"They're blowing up my phone": Group Messaging Practices Among Adolescents

Madeline E. Smith[1,2]
[1]Microsoft Research
1065 La Avenida
Mountain View, California 94043 USA
johntang@microsoft.com

John C. Tang[1]
[2]Technology & Social Behavior
Northwestern University
Evanston, Illinois, USA
madesesmith@u.northwestern.edu

ABSTRACT
While group messaging has become popular, particularly among adolescents, it has not yet been explored in the HCI literature. We interviewed 48 adolescents, aged 15-24, who use group messaging regularly. We present a framework for understanding the types of groups they communicate with according to three dimensions: focus, membership, and duration. We also present findings about factors influencing their choice of group messaging tools and the problems they have managing multiple group threads using multiple tools. We explore the problem of notification overload and users' strategies for managing frequent notifications. We describe one approach of "social alerting," when group members notify one another directly, rather than rely on app notifications. We relate our findings to prior work and offer design suggestions to address the challenges our participants faced in managing frequent group notifications.

Author Keywords
Group messaging, small group communication, adolescents, teenagers, young adults

ACM Classification Keywords
H.5.3 Information interfaces and presentation (e.g., HCI): Group and Organization Interfaces

INTRODUCTION
While research has explored many aspects of text and instant messaging over the past 15 years [1,3,4,10,22,28], the majority of this work has focused on individual messages. Relatively little is known about group messaging, which has become increasingly popular [30]. Group messages are text or instant messages sent to two or more recipeints. Responses are sent to all members of the group, as with Reply All emails, with each message often generating a new mobile phone notification. Messages are organized in conversation threads among those people. Figure 1 shows an example

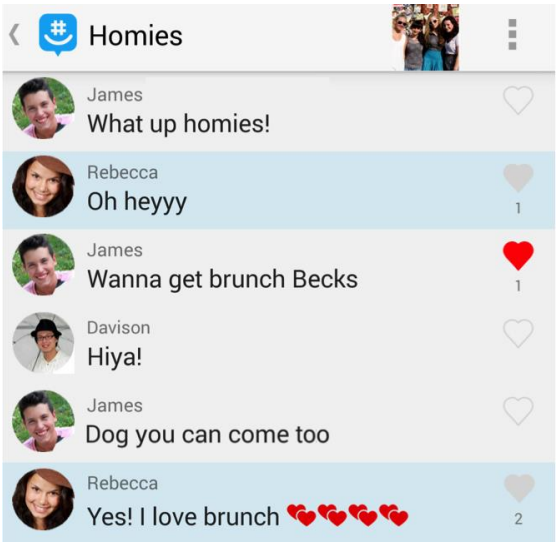

Figure 1: Example GroupMe conversation

three-person group conversation using GroupMe, one of a number of currently popular tools that support group messaging. Other group messaging apps, include: text messaging (MMS), iMessage, Facebook Messenger, Google Hangouts, Kik, Skype, WhatsApp, and Viber. All of these tools allow users to send group text and multimedia messages, and many offer additional group features, such as naming message groups or liking messages.

We focused our investigation of group messaging on the adolescent life stage between childhood and adulthood. During this time adolescents undergo physical, cognitive, social, and emotional changes as they transition into adulthood [23]. Messaging is an important aspect of adolescents' active social lives [3,10] and has become increasingly popular in recent years as the number of adolescents owning smartphones has increased [19]. We focused specifically on older adolescents (aged 15-24) due to the importance of social and identity exploration during this transitional time, as well as their access to and frequent use of messaging tools [19,26].

In this paper, we present results of an interview study of 48 15-24 year old adolescents in the United States. We develop a framework for understanding the groups adolescents message with according to three dimensions: focus, membership, and duration. We describe factors influencing adolescents'

choice of group messaging tools and their strategies for managing notifications from multiple groups and tools. Finally, we discuss challenges our participants encountered with group messaging and present design suggestions to address those challenges.

BACKGROUND

Messaging Studies

Text messaging has become increasingly popular among adolescents with the median teenager sending 60 text messages each day [19]. In a large-scale study of text messaging among university students, Battenstini, Setlur, & Sohn [1] found participants used text messaging with a large number of contacts (M=47.1) and often carried on multiple conversations simultaneously.

Recently, IP-based messaging tools such as WhatsApp and iMessage have become popular as well. In a recent study comparing WhatsApp to traditional text messaging (SMS), Church and de Oliveira [4] and found that participants sent messages to groups more frequently using WhatsApp than text messaging. Similarly, in an interview study of WhatsApp users, O'Hara et al. [22] found that participants frequently sent group messages to coordinate in-person social activities as well as to virtually hang out with their friends. Schuler et al. [24] found social groups sometimes uses group messages when coordinating group activities, although they used individual messages more frequently.

These studies investigated the popularity of and motivations for using text messaging and IP-based messaging tools. Further, they provide evidence that people often use these messaging services to communicate with groups. Given the rising popularity of group messaging [30], led by the young age demographic [19], we chose to focus specifically on adolescents' use of commercially available messaging platforms for group messaging.

Group Messaging Systems

Researchers have designed and studied a number of prototype group messaging tools. "Swarm" [8] was developed as a group text messaging system to provide social groups with awareness of each other's locations, help them spontaneously coordinate social activities, and determine the best location to converge upon. During a 10-month deployment, participants quickly developed group norms and felt more connected to one another than before using the service. Interestingly, Swarm was used primarily to coordinate in-person social activities, rather than to chat.

"Rhub" [13] was a group messaging system that allowed users to send and receive messages through text messaging, instant messaging, email, or a website interface. Like Swarm, the majority of messages sent during an 18-month Rhub deployment were related to coordinating activities, rather than social chatting. In contrast, "Slam" [5] was a group messaging service designed to support leisure, rather than coordination activities. A field experiment comparing Slam group messaging with one-to-one messaging showed that more messages were sent to groups than to individuals. Categorization of messages revealed that most Slam group messages were chatting, coordinating, joking, and sharing, with only a small percentage related to micro-coordination.

Researchers have also developed a number of other group messaging systems to study new features including: support for serendipitous group conversations [14], reducing the effort required to manage group membership [2,11], preserving users' privacy [20], and reducing costs for users in developing nations [21]. While these experimental systems provide insights about the potential benefits of group messaging systems, these small-scale deployments do not approach the popularity of commercial systems today. Further, as the majority of these studies were conducted with adult participants, it remains unclear how adolescents will adopt and adapt group messaging tools.

Managing Groups

Problems can arise when people use the same communication technologies to interact with people they have met in a variety of different contexts. As young adults transition from college to the working world, they employ various strategies to manage their self-presentation with different groups of their Facebook friends [6]. When not successfully managed, tensions between social networking with friends and coworkers can have unexpected, and undesirable impacts on the workplace [25]. However, some people's lives are more faceted than others, and social technologies can also differ in the degree to which they enable people to keep aspects of their identities separate [7].

Social network sites, in particular, can be problematic as people use them to connect with a "multiplicity of groups" including people they have met at different times and in different places [17]. Lampinen, Tamminen, and Oulasvirta found interview participants employed a number of behavioral and mental strategies to avoid such problems. Stutzman & Hartzog [27] found some people even maintaining multiple profiles on the same site to maintain boundaries between separate segments of their lives. Some people manage multiple groups by using different tools to communicate with different groups of people. Sometimes communication serially moved through various tools as their relationships with specific contacts become more intimate [31]. These behaviors may differ depending on the users' age, as one study found younger users were more likely to communicate with the same people using multiple tools than older people [16].

Clearly people use technology to communicate with a wide variety of contacts. Problems can arise when contexts become collapsed and people fail to present themselves differently to their various groups of contacts. To avoid these problems, users employ a variety of strategies including maintaining distinct profiles and using separate tools to communicate with different groups of people. In this study, we focused on the ways in which adolescents manage their communication with different groups.

STUDYING ADOLESCENTS' GROUP MESSAGING

Grounded in this prior literature, we sought to explore the ways in which adolescents use current commercially available group messaging technologies to communicate with multiple groups of people. Our first question asked:

RQ1: What types of groups do adolescents communicate with using group messaging?

Second, given that people generally communicate with multiple groups and that there are a number of popular messaging tools available, we asked:

RQ2: How do they use various group messaging technologies to communicate with multiple groups?

Finally, since notifications may be particularly problematic with group messaging [4,5,8], we asked:

RQ3: What problems arise with group messaging notifications and how do adolescents manage them?

Participants & Recruitment

To investigate our three research questions we interviewed 50 adolescents. We worked with an outside company specializing in youth market research to recruit 30 participants and recruited an additional 20 participants through personal social networking. One participant was excluded from the market research sample because she was outside our target age range, and one was excluded from our social network sample due to an equipment failure; our analysis focused on the remaining 48 interviews.

Market Research Sample: The 29 interviews analyzed include 16 female and 13 male participants aged 15 to 24 (M=19.1). Ten of these participants were Caucasian, seven African-American, six Asian, and four Latino. Participants lived in 18 different U.S. states. The majority were students (8 high school, 14 college, 1 graduate school); four had full-time jobs and 12 had summer or part-time jobs. Almost all participants were smartphone users (18 iPhone, 9 Android, 1 Windows Phone), although one used a feature phone and iPod Touch. Participants were regular group messaging users (18 sent group messages daily, 9 weekly, 2 monthly).

Social Network Sample: We recruited 20 participants by distributing a short screener survey with the help of friends, family and co-workers and through posting on social networks. We received responses from 98 eligible potential participants and selected 20 to interview, giving preference to those who used group messaging most frequently while aiming to balance gender and age. None of the participants interviewed were known personally by either of the researchers. We initially focused specifically on GroupMe app users, but later expanded to group messaging users more generally.

The 19 interviews analyzed include 10 female and nine male participants aged 15 to 24 (M=18.8) from eight different U.S. states. Seven participants were Asian, five were Latino, four Caucasian, and two African-American. Five were in high school, eleven in college, and two in graduate school; two had full-time jobs and five had summer or part-time jobs. All participants were smartphone users (11 iPhone, 5 Android, 3 Windows Phone). All participants were regular group messaging users (14 sent group messages daily, 5 weekly).

Interview Procedure

The first author conducted all interviews and the second author joined for seven interviews. They were conducted via Skype video calls during July and August of 2014, and lasted 33 to 63 minutes (M=48:10). Consent was obtained from all participants and from a parent or guardian for those under the age of 18. Interviews were semi-structured, following a protocol that was iteratively refined during six pilot interviews (not included in this analysis).

At the start of the interview, participants were asked to look through their phones and list all apps and services (i.e., tools) they used to communicate with others. That list was used to guide the remainder of the interview. For each app, participants were asked to describe the groups of people they used it with as well as other ways each of those groups communicated. Participants were encouraged to refer to their conversation histories and provide specific examples. They were then asked to compare the different tools and groups of people with which they communicated. Following the interview, participants each received a $50 electronic gift card gratuity.

Analysis

Interviews were fully recorded and transcribed for analysis. During the first phase of our analysis, a selection of interview recordings and transcripts were reviewed and we used open-coding to identify issues relevant to our research questions. The authors met to iteratively review the data and refine the coding categories until the final set of categories was established. The remaining interview transcripts and recordings were then reviewed and coded by the first author.

No differences were observed between the market research and social network samples during our analysis, so we present the results of all 48 interviews here together. Throughout the paper we refer to participants by sample ("MR" for Market Research or "SN" for Social Network) and participant number, followed by their age and gender.

FINDINGS

Framework for Classifying Messaging Groups

Our first research question asked about the different groups of people adolescents communicate with via group messages. To answer this question we developed a framework for classifying the wide variety of message groups according to three dimensions: *Focus*, *Membership*, and *Duration*. Each of these dimensions can be represented as a continuum along which specific groups can be located.

Focus

Message groups varied significantly in how focused they were on a given topic or purpose. Some message groups were dedicated to a specific topic, whereas others included messages related to any number of scattered topics. Many of the groups our participants described fell somewhere between

these two extremes, often discussing a range of loosely affiliated topics. Participants also described a number of groups that changed their focus over time, such as shifting from a specific event invitation to general chatting. A few participants also described message groups whose focus completely changed over time, for example:

> *Originally I had made that [group] to study for Physics. We just started inviting other people in and it sort of evolved into a group for fun. Now it's a group to stay in touch or make plans.* SN-12 (18,M)

Membership

Message groups also varied in the ways in which they managed their membership. Closed groups were typically restricted to members in an offline organization or workgroup, such as groups of fraternity brothers or students collaborating on a class project. In contrast, open groups had no defined membership requirements and any member could add others. Participants also described message groups with loose membership requirements, such as people living in the same apartment complex or friend groups.

Message group members sometimes had conversations amongst themselves to decide whether or not they should add new members:

> *In our apartment group we discussed, "Do we want to add the subletters?" And we were like, "Nah." Even just people who would come to our apartment a lot, we'd be like, "Do we add them?" Then we're like, "No." We say a lot of things on here that you just say to your roommates. And you don't want everybody to know that you yelled at your roommate for not cleaning the bathroom or something.* SN-10 (22,F)

Having such conversations in the group thread could be problematic with messaging tools, such as GroupMe, that enable new members to access messages sent before they were added. Some groups intentionally discussed potential new members in other tools to avoid such problems.

Duration

Message groups also varied in their duration. Some group threads were very short-lived, particularly those used to share information about a one-time event, such as a birthday party. Others were persistent group threads, used regularly over an extended period of time, up to multiple years. Often message groups were started to share a particular one-time message but were recycled whenever members wished to share information with that same group of people, becoming recurring or persistent groups.

Examples

To illustrate the diversity of message groups our participants described and the relationships among these dimensions, we provide three example groups from our data and classify each along our three dimensions (see Figure 2):

(1) *National Sorority-Fraternity Chat Room*: SN-01 (21,F) described a message group including approximately 200 members of her sorority and its brother fraternity from all across the country. The group is very social and members typically share and view messages whenever they are bored. This group has been used for years and is open to any current or alumni sorority sisters or fraternity brothers.

(2) *Literature Class Study*: SN-22 (15,M) used group messages to study with members of his high school literature class. One student collected phone numbers from any interested student in the class and sent out the first group message. Members used the group to share pictures of their study guides and ask questions related to the class during the week leading up to their final exam.

(3) *Bike Trip*: SN-16 (24,F) used group messages among the riders during a cross-country bike fundraiser trip. While they were riding, the group used the thread only to share important updates, such as changes to their route. In the evenings, however, the thread became more social. Group messages have been used a few times since the trip ended, to share announcements such as when two people who met on the trip got engaged.

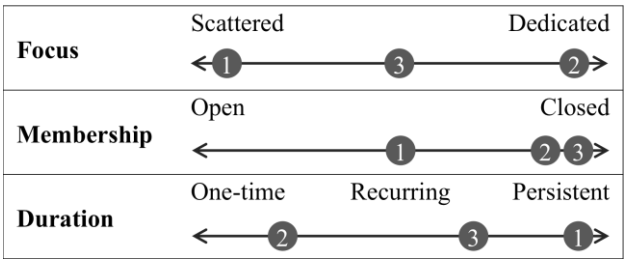

Figure 2: Example Messaging Group Dimensions

All of our participants were members of multiple message groups; the following section explores the ways in which they used a variety of group messaging technologies to manage group communications.

Multiple Tools and Groups

Our second research question asked how adolescents use a variety of communication technologies to communicate with multiple messaging groups. Nearly all of our participants described using text messages (83%) and Facebook Messenger (77%) for group messaging. Many also used a number of other tools for group messaging, including GroupMe (50%), iMessage (35%), Google Hangouts (17%), WhatsApp (15%), and Kik (4%). While all of these tools allow users to send group text and multimedia messages, differences between them influenced the ways in which our participants perceived and used them. In this section, we explore the factors influencing participants' group messaging tool choices.

Factors Influencing Tool Choice

Participants generally used the messaging service that was most accessible to them and their other group members. Because they were all frequent mobile phone users, text messaging was often viewed as the most convenient way to send group messages. However, many participants had encountered problems sending or receiving group text messages among the different phone platforms:

If I get a group text message I'll ignore it 'cause it's so frustrating on Android. ... [The messages] come through as individual texts, and I can't follow the conversation. And if someone is included in the group message that I don't know, then I'll just have a bunch of texts from this random number that I don't know who they are. So it's very frustrating. SN-05 (30,M)

Further, participants described a number of situations during which they were temporarily unable to access their mobile phones, such as when they were in class:

Being in class it's just easier to get away with say Skypeing someone or Facebook messaging someone [from your laptop] than on your cell phone, because you would have it in your hand. You can easily just minimize the screen and be at your Word document when the professor walks by. MR-26 (24,F)

Participants also turned to online messaging services when they were temporarily unable to access their mobile phones, such as when their phones were broken, during international travelling, or, for younger participants, when their phone access was limited by parents:

I introduced my two best friends to it [GroupMe]. They get their phones taken away at 10:00pm. So they're on the computer and they just chat with me and I'm on my phone. MR-30 (15,F)

To resolve these problems with accessing specific devices, participants often preferred group messaging from services that could be accessed across multiple devices, such as Facebook Message, iMessage, Google Hangouts, and GroupMe, which can be used on all major phone or computer platforms. Such services provide the flexibility for each group member to participate in the conversation via the device that is most accessible to them at that moment. In contrast with the pervasive notion that youth are abandoning desktop computers for mobile devices, our data document use cases where access from computers becomes an important affordance.

However, the start-up costs associated with using these services, such as downloading a specific app and/or creating an account, are generally higher than with text messaging and prevented their adoption in some groups. For example, MR-28 (16,M) would prefer to use Facebook Messenger with his group of close friends but "*not everybody wanted to create a Facebook*."

Temporal dynamics of the group communication also influenced participants' group messaging tool choices. When considering the costs and benefits afforded by various group messaging tools, participants also considered the expected duration of the group thread:

If it's gonna be a sustained communication, not just one issue that will pop up, then I'll make a GroupMe. But usually if it's something really low-key or trivial I'd do a Facebook message really quick. SN-09 (20,M)

Participants also frequently considered the urgency of the content to be communicated. They chose tools that were less likely to interrupt their contacts when the message did not have immediate importance and tools that they expected group members would immediately attend to when the content was urgent. These expectations were rooted in participants' prior experiences in communicating with particular group members and norms varied from group to group. Consider these conflicting expectations:

It seems like a lot more people are doing that, they may not answer your text, but if you message them on Facebook, they respond. MR-04 (22,M)

You know 100% that the person is gonna get your [text] message. Whereas if you use Facebook Messenger, you don't know if they have the Messenger app, so you don't know if they're gonna get it in five hours or five minutes. SN-08 (19,F)

These decisions about which tool to use are not static and some groups that start out with one tool ultimately switch to another when the group's needs change. For example, SN-21 (18,F) described a message group with four of her closest friends that started as a quick Facebook message about eating lunch together and evolved into an on-going conversation thread. They moved the conversation to iMessage as group members got new phones, and again to GroupMe when they ran into technical difficulties. Groups generally change tools when the conversation changed, when members upgraded their devices, when new features became available, and when they discovered new tools.

Rather than permanently moving from one tool to another, some groups use multiple tools to communicate, switching back and forth depending on the conversation needs at a specific time. A number of participants described groups using two tools; one, commonly an email listserv or a Facebook page, for official or on-topic content and the second for more casual conversations. For example, SN-19 (16,F) described a school club that used both a Facebook Group and a Facebook Messenger thread, "*The page is more formal and the group messaging is more conversational.*"

These findings show that message groups make nuanced decisions about which tool to use, motivated by a number of contextual factors including group members' access to the technology and the anticipated nature of the communication itself. These factors and groups' technology choices can change over time as groups and the technologies they use to communicate evolve.

Managing Multiple Groups with(in) Multiple Tools

All of our participants used multiple group messaging tools. Some participants siloed their communication with different groups into separate tools, using different tools to communicate with each group. For some participants, this strategy was an intentional way of keeping the distinct parts of their faceted identities separate from one another:

I'm a giant fangirl. And fangirl-ing is not very much a thing at my school … I used to be really paranoid about school people following me on Twitter and Instagram. I

wanted to keep my school life and Internet life separate. MR-22 (15,F)

Although the majority of participants did not have as clear goals as MR-22 for partitioning their communication, most could articulate differences in the groups of contacts they used various tools to communicate with when we asked. Often the differences between these groups were related to how close the participant felt to the people in those groups:

I just use texting for people that are close to me, 'cause I only give out phone numbers to people that I actually text all the time. SN-20 (15,M)

Many participants described using a number of different tools to communicate with their closest friend group, while only using one tool to communicate with other groups.

Frequently participants communicated with multiple message groups using the same tool. For example, SN-08 (19,F) used GroupMe to communicate with more than 10 separate groups and had friends who used it with many more than that. Modern messaging tools support this by separating messages into distinct threads for each message group. However, it can still be confusing when messages are actively being sent in multiple groups simultaneously, particularly when the same people are involved in multiple group threads. Participants described a number of instances when messages were accidentally sent to the wrong group:

Sometimes people will message the wrong chat, which is another reason why I try to keep the number of group chats down. If you have too many, then the chat bubbles pop up a lot. You try to keep clicking back and forth but it's kind of overwhelming. MR-31 (16,M)

Some tools allow users to assign names and avatars to each group thread. However, not all groups use these features and some that use them change the settings so often that they are no longer a reliable indicator of which group is which:

We have a couple of guys that are borderline obsessed with changing the group picture and name, they tend to change every other day. … It's been everything from "Nighthawk" to "Catch." Whatever they see when they wake up, there's no rhyme or reason to it. MR-17 (22,F)

We found that adolescents use a variety of strategies to manage their group communications. While some silo messaging with different groups into separate tools, tools are often used to communicate with more than one group. And while messaging tools support multiple threads, simultaneous conversations can be confusing and lead to embarrassing mistakes. The following section explores other problems our participants encountered with group messaging and notifications.

Problems & Strategies for Managing Notifications

Our final research question asked about the problems that participants experienced with notifications and their strategies for managing those problems.

Notification Overload

We were particularly interested in problems with managing notifications for group messages, as a number of previous studies raised this as a potential concern [4,5,8]. All of our participants described situations in which they were temporarily away from their devices and returned to a large number of unread group messages. While numerous notifications can occur in one-to-one conversations as well, the number of notifications is often much greater in group messaging because the conversation can continue whether or not all members are presently engaged:

During the school year it's very active. Coming out of class, I'll have 15 messages I haven't seen or I'll wake up and they're blowing up my phone. SN-02 (19,F)

Many participants had been added to group messages that they were not interested in receiving notifications for:

Honestly, I find it kind of annoying when you have big groups and you get notifications for every single person responding. If it's, "I'm having a party, are you coming?" and 25 people are like, "Yes, yes, yes, no." And so I don't want my phone "blowing up" with all of that. MR-01 (21,F)

Some tools enable participants to disable notifications for specific threads, "muting" that thread, while continuing to receive notifications for others. Savvy participants used this feature to mute conversations they were not interested in:

Usually the officer posts the details. That's how she starts off the chat, so I'll read that. But once everyone starts posting and asking questions about carpools and what else should we bring, I start muting it, 'cause I already have all the information I need. SN-23 (17,F)

A more extreme approach to managing notifications is to leave the message group altogether. However, not all tools enable users to leave groups. In order to leave a group text message, for example, participants described asking the other members to start a new group thread without them. Other participants perceived leaving a group to be rude, so they choose to remain in the group and simply ignored the messages they continued to receive.

These findings show that participants were often overwhelmed by the frequency of notifications they received from group message threads. Participants used both technical and social strategies to manage this notification overload, such as muting notifications or asking to be removed from specific group threads.

Staying Connected

Notifications about missed group conversations were not always unwanted; participants were sometimes interested in catching up on all of the messages sent in their absence. This was particularly true for tight-knit friend groups and/or narrowly focused groups:

I would leave my phone for five minutes and I'd come back and I'd have like 250 messages from them just talking about random stuff. ... I would try to go back and read

all of them so I could catch up and I would also be like, "Guys, just stop for a second so I can read everything!" MR-30 (15,F)

Participants also observed other group members catching up on missed messages, such as when they commented on or liked messages some time after they had been sent:

One thing I do see is that messages will be liked, even though they're not on the current screen. They maybe will like scroll up a little bit to find the message. So I think that a lot of people may have been reading the messages later. SN-07 (20,M)

Further, participants described times when they (or other group members) were not actively participating in conversations but continued to read the group messages. As MR-27 (21,F) described, "*people might call them lurkers, they look at what's going on but they're not involved*." Generally, participants understood that any group member could read any message sent to the group, and this type of monitoring was considered to be socially acceptable:

Facebook says "so and so has seen this," you know everyone usually sees it. So you'll have like those maybe four or five kids who just are reading everything, getting the information they need but never really contributing. ... And that's fine. No one really cares. We all know that whole messenger group is just there to help, you don't have to contribute to it. MR-32 (18,M)

These findings show that, although notifications are sometimes seen as problematic, they also help interested group members to stay connected to group threads. Adolescents sometimes monitor group threads, reading the messages sent to the group without contributing or responding; and this is not considered to be problematic.

Nested Subgroups

While participants understood that any message sent to the group could be read by all members of the group, there were some situations where they wished to selectively share information with certain members and not others. For instance, some groups temporarily removed members in order to keep birthday party plans a surprise:

Sometimes when we have birthdays, and we want to plan on that GroupMe, we kick the person off that's having the birthday. And then we post that so-and-so's having a birthday, everyone come on over. And that person wouldn't know. SN-12 (18,M)

Many participants described subgroups used to selectively communicate information with particular members of larger message groups:

We have two. We have one for the officers where we discuss what we'll talk about, what kinds of action we have. And we have one for all the members of the club, where we post the final product. MR-21 (17,F)

Similarly, many student organizations (including sports teams, clubs, and fraternities) maintained message groups for currently active members as well as a larger group including both current members and alumni. These nested message groups enabled participants to selectively share information with the applicable members, rather than annoying the entire group with irrelevant information.

Group messaging tools do not explicitly support nested subgroups and, as previously discussed, participants sometimes became confused while communicating with multiple groups simultaneously. This confusion was even more pronounced when subgroups with overlapping group membership were involved. For example, one participant accidentally shared bachelorette party plans with the group including the bride rather than the group without her:

I sent the wrong window, and it was almost a catastrophe –so close– but, thankfully, it wasn't. I caught it before I sent anything vital. MR-29 (23,F)

These findings show that adolescents often use nested groups to selectively communicate with both large groups and smaller subgroups. Often contacts are members of multiple subgroups, adding to the confusion users face when attempting to manage multiple group threads.

Social Alerting

Although all group members are able to read all messages sent to the group, there are times when members choose to ignore received group messages. Rather than reading all of the messages they missed while they were away from their devices, some participants quickly skimmed the messages or read only a few of the most recent messages in order to decide whether they missed anything important or relevant that they should go back and read:

If I see something at the bottom of my screen that looks like something interesting happened earlier, I'll usually go up and read it. But if it looks like people are just planning lunch, then I'm like, "Okay, I don't have time right now for lunch," or, "I had lunch earlier." So I just won't go back up. SN-10 (22,F)

Rather than deciding for themselves whether they had missed anything of interest, some participants asked others in the group to summarize what they missed. For example, MR-07 (23,M) described, "*I'll just ask somebody, 'What did I miss?' Because I won't go back and read* it*."*

This practice is a type of "social alerting," wherein group members rely on one another to alert them to relevant or important messages sent within the group. Social alerting was also used to notify group members of messages they were unlikely to have seen on their own. Participants were generally aware of which group members were likely to read the entire group thread and which were not, and they often went outside the group messaging tool to alert less active group members of relevant information:

We have a couple of friends in the chat who don't check Facebook very often. ... So when we got back to school a couple of days ago, we told the ones that weren't really looking at the group chat, "Guys, you have to see this video we found!" MR-22 (15,F)

Social alerting was also used to spread information to other members of the group who were not members of the message group. For example, SN-22 (15,M) used an iMessage group to share information with his baseball teammates. However, those messages were only sent to players who used iPhones, which included only half of the team. The players who were part of the iMessage group were responsible for alerting the other players whenever important information was shared in the group thread. This social alerting often happened in person during school or via individual text messages.

These findings show that adolescents engage in social alerting to notify one another of important content shared in a group thread that may otherwise be missed. Based on their understanding of individual group members' behavior and preferences, users are able to selectively share the most relevant and timely content. Some groups rely on social alerting to notify all members of important announcements.

DISCUSSION

Our work has documented and described current adolescent group messaging practices. We developed a framework to classify message groups along three dimensions: focus, membership, and duration. This framework can be used to explore the ways in which various groups use group messaging to communicate with one another. To communicate with multiple groups, our participants used a variety of messaging tools to send group messages. Decisions about which group messaging tool(s) to use are complex, influenced both by group members' access to tools and devices, as well as the nature of the group's communication. Further, these choices are not final; as groups evolve they sometimes switch to or add additional tools. Adolescents' use of group messaging is part of a varied communication ecology; they frequently switch between and blend multiple channels while communicating with each other [15].

Our findings confirm prior work [4,5,8] that found the volume of notifications generated by group messaging can become problematic. In some ways this group messaging notification overload problem is similar to the well-known email overload problem [9,29]. Just as there are numerous strategies for managing email, our participants engaged in various behaviors to manage their group message notifications. Notification management is a complex mix of sender's actions, group settings, and receiver's settings (both within the app and for their phone more generally). Reviewing how participants coped with notification management helps bring many of our findings together.

We found that adolescents use multiple strategies to manage their communication with various groups of contacts, driven at least partially by a need to manage notifications and confusion about how to effectively do so. Similar to previous work on identity management and self-presentation in mediated communication [7,27], some participants siloed their communication by using different tools to communicate with separate social circles. This approach is perhaps the simplest way to differentiate notifications from different groups according to different apps. And while some tools allow users to mute notifications for specific threads, not all participants were able to discover how to use those options to manage notifications. Thus we saw a range of strategies for dealing with notifications from multiple groups depending on what strategy they took, what tools they used, and how well they understood some of the features for managing notifications.

While some participants used features of their messaging tools and devices to limit unwanted notifications, only some tools offered those features, they can be confusing to use, and may not be nuanced enough to manage users' complex group interactions. Thus, our participants often turned to social means for managing their notifications, such as asking their contacts not to include them in future group messages or creating subgroups to selectively share information and avoid unnecessarily notifying all group members. Despite prior work predicting the need to create subgroups [5], today's group messaging tools do not explicitly support creating hierarchical group structures. We also found our participants to use social alerting to notify one another when relevant or important content was shared within a group message thread or getting highlight summaries of what they missed. These behaviors rely on an awareness of group norms and other group members' notification preferences.

Group message notifications were not always perceived to be burdensome; participants sometimes preferred to read every message sent to a group, particularly with close friend groups or groups that were focused on a specific topic. In those cases, notifications supported participants' desire to monitor the group thread and to stay connected to the group by reading all the messages, whether they were actively responding or not. This monitoring behavior is somewhat similar to "lurking," which was often viewed negatively, something that users attempted to hide from one another [28]. In contrast, monitoring was expected and accepted by our group messaging participants. This behavior may be better understood as "peripheral participation," where a peripheral group member with legitimate interest observes the work of the primary group members while learning about the task and the group dynamics [12,18]. Notifications may therefore benefit some groups as a means of supporting monitoring and enabling members to learn through peripheral participation.

Implications for Design

Our findings highlight the diversity of messaging groups and strategies for managing group notifications. Given that messaging groups come in a variety of shapes and sizes, we suggest that different groups would benefit from different notification settings. Our framework for classifying message groups according to their focus, dimension, and duration might serve as a useful way of adjusting group settings. A tool could have a variety of group templates for settings and suggest the best fitting template based on specifying the group's dimensions when creating the group. For instance, if a user indicates that a group's membership will be closed, the

tool could default to a template that notifies users when members are added to or removed from the group and does not allow new members to see old messages.

Our findings have also highlighted a number of scenarios that were poorly supported by current group messaging tools. We present four such scenarios as well as behavioral solutions our savvy participants employed and potential technical solutions for each.

First, there are times when users are away from their devices or unable to follow along with the group conversation for a variety of legitimate reasons. Users often return from such absences to a large number of unread message notifications. While they could read every message they missed, users would benefit from a way to catch up more efficiently. Some participants employed a social solution, by asking the other group members to summarize what they missed. Group messaging tools could draw on other group members' interactions with messages to infer which are the most popular and show the top-ranked messages with the missed message notification. Tools that offer a feature of liking messages, for example, could calculate a simple popularity value for each missed message based on the number of likes it received. Tools might also use the number of members who viewed the message or the time between notification and viewing to compute a ranking for each message.

A second problem identified by our participants is finding important information buried within a long group thread. Some savvy participants who recognized the importance of a message when it was received thought to take a screenshot, making it easier to find later instead of scrolling through the message history. Messaging systems could allow members to "pin" important messages to the top of the screen so they remain visible for all group members. When participants did not recognize an important message as it was received or did not think to save it, they had to manually look through the old messages or ask other group members to recall the information. The ability to search within group threads would aid this information finding process. A search algorithm could also incorporate message popularity scores, to help users quickly find the important messages.

A third problem is wondering who saw a particular group message. Some of our participants had co-opted the like feature in GroupMe as a way to acknowledge that they had seen a specific message. Some tools, such as iMessage, Facebook Messenger, and Google Hangouts, already include read receipts, which would help in this situation. Participants also relied on outside social information to predict which group members were likely to have read or not read a message, such as knowing that certain people read every group message or that others rarely logged on. To support this awareness, tools could enable users to see which members are receiving notifications and who has muted the group, a feature GroupMe already has.

Finally, there are times when it would be useful to notify specific group members, such as when the conversation changes to one they would be interested in. Some of our participants accomplished this through social alerting via other channels. A tool could enable this behavior by allowing users to tag another group member in a message and sending a different type of notification to the tagged user. Such a notification might override muting or remain at the top of the notification list to stand out for those who are already receiving, but possibly ignoring, notifications.

Limitations and Future Work

This work is limited by our focus on adolescents in the United States who regularly used group messaging. Future work in international contexts would allow for important cross-cultural comparisons. Although adolescents are currently the most active users, other groups of users may adopt group messaging in the future and develop different practices and future work should consider a wider variety of users. Additionally, these findings were based on a relatively small sample size. A larger survey study would establish the generality of these findings and could take a more systematic approach to classifying different message groups and investigating variation in practices by age, gender, and other factors. Future analyses would also benefit from inclusion of multiple group members' perspectives on the same group, as individuals' understandings of group norms may differ.

As active group messaging users, our participants may be considered early adopters, and are likely to be more familiar with the tools and features available in current group messaging tools than the average user. Thus, other users may have more trouble with the situations where our participants found technical and behavioral solutions. Thus, prototype systems that implement our design suggestions should be deployed within a variety of groups and users in order to evaluate their overall effectiveness.

CONCLUSION

Group messaging has emerged as a popular but under-studied communication method. We presented findings from an interview study of 48 adolescent users. We developed a framework to demonstrate the diversity of groups adolescents message with and to classify those message groups according to their focus, membership, and duration. We identified factors, including access and temporality, which influence choice of group messaging tools and highlighted practices for managing group notifications, including monitoring and social alerting. We discuss the various strategies our participants employed to manage multiple groups and frequent notifications, highlighting the diversity of messaging groups' needs. We highlight challenges faced in current tools and offer design suggestions for future development.

ACKNOWLEDGEMENTS

We thank our anonymous participants for their time as well as our research group for their feedback on this project.

REFERENCES

1. Battestini, A., Setlur, V., & Sohn, T.A large scale study of text-messaging use. In *Proc. MobileHCI* (2010), 229-238.
2. Boix, E.G., Carreton, A.L., Scholliers, C., Van Cutsem, T., De Meuter, W., & D'Hondt, T. (2011). Flocks: enabling dynamic group interactions in mobile social networking applications. In *Proc. SAC '11*. 425-432.
3. Bryant, J.A., Sanders-Jackson, A., & Smallwood, A.M. (2006). IMing, text messaging, & adolescent social networks. *JCMC*, 11(2), 577-592.
4. Church, K., & de Oliveira, R. What's up with WhatsApp? Comparing Mobile Instant Messaging Behaviors with Traditional SMS. In *Proc. MobileHCI* (2013), 352-361.
5. Counts, S. (2007). Group-based mobile messaging in support of the social side of leisure. *CSCW*, 16(1-2), 75-97.
6. DiMicco, J.M., & Millen, D.R. Identity management: multiple presentations of self in Facebook. In *Proc. GROUP* (2007), 383-386.
7. Farnham, S.D., & Churchill, E.F. Faceted identity, faceted lives: social & technical issues with being yourself online. In *Proc. CSCW* (2011), 359-368.
8. Farnham, S., & Keyani, P. Swarm: Hyper awareness, micro coordination, & smart convergence through mobile group text messaging. In *Proc. HICSS* (2006), 3:59a.
9. Grevet, C., Choi, D., Kumar, D., & Gilbert, E. Overload is overloaded: email in the age of Gmail. In *Proc. CHI* (2014), 793-802.
10. Grinter, R.E., & Palen, L. Instant messaging in teen life. In *Proc. CSCW* (2002), 21-30.
11. Grob, R., Kuhn, M., Wattenhofer, R., & Wirz, M. Cluestr: mobile social networking for enhanced group communication. In *Proc. GROUP* (2009), 81-90.
12. Gutwin, C., Penner, R., & Schneider, K. Group awareness in distributed software development. In *Proc. CSCW* (2004), 72-81.
13. Heyer, C., Brereton, M., & Viller, S. Cross-channel mobile social software: an empirical study. In *Proc. CHI* (2008), 1525-1534.
14. Inkpen, K., Whittaker, S., Czerwinski, M., Fernandez, R., & Wallace, J. GroupBanter: Supporting Serendipitous Group Conversations with IM. In *Proc. CollaborateCom* (2008), 485-498.
15. Isaacs, E., Szymanski, M., Yamauchi, Y., Glasnapp, J., & Iwamoto, K. Integrating local & remote worlds through channel blending. In *Proc. CSCW* (2012), 617-626.
16. Kim, H., Kim, G.J., Park, H.W., & Rice, R.E. (2007). Configurations of relationships in different media: FtF, email, instant messenger, mobile phone, & SMS. *JCMC*, 12(4), 1183-1207.
17. Lampinen, A., Tamminen, S., & Oulasvirta, A. All My People Right Here, Right Now: Management of group co-presence on a social networking site. In *Proc. GROUP* (2009), 281-290.
18. Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge university press.
19. Lenhart, Amanda. (2012). Teens, Smartphones & Texting. *Pew Internet & American Life Project*.
20. Mayrhofer, R., Sommer, A., & Saral, S. Air-Writing: a platform for scalable, privacy-preserving, spatial group messaging. In *Proc. iiWAS* (2010), 183-191.
21. Odero, B., Omwenga, B., Masita-Mwangi, M., Githinji, P., & Ledlie, J. Tangaza: frugal group messaging through speech & text. In *Proc. DEV* (2010), 1.
22. O'Hara, K.P., Massimi, M., Harper, R., Rubens, S., & Morris, J. Everyday Dwelling with WhatsApp. In *Proc. CSCW* (2014), 1131-1143.
23. Poole, E.S., & Peyton, T. Interaction design research with adolescents: Methodological challenges and best practices. In *Proc. IDC* (2013), 211-217.
24. Schuler, R.P., Grandhi, S.A., Mayer, J.M., Ricken, S.T., & Jones, Q. The doing of doing stuff: understanding the coordination of social group-activities. In *Proc. CHI* (2014), 119-128.
25. Skeels, M.M. & Grudin, J. When social networks cross boundaries: a case study of workplace use of Facebook & LinkedIn. In *Proc. GROUP* (2009), 95-104.
26. Smith, A. (2013). Smartphone Ownership 2013. *Pew Internet & American Life Project.*
27. Stutzman, F., & Hartzog, W. Boundary regulation in social media. In *Proc. CSCW* (2012), 769-778.
28. Voida, A., Newstetter, W.C., & Mynatt, E.D. When conventions collide: the tensions of instant messaging attributed. *In Proc. CHI* (2002), 187-194.
29. Whittaker, S., & Sidner, C. Email overload: exploring personal information management of email. In *Proc. CHI* (1996), 276-283.
30. Wortham, J. GroupMe and Rivals Offer Group Texting for Smartphones. *The New York Times*, March 11, 2011. p. B1. New York. Retrieved from http://www.nytimes.com/2011/03/11/technology/11group.html
31. Yang, C., Brown, B.B., & Braun, M.T (2014). From Facebook to cell calls: Layers of electronic intimacy in college students' interpersonal relationships. *New Media & Society*, 16(1), 5-23.