Fiore, A. T. (2001, March). Visualization components for persistent conversations. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 136–143). ACM.

Snapchat photos sent per second. (May, 2015). Retrieved from http://www.businessinsider.com/snapchat-photos-sent-per-second-2015-5/

Strauss, A. L. (1987). *Qualitative analysis for social scientists*. Cambridge University Press.

Suh, K. S. (1999). Impact of communication medium on task performance and satisfaction: an examination of media-richness theory. *Information & Management*, *35*(5), 295–312.

Tat, A., & Carpendale, S. (2006, January). CrystalChat: Visualizing personal chat history. In *System Sciences, 2006. HICSS'06. Proceedings of the 39th Annual Hawaii International Conference on* (Vol. 3, pp. 58c–58c). IEEE.

Tong, S. T., Van Der Heide, B., Langwell, L., & Walther, J. B. (2008). Too much of a good thing? The relationship between number of friends and interpersonal impressions on Facebook. *Journal of Computer-Mediated Communication*, *13*(3), 531–549.

Van Dijck, J. (2008). Digital photography: communication, identity, memory. *Visual Communication*, *7*(1), 57–76.

Walther, J. B. (1992). Interpersonal effects in computer-mediated interaction: A relational perspective. *Communication research*, *19*(1), 52–90.

Walther, J. B. (2002). Time effects in computer-mediated groups: Past, present, and future. *Distributed work*, 235–257.

Walther, J. B., & Parks, M. R. (2002). Cues filtered out, cues filtered in. *Handbook of interpersonal communication*, *3*, 529–563.

Wang, Y., Norcie, G., Komanduri, S., Acquisti, A., Leon, P. G., & Cranor, L. F. (2011, July). I regretted the minute I pressed share: A qualitative study of regrets on Facebook. In *Proceedings of the seventh symposium on usable privacy and security* (p. 10). ACM.

What's happened to ~$7 million app 'Yo' now. (2014, September). Retrieved from http://www.businessinsider.com/whats-happened-to-7-million-app-yo-now-that-the-hype-has-died-2014-9

Whittaker, S., & Sidner, C. (1996, April). Email overload: exploring personal information management of email. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 276–283). ACM.

Wolf, T., Schröter, A., Damian, D., Panjer, L. D., & Nguyen, T. H. (2009). Mining task-based social networks to explore collaboration in software teams. *IEEE Software*, *26*(1), 58–66.

Xu, B., Chang, P., Welker, C. L., Bazarova, N. N., & Cosley, D. (2016, February). Automatic Archiving versus Default Deletion: What Snapchat Tells Us About Ephemerality in Design. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing* (pp. 1662–1675). ACM.

Xu, B., Gao, G., Fussell, S. R., & Cosley, D. (2014, April). Improving machine translation by showing two outputs. In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems* (pp. 3743–3746). ACM.

Xu, B., Qin, Y., & Cosley, D. (2017, June). De-emphasizing Content to Study the Relationship between Meaning, Messages, and Content in IM Systems. In *Proceedings of the 2017 Conference on Designing Interactive Systems* (pp. 599–610). ACM.

Xu, B., Yuan, T. C. W., Fussell, S. R., & Cosley, D. (2014, February). SoBot: facilitating conversation using social media data and a social agent. In *Proceedings of the companion publication of the 17th ACM conference on Computer supported cooperative work & social computing* (pp. 41–44). ACM.

Yik Yak: the anonymous app taking US college campuses by storm. (2014, October). Retrieved from https://www.theguardian.com/technology/2014/oct/21/yik-yak-anonymous-app-college-campus-whisper-secret.

"Yo app: what is it and why is it popular?" In *Week Business*. 2014. Retrieved January 2017 from http://www.theweek.co.uk/technology/59094/yo-app-what-is-it-and-why-is-it-popular

Zhao, X., Salehi, N., Naranjit, S., Alwaalan, S., Voida, S., & Cosley, D. (2013, April). The many faces of Facebook: experiencing social media as performance, exhibition, and personal archive. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1–10). ACM.

Zhang, Y., & Leung, L. (2015). A review of social networking service (SNS) research in communication journals from 2006 to 2011. *New Media & Society*, *17*(7), 1007–1024.

Ziemer, R. E., & Peterson, R. L. (2001). *Introduction to digital communication*. Prentice Hall.

Zillmann, D. (2013). *Selective exposure to communication*. Routledge.

INTERVIEW GUIDE FOR SNAPCHAT STUDY

Thank you for agreeing to be interviewed for the study. The purpose of the study is to better understand how people communicate through Snapchat. Specifically, we will be asking you about your experiences of using Snapchat both as the message/snap sender and the message receiver. We'd also like to make a note that throughout the interview you should not use full names of people you interact with through Snapchat, but feel free to use their first names.

SC stands for Snapchat

General Use:

1. When did you start to use SC?

2. How did you learn about SC?

3. How often do you use Snapchat? How much time each day do you typically spend and use SC?

4. How does the use of Snapchat affect your everyday activities? [If they don't understand question or if they can't think of an answer, you can prompt them with examples (i.e. does it affect your time? your other use with other apps?)]

5. What other social media apps or messaging apps do you use to communicate with other people? (Tell participants that they can use their phone to look through the apps they use)? How do you compare your frequency of using SC vs these apps? [focus on SC.]

Patterns of Use (Content):

6. What are your reasons for using SC? And Why?

7. What formats of snaps do you normally send and receive? (i.e. pic vs. video)

8. What kinds of SC snaps do you highly anticipate/would like others will send you? can you give us some examples? why do you anticipate/would like these? (asking who?)

9. What kinds of SC snaps do you actually receive? can you give us some examples?

10. Was there anyone unexpected that sent you a snap? Why did you not expect that person to send you a snap? How did you deal with it?

11. Among those you normally interact with on SC, did they ever send you some snaps unexpectedly? Why did you not expect these snaps? How did you deal with them?

12. What kind of SC snaps do you send to others? examples? why?

13. From these SC snaps that you send, what are responses you receive? do you think others find your snaps satisfactory?

14. What kind of SC snaps and snapchat interactions do you find most satisfying? Examples?

15. What kind of SC snaps and snapchat interactions do you find least satisfying? Examples?

16. How would you normally respond?

   a.   What kinds of SC snaps are most likely to influence you to respond and get you to engage with the sender? Examples and why? Does this apply to when you send SC snaps too? If not, why?

   b.   [follow-up if mention mass] Why? And how would you figure out whether the snap was a mass snap vs p2p snap?

   c.   Have you ever received a snap from someone you would rather not respond to? Examples? Why? What did you do?

   d.   How long do you wait before you respond to a sc on average? What factors do these depend on? (expectation)

e. Have you had snaps that you left there unopened for a while? Examples? Why?

Pattern (Contact):

17. How typical is it for people (or students in Cornell?) you know to use SC?

18. What would you think are the differences and similarities within and between groups like teenagers and people after college? Why?

19. Who do you communicate with on SC. Why these people?

20. Who are the easiest and most satisfying for you to chat with on SC?

21. Is there anyone that you feel difficult to chat with on SC?

22. Is there anyone you would rather not communicate with? Why would you rather not communicate with this person? What did you do?

23. Let's chat about people who don't use SC. Why do you think they do not use SC? Can you give us specific reasons?

24. For someone who does not use SC, do you think this has any effect on their social life? If so, please explain.

a. Do you have someone who do not use SC, but you wish they did? Why?

25. [Intimacy Building] How would you think about Snapchat's role in your social life, and relationships?

a. Would it affect your social life if you cannot use SC? How?

Norms:

Let's now talk about your use of SC: [For interviewer: you are free to jump to questions in ownership and violation based on their answers here]

26. What are the unwritten rules and norms of using SC?

27. What makes a good SC user? Why?

and what makes a bad SC user? Why?

Comparison:

28. Are SC snaps different than communicating by F2F? SMS? Phone? Email? Facebook Messenger? If so, How? And Why? [For interviewer, try to probe questions about self-presentation, image management]

a. content

b. contact (person, friends)

c. response expectation

d. response frequency/waiting

e. based on example, would you also put that picture on other apps? Why, or Why not?

System (other features):

29. Let us talk about the app itself, what features of SC do you think make you want to use it? [Note for interviewer: Let interviewee answer, if they give answers that related to later questions, jump there, but come back for more points] Or not?

a. What else [ask about more features]

30. Do you use text/captions on the pictures? What do you normally write? why?

19. Do you use drawing on the picture? What do you normally draw? why?

31. What do you think about the time limit?

a. As a sender, how do you normally set the time limit? Based on what?

b. As a receiver, how do you feel about the time limit? Have you ever felt that 10s is not enough? When? How would you make up the limitation?

Ownership:

32. What do you think about screenshotting? Do you screenshot others' snaps? Examples? (If they do not give example, ask previous examples and ask whether they will screenshot these snaps)

a. what kinds of snaps you would screenshot? based on what factors you feel it would be OK to screenshot them? Why?

b. what kinds of snaps you would not screenshot? based on what factors it would not be OK to screenshot them? Why?

c. Would these factors also apply to the case when other people screenshot your snaps? Why and why not?

33. What do you think about sharing screenshotted snaps to a third person? Did you or someone around you did that? Examples.

a. What kinds of snaps would be shared to a third person? based on what factors would it be OK to share saved snaps to a third person. Why?

b. What kinds of snaps shall not be shared to a third person? based on what factors would it not be OK to share saved snaps to a third person. Why?

c. What kinds of snaps you are ok to be screenshotted by others, but not be ok to share to a third person? Based on what factors you would be OK and not be OK? Why?

d. Would such decision-making also apply to the messages on SMS? FB? Instagram? Why or why not?

34. Do you save your own snaps? What kinds of snaps you save? What was your expectation to do with them? And what did you actually do with them?

Privacy Violation:

35. (This might overlap Q39.c, but I still put it here as this explicitly ask about violation) Did you have experiences that you were uncomfortable about your snaps being screenshotted?

    a. Why you were not OK with it?

    b. How did you do with it?

36. Did you have experience that you were uncomfortable about your snaps being shared to a third person?

    c. Why you were not OK with it?

    d. How did you do with it?

Ending thoughts:

Do you have other thoughts/ things/comments/likes/dislikes about Snapchat, which we have not talked about?

[Thank them and ask them to fill the survey]

INTERVIEW GUIDE FOR BUBBLEQ STUDY

Thank you for agreeing to be interviewed for the study. The purpose of this interview is to learn about how you use our prototype BubbleQ to communicate with other people

General Use:

1. First question, what kinds of messaging application you normally use? Please give the top 3 ones.

   a. How often do you use it?

   b. Who you normally use it with?

   c. What main purpose you use it for?

2. In the past two weeks, how often do you use BubbleQ?

   General Perception:

   (In very high odd, they will start to talk about questions that will be asked later, so based on what they say, please redirect to some of the following questions, like if they start to talk about empty bubbles, go to 4 for example.)

3. So how do you normally use it for?

4. What BubbleQ offers you?

   a. What that means to you

   b. Then what BubbleQ cannot do, and what that means to you?

   c. [please follow that user says, to direct to following questions about comparisons]

5. So how do you think of BubbleQ? [What kind of application do you think it is?]

   Patten and Motivation:

6. Can you recall a couple of times that you used BubbleQ, what were you doing at that time, and who did you use it with?

    a. Did you notice the differences between empty bubble and filled bubble?

    b. When do you normally send empty bubbles? To who? What did you want to achieve by sending the empty bubbles?

        i. are there other reasons you send an empty bubble?

        ii. How often do you send this person empty bubble? Do you also send other people with similar frequency? Why or why not?

        iii. [if they talk about same-gender or cross-gender difference, ask them what the differences are, and why.]

    c. So how many empty bubbles you receive normally every day? Who sent them to you? How do you feel about it when you receive an empty bubble from this person?

        i. Do you feel a similar way if other persons send you empty bubbles? Why or why not?

        ii. You talked about your reasons of sending an empty bubble, do you think others have similar reasons when they sent empty bubbles to you? If no, why not?

7. After you received empty bubbles, how long did you take before you opened to fill them? Does this apply to other contacts you have? If you do not have another contacts, would you expect to apply a similar response pattern if for example others are using BubbleQ with you?

8. What do you normally fill in empty bubbles? What kinds of messages?

a. Why do you think you choose to put such kind of messages? Do you apply similar rules to other people too?

b. What kinds of messages you will not put in a bubble, why not?

9. Between visual messages, text messages and the emoji, do you use them differently? If yes, How?

a. What benefits do you think the visual message and emoji have than text message?

b. What concerns do you have?

10. What do you normally receive in a returned filled bubble?

a. You talked about some reasons on how you fill an empty bubble, do you think these reasons are also the others think when they send you filled bubbles? Why or why not?

11. How often do you receive different message, among visual, text and emoji?

a. Who normally send certain kind of messages, why do you think they send you this kind not the other kinds?

b. Were there some instances that you expected different format of messages?

12. And you also notice that you can only send a bubble first to get a message, how do you feel about that?

a. Would you think this empowers or limits you to do certain things? Why? And how would you work around it if you think it limits you?

13. [they might start to talk about the ephemeral or open-once feature, then now it is a good time to ask this question, otherwise, wait]. So you talked about that the bubbles can only open once. How do you feel about in general, would you compare this to Snapchat?

14. So how would you think about the importance of open-once feature in BubbleQ? Do you think it is a good combination to the empty bubble feature or not? Why? If not, what a good combination would you think to be? Why?

   a. Do you also do screenshot of bubbles as people can do in Snapchat? When do you normally do?

   b. Would you be aware that people can screenshot your bubble? Why or why not, comparing to Snapchat, are you more aware while Snaping?

15. [Based on Question 3, if they made some explicit comparison to some other apps, do not ask again those apps. But if they did not compare with for example Facebook messenger, but they use FB messenger, ask:]. You said you use (for example, Facebook messenger) How would you compare it with BubbleQ?

   a. What is the similarity and difference?

   b. Do you use them with different contents?

   c. What different purposes you have if you to use BubbleQ other than Snapchat? And do you purpose in using BubbleQ apply in some other apps?

16. [if they did not say Snapchat at all, ask:] Do you use Snapchat? How would you compare this app to Snapchat?

   a. What is the similarity and difference?

   b. Do you use them with different contents?

   c. What different purposes you have if you to use BubbleQ other than Snapchat? And do you purpose in using BubbleQ apply in some other apps?

17. Did you ever use Yo or Facebook pokes?

   a. If yes, what do you think about them with BubbleQ?

18. How do you feel about the home page with all the bubbles?

    a. When you see the bubbles, how do you feel while seeing them?

        i. Did you pay attention to whose bubbles they were?

        ii. How would feel if you see many empty bubbles from certain people? What would you do with them? Why?

    b. Did you ever double click read bubbles to 'break' them? When did you do that? Why? Who were these bubbles from? Why you choose to break these ones other than others'?

19. Would you think there is an analogy in real life like what you did in BubbleQ in real life? How?

20. [if they did not talk much about what they think about BubbleQ is, please ask them again the question 2.]

21. Let us talk about some design suggestions?

    a. What do you suggest BubbleQ should have? Why?

    b. What do you suggest it should get rid of? Why?

    c. What other formats of message would you like BubbleQ to have? Why?

    d. Who do you think are the suggested users? Why?

    e. Who do you think are not invited to the system? Why?

Ending thoughts:

Do you have other thoughts/ things/comments/likes/dislikes about BubbleQ, that we have not talked about?

[Thank them and ask them to fill the survey]