

Northumbria Research Link

Citation: Podlubny, Martin, Rooksby, John, Rost, Mattias and Chalmers, Matthew (2017) Synchronous Text Messaging. Proceedings of the ACM on Human-Computer Interaction, 1 (CSCW). p. 86. ISSN 2573-0142

Published by: Association for Computing Machinery

URL: <https://doi.org/10.1145/3134721> <<https://doi.org/10.1145/3134721>>

This version was downloaded from Northumbria Research Link:
<http://nrl.northumbria.ac.uk/id/eprint/33627/>

Northumbria University has developed Northumbria Research Link (NRL) to enable users to access the University's research output. Copyright © and moral rights for items on NRL are retained by the individual author(s) and/or other copyright owners. Single copies of full items can be reproduced, displayed or performed, and given to third parties in any format or medium for personal research or study, educational, or not-for-profit purposes without prior permission or charge, provided the authors, title and full bibliographic details are given, as well as a hyperlink and/or URL to the original metadata page. The content must not be changed in any way. Full items must not be sold commercially in any format or medium without formal permission of the copyright holder. The full policy is available online: <http://nrl.northumbria.ac.uk/policies.html>

This document may differ from the final, published version of the research and has been made available online in accordance with publisher policies. To read and/or cite from the published version of the research, please visit the publisher's website (a subscription may be required.)

Synchronous Text Messaging: A Field Trial of Curtains Messenger

MARTIN PODLUBNY, JOHN ROOKSBY, MATTIAS ROST, and MATTHEW CHALMERS,
University of Glasgow, UK

We have created and evaluated a novel mobile messaging app named Curtains Messenger. The app has been designed to support synchrony in messaging. It does this by requiring users to be in the app at the same time as each other in order to send, receive and read messages. This design is contrary to typical apps where messages can be sent and read asynchronously at an individual's convenience. We have conducted a field trial in which 15 users installed the app on their own devices and used it in the wild. We present a qualitative analysis of interviews with the participants following the trial. The findings address how the app was used, how synchrony affected conversational flows, how synchrony raised issues of attention and intimacy, and what issues users faced in the practical work of conducting synchronous messaging. This work demonstrates how core concepts in the study of cooperative work such as a/synchrony can be drawn upon to reconsider taken-for-granted design features of mobile applications and the lived experience of communication.

CCS Concepts: • **Human-centered computing** → **Interaction design theory, concepts and paradigms**; *Empirical studies in collaborative and social computing*;

Additional Key Words and Phrases: Counterfunctional design; Field trial; Mobile app; Text messaging; Mobile instant messaging

ACM Reference Format:

Martin Podlubny, John Rooksby, Mattias Rost, and Matthew Chalmers. 2017. Synchronous Text Messaging: A Field Trial of Curtains Messenger. *Proc. ACM Hum.-Comput. Interact.* 1, 2, Article 86 (November 2017), 20 pages. <https://doi.org/10.1145/3134721>

1 INTRODUCTION

Text messaging has long been a popular way to communicate [10, 39, 47]. Over the last decade, mobile instant messaging (MIM) apps such as WhatsApp, WeChat, KaKaoTalk, and Facebook Messenger have begun to overtake older technologies such as SMS, MMS and i-mode based systems [35]. Unlike a telephone call, users of messaging apps are not expected to be in the system together at the same time. Messages can be sent and read at any time and so conversations can, for better or worse, become drawn out and interspersed among other activities and conversations. Mobile instant messaging need not be done asynchronously. Yet asynchronous communication is supported by every app we are aware of, and is typically seen as the default style of communication [4, 13, 51].

Asynchrony is often seen as an advantage in mobile messaging [16, 22, 30]. According to Baym [4] "*we can place fewer demands on other's time by leaving asynchronous messages*" and it "*gives people time to manage their self presentations more strategically*". According to Turkle [48] however, asynchronous messaging is costly to our relationships; we "*subscribe to a new etiquette, claiming the need for efficiency in a realm where efficiency is costly*." Either way, it is apparent that interesting issues associated with human interaction, emotion and intimacy are entangled with asynchrony.

Authors' address: Martin Podlubny; John Rooksby; Mattias Rost; Matthew Chalmers,
University of Glasgow, School of Computing Science, Sir Alwyn Williams Building, Glasgow, G12 8RZ, UK, [firstname.lastname]@glasgow.ac.uk.

© 2017 Copyright held by the owner/author(s). Publication rights licensed to Association for Computing Machinery. This is the author's version of the work. It is posted here for your personal use. Not for redistribution. The definitive Version of Record was published in *Proc. ACM Hum.-Comput. Interact.*, <https://doi.org/10.1145/3134721>.

To explore these issues, we have created a novel messaging app that follows one of Gaver et al.'s [15] research-by-design strategies: "*block expected functionality to comment on familiar products*".

We have taken a research through design [14] approach to ask what happens if synchrony is enforced in a mobile messaging app. Our approach is exploratory, our question being: what if in order to communicate, two people have to be reading and writing together as if they were in a voice call? To address this question, we present Curtains Messenger, a novel mobile messaging application that enforces synchronous messaging. While other messaging apps can be used in a synchronous way, Curtains Messenger gives the users no choice but to both be there at the same time. Our aim has not been to produce something that is convenient or meets consumer demand, but instead to use a counterfunctional design [38] approach for critically exploring (a)synchrony in computer mediated communication.

Curtains Messenger has been released for iOS and Android. We have recruited 15 people to use Curtains Messenger in the wild on their own devices and have interviewed them about their experiences with the app. This paper presents an in depth analysis of the interviews, and from this contributes insight into how design choices underlying mobile messaging technology can influence human communication in both practical and emotional ways.

2 BACKGROUND

SMS was originally seen as a limited technology with niche potential [47]. Uptake was slow at first, but by the millennium text messaging had exploded in popularity [16, 39]. Several studies of text messaging have explored why, despite technical limitations such as small screens, difficult input and short character limits, this popularity came about [22, 30]. Farman [13] has argued that with the rise of the mobile phone, people became contactable "*irrespective of location, activity and availability*". Thus (synchronous) telephone calls could be intrusive on everyday life but (asynchronous) text messaging far less so. A study by Grinter & Eldridge [17] made a similar argument, but also pointed to other factors: the convenience of not needing to enter into long conversations, and the low and predictable cost of messaging. In addition, Lasen [27] has pointed to the relative privacy afforded by text messaging when in settings such as the family home.

From the above, we see that asynchrony is one of several reasons given for the growth of popularity in messaging. It should not be taken for granted that asynchrony is of fundamental importance.

2.1 Convergence of Instant Messaging and Text Messaging

The rise of Internet connected smartphones has seen a convergence of instant messaging technology and SMS messaging. In the early/mid 2000s, Grinter et al. [18, 19] characterised instant messaging as a computer-based activity and SMS as mobile phone based, but noted that the reasons for uptake of these technologies were very similar. Several years later, apps such as WhatsApp and Facebook Messenger bridged this divide. Church & Oliveira [9] have described and explored the differences between WhatsApp and SMS, pointing out that WhatsApp has no direct cost of use, enables easy sharing of images, video, audio and location based messages and that it provides additional social information such as when someone is typing, whether messages have been received and when someone was last online. They also find differing practices with WhatsApp, that messages are exchanged more often, are more conversational in nature, are used to communicate within closer social circles and are used more often for group-based communication. Studies of WhatsApp and other mobile instant messengers [7, 24, 25, 29, 32, 34, 37, 50, 54] point to an always connected, always on style of communication where asynchronous interactions pervade day-to-day lives to produce "*a particular way of being together ... that is casual and never-ending*" [36].

The relationship between mobile messaging and voice/video calling has also shifted over time. Many messaging apps now incorporate the ability to send voice and video messages and to talk in real time (e.g. in WeChat, voice messaging has become very popular [51]). Asynchronous video messengers have also been launched [40]. Video call services such as Skype also incorporate instant messaging. Originally, Skype desktop clients required both parties to be online when using text chat, but this is no longer the case and their mobile apps are unlike the app we describe in this paper. Overall, the lines between synchronous and asynchronous technologies are have become blurred, and few technologies these days are as strongly synchronous as the telephone once was.

2.2 Studies of Everyday Messaging

Almost twenty years ago, Grinter & Elridge [16] found that many SMS conversations were typically short sequences or single turns, and that texting is often embedded into other everyday social activities and communication practices. More recently, Battestini et al. [3] have found much higher usage rates (possibly because of the low cost and ease-of-use of modern messaging apps [9]). They found that people communicate with large numbers of contacts over extended periods and engage in simultaneous conversations with up to nine people. They found that conversations are common (defining these as exchanges that take place with less than 20 minutes between turns). Battestini et al. [3] found the most common topics and functions of conversations in text messaging are planning, maintaining relationships, chatting, or school/work related.

Taylor et al. [46] recognize the importance of using messaging to maintain relationships, discussing the exchange of SMS messages as gifting rituals. Their argument is that new technology gives new means for people to engage in age-old social rituals. In a more recent study of people's use of WhatsApp, O'Hara et al. [36] argue that in sharing "*the pointless chit-chat, the garbling of asides, the jokes, and the non-sequiters*", people make and display ongoing intimacy with friends and relatives. Kim & Lim [24] and Wang et al. [51] point out that this kind of everyday "*dwelling*" occurs across other messaging apps, and is performed in ways that are tailored for different forms of relationship. Similarly, Harper [20] discusses the playful ways in which many kinds of communication technology are used within social and romantic relationships.

O'Hara et al. [36] give a positive view on the influence of asynchronous messaging technology on everyday intimacy. Turkle [48], on the other hand, views it as destructive, arguing asynchronous messaging provides only an illusion of intimacy. As Farman [13] points out, we should not assume that asynchronous communication fosters face-to-face talk but recognize it becomes a primary mode of engagement. Others point to problems of overload, for example an abundance of mobile notifications [9] and attention demands at disruptive and inconvenient times [1, 8]. Vaterlaus et al. [49] point to a negative emotional impact of messaging, such as the promotion of jealousy.

2.3 Field Trials of Novel Messaging Technology

Most studies of mobile messaging have looked at the use of commercially available technology, often critically examining how and why new technologies are used. A smaller but nevertheless important body of work also exists in which novel messaging technology is created and trialed. Early examples include Mitsuoka et al.'s [33] trial of a chat and awareness messenger, and Issacs et al.'s [23] workplace messenger for Pocket PCs.

More recent trials of mobile messenger applications include Fagerberg et al.'s [12] creation of an 'emotional messenger', Rost et al.'s [44] creation of an ephemeral text messaging app, Xu et al.'s [53] creation of a message requesting app, Bentley & Peesapati's [5] app that interlinked search and messaging, Barkhuus et al.'s [2] app for location sharing, Rooksby et al.'s [43] incorporation of messaging and activity tracking into a turn taking app, and Hassib et al.'s [21] integration of

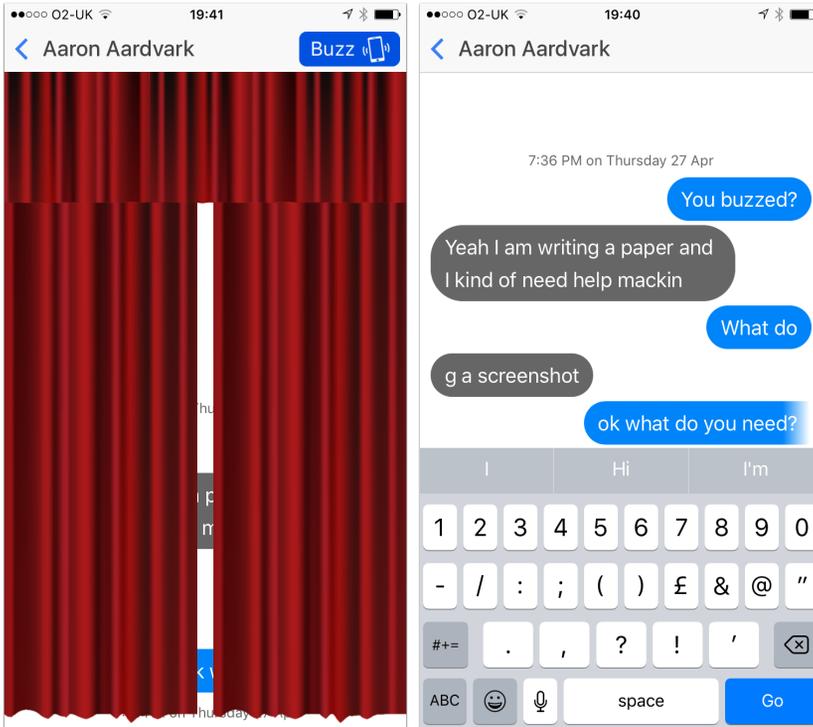


Fig. 1. Curtains Messenger Screenshots. Left: the conversation screen with the curtains closed (because only person A is in the app). Right: the conversation screen with curtains open (because both people are in the app).

biometrics. While these studies demonstrate a great deal of innovation, design for asynchrony pervades this body of work.

3 APPROACH

We have created and evaluated a novel messaging application. The artifact we have created is not intended to solve a specific problem or to offer improvements over existing messaging application, but is a means of exploring concepts.

Our approach can be characterized as counterfunctional design. Drawing upon Pierce and Paulos' concept of counterfunctional design [38], we have deliberately restricted taken for granted functionality in order to reveal aspects of everyday interaction by problematizing them. The novelty of the work we present is not that it enables synchrony, but that it does this by restricting asynchrony. In order to do this we had to carefully design the app in order for it to be feasible for people to use. Following Laseau's design funnel [26], we moved from broad ideas about what synchronous mobile messaging might be, and narrowed these down (via sketching, brainstorming, and prototyping) to a single concept that could realistically be implemented on existing mobile platforms.

To evaluate the work, we have used a field trial. Following Brown et al. [6], we have invited people to install the app on their own devices and use it during their day-to-day lives. We did not mandate sole use of this messaging app, but encouraged participants to use the app enough

Table 1. Comparison of Curtains Messenger and WhatsApp

	Curtains Messenger	WhatsApp
Message types	Text only	Multimedia
Group messages	No	Yes
Synchronous transmission	Keystrokes in real time.	Indicator other person is online.
Turn taking	New turn interrupts other message.	Messages ordered as sent.
Ability to compose and receive messages	Not possible unless both people in same conversation in app.	Messages can be written, received and viewed at any time.
Message history	Messages stored but not viewable unless both people in app.	Messages stored and viewable at any time.
Notifications	Buzz button notifies desire to start conversation	Notification when message received
Platforms	Android and iOS	Smartphone (multiple) and web.
User base	<100	>1 billion

to be able to comment upon the design through experience. We have individually interviewed trial participants about their use of the app and their opinions on synchronous messaging. The interviews were semi-structured, and we used a framework approach [41, 52] for analysis. We also logged data from participants during their use of the app to a server and have used this to describe their use of the app and to supplement the qualitative analysis.

This paper is primarily concerned with qualitative findings from the interviews. By analyzing interviews with field trial participants we have been able to unpack issues relating to the practical and emotional work of mobile messaging.

4 CURTAINS MESSENGER

Curtains Messenger (figure 1) is a mobile messaging app released for Android and iOS devices. The app resembles other text messaging apps but is designed to enforce synchronous communication between users. A central design feature, and the reason for naming the app Curtains Messenger, is a pair of stage curtains that obscure the conversation area of the app. The curtains are closed unless both conversation partners are in the conversation at the same time. Key differences between Curtains Messenger and WhatsApp are given in table 1.

4.1 Functionality

Curtains Messenger allows users to send and receive messages with others they are connected to. The app uses Facebook to manage user identity and to manage connections. When a user first installs the app, they must use a Facebook account to log in and they are able to invite other Facebook friends or connect to friends with the app already installed.

4.1.1 Reading and Writing Messages. The messaging feature of the app has similarities with MIM style applications. Messages sent between two users appear within bubbles in a conversation screen. However there are several novel features in Curtains Messenger:

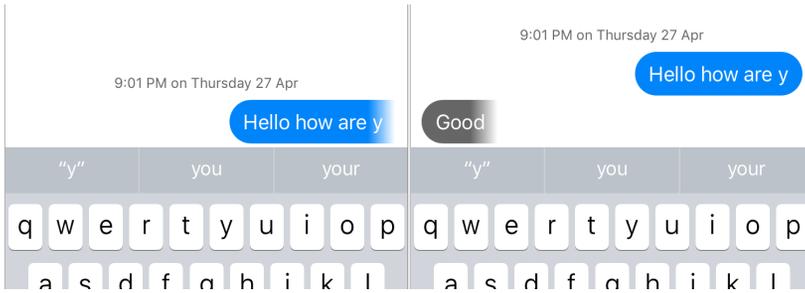


Fig. 2. Synchronous conversation - interruption. Left: Person A is typing. Right: Person B interrupts, which finishes person A's speech bubble and creates a new speech bubble for person B.

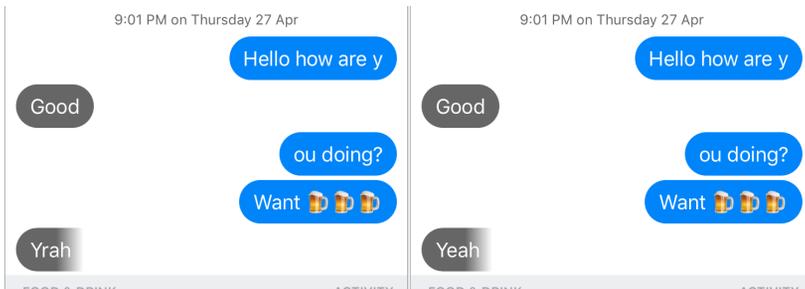


Fig. 3. Synchronous conversation - corrected typo. Left: Person B makes typo. Right: Person B corrects typo (only possible in an unfinished speech bubble).

Firstly, a pair of curtains obscures the conversation if only one conversation partner is in the conversation at that moment (see figure 1). The use of curtains was chosen as these provide a clear metaphor for the functionality of the app: conversations 'open' and 'close'. Curtains also potentially evoke other interesting factors such as 'performance', 'intimacy' and 'privacy'. We chose to leave a small gap between the curtains allowing a glimpse of the conversation, in order to make their purpose very clear.

Secondly, any typing by the user appears in the conversation area in real time. Whereas most MIM applications have a message editing area that is separate to the speech bubbles in which the sent messages appear, in Curtains Messenger any typing appears directly in the bubble (figure 2). The bubble remains editable, meaning that more text can be added or existing text edited (figure 3), until the sender presses the enter button or their conversation partner starts writing. If both people try to message at the same time, a new character from either user will activate a new message bubble. To provide a static visual cue for the users that a message is being typed, the most recent message that the author is still potentially expanding will have one edge blurred (the edge on the right-hand side where more letters are added as they are typed). The design then makes it obvious, that only the latest message, regardless of who is its author, can be appended. As soon as that message is interrupted, its blurred edge becomes solid and rounded off indicating to the user that the message is done.

4.1.2 Starting and Ending a Conversation. A conversation starts when both users are in a conversation and the curtains open. In order to make it feasible for users to get into a conversation a



Fig. 4. Buzzer. Left: Buzz button, Right: Notification that someone is buzzing you.

user can notify another user by pressing the 'buzz' button (figure 4). Pressing the button repeatedly will send repeated notifications.

Conversations end when one of the users leaves the conversation view. As soon as a user leaves, the curtains close for the other user. Leaving might be done by pressing the leave button, exiting the app (e.g. by pressing the home button), or putting the phone to sleep (e.g. by pressing the power button). If an Internet connection is lost, the user is also considered to have left the app and the curtains are closed. When the curtains close, a banner message will state whether this is a result of connectivity issues or the partner purposefully leaving the conversation.

4.2 Implementation

Curtrains Messenger was implemented specifically for this project. The client was developed using Cordova, and the server backend using Node.js. Websockets were used for the real time messaging using Socket.io. The server maintains the state of the conversation, and each keystroke on a client is sent as an event that causes the state the change and is further propagated to both clients of the conversation as a state change. A custom database was implemented to support this. The buzz feature is implemented by sending push notifications using Google's Firebase service.

To determine whether both users were present in the conversation view, the client sends an event whenever the user leaves the conversation view, closes the app, or puts the phone to sleep. In order to handle other cases, such as network connectivity issues, the server pings the clients and a timeout is used to determine if the user is present or not.

The app has been released for Android on Google Play, and for iOS on the Apple App Store. We tested the app internally to make sure network latency and connectivity issues were handled smoothly, which they were.

5 FIELD TRIAL

We recruited fifteen participants aged 18-25 to use the application for approximately ten days. We targeted teens and young adults on the premise that they were likely to regularly use messaging applications with broad social circles. We targeted existing social groups via a snowballing approach. Six participants were working together (five on an almost daily basis), three were teammates of the same sports team, and six were close friends (three were living together). Twelve participants were students and three were in full time employment. Four were partners (two couples) in romantic relationships. All participants were resident in the same UK city, but they had varied nationalities. English was the first language for about half of the participants. Participants are described in table 2.

In an introductory meeting, each participant was given information about the study and asked for consent to participate. They were then asked to download the app to their own device. Participants were invited to use the app as much or as little as they wished. They could use it to connect and converse with others whether or not they were participants in the study. The participants were able to message people outside of the trial as usual using other apps (therefore they did not have to make all of their contacts install Curtrains Messenger as well). In principle, the participants were free to

Table 2. Overview of participants

	Device	Gender	Circle ^a
P1	Android	M	Sports team
P2	iOS	F	Co-workers
P3	Android	M	Co-workers
P4	Android	M	Sports team
P5	Android	F	Friends
P6	iOS	M	Sports team
P7	Android	M	Co-workers
P8	iOS	M	Co-workers
P9	Android	M	Friends
P10	Android	F	Friends
P11	Android	M	Friends
P12	Android	F	Friends
P13	iOS	M	Co-workers
P14	iOS	F	Friends
P15	iOS	F	Co-workers

^aCircle' gives a simple, single category for each participant's social circle. In reality, participants' identities and relationships were multiple and complex.

use other apps to message each other as well; the use of Curtains Messenger was not mandated. Our approach is in keeping with an exploratory, in the wild evaluations, and was not intended to be a controlled experiment or intervention. Given the counterfunctional (and thus potentially frustrating) nature of the app we opted for a relatively short trial period rather than aim to track use over the long term.

5.1 Data Collection and Analysis

Two forms of data were collected for this study, log data from the app, and qualitative interview data. The main focus of this paper is on the interview data, the log data is treated as supplementary to this.

The post-trial interview was semi-structured using open-ended questions. Each interview was audio recorded and transcribed. A framework approach [41, 52] was used for data analysis. This approach allows interview data to be combined with user log data. The findings in this paper represent 'analytic themes' drawn from the across the frame.

The log data was generated by users' interactions with the app, including events such as opening and closing the app, buzzing others and starting and stopping conversations. No actual conversation data was collected for our research, and participants were told that their conversations in the app would not be accessed by us (on the grounds that we wanted participants to communicate 'naturally', and that they would not necessarily communicate just with other participants).

Consent for logging is gained in-app (following [42]), and informed consent for the trial participants was further gained in a face-to-face setting. Privacy settings in the app allow logging to be turned off.

Table 3. Participants' engagement with Curtains Messenger

	Conv. ^a	Median ^b	Sent (fin) ^c	Contacted
P1	5	67s	25 (9)	P6 (+2 others)
P2	-	-	-	P7, P8 (+7 others)
P3	9	62s	52 (1)	P7, P8 (+4 others)
P4	12	141s	69 (37)	P7, P15 (+5 others)
P5	6	36s	10 (3)	No participants (+4 others)
P6	5	57s	28 (15)	P1 (+3 others)
P7	15	52s	28 (21)	P2, P3, P8, P15 (+4 others)
P8	22	59.5s	50 (45)	P2, P7, P13 (+6 others)
P9	36	14.5s	151 (69)	P10, P11, P12, P14 (+1 other)
P10	37	19s	153 (23)	P9, P11, P12, P14
P11	30	14s	73 (38)	P9, P10, P12, P14 (+7 others)
P12	48	20s	205 (46)	P9, P10, P11, P14
P13	-	-	-	P2
P14	74	19s	289 (129)	P9, P10, P11, P12 (+3 others)
P15	13	38s	128 (47)	P3, P7, (+4 others)

Source: The data in this table is taken from the log data collected from Curtains Messenger. There was some missing data for P2 and P13.

^aNumber of conversation sessions, defined by Curtains Open event

^bMedian length of conversation session in seconds

^cTotal number of sent messages in all conversations, and number of 'finished' messages where the user had tapped enter after typing a message.

6 FINDINGS

"I am so used to sending messages to people whether they are there or not ... having someone buzz you and say come and talk to me, it reminded me of being a kid." P14

Our intention in this paper is to explore participants' usage of and opinions on Curtains Messenger. As P14 confirms above, this app is contrary to the kinds of messaging app people typically use and leads them to a situation where they are "a kid" or novice again with communication technology.

In this section we will begin with basic exploration of how the app was used during the trial, participants' reported styles of use, and how synchronous conversations flowed. We will then focus on practical, emotional, and moral issues associated with attention and conduct in Curtains Messenger.

6.1 User Engagement

We invited the trial participants to use Curtains Messenger on their own devices as part of their everyday lives. We did not set tasks or minimum usage levels, but wanted the participants to use the app autonomously in a way that made sense for them. All participants attended the final interview. Data collection for P2 and P13 was unreliable (the result of a misconfiguration for P2 and a possible bug or configuration issue for P13). These participants have been included in the analysis because of our emphasis on interview data, and because their interaction with others can be partially reconstructed from the other's data. A summary of the log data can be found in table 3.

6.1.1 Attitudes. All fifteen trial participants were positive about the app and their participation in the trial. P8 said *"I really liked it"* and P3 found it *"a pretty solid, interesting app, more unique than*

any others". The most critical participant was P9 who found the app "annoying". However, P9 seems to have taken some pleasure in playing with the app: "*The buzzing feature we enjoyed, we used it to annoy each other, just to get attention*".

6.1.2 Level of Use. Our log data shows that on average, each participant used the app on six unique days (SD 3.5) over the trial period, often multiple times each day. There were a total of 312 conversations (defined by a curtains-open log event) during the trial period involving at least one participant. Participants sent a total of 1306 messages (of which 483 were 'finished' messages, where the user had pressed enter to round off a speech bubble).

Participants contacted an average of 6 other people with the app (SD 2.7). We made no effort to introduce participants to each other, and did not oblige participants to contact each other. Participants did not necessarily go out of their way to speak to each other. In the words of P1:

"I've texted with P6. I haven't texted P4 even though I know he has it as well." P1

The participants mainly reported using the app to contact people they ordinarily message. For example P3 reported mainly messaging his partner (also a participant) who was:

"Probably the most active person I message anyway." P3

Most participants contacted people outside of the study; typically friends, teammates and family. For example P14 invited:

"my mom ... I just basically told her that I will have this interview and she just got curious, so she downloaded it as well." P14

6.1.3 Contexts of Use. Time and place of use appears to have been contingent upon the circumstances of the participants. Several participants reported using it while out and about, for example P3 stated:

"If I was out walking somewhere, to uni, or in the shop, or in the gym, that's when I most used it, I most chose it over other apps." P3

However, for P1, using it in this way was not an option. For financial reasons he does not use mobile data and so relies upon WiFi. Others discussed using the app at home, sometimes with other users co-present:

"Often instead of shouting at each other we were buzzing each other." P9

One of the working participants said the app was impossible to use while at work:

"I think every single conversation I wasn't able to finish that I tried to do at work." P11

Similarly P9 stated:

"I don't have time to chat during the working day." P9

All participants used messaging apps in their day-to-day lives (some just occasionally, but one for "*maybe even two hours a day*" P14). Facebook and WhatsApp were reported as being most frequently used, mostly on the grounds that these were what others also used. The participants continued to use other messaging apps during the trial, but showed a high degree of willingness to use and encourage others to try Curtains Messenger.

6.1.4 Styles of Use. Based upon participants self reports of conversations, we have identified four styles in which the app was used. Most participants used the app for more than one of these. Given the relatively short duration of the study, these styles should not be seen as mature or fixed.

The first style of use was participatory messaging where the app was used for project purposes. None of the participants felt they needed a new messaging app; they were using the app purely in order to participate in this study. However, most found that the app was useable for real-world purposes and over time, use of the app became more natural:

"First two days were because of the study, but then I kind of liked it, so I just continued using it." P8

The second style was casual messaging. Several participants discussed using the app for sending causal, friendly messages. P5 talked about using the app for "*random life*" and "*casual conversations*". P9 used the app for "*casual stuff*". P11 described how casual messaging grew organically from participatory messaging:

"At first it was just to use Curtains, we literally talked about the app, why we like it and why we dislike it, then I started talking to some of my friends what we would normally talk about which is just what have they been up to during the day or something interesting, or stuff like that." P11

The third style was transactional messaging where the app was used to gain a response to a question or request. This style of messaging was said by several participants to be best supported by the app. In the words of P1:

"The way Curtains works, it ensures that the other person is there and has received the information." P1

One example of this from P4 has similarities to casual messaging:

"We are going on a trip this summer - so we spoke about that. Trying to organise times, sit down and plan it out." P4

Other examples were far less casual. For example, P5 and P7 spoke about the value of transactional messaging:

"I really needed a document to be sent out to me, and it was kind of an emergency situation, and I messaged the person who had the document on Curtains just to make sure that they saw my message and they are going to send me the document." P5

"I was trying to get in contact with a committee member of mine who has a tendency of just reading stuff and leaving it, and therefore I found that Curtains is quite a good app for that. If you manage to get them Curtains, then they don't really have much of a choice of not answering." P7

The fourth and final style we identified was playful messaging. We found that participants were sometimes using the app to tease and "*annoy*" (P9) each other:

"I really enjoyed annoying people with buzzing them. That's my favourite thing... I buzzed them and then I left, and then I buzzed them and then I left, and I did it like seventeen times." P12

This is probably not something participants would enjoy over the long term. As P4 explained of playful buzzing: "*It was funny the first couple of times*". When it came to actually writing messages, P12 and P10 used the app to write "*hilarious horrible things*" to each other. P11 said:

"Seeing what you type and what the other person types is absolutely amazing, it makes for fun conversations". P11

The four styles show the app had flexibility in use and that while the trial did influence behaviour it did not determine it. The styles here do not represent the range of messaging activities reported by Battestini et al. [3] and others (see section 2.2), but show the app is usable for being casual and playful as well as for more serious transactional tasks.

6.2 The Flow of Conversations

Conversational flows were reported to differ in Curtains to other apps. P12 explained that she commonly engages in something she called "*multi-texting*", holding multiple conversations with multiple people:

"On [Facebook] Messenger, you know that the person can be writing with other people at the same time. But the good thing is that you can just write them like a trillion messages and when they come back they will just find them." P12

P6 and P13 explained that messages are not always acted on immediately, and sometimes never at all:

"I am pretty bad for replying to people, I would usually read a message and if I am busy put the phone away and go back to it whenever I can." P6

"With [Facebook] Messenger ... people would write something, then they would do something else for maybe 4-5 minutes, and then they would return to it" P13

Curtains Messenger constrains people's ability to engage in conversations in these ways; it "*kind of takes that away*" (P9). Participants would often refer to conversations in Curtains being more focused or articulated. In Curtains Messenger:

"You have your conversation, and then you both leave at the same time." P13

P15, talking about using the app with her boyfriend, discussed the effect of moving to articulated conversations:

"He said I bugged him less, because I couldn't leave him messages while he's not there, I would send less messages. So we would talk less frequently, but get our point across more quickly. So rather than sending maybe 10 messages throughout the day with bits of information in them, we would just have one conversation with straight to the point information. And less chit-chat, less nonsense talk." P15

Synchronous conversations thus are more of an articulated unit, both temporally and interpersonally. Synchronous conversations flow between two people within a specific period of time, whereas asynchronous conversations flow across time and are interspersed with other activities.

6.3 Attention

Participants had much to say about how using Curtains Messenger requires both parties to pay attention to each other and what is being written. As P8 put it:

"The fact that the app makes you wait until the other person finishes is kind of making you actually read and think what they wrote, not just skim through it." P8

Participants all talked about a heightened sense of the other when messaging, that their conversational partner gives attention:

"You know that like all their attention is just on you and on your dialogue." P2

"You know that the other person is actually dedicating time for speaking with you and messaging with you." P7

This paying of attention went hand in hand with the articulated flow of conversations. For the time during which a conversation happens, you know that the others' attention is on you:

"You know that the person is there and looking, and that your messages are not sitting on the screen somewhere." P15

"The other person had to pay their whole attention to me when we were communicating, so they were more focused on the conversation." P14

P8 was positive about synchronous conversations, feeling that they can actually make people more considerate and respectful:

"I would say you are more considerate to the other person, because you actually respect that they are writing, which I don't feel in other apps at all." P8

However, not everything said about attention in synchronous messaging was positive. Firstly, it is an effort to give attention. P13 jokingly pointed out that it's far nicer to receive than to give attention. P7 actually found that he didn't always have the necessary time to dedicate to others, especially while working:

"In some cases it is an advantage in which you know that the other person is actually dedicating time for speaking with you and messaging with you. In others, you sometimes don't actually have time to dedicate, and you can only just literally pick it up and answer and then continue doing something else, which would not work with this" P7

P3 on the other hand didn't like reading messages as they were written because he felt keeping the app open was adverse for his battery life. P4 talked about the problem of keeping the app open and in use while out walking:

"If I am walking to work or whatever, I'll send a message and then close it. But because we both have to be there, I would have to send the message and then keep it open, so that he can type back and stuff like that". P4

P13 pointed out that there is an issue of manners, that you risk being rude by leaving a conversation:

"This app in itself probably does make you stay until the conversation is finished, unless you want to be rude, you are going to stay until it's finished" P13

Another problematic issue associated with attention is that it can become coupled with obligation. When asked something in Curtains Messenger, participants felt there was "no choice" but to respond:

"If you don't want to answer a question you can't really avoid it. ... you have to have read it." P7

We see then how reading and the sense of being read changes in synchronous conversation. Reading and writing becomes paired and mutually collaborative. Presence can be positive, but can also present practical issues of interweaving conversation with life and with handling digital devices. We also see that with presence comes a need for manners and the possibility of obligation.

6.4 Privacy and Intimacy

We thought that the curtains metaphor would evoke feelings of privacy, but most participants either rejected this notion or were indifferent to it when asked. Instead, participants talked about how intimate it was to be present in the app at the same time and to be reading and writing together. *"It's just more personal"* (P6). In some respects this mutual attention was found pleasurable:

"It's very nice to feel the presence of the person." P12

"It was nice to know that they are there." P13

Some participants went further, to equate writing with thinking:

"You can really see what they are thinking." P5

"It feels like you are reading their thoughts ... like you are reading what they are thinking of saying, but not actually sending, which makes the conversation more personal. At least, it made it feel like that to me." P11

"There were moments when somebody was typing something, and I could see what they are thinking, and then they deleted it, and then they sort of retype it in a different way."

P2

P12 claimed that being able to see people write "*makes them look more human*". More reflexively, P4 said about himself:

"Probably it's an eye opener to see what my original thoughts are before I have time to edit them." P4

Some participants saw a negative side to this, particularly in terms of managing the presentation of self. For P1, there was a language issue. He claimed that native speakers of English do not need to worry as much about spelling and grammar as he has to. P5 said she was sometimes "*a bit panicking*" about others seeing her "*typos in real time*". P8 however was more indifferent:

"I realised that there is nothing to worry about - it's more grammar that I change, which I don't think is a big deal. I don't know. I think it's funny. It's not better or worse, it's just funny." P8

Conversations in the app were intimate in that one has access to the production of messages rather than the completed version. One therefore has no opportunity to do what Ling [30] refers to as 'arrange face', which can be both "*interesting*" but also stressful and "*panicking*".

6.5 Conducting Conversation

Several participants spoke about how conversation in the app was more like "*normal*" or "*natural*" conversation, meaning that messaging was conducted as if it were a phone call or face-to-face conversation:

"It's more like a normal conversation, because really the only difference is that you are typing what you want to say and not saying it out loud." P8

All participants spoke in one way or another about features of conversation. Firstly, participants universally reported having to learn how to take conversational turns, as opposed to fire messages at each other:

"In the beginning we need to find out a way of how we would talk, because once you're in the app and the other persons in the app you start messaging each other, hence you start interrupting each other, hence it just its, it's a big pile of gibberish and you can't read anything." P2

"Eventually, after a while, you do get into the rhythm of letting the other person finish and then you can finish as well." P13

Turn taking remained somewhat problematic in Curtains Messenger. Some participants developed signaling tactics such as pressing enter at the end of a turn. Most participants said however that the most effective strategy was to use pauses to identify turn relevant positions.

Beginning a conversation was, unsurprisingly, a problematic aspect of the app. Many participants experienced a lot of back and forth with buzzing, and "*waiting at the curtain*". Sometimes the effort of getting into a conversation far outweighed the value of the conversation. For example P4 said it was

"...annoying to have to sit and buzz him 2-3 times to ask that one question." P4

As with telephone calls [45], participants also reported feeling that the person buzzing should have a reason for doing so, and that they would have the first turn:

"If someone buzzed me, I would expect that they had something to say to me." P6

"There is always one person who is initiating the conversation so I would assume that they have something to say, so I would wait for them, or if I was the one then I would expect the other person to wait for me." P13

There can also be some difficulty and even anxiety in contacting someone. As P12 said, "*you never know what the other person is doing*".

Conversations in Curtains Messenger also had to be brought to a close. Simply leaving the app could be perceived as "*rude*" (P6). If someone were to just leave:

"It felt like I was talking to someone, and they just leave the room and shut the door." P5

"I got a bit offended." P7

Unlike in other apps, signals need to be given to end the conversation.

"I feel more comfortable making clear that I am leaving because it's a little bit dramatic when the curtains close and the person is gone, rather than on [Facebook] Messenger when it says that the other person has just gone offline or they were last seen at whatever time, like on WhatsApp." P15

"It does sort of, the way it closes, creates more of a need to tell the person that you are going. More so than in something like Facebook which is quite easy to just forget and come back to it two hours later." P3

One of the problems here is that sometimes participants would lose connection, their screen would sleep, they would need to open another app such as a calendar, or they would receive a phone call - causing the curtains to close. Participants reported waiting at the curtain after an abrupt closure in order to resume or finish conversations, something that "*felt awkward*" (P6).

In summary, in the switch from "*multi-texting*" (P12) to the articulated flow of synchronous conversations it becomes necessary to put more effort into managing how conversation happens. One must do more work to open a conversation, and more work to bring it to a satisfactory close. The actual conduct of turns had to become disciplined. Participants overtly drew upon the normative order of spoken conversation in order to achieve this.

7 DISCUSSION

With Curtains Messenger, we sought to create an app that would spur reflection on issues relating to a/synchrony in mobile messaging. Following Pierce & Paulos [38], we took a counterfunctional approach to the design of Curtains Messenger. Given this approach, Curtains Messenger was surprisingly well received by the participants. The app proved robust enough for use in everyday life and meaningful enough to invite and engage with others beyond the trial. We found that participants did not use the app just in a way to familiarize themselves with it for the purpose of the trial, but for casually and playfully interacting or engaging in more organizational and transactional conversations. That this happened is encouraging for the validity of our findings, and underscores the feasibility and value of field trials for exploratory research. Moreover it is interesting that irrespectively of the particulars of synchronous and asynchronous conversation, human interaction happens anyway: social life is remarkably robust.

From this study, it is apparent that the design of messaging applications has implications for what Harper [20] calls the "*texture*" of conversation, the particulars of how conversation is done and how it felt. Below we will discuss what synchronous messaging reveals about the practical demands on users in mobile messaging, and the relationship between design and emotion.

7.1 The Demands of Synchronous Messaging

Requiring users to both be present in order to hold a conversation in Curtains Messenger created extra practical demands for them. Firstly, there was extra effort required in initiating a conversation, with one person having to get the attention of another by 'buzzing' them and typically then waiting at the curtain for it to open. Secondly there were issues in actually conducting the conversation,

with users having to keep the app open for the duration of the conversation and having to wait as the other writes. There were also issues in having to keep the app open during conversations, such as worries about battery life, handling a device when doing activities such as walking, and the inability to switch to another app part way through a conversation. Thirdly there were issues in successfully closing a conversation, with users often having to signal and sometimes justify the end of a conversation. There is a practical dimension to this work with it involving time and effort, but we should note there is also a moral dimension with the app requiring certain forms of behavior in order to avoid rudeness and conversational breakdowns.

As a design implication, we can say that synchronous technology is not ideal in situations where effort by users is to be minimized. Correspondingly, for designing synchronous technology, attention needs to be paid to supporting and minimizing the practical and moral work of initiating, conducting and ending a conversation.

The effort and practicalities of synchronous conversation have an interesting side effect. The design of Curtains Messenger, and the efforts of using it, led to conversations being more articulated. Whereas conversations in asynchronous messaging applications can be spread across time with the reading and writing of messages being interwoven with other activities, synchronous conversations are articulated events that punctuate rather than interweave with other activities. Instead of flowing across time, synchronous conversations are a more cohesive whole, with a beginning, middle and end. In this respect, design choices relating to a/synchrony appear to influence not just the effort required in a conversation but also conversational form.

Our findings align with Baym [4] when she claims asynchronous communication places fewer demands on people's time. It is clear that there are extra demands from Curtains Messenger in terms of the practical effort required to coordinate and conduct a conversation. However the issue is not just that this style of application requires extra time to use, but that it also influences the temporality of conversations across the day. Conversations become more articulated, with periods of conversation and non-conversation.

As a design implication, there is interesting potential here for reducing the extent to which being on-demand in messaging pervades everyday life. Lord et al. [31] call for technology to support communicative "dead time", which to an extent Curtains Messenger does. The fact that users of Curtains could buzz each other at any time and sometimes did so playfully to annoy each other means that the app itself does not fully conform to this idea, but our findings point to the potential of synchronous technology for supporting dead time.

7.2 Synchronous Messaging and Emotion

We noted in the previous section that the work of messaging is not just shaped by practical demands but also moral demands. There is a clear emotional dimension to messaging, and in particular an interesting relationship between a/synchrony and forms of intimacy.

To O'Hara et al. [36] intimacy in mobile messaging is entwined with asynchrony; they address how people maintain relationships via incidental and rolling interaction via mobile messaging over time. Curtains Messenger constrains the possibility for this sort of interaction, and yet participants still spoke about issues relating to intimacy. The kinds of intimacy revealed in our study had far less to do with actively staying in touch, and more to do with making oneself available and engaging in the unguarded production of text. This suggests that forms of intimacy can be supported by both synchronous and asynchronous communication technology.

To Turkle [48], the kind of intimacy O'Hara et al. describe is an illusion. She claims that we "*look to technology for ways to be in relationships and protect ourselves from them at the same time...*". In Turkle's words, synchronous conversation is more "risky" because it enables people to ask more of each other; not necessarily ask more questions, but to ask for more responsiveness, consideration

and/or obligation. She argues that asynchronous messaging also protects us from revealing our slowness, mistakes, and disordered thinking. A telephone call "*can seem fearsome because it reveals too much.*" Similarly to a telephone call, Curtains Messenger reduces a user's ability to "*arrange face*"; there is no opportunity to construct a message away from the other person. The participants in our study were not entirely unhappy with this situation, and while some felt that having someone watch as you type was revealing and stressful, many also found it interesting and enjoyed the intimacy of seeing the others' "*thinking*".

Ling [30] explains of asynchronous communication that the sender does "*does not need to engage the complete attention of the receiver*". Curtains Messenger on the other hand, as a synchronous messenger, requires that users dedicate a period of attention to that conversation. Our work shows that in doing so, one enters into a more overtly emotional and obligation ridden exchange.

In terms of design implications, our work here suggests that instead of designing for speed and convenience in messaging, designers can consider designing for slowness and presence where time is spent reading and writing with others. Synchronous communication enables a kind of intimacy where people let down their guard with each other and spend time in each others presence. This is not always desirable, but designers might consider ways for people to, on occasion, do things like reveal how they construct messages.

7.3 Limitations and Further Work

For this study we have designed and implemented a novel application and trialled it in the wild. In design terms, our work has focused on producing a single artifact rather than exploring multiple alternatives. There are many ways to design a synchronous messaging technology, and further work might explore these with potentially different findings to those in this paper. Curtains Messenger itself also could have been taken further with the inclusion of picture messaging, and potentially with support for group communication.

In terms of the evaluation, the trial has focused on a limited number of participants over a relatively short period of time. Future work may explore if and how the app is used among other demographics, in alternative contexts, and across generations. We chose to trial the app over a relatively short period of time because of the counterfunctional nature of the design, but our work shows that longer-term use of this style of application is feasible.

In our work participants were able to use other mobile messengers alongside Curtains Messenger. This created a situation in which users were able to experience and talk about the difference between synchronous and asynchronous communication. Future work could go further by exploring complete restriction of asynchronous technologies, particularly to explore issues such as support for 'dead time'. Future work could also address how more overt support for synchrony could be integrated into existing messaging platforms.

8 CONCLUSION

In this paper we have gone 'back to basics' with CSCW theory [11, 28] by addressing the distinction between synchronous and asynchronous communication. This distinction, which was fundamental to the 'classic' CSCW matrix, appears to have been losing its descriptive power of late with messaging apps because they enable and blur both forms of interaction. Our work serves as a reminder that this need not be the case, and that by blurring this distinction designers do not necessarily enable the kinds of interaction that are specific to one or another.

Our work has confirmed and elaborated on a range of prior research in CSCW, but also is suggestive of an alternative way of thinking about communication technology. In limiting the opportunity to communicate asynchronously in an app, we have found that interaction takes on some particular qualities and characteristics. Some of these are directly caused by the limitations

of the app, for example having to buzz and wait for the other to appear. But others are rooted in the morality of everyday interaction, such as the need to give reasons for buzzing and to exit a conversation appropriately. Overall, our work reveals a way of thinking about how to design messaging technology that is slower and more intimate.

ACKNOWLEDGMENTS

We are grateful to the study participants, and to the anonymous reviewers of this paper. Rooksby, Rost and Chalmers were funded by an EPSRC award EP/J007617/1 ("A Populations Approach to Ubicom Systems Design").

REFERENCES

- [1] Daniel Avrahami and Scott E. Hudson. 2006. Responsiveness in Instant Messaging: Predictive Models Supporting Inter-personal Communication. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '06)*. ACM, New York, NY, USA, 731–740. <https://doi.org/10.1145/1124772.1124881>
- [2] Louise Barkhuus, Barry Brown, Marek Bell, Scott Sherwood, Malcolm Hall, and Matthew Chalmers. 2008. From Awareness to Repartee: Sharing Location Within Social Groups. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '08)*. ACM, New York, NY, USA, 497–506. <https://doi.org/10.1145/1357054.1357134>
- [3] Agathe Battestini, Vidya Setlur, and Timothy Sohn. 2010. A Large Scale Study of Text-messaging Use. In *Proceedings of the 12th International Conference on Human Computer Interaction with Mobile Devices and Services (MobileHCI '10)*. ACM, New York, NY, USA, 229–238. <https://doi.org/10.1145/1851600.1851638>
- [4] Nancy K Baym. 2010. *Personal Connections in the Digital Age*. Polity.
- [5] Frank R. Bentley and S. Tejaswi Peesapati. 2017. SearchMessenger: Exploring the Use of Search and Card Sharing in a Messaging Application. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17)*. ACM, New York, NY, USA, 1946–1956. <https://doi.org/10.1145/2998181.2998255>
- [6] Barry Brown, Stuart Reeves, and Scott Sherwood. 2011. Into the Wild: Challenges and Opportunities for Field Trial Methods. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)*. ACM, New York, NY, USA, 1657–1666. <https://doi.org/10.1145/1978942.1979185>
- [7] Luiz Henrique C.B. Cavalcanti, Alita Pinto, Jed R. Brubaker, and Lynn S. Dombrowski. 2017. Media, Meaning, and Context Loss in Ephemeral Communication Platforms: A Qualitative Investigation on Snapchat. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17)*. ACM, New York, NY, USA, 1934–1945. <https://doi.org/10.1145/2998181.2998266>
- [8] Donghun Chung and Chang Soo Nam. 2007. An analysis of the variables predicting instant messenger use. *New Media & Society* 9, 2 (2007), 212–234.
- [9] Karen Church and Rodrigo de Oliveira. 2013. What's Up with Whatsapp?: Comparing Mobile Instant Messaging Behaviors with Traditional SMS. In *Proceedings of the 15th International Conference on Human-computer Interaction with Mobile Devices and Services (MobileHCI '13)*. ACM, New York, NY, USA, 352–361. <https://doi.org/10.1145/2493190.2493225>
- [10] Trinh Minh Tri Do, Jan Blom, and Daniel Gatica-Perez. 2011. Smartphone Usage in the Wild: A Large-scale Analysis of Applications and Context. In *Proceedings of the 13th International Conference on Multimodal Interfaces (ICMI '11)*. ACM, New York, NY, USA, 353–360. <https://doi.org/10.1145/2070481.2070550>
- [11] Clarence A. Ellis, Simon J. Gibbs, and Gail Rein. 1991. Groupware: Some Issues and Experiences. *Commun. ACM* 34, 1 (Jan. 1991), 39–58. <https://doi.org/10.1145/99977.99987>
- [12] Petra Fagerberg, Anna Ståhl, and Kristina Höök. 2004. eMoto: Emotionally Engaging Interaction. *Personal Ubiquitous Comput.* 8, 5 (Sept. 2004), 377–381. <https://doi.org/10.1007/s00779-004-0301-z>
- [13] Jason Farman. 2013. *Mobile interface theory: Embodied space and locative media*. Routledge.
- [14] William Gaver. 2012. What should we expect from research through design?. In *Proceedings of the SIGCHI conference on human factors in computing systems*. ACM, 937–946.
- [15] William W. Gaver, Jacob Beaver, and Steve Benford. 2003. Ambiguity As a Resource for Design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '03)*. ACM, New York, NY, USA, 233–240. <https://doi.org/10.1145/642611.642653>
- [16] Rebecca Grinter and Margery Eldridge. 2003. Wan2Tlk?: Everyday Text Messaging. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '03)*. ACM, New York, NY, USA, 441–448. <https://doi.org/10.1145/642611.642688>
- [17] Rebecca E Grinter and Margery A Eldridge. 2001. y do tngrs luv 2 txt msg?. In *ECSCW 2001*. Springer, 219–238.

- [18] Rebecca E. Grinter and Leysia Palen. 2002. Instant Messaging in Teen Life. In *Proceedings of the 2002 ACM Conference on Computer Supported Cooperative Work (CSCW '02)*. ACM, New York, NY, USA, 21–30. <https://doi.org/10.1145/587078.587082>
- [19] Rebecca E. Grinter, Leysia Palen, and Margery Eldridge. 2006. Chatting with Teenagers: Considering the Place of Chat Technologies in Teen Life. *ACM Trans. Comput.-Hum. Interact.* 13, 4 (Dec. 2006), 423–447. <https://doi.org/10.1145/1188816.1188817>
- [20] Richard Harper. 2010. *Texture: Human Expression in the Age of Communications Overload*. The MIT Press.
- [21] Mariam Hassib, Daniel Buschek, Pawel W. Wozniak, and Florian Alt. 2017. HeartChat: Heart Rate Augmented Mobile Chat to Support Empathy and Awareness. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 2239–2251. <https://doi.org/10.1145/3025453.3025758>
- [22] Susanna Hedbring. 2002. Mobile messaging usability—Social and pragmatic aspects. *TRITA-NAE02088, CID-192, ISSN (2002)*, 1403–0721.
- [23] Ellen Isaacs, Alan Walendowski, and Dipti Ranganathan. 2002. Mobile Instant Messaging Through Hubbub. *Commun. ACM* 45, 9 (Sept. 2002), 68–72. <https://doi.org/10.1145/567498.567501>
- [24] Da-jung Kim and Youn-kyung Lim. 2015. Dwelling Places in KakaoTalk: Understanding the Roles and Meanings of Chatrooms in Mobile Instant Messengers. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '15)*. ACM, New York, NY, USA, 775–784. <https://doi.org/10.1145/2675133.2675198>
- [25] Hyo Kim, Gwang Jae Kim, Han Woo Park, and Ronald E Rice. 2007. Configurations of relationships in different media: FtF, email, instant messenger, mobile phone, and SMS. *Journal of Computer-Mediated Communication* 12, 4 (2007), 1183–1207.
- [26] Paul Laseau. 2001. *Graphic thinking for architects and designers*. John Wiley & Sons.
- [27] Amparo Lasen. 2005. History repeating? A comparison of the launch and uses of fixed and mobile phones. *Mobile World (2005)*, 29–60.
- [28] Charlotte P. Lee and Drew Paine. 2015. From The Matrix to a Model of Coordinated Action (MoCA): A Conceptual Framework of and for CSCW. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '15)*. ACM, New York, NY, USA, 179–194. <https://doi.org/10.1145/2675133.2675161>
- [29] Che Hui Lien and Yang Cao. 2014. Examining WeChat users' motivations, trust, attitudes, and positive word-of-mouth: Evidence from China. *Computers in Human Behavior* 41 (2014), 104–111.
- [30] Rich Ling. 2004. *The mobile connection: The cell phone's impact on society*. Morgan Kaufmann.
- [31] Carolynne Lord, Mike Hazas, Adrian K. Clear, Oliver Bates, Rosalind Whittam, Janine Morley, and Adrian Friday. 2015. Demand in My Pocket: Mobile Devices and the Data Connectivity Marshalled in Support of Everyday Practice. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15)*. ACM, New York, NY, USA, 2729–2738. <https://doi.org/10.1145/2702123.2702162>
- [32] Joanne Meredith and Elizabeth Stokoe. 2014. Repair: Comparing Facebook 'chat' with spoken interaction. *Discourse & communication* 8, 2 (2014), 181–207.
- [33] Madoka Mitsuoka, Satoru Watanabe, June Kakuta, and Satoshi Okuyama. 2001. Instant messaging with mobile phones to support awareness. In *Applications and the Internet, 2001. Proceedings. 2001 Symposium on*. IEEE, 223–230.
- [34] Midas Nouwens, Carla F. Griggio, and Wendy E. Mackay. 2017. "WhatsApp is for Family; Messenger is for Friends": Communication Places in App Ecosystems. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 727–735. <https://doi.org/10.1145/3025453.3025484>
- [35] Ofcom. 2016. Communications Market Report 2016. Research document. (Aug. 2016).
- [36] Kenton P. O'Hara, Michael Massimi, Richard Harper, Simon Rubens, and Jessica Morris. 2014. Everyday Dwelling with WhatsApp. In *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '14)*. ACM, New York, NY, USA, 1131–1143. <https://doi.org/10.1145/2531602.2531679>
- [37] Cecile Petitjean and Etienne Morel. 2017. "Hahaha": Laughter as a resource to manage WhatsApp conversations. *Journal of Pragmatics* 110 (2017), 1–19.
- [38] James Pierce and Eric Paulos. 2014. Counterfunctional Things: Exploring Possibilities in Designing Digital Limitations. In *Proceedings of the 2014 Conference on Designing Interactive Systems (DIS '14)*. ACM, New York, NY, USA, 375–384. <https://doi.org/10.1145/2598510.2598522>
- [39] Donald Rice and James Katz. 2003. *Mobile Democracy. Essays on Society, Self and Politics*. Passagen Verlag, Chapter Mobile Discourtesy. National Survey Results on Episodes of Convergent Public and Private Spaces.
- [40] Sean Rintel, Richard Harper, and Kenton O'Hara. 2016. The Tyranny of the Everyday in Mobile Video Messaging. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*. ACM, New York, NY, USA, 4781–4792. <https://doi.org/10.1145/2858036.2858042>
- [41] Jane Ritchie and Liz Spencer. 2002. Qualitative data analysis for applied policy research. *The qualitative researcher's companion* 573, 2002 (2002), 305–329.

- [42] John Rooksby, Parvin Asadzadeh, Alistair Morrison, Claire McCallum, Cindy Gray, and Matthew Chalmers. 2016. Implementing Ethics for a Mobile App Deployment. In *Proceedings of the 28th Australian Conference on Computer-Human Interaction (OzCHI '16)*. ACM, New York, NY, USA, 406–415. <https://doi.org/10.1145/3010915.3010919>
- [43] John Rooksby, Mattias Rost, Alistair Morrison, and Matthew Chalmers. 2015. Pass the Ball: Enforced Turn-Taking in Activity Tracking. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15)*. ACM, New York, NY, USA, 2417–2426. <https://doi.org/10.1145/2702123.2702577>
- [44] Mattias Rost, Christos Kitsos, Alexander Morgan, Martin Podlubny, Pietro Romeo, Edoardo Russo, and Matthew Chalmers. 2016. Forget-me-not: History-less Mobile Messaging. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*. ACM, New York, NY, USA, 1904–1908. <https://doi.org/10.1145/2858036.2858347>
- [45] Emanuel A Schegloff. 1968. Sequencing in conversational openings. *American anthropologist* 70, 6 (1968), 1075–1095.
- [46] Alex S. Taylor and Richard Harper. 2002. Age-old Practices in the 'New World': A Study of Gift-giving Between Teenage Mobile Phone Users. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '02)*. ACM, New York, NY, USA, 439–446. <https://doi.org/10.1145/503376.503455>
- [47] Alex S Taylor and Jane Vincent. 2005. An SMS history. In *Mobile world*. Springer, 75–91.
- [48] Sherry Turkle. 2012. *Alone together: Why we expect more from technology and less from each other*. Basic books.
- [49] J Mitchell Vaterlaus, Kathryn Barnett, Cesia Roche, and Jimmy A Young. 2016. "Snapchat is more personal": An exploratory study on Snapchat behaviors and young adult interpersonal relationships. *Computers in Human Behavior* 62 (2016), 594–601.
- [50] Xiaobo Wang and Baotong Gu. 2016. The Communication Design of WeChat: Ideological As Well As Technical Aspects of Social Media. *Commun. Des. Q. Rev* 4, 1 (Jan. 2016), 23–35. <https://doi.org/10.1145/2875501.2875503>
- [51] Yang Wang, Yao Li, and Jian Tang. 2015. Dwelling and Fleeting Encounters: Exploring Why People Use WeChat - A Mobile Instant Messenger. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '15)*. ACM, New York, NY, USA, 1543–1548. <https://doi.org/10.1145/2702613.2732762>
- [52] Deborah J Ward, Christine Furber, Stephanie Tierney, and Veronica Swallow. 2013. Using framework analysis in nursing research: a worked example. *Journal of advanced nursing* 69, 11 (2013), 2423–2431.
- [53] Bin Xu, Yang Qin, and Dan Cosley. 2017. De-emphasizing Content to Study the Relationship Between Meaning, Messages, and Content in IM Systems. In *Proceedings of the 2017 Conference on Designing Interactive Systems (DIS '17)*. ACM, New York, NY, USA, 599–610. <https://doi.org/10.1145/3064663.3064719>
- [54] Rui Zhou, Jasmine Hentschel, and Neha Kumar. 2017. Goodbye Text, Hello Emoji: Mobile Communication on WeChat in China. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, USA, 748–759. <https://doi.org/10.1145/3025453.3025800>

Received April 2017; revised July 2017; accepted November 2017