Ten-Minute Silence: A New Notification UX of Mobile Instant Messenger

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ABSTRACT

People receive a tremendous number of messages through mobile instant messaging (MIM), which generates crowded notifications. This study highlights our attempt to create a new notification rule to reduce this crowdedness, which can be recognized by both senders and recipients. We developed an MIM app that provides only one notification per conversation session, which is a group of consecutive messages distinguished based on a ten-minute silence period. Through the two-week field study, 20,957 message logs and interview data from 17 participants revealed that MIM notifications affect not only the recipients' experiences before opening the app but also the entire conversation experience, including that of the senders. The new notification rule created new social norms for the participants' use of MIM. We report themes about the changes in the MIM experience, which will expand the role of notifications for future MIM apps.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; *Empirical studies in collaborative and social computing*.

KEYWORDS

Mobile instant messaging, notifications, social interaction

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1 INTRODUCTION

Today, mobile instant messaging (MIM) apps have become a major tool for mobile-based text communication. In MIM, compared to short message service (SMS), people exchange messages more often, are more conversational, and use group chats more often [4]. These characteristics lead to crowded smartphone notifications [31]. Many HCI studies have proposed solutions to solve the problem of the overcrowding of notifications from the recipient's perspective. This study investigated how users would experience and change their messaging behaviors if both recipients and senders shared a rule to mitigate notification problems.

Most current MIM apps provide one notification per message (Figure 1(a)). We made a new rule that provides one notification per *conversation session*, which is a group of consecutive messages, rather than per message. We tried to distinguish between conversation sessions based on a break (i.e., a certain period of silence) in the chat room and to provide only one notification for the first message in each conversation session (Figure 1(b)). There are many asymmetrical notification management approaches only for recipients. In this study, we newly attempted to use a symmetrical approach to mitigate notifications. We set up one rule that recipients and senders share and set the criterion for this rule to 10 minutes, which we call the "ten-minute silence."

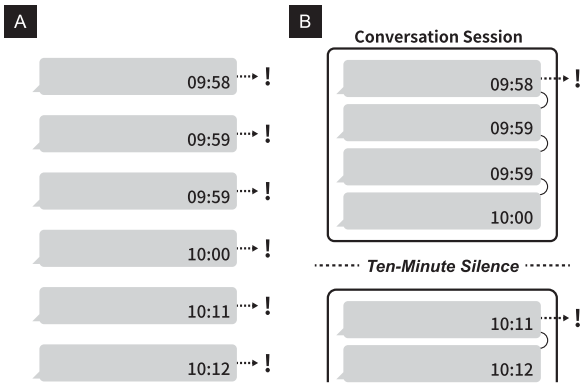

Figure 1: (a) Current MIM notification per message; (b) a new rule for a conversation session based on ten-minute silence.

To explore the impact of our rule on the messaging experience, we developed *HelloBye*, an MIM app that uses this new notification rule. We conducted a two-week field study with 17 participants and analyzed message logs and interview data. This paper reports a descriptive quantitative result of 20,957 messages (1,024 conversation sessions generated) collected over two weeks, including five themes from the qualitative analysis. Generally, in HCI, notifications are expected to mostly affect the recipients before a conversation, but our data revealed changes in both recipients' and senders' experiences at the start, middle, and end of a conversation, and even after the conversation. Furthermore, the results revealed that new social norms and conversation manners stem from the shared notification rule.

This study contributes to the understanding of the relationship between MIM experiences and notifications, as well as the discovery of the impact of shared notification rules on social interaction.

2 BACKGROUND AND RELATED WORK

A Large Number of Mobile Instant Messages

Today, people receive tens to hundreds of mobile instant messages a day, accounting for 50–90% of all smartphone notifications [2, 16, 25]. Before the introduction of smartphones, SMS had exploded in popularity as an everyday text communication tool on mobile phones [8]. Since then, with the advent of the smartphone, MIM apps such as WhatsApp, Facebook Messenger, and KakaoTalk have started to replace SMS. The change from SMS to MIM was not just about where the message came from; SMS conversations typically consist of a single message or short sequences [8], but MIM has the advantage of being free to use and making it easy to share multimedia-based messages such as images and videos, which enables flexible messaging and a more conversational nature [4]. In SMS, people send more refined messages. In MIM, however, messages are shorter and more fragmented, and as a result, users can experience stress due to crowded message notifications [31].

Another likely basis for the increased number of messages is group chat. In group chat, multiple people send messages at the same time, and the messages are delivered to everyone in the chat room. Group chat is one of the biggest differences between SMS and MIM [4]. When people use SMS, all conversations are one-on-one, but in MIM, chats are often conducted in groups. Today, MIM users are creating group chat rooms that include many people and for various purposes, including chatting with friends, business communication, and other activities [4, 14, 21]. Some studies have shown that group chat is a significant part of users' MIM usage, and users tend to belong to lots of various types of group chats, which increases the total number of messages received [4, 14]. Therefore, we explore the messaging experience including group chat in this paper because many recent novel MIM trials in HCI [28, 29, 35] have been focused on the one-on-one chat experience.

MIM Notifications: Push and Badge

MIM notifications are provided by push and badge notifications. First, MIM push notifications on smartphones (Figure 2, left) are delivered through a lock screen, notification center (iOS), or notification drawer (Android). Push notifications are usually generated with information about the message sender and a snippet of the message content, along with a sound or vibration alert, according to the user's preference. Another important characteristic of MIM notifications is the icon badge (Figure 2, right). Badge notifications are marked with red dots and numbers above the app icon. The badge is usually accompanied by a push notification, and its most important function is to provide numerical information. Almost all currently popular MIM apps show the number of unread messages on their badges.

Excessive notifications can cause problems, including annoyance, inattention, and stress [5, 15, 19, 27, 31]. Many HCI studies have focused on providing solutions for smartphone notifications in general rather than MIM notifications. The studies have mainly focused on interruptions stemming from notifications and have discussed notifications' improper content and timing [6, 17, 18, 23, 24, 33]. Although these studies have invented excellent methods for managing notifications, we believe there should also be MIM-focused solutions for the aforementioned reason (a high proportion of MIM notifications).

In this study, we attempted to follow a new rule that provides one notification for each conversation session, which is a group of consecutive messages, instead of per message. We tried to distinguish between conversation sessions based on breaks in a chat room (no messages sent for a certain amount of time) and to provide only one notification for the first message of each conversation session. Although deferral techniques (holding a notification for a certain amount of time or until a user finishes an ongoing task) are the most popular notification management methods, which have been studied since the desktop environment was developed [10, 13, 23], we wanted our design to fit the unique experience of MIM, in

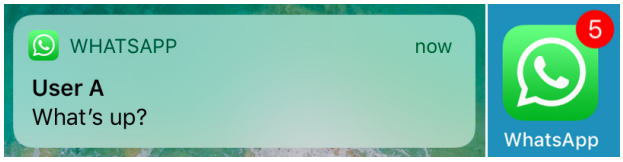

Figure 2: Existing MIM apps' push and badge notifications.

which users normally expect to receive immediate responses to their messages [4, 11]. Therefore, to reduce the number of notifications while preserving the inherent characteristics of MIM, we chose not to defer the notifications but instead to send a notification of the first message directly and then skip notifications of the following messages. This approach is not technically new; it has been applied in some mobile and PC-based apps. For example, an Android app called Mutifier[1] is a mobile notification manager. Mutifier allows the user to set a delay on an app after a message and to customize the length of the delay. Many other apps allow the user to control the notification settings, but the difference is that we chose a symmetric approach: The recipient and the sender share one criterion and rule. This study reports messaging experience changes when the MIM notification management rule is shared.

Toward a Deeper Understanding of the MIM Experience

HCI is continuing to expand its understanding of emerging MIM technology. MIM is no longer just a tool for delivering text—it creates a unique experience. In an early MIM study, Church and Oliveira [4] found that MIM behaviors differ from traditional SMS behaviors in many aspects; people's conversations are more natural and flexible, and they build a sense of community through MIM. Since then, many studies have provided an in-depth understanding of the MIM experience that is prominent in today's text-based mobile communications [21, 22, 31, 34, 36]. In addition to these studies focusing on existing MIM apps, some novel MIM apps have recently been created to explore unseen areas. Examples include Rost et al.'s Forget-me-not [29], which is a history-less mobile messaging app; Xu et al.'s Bubble Q [35], which de-emphasizes content to explore the role of messages in MIM; and Podlubny et al.'s Curtains Messenger [28], an app for discovering synchronization in mobile messaging.

Some studies continue to understand the MIM experience by focusing more on specific design. MIM has a variety of features that can be found in previous PC-based instant messaging but is creating new experiences in the mobile environment. For example, MIM chat rooms act as dwellings reflecting human territoriality [14]. A "last seen" feature makes users concerned about sharing their availability [26]. The read receipt feature could cause the recipient to feel social pressure and the sender to experience anxiety [11].

These studies demonstrate a great deal of innovation and have deepened the understanding of the MIM experience. Our work draws upon these threads. In particular, by attempting a new case by tackling notification crowdedness in MIM app use, this study reinforces the understanding of the relationship between notifications and MIM experience.

[1]Mutifier - Apps on Google Play. Retrieved January 7, 2019 from https://play.google.com/store/apps/details?id=com.iniro.mutifier

3 STUDY METHOD

The Design of HelloBye

We designed an MIM app called HelloBye with a new rule of ten-minute silence: one notification per conversation session, not per message, and shared between senders and recipients. We needed a sample time criterion to delineate this new concept. From several previous studies on notifications, we found that most people check MIM notifications quickly [7, 19, 25, 26, 30]. For example, Pielot et al. [25] revealed that the median time range for people to see MIM notifications is 3.5 to 6.6 minutes after receiving them, and another study revealed that the median time is 6.15 minutes [26]. Based on these studies, we decided that setting a 10-minute break would distinguish different conversations in the chat room and is proper to test our concept. However, at the same time, we note that this 10-minute criterion is for exploring this new concept, not the proven optimal value. We further discuss this criterion later; it was adequate for us to uncover the user experience with a new concept.

Therefore, HelloBye has the new notification rule based on conversation session, which is defined by a 10-minute interval between two consecutive messages. For example, assuming a group chat to which user A, user B, and user C belong, A and B send four consecutive messages (09:58 to 10:00), and the last message sent by B is at 10:00 (Figure 3). C will only be notified when the first message is sent by A at 09:58 instead of receiving notifications for all four messages. Furthermore, if A or B sends another message (the fifth message) to the same chat room before 10:10, which is before the 10-minute cutoff, it will be included in the previous conversation session, and no notification will be sent. However, if the fifth message is sent after 10:10, as shown in Figure 3, then that message will create another notification because the conversation session ended by the 10-minute break.

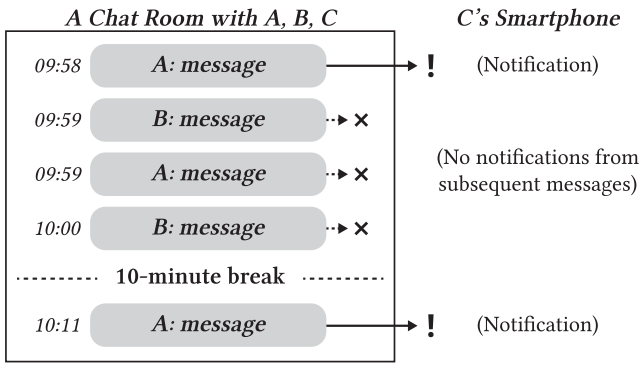

Figure 3: Example of HelloBye's notification rule.

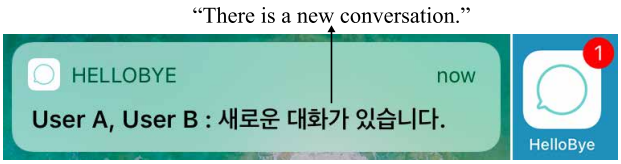

Figure 4: HelloBye's push and badge notifications.

In HelloBye, we decided to use a push notification to provide information about the member(s) of the chat room besides the recipient and the fact that "There is a new conversation" (Figure 4, left) instead of the sender and content snippet of conventional existing MIM; additionally, the badge displays the number of conversation sessions (Figure 4, right) instead of the number of unread messages, as in conventional existing MIM.

Figure 5 shows HelloBye's chat room. Users can see the members of the chat room at the top and can turn notifications on or off with the top right notification button. If users turn off notifications for a chat room, push notifications will not be generated, but the icon badge will still display the number of unread conversation sessions. HelloBye displays the ranged timestamps for conversation sessions (i.e., the time of the first and last message) at the top of the session. These timestamps are created when the first message in the conversation session is sent and updated every time a new message is sent.

In this study, HelloBye offered representativeness of MIM clients in that users could create one-on-one and group chats with smartphone contacts, send texts and photos in real time, see messaging history, and set their profile names and pictures. At the same time, there were limitations. For example, users could not send other multimedia, such as videos, locations, or files. In addition, today's MIM apps offer a number of features for convenience, such as read receipts and typing indicators, but HelloBye does not provide these features because this study focused on user experience with messages and notifications. However, because our study focused more on the representative MIM use situation for notification overload instead of covering all possible MIM features, we believe that the setup of this study was adequate for our research purpose.

HelloBye was developed as an iOS native app. SendBird API was used to implement messaging functions, including sending text and pictures and creating chat rooms. We used SMS authentication to enable users to create a chat room based on their smartphone contacts. We stored user information and message logs and sent SMS for authentication using a Web host and its database, and we provided push notifications for each conversation session using Google's Firebase Cloud Messaging. The app was deployed on the App Store.

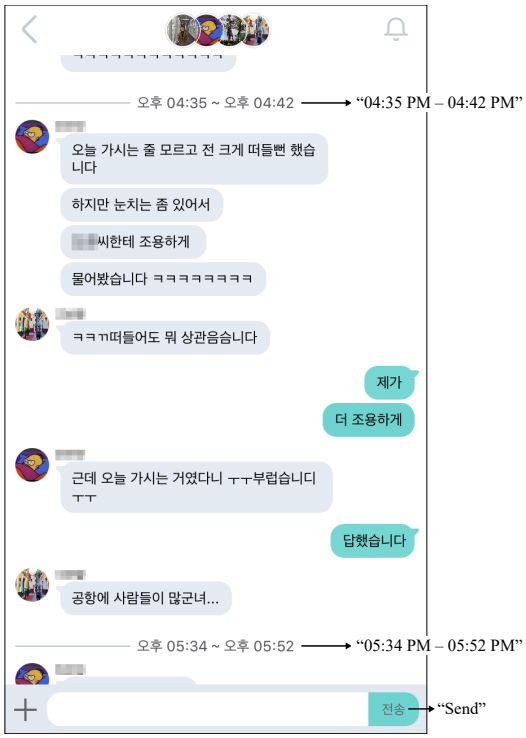

Figure 5: HelloBye's chat room. Two distinguished conversation sessions are present (04:35PM – 04:42PM and 05:34PM – 05:52PM).

The Field Trial

We considered HelloBye to be a technology probe [12] and conducted a two-week field trial in January 2018.

Procedure and Participants. We wanted to discover users' experience not only in one-on-one chats but also in group chats. Therefore, we wanted to recruit participants who already had social ties and used group chats with existing MIM apps. We posted recruitment articles containing the above requirements (the members of the group having social ties and using their own group chat, and all of the members being able to participate in two weeks of trial and interviews) in online communities, and we posted printed flyers in local apartment buildings.

From among the applicants, we selected participants based on variety in age, gender, and types of relationship. Finally, we recruited four groups of four to five people each: two groups of friends and two groups of colleagues. Seventeen people in total participated in our study. One friend group was composed of two male and two female undergraduates, who were two pairs of couples (ages 19–20; anonymized as P1–P4). The other friend group was composed of four male graduate students belonging to the same bicycle club (ages 23–29; anonymized as P5–P8). One colleague group

was composed of four female office workers at an institute of biotechnology (ages 22–25; anonymized as P9–P12). The other colleague group was composed of two male and three female technical workers at a public enterprise (ages 26–31; anonymized as P13–P17).

Before the actual trial, we invited the participants by group to the lab and introduced them to HelloBye. We briefly explained how to use the app and the study procedure. In addition, we asked the participants to use HelloBye as their main MIM app with the other recruited members. After the two-week trial, the participants returned individually to the lab to participate in interviews. We thought that even if the participants were in the same group, each participant would have a different experience, so we interviewed them individually. One researcher led the interview, while another researcher took notes and supplied missing or improvised questions of interest.

Data Collection and Analysis. We collected two forms of data: message metadata and qualitative interview data. First, our system recorded message log data, including message senders, sending times, and chat rooms in which messages were sent. However, the message content was not recorded because recording the content of the messages would affect the participants' natural use. This paper uses log data to show the participants' practice of using messages and chat rooms and creation of conversation sessions, and more key findings about the messaging experience were found through interview data. All recorded user information was anonymized prior to analysis, and the record settings and study procedures were approved by the university's institutional review board.

Qualitative data were collected through semi-structured interviews. At the beginning of the interview, there were questions about how participants were using an existing MIM app and what kinds of notification problems they were experiencing. Then, we asked about these experiences using HelloBye: how much the notifications seemed to be reduced, when and how users experienced notification reduction, their thoughts on how the push and badge notification changed, and their positive or negative experiences. We also asked them to compare their experiences with their experiences with existing MIM apps they used, especially existing chat rooms with recruited members, so as to capture changes in their messaging patterns.

The interviews were audio recorded and transcribed. Two researchers participated in the analysis. The lead author first wrote memos at the initial reading of all transcripts. After the first reading, the second author, who also attended the interview, participated in discussing and deriving key themes in an open coding process, in which we coded distinct concepts and categories in the data. All these analyses took over six months, and during the iterative analysis process, we noticed that our design led to notable changes depending on the participants' "conversation phases," and themes could be categorized depending on those phases. For the axial coding process, we reanalyzed the data and derived themes from the conversation phases as the analytical frame. After going through the refining process, we ultimately derived five themes.

4 RESULTS OF OVERALL MESSAGING PRACTICE

Before describing our interview findings, in this section, we report quantitative results about the use of messages and creation of conversation sessions. We hope that these data complement our interpretation in the next section.

Table 1 shows an overall summary of the participants' use of HelloBye. The 17 participants and 1 external user (a friend of P10) sent 20,957 messages over the two weeks of the trial (the participants who sent the most and fewest messages sent 2,134 and 608 messages, respectively). The participants used a total of nine one-on-one chat rooms and five group chat rooms, and a total of 1,024 conversation sessions were created. Each session contains an average of 20.47 messages (SD = 32.71). By chat type, in the nine one-on-one chats, 4,217 messages were sent, 271 conversation sessions were created, and the average number of messages per session was 15.56 (SD = 24.55). In the five group chats, 16,740 messages were sent, 753 conversation sessions were created, and the average number of messages per session was 22.23 (SD = 35.03).

Table 1: The number of messages and conversation sessions for two weeks (white = one-on-one chat; gray = group chat). [a] P10's friend, not a study participant, used HelloBye during the field trial. This use is only included in the statistics.

Members of Chat Rooms	# of Messages	# of Sessions	# of Messages /Session
P13, P14	106	1	106.00
P13, P15	593	8	74.13
P13, P14, P15, P16, P17	4,260	71	60.00
P1, P2, P3, P4	3,953	160	24.71
P2, P3	2,237	92	24.32
P9, P10, P11, P12	4,540	268	16.94
P5, P6, P7, P8	3,965	251	15.80
P10, P10f [a]	435	43	10.12
P1, P2	132	14	9.43
P13, P14, P15	22	3	7.33
P10, P12	623	91	6.85
P9, P11	26	5	5.20
P1, P4	38	9	4.22
P10, P11	27	8	3.38
Total	20,957	1,024	20.47

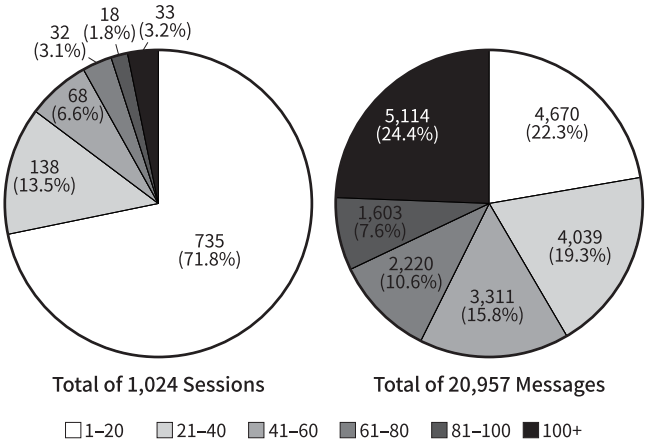

Figure 6: Distribution of sessions (left) and messages (right) based on the number of messages in a session.

Figure 6 shows the distribution of conversation sessions based on the number of messages contained. The number of messages included in one conversation session varied from 1 to 317. The most frequently generated conversation sessions were the sessions with 1–20 messages, which accounted for over 70% of the sessions. On the other hand, the number of conversation sessions containing a larger number of messages was very small. For example, of the total of 1,024 conversation sessions, there were only 33 conversation sessions containing 100 or more messages (i.e., a little over 3%). However, this relatively small number of sessions contained 5,114 messages, which accounts for about one-quarter of the total number of messages for two weeks. This shows that the participants sometimes sent and received many messages in a conversation session, and these messages took up a significant amount of the message total.

5 MESSAGING EXPERIENCE CHANGES DEPENDING ON CONVERSATION PHASE

In this section, we report our findings about how our design changed the way the participants communicated based on the qualitative data. The results were refined into five themes according to the phase of the conversation: *Before conversation; Starting conversation; During conversation; Ending conversation; After conversation* (Figure 7). Although our findings were separated to make clear distinctions according to the phase of the conversation, these themes are closely related, and such relationships are also described.

Before we describe the findings, we present a brief summary of the participants' answers to their existing MIM usage patterns. All participants were relatively young Koreans (ages 19–31); some participants used two or more MIM apps, but all of the participants used KakaoTalk as their primary

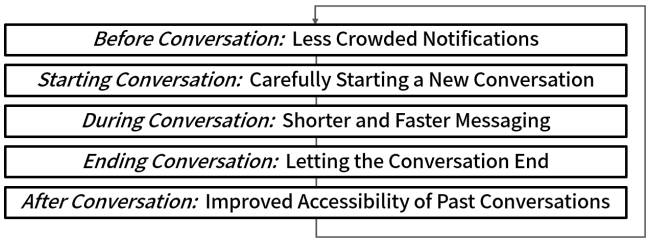

Figure 7: Five themes based on conversation phase.

MIM app. They were connected to most of their family members, friends and acquaintances with KakaoTalk, and they actively used both one-on-one and group chats. They sent lots of messages via existing MIM—from 10 to 300 cumulative messages in daily-life group chats—and were often bothered by MIM notifications. Such heavy use is consistent with previous reports of young Korean users [14, 16, 31].

Before Conversation: Less Crowded Notifications

First, the participants experienced reduced notifications before they participated in the conversation by opening the app. As reported in the statistics above, because approximately 20 messages were sent during one conversation session, the participants noted that both push and badge notifications were significantly reduced compared to the amount of messages they received.

As shown in the distribution of the sessions (Figure 6), the participants occasionally sent a large number of messages. However, the participants said that they do not like to receive many notifications, especially when they do not participate in the conversation. They noted that HelloBye was good at preventing this kind of annoyance when they were not participating: *"The good thing was, I could concentrate on what I was doing [with HelloBye]. When I received notifications with the existing MIM while I was working, I could not see it, but the screen was bright and I was nervous about it"* (P14). This is in line with previous studies' claims that people felt they were more productive when they received fewer notifications [15, 27].

The participants also said that it was common to see a badge notification number greater than 100 in existing MIM. However, because HelloBye provided badge numbers per conversation session, the participants said that they saw small numbers, usually one or two. A large badge number in MIM can create pressure for users [31]. The participants said that the relatively small number of notifications relieved them of the pressure of seeing a large number: *"I have about 30 notifications as usual. If there are a lot, there are 200, 300. If there are too many notifications, I feel the burden of them accumulating. But it was only one [in HelloBye], I felt less burdened"* (P2).

Out of 17, 16 participants stated that they experienced this dramatic notification reduction. However, one participant did not (P15). P15 said that she checks messages as soon as possible because she dislikes any red badges remaining on the app, so she always tries to keep the app without a badge (i.e., no unread messages). On the other hand, the participants who responded that they checked their notifications relatively slowly felt that their notifications were greatly reduced in HelloBye. This showed that our design can have different effects on reducing notifications depending on the user's MIM usage patterns.

With typical MIM use, our participants felt that messages in group chats were generally less important than messages in one-on-one chats. People usually turn off notifications they believe are unimportant in order to focus more on important notifications [3]. The participants said that they turn on most notifications for one-on-one chats but turn off notifications for most group chats in existing MIM, even if it is a chat room with close friends; however, in HelloBye, most participants did not turn off notifications for one-on-one or group chats because they said they did not need to. Not having to turn off notifications for group chats was positive to them: *"I usually turn off the notifications in group chats, but HelloBye reduces the notifications, so that now I can use the notification feature properly"* (P8).

Nevertheless, reduced notifications resulted in missing some signifiers [20] that existing MIM notifications provide. The participants inferred more than just senders and snippets from push notifications and the number of messages on the badge in existing MIM. For example, the participants inferred the importance of the conversation according to the badge number before opening the app. If they saw a quickly increasing badge number, they inferred that there was an ongoing conversation in the group chat: *"If there were 300 floats [on the badge], I would think, 'I'll look at it sooner, something has happened' "* (P7). The snippets of push notifications and the badge numbers allowed the participants to gauge how active the conversation was. In HelloBye, they felt discomfort about the lack of this other information: *"It was good that the notifications were reduced, but I wish I could see how many came. Only then can I see if the conversation is active or not"* (P13).

Reducing the number of notifications does not just make notifications more manageable. This reduction also gave the participants different perceptions of their notifications. In HelloBye, one notification could represent only one message, but it could also represent dozens of messages. The participants described a notification using various terms: *"a conversation," "a group of messages," "a time slot," "a thread,"* or *"a bundle."* Instead of recognizing a notification as receiving a message, the participants usually recognized a notification in HelloBye as the start of a conversation: *"I thought that number one [on the badge] was the start of the conversation"* (P17). This change of the perception of each notification influenced the behavior of sending messages, which we will discuss further in the following sections.

Starting Conversation: Carefully Starting a New Conversation

The participants were more cautious about starting a new conversation session. Out of 17, 13 participants said that they more carefully sent a message when there was no ongoing conversation than they would in existing MIM. This is highly related to the change in perception and meaning of notifications experienced by the participants in the first theme, "Before Conversation: Less Crowded Notifications." The participants stated that while sending messages from an existing MIM is very easy, it is relatively more difficult to send a new message in HelloBye when they must create a new conversation session, which generates a new notification.

When sending messages in HelloBye, the participants were more concerned about whether others could respond to them within 10 minutes. They said they would send a message right away when they needed to and wait for a reply in existing MIM, but this was not the case with HelloBye. For example, they considered the timing of sending a message in terms of whether someone in the chat room could answer or not within the same session. If they thought that no one in the chat room would be able to reply within the same conversation session, they tended not to create a conversation session: "I have something to say, but the time is too late and nobody seems to answer. Then I did not make a conversation when it seemed that only new bundle would occur" (P15).

The participants were also careful about creating a conversation session if it was a relatively unimportant message. In MIM, people engage in a lot more chitchat than in SMS [4, 22]. The participants also mentioned that in existing MIM, they send a lot of meaningless messages without much thought; however, in HelloBye, they often paused and carefully thought about sending messages that were not as important. Some participants said that they did not send an unimportant message immediately; instead, they waited a while and sent it when a conversation session had been created by another member or along with other important messages: *"We talked about everything that was not important at one time. For example, if I had a little story about my boss, I talked when a conversation opened"* (P11).

There was a difference in the degree of carefulness among the participants. The most prudent group regarding this issue of creating new conversations was the older group of colleagues (P13–P17). They had a stronger sense of having

to read messages as soon as possible if they received notifications, and they were more cautious about creating new notifications. We believe that the group trait could explain the fact that a much smaller number of conversation sessions were created by the members of this group compared to other participants, considering the number of messages they sent: The number of messages per session (60.01) in the four chat rooms of this group's members is much higher than the overall average of 20.47. This shows that the relationship between chat members can affect the experience of this theme.

In a messaging experience, the start of a conversation is entirely up to the message sender. However, so far, the relationship between sender behavior and notifications has rarely been explored. HelloBye changed the way these message senders start conversations; senders were cautious about sending a new message when the conversation had not yet begun, considered the possibility of getting replies within the session, and put off less important chitchat for later if no conversation session was going on.

During Conversation: Shorter and Faster Messaging

Once a conversation had started (i.e., when a new session was created), the participants engaged in faster, shorter messaging. MIM has the characteristics of being flexible and allowing participants to talk more quickly than in SMS [4]. Out of 17, nine participants mentioned that messaging in KakaoTalk tends to be shorter and faster than in SMS, but it was more so in HelloBye when the participants compared it to their experience in KakaoTalk.

Based on message log data, we found that the participants sent a lot of messages in a row within a very short amount of time. In the interviews, the participants said that they knew that their messages would not result in additional notifications to the other parties. In particular, the participants in groups of friends (P1–P8) said that they often pointlessly chitchat when using MIM, and the tendency to send a lot of messages without considering notifications seems to be greater. They said that they felt freedom from notifications and that the experience felt much closer to verbal communication. They experienced the characteristics of a desktop environment's instant messaging in the mobile environment, in which users treat conversation casually and informally without hesitation, as with verbal communication [32]: *"Everybody wrote messages shorter and shorter. It was more than KakaoTalk. It seems to be written in almost one or two words. It feels like reflexively talking without filtering"* (P6). An experimental MIM app that allows for only synchronous texting enabled the conversations to be more natural, like phone calls or face-to-face conversations [28], and our design had similar effects in a different way.

The participants said that even if only a few members of the chat room were chatting, they often continued to send messages in the group chat, not creating other separate chat rooms. For example, even if only two members talked in a group chat room that had four members, the participants often kept talking in the group chat and did not use a separate one-on-one chat. The MIM chat room serves as a dwelling for users' social relationships [14]. The participants thought that even if conversations involved only two people, remaining members should be able to see the message history later: *"It's a group chat with four people. [Sometimes] only two people talk. It's commonly happened. Because the topics are similar, I keep talking in there [the group chat]"* (P6). Our design was positive when some participants of the group chat participated in conversations. When they had these conversations in particular, they felt more freedom to generate notifications.

However, some participants, especially those in work relationships, mentioned negative nuances, such as feeling rushed. They said that if they received a new message, they felt pressured to respond within 10 minutes. As we described in the previous theme, "Starting Conversation: Carefully Starting a New Conversation," the participants had difficulty starting a conversation, so their sense of obligation to participate when the conversation began also increased: *"I tried to answer as soon as possible; when I saw the conversation, I was going to reply quickly"* (P9). They also mentioned that when they sent a reply more than 10 minutes after the last message and a new conversation session was created, they felt that they had responded late: *"When I sent the message, a time mark occurred. Oh, it was late. I answered late"* (P12).

Ending Conversation: Letting the Conversation End

This section is about the participants' experience with ending their chat room conversations. When 10 minutes had passed after the last message was sent (i.e., in a situation when a new conversation session would be created by a new message), the participants were reluctant to create a new conversation (see second theme, "Starting Conversation: Carefully Starting a New Conversation"); instead, they wanted to treat the previous conversation session as one that had ended. This theme was found in interviews with 12 of the 17 participants. Although the conversations in MIM have a tendency to be endless [22], compared to single-turn SMS [8], our new notification system implicitly strengthened the end of conversations.

We found that sometimes, the participants did not send a reply because they did not want to create a new conversation session. If 10 minutes had already passed since the previous message, the participants considered whether it was important enough to send a reply. For example, in existing MIM, people often reply with a short message, such as "okay" or an

emoji, as an indication that they have read the message [36]. However, in HelloBye, if 10 minutes had passed since the previous message was sent in a chat room, the participants sometimes did not answer if they thought their reply was not important enough to create a new conversation: *"When I saw the messages later, sometimes I passed it without responding. It feels like I'm making a new conversation"* (P17). We wondered about their feelings when they did not get or send a reply, and they responded that it was natural not to reply in that situation and not bad at all. Rather, they were reluctant to create new conversation sessions with unimportant messages.

O'Hara et al. [22] found that conversations in MIM tend to exhibit "never-endingness." Participants in O'Hara et al.'s study discussed the discomfort of never-endingness using WhatsApp in particular relationships; our participants also mentioned that sometimes they had difficulty ending conversations in existing MIM, especially when the other participants were not close friends: "If the boss is in the chat room, it is harder to finish the conversation" (P16). While conversations in MIM tend to be ongoing and not have a clear ending, the start and end of a conversation in HelloBye was relatively clear. The participants recognized that the conversation ended when 10 minutes had elapsed from the latest message, and they were relieved of the burden of having to answer. The participants were positive in terms of the clear end of the conversation: *"The conversation has already ended. I would still send a message if it's essential, but I did not send it unless absolutely necessary"* (P12).

Also, combined with the third theme, "During Conversation: Shorter and Faster Messaging," the participants seemed to have denser conversations. The participants engaged in fast and active conversations during the conversation session, and if there was a 10-minute break, they then had to decide whether to end the conversation or start a new conversation. Because of this characteristic, using Grinter et al.'s terms [9], HelloBye led the participants to engage in a discrete-intensive usage style to some degree, rather than the continuous-sporadic style usually seen in reports of existing MIM: *"I sent more messages in a shorter time [in HelloBye]"* (P11).

After Conversation: Improved Accessibility of Past Conversations

Finally, HelloBye improved participants' ability to access past conversations. We believe that this was possible due not only to the change in notifications but also to the change in the timestamps in the chat room (Figure 5). We designed the timestamps to distinguish the conversation sessions for which notifications were provided, which served to allow participants to recognize multiple messages as conversation units.

Some of the participants thought the unit of communication was a conversation session, not a message. This theme was found in interviews with four of the 17 participants. This number is relatively small compared with the participant numbers of other themes, but we believe that this theme is still important because viewing the previous messaging history is a less common MIM behavior than sending/receiving a new message, and also, the field study lasted only two weeks. If they had used this app for a longer period than our study length, we expect that we probably would have had more opportunities to hear reports of such experience.

A previous study on existing MIM reported that messages were fragmented and therefore lacked a connection between them [31]. However, HelloBye tied messages within the same session to each other more closely. The participants could more easily perceive subjects, times, and situations in conversations. In existing MIM, there are constant ongoing conversations taking place [22]; however, HelloBye clearly showed the pauses and recommencements of conversations: *"It is a chat room that does not have much meaning if you see messages one by one. But if the messages are in a group [like HelloBye], I can see the flow of conversation"* (P8).

The participants mentioned that these conversation sessions were useful for looking up something in a past conversation. They said that the conversation sessions categorized messages over time, and thus, they were able to find certain messages more quickly. In existing MIM, it can be hard to find something because there are no specific divisions. However, in our design, if they know the general time of day a message was sent, they can look for it in a specific conversation session marked by that time: *"When I do not remember the exact words that were included in the conversation, then the search is very difficult [in existing MIM]. Now, I feel like I have a narrower range, and it was really easy to find"* (P6).

Our design seems to allow participants to give a higher level of meaning to the conversation sessions in the messaging history than to individual messages. In today's MIM, each message is very short and fast-paced; therefore, it is difficult for one message to be meaningful [31]. Some participants found it easier to give personal meaning to conversation sessions, including the situation, the subject, and the feelings at the time the conversation occurred. Because we did not expect the conversation session to be an object of meaning, we did not provide any interface to archive the sessions. Previous studies have found that MIM messages convey meaning rather than just deliver content [35], and the messages in the chat rooms could be cherished virtual possessions [14]; therefore, a design for archiving sessions could help users establish more meaning.

Taking all the themes together, notifications affect the overall process of conversation. Due to the much smaller

number of notifications, the participants gave each notification a larger meaning, which made starting a conversation more difficult and ending it easier. On the other hand, notifications that did not occur consecutively made it possible to send faster and shorter messages freely, without the generation of notifications during the conversation. This perceptional change allowed the participants to recognize the messages as a larger whole, making it easier to access past conversations.

6 DISCUSSION: FROM PERSONAL TO SOCIAL NOTIFICATION

In an in-situ notification study involving mobile phone users, Pielot et al. [25] said that "mobile notifications are inherently social." We receive more and more notifications from people rather than from systems. However, the current notification designs do not yet seem to be social enough. Based on this study, we believe that we need a deeper understanding of the social aspects of notifications.

We believe that one of the keys to our findings is that the new notification rule is not personal; it is "shared" between the recipients and the senders. Because this notification reduction rule is symmetric between the recipient and the sender, this rule can change the messaging behaviors of not only the recipients but also the senders. In existing MIM, users usually do not know the other's notification settings. However, with the shared rule, the participants know that their messages do not generate notifications for others in certain conditions, which resulted in some kind of consensus about the way to use the app and led to the creation of a unique communication style in our study. If our rule had not been shared but rather were individually configurable, we would not have found the aforementioned messaging patterns.

Therefore, the contribution of this study is the discovery that the newly shared and enforced notification rule between senders and receivers creates new social norms and communication experiences in MIM usage. In particular, among our five themes, the second theme (Starting Conversation: Carefully Starting a New Conversation) and fourth theme (Ending Conversation: Letting the Conversation End) were not directly induced by the rule; rather, the participants formed social norms over time. The participants experienced relived MIM usages in the reduction of notifications that our study originally intended, but carefully starting a new conversation and letting the conversation end also led to a relived MIM experience in a social way.

In addition, we learned that the notification design also can affect the way users engage in conversations. In our study, one of the interesting experiences with using HelloBye was the transition from *observer* to *participant* in the conversations. Many of our participants described themselves as observers or listeners in existing MIM, not participants in their chat rooms. They often said that there are always a few principal people who speak in the chat rooms and that they are only part of the chat rooms when they use existing MIM. In the previous PC-based chat experience, users had to spend time trying to access certain chat rooms and remain connected. On mobile phones, however, everyone is always connected [1, 3], and chat rooms are eternal unless purposely erased [14]. Because all users are not always able to engage in all conversations, they are mostly observers. However, some participants said that they felt more a part of conversations using HelloBye compared to using KakaoTalk; we believe the reasons are that the participants considered whether others could participate when they sent messages and that there was much more freedom to send messages as long as a conversation had started.

We also recommend considering relationships with other existing MIM features, such as read receipt, typing indicator, and "last seen," which have been already studied for their impact on social interaction [11, 26, 31, 34]. One case in our study is the relationship between notification and read receipt. The read receipt is an MIM feature displaying whether recipients have read a message, and in a survey study, it was revealed that the read receipt can put social pressure on recipients [11]. In our study, HelloBye includes no snippet in the push notification, and two participants (P1, P3) mentioned an interesting reason that the lack of snippet was not inconvenient: HelloBye does not have a read receipt feature. For them, snippets in notifications are only important to read a message without generating a read receipt, rather than previewing the message content. In our interviews, we found that many of our participants used the content snippet of push notifications to read messages without generating a read receipt in existing MIM. This shows that the MIM notification has been used as a means of coping to avoid the social pressure that the read receipt generates.

To summarize, MIM notification rules need to be dealt with as components of social interactions that influence the overall messaging experience and the social norms between the people who use it. We do not want to suggest our design, HelloBye, merely as a solution for reducing crowded notifications. We would rather focus on contributing to HCI by showing the possibility that MIM notifications can be used as a design resource for improving the overall messaging experience and notification cultures. As the HCI community continues to explore the nature of the messaging experience, we hope that this study promotes a more deliberate consideration of notifications in MIM design and that MIM notifications continue to be further researched as one of the key elements of social interaction.

7 LIMITATIONS AND FUTURE WORK

This study explored the experience of conversation sessions based on a 10-minute interval criterion, and we did not compare them with shorter or longer intervals. Out of 17, 12 participants in our study wanted to experience longer time criteria of 20 to 30 minutes because they wanted greater notification reduction. Therefore, further exploration using different length criteria would be valuable. Also, because our notification design using conversation sessions is just one of many possibilities for modifying notification rules, a variety of other notification designs to change messaging patterns need to be studied further. In terms of data collection, this study only explored the experience in group chats with up to five members. MIM users often engage in group chats with a small number of members, such as family and friends, but sometimes, they engage in very large group chats with dozens of members [14, 21, 31]. In the case of extremely large group chats, we suggest that it is necessary to further explore which messaging pattern the notification change would lead to. In addition, we developed apps on iOS only because of the development resources. We could not find empirical differences between experiences with HelloBye and existing MIM on the Android OS, which is worth exploring.

8 CONCLUSION

We reported a trial of a new notification design in MIM. We developed an MIM app, HelloBye, which provides one notification per conversation session rather than per message. This rule was designed to be shared between both senders and recipients. We provided the quantifiable results of the log data of 20,957 messages collected through a two-week field trial and five themes determined through the qualitative analysis of interview data from 17 participants. We reported the participants' changes in messaging experiences according to the five conversation phases: less crowded notifications, carefully starting a new conversation, shorter and faster messaging, letting the conversation end, and improved accessibility of past conversations. We also highlighted how notifications can play an important role in shaping the social interactions of MIM users. We believe that these findings will enhance the understanding of notifications and offer support in further expanding the role of notifications.

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