

Integrating Local and Remote Worlds Through Channel Blending

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ABSTRACT

Recent advances in ubiquitous technology have greatly changed the way people stay connected. We conducted an in-depth video shadowing study to observe how close-knit groups use all the technology at their disposal to stay in touch and share their lives. We observed a pattern of related behaviors that we call *channel blending*, the integration of interactions and content over multiple channels into one coherent conversation, often including both local and remote participants. Channel blending is the opposite of multitasking in that it involves merging many lines of focus into one, rather than switching attention between them. We discuss ways technology could better support this emerging style of multichannel content-sharing and communication.

Author Keywords

Computer-mediated communication, mobile, ethnography, video shadowing, conversation analysis, channel blending.

ACM Classification Keywords: H.5.m. Information interfaces and presentations: Miscellaneous.

General Terms: Human Factors.

INTRODUCTION

The past five years or so have seen dramatic changes in the way people connect and share their experiences with others. People can now choose from a wide range of technology options when connecting remotely, and they can connect from almost anywhere any time. There are also more ways for people to capture their experiences and more options for sharing those experiences and other recorded content.

Not only are there more technology options, but the nature of content sharing and communication has also been changed by technology in the following fundamental ways:

- **Bite-sized content:** The content people share has become much smaller in that it takes less time to consume and often generate. People send one-sentence text updates rather than long emails, they share short

video clips rather than full-length movies, and they share individual photos rather than a whole roll of film.

- **Ubiquitous content:** Content is available from almost anywhere through internet-enabled devices.
- **Proliferation of captured experiences:** People are capturing their experiences in many ways, not just taking photos and videos, but also using applications to track their sleep cycles, game-playing activity, and travel patterns, to name just a few.
- **Ubiquitous communication:** People can connect with each other from almost anywhere using a wide range of devices and media.

In this study, we set out to understand how these relatively recent changes in our communication and content-sharing technologies have affected the way people are staying connected and sharing their lives with those they care about. We did so not by looking at any one technology but instead by centering our investigation on groups of close contacts and video shadowing them to see how they enlisted different technologies (or not) to stay connected.

This study builds on the extensive body of research on the adoption and use of *individual* technologies by examining how and when people *integrate* and *combine* them to keep in touch. For example, studies of mobile text chat show that people use that technology to coordinate their activities, to arrange a time to talk later, and to chat [8, 16], and it can also be used to maintain a sense of “ambient virtual copresence” with others [10]. People also maintain this ongoing background awareness by sending each other photos through their phones [20], and by sharing status updates, photos, and links through social media [11, 15].

Studies of home video communication indicate that people use video conferencing both to support focused conversations and to maintain ongoing open connections that provide a similar sense of ambient co-presence [13, 14]. Although video is usually used for talking-heads style conversation, people also commonly use it to show each other things, such as a tour of their home or their children’s activities. However, video also requires dedicated time, as people don’t feel comfortable multitasking while video chatting. As a result, finding a time to video chat can be a challenge, especially for friends and family separated across time zones [3]. Social media addresses this problem by allowing people to check in asynchronously [11, 15].

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People are starting to adopt mobile video to do a similar set of activities, specifically to keep in touch, coordinate, and show each other things, such as products in a shop [19]. However, the public nature of mobile video can cause socially awkward situations, since bystanders can easily overhear interactions and participants are more accountable to each other for their visual surroundings.

A common thread among these studies is that people use different technologies to stay aware of and connect with others, and they adapt their approach based on the strengths and constraints of each technology. What isn't well understood is how people combine them to achieve their goal of staying connected. In this study, we set out to learn: (a) How do people use and combine the myriad technologies available to stay connected, coordinate, and share their experiences? (b) How effectively are current technologies supporting people's needs? (c) How are people working around gaps in the patchwork of technologies to stay close to one another? By answering these questions, we can learn whether current technology is adequately supporting people's desire to stay connected and if not, how it may be improved.

We addressed these questions by conducting an in-depth video shadowing study in which we directly observed ten people in four close-knit groups as they went about their activities and connected with one another. For each group, we video recorded each member over the same period of time and micro-analyzed the interactions from each person's point of view. We captured interactions that varied among different dimensions, including cases when they were (a) physically together vs. separated by distance, (b) mobile vs. stationary, (c) sharing content vs. just talking, and (d) one-on-one vs. in groups.

Through a detailed analysis of these video recordings we saw a variety of ways that people's practices are changing as they adopt current technology. In particular, we saw how people are incorporating local people into their remote interactions and, conversely, bringing remote content into their face-to-face (F2F) conversations. We also saw how bite-sized, ubiquitous content is altering the way people tell each other the stories of their lives, and how people interact over a series of related interactions, both mediated and in person. By watching interactions as they unfolded over time, we noticed ways that technology is not adequately supporting these changing behavior patterns.

METHOD

To identify suitable participants for video shadowing, we recruited two- and three-person groups that considered themselves highly connected. Based on a screening survey and a logging study (not discussed here), we narrowed a set of 14 potential groups down to four that demonstrated they communicated with one another at least 1-3 times per day, used at least five communication technologies, were at least moderately mobile, and held a range of attitudes about technology, from enthusiastic to uninterested. The four groups consisted of two triads and two pairs, made up of

eight women and two men, mostly in their 20s but ranging in age from 18 to 35. (The gender imbalance reflected the proportion of women and men who responded to our call for "groups of friends or family who like to stay in close contact.") All participants lived in the San Francisco Bay Area, except that one group included a member in Austin, Texas. Participants were paid \$300.

Video shadowing consisted of separately recording each member of a group as they went about their activities during the same 5-6 hour period. Each researcher observed a different group member. Participants wore wireless microphones to ensure that we captured high-quality sound. When they used technology, we zoomed in on the screen to capture their mediated interactions as much as possible. During the shadowing we observed them in their homes, in their cars, and in many public places, including stores, restaurants, a farmer's market, a mall, and on the street. Despite our initial concerns about video recording in public, only once were we asked to stop recording, in a store, until we received management approval. Other researchers have avoided this method out of an understandable concern about the practicality of following and recording people all day [8, 10], but we were pleasantly surprised to find that it was relatively unproblematic and yielded very rich interactions.

To analyze the data, we used a Conversation Analysis (CA) approach in which interactions are analyzed turn by turn, taking the participant's point of view as the conversational interaction unfolds [12]. First, each researcher reviewed their video and selected segments they judged to be of interest to our research questions. Video clips usually lasted 1-5 minutes; longer interactions were divided into shorter segments. We then viewed these video clips as a group and did an initial assessment. Clips deemed to be of particular interest were transcribed in detail according to the standard format [23], including gestures, intonation, glances, etc. If the interaction involved other members of that group, we clipped the same segment from those videos and combined them to generate one "mosaic" video showing the interaction from everyone's point of view simultaneously. As a group, we then analyzed these merged video segments in more detail, repeatedly viewing them to ground our understanding of what was happening, using the transcripts as analytic aids. As we came to understand the videos, we sometimes went back to clip other segments that involved similar behaviors in another context, and in this way we built up collections of excerpts that demonstrated themes or patterns of action. (Isaacs & Szymanski [9] explains our method in greater detail.)

The CA method generates an in-depth understanding of the sort of behavior people take for granted, which makes it difficult to detect through self-report methods such as diary or probe studies, interviews, or experience sampling. It does not tell us how common these behaviors are, but it is useful in alerting us to patterns of action that may foretell interesting and subtle interactional shifts that may suggest opportunities for future technologies.

FINDINGS

During the video shadowing study, we recorded about 48 hours of the 10 participants' experiences. We clipped 83 interactions, transcribed 38 of them, and deeply analyzed 29 that best illustrated the patterns of interest. Our analysis revealed several ways that the basic changes in current technology discussed earlier (bite-sized content, ubiquitous content, proliferation of captured experiences, and ubiquitous communication) affected our participants' interactions, particularly when face-to-face. Further, we noted ways that technology is not adequately supporting these evolving interaction patterns.

The main theme that emerged from our data was the *integration* of interactions and content over multiple channels into *one coherent conversation*, often involving both local and remote participants. We call this phenomenon *channel blending*, where a channel indicates a means of connecting with a person or content (including face-to-face). Examples include cases where people: blended connections with both remote and local people into one interaction, interacted remotely with people over multiple channels, integrated data from multiple channels into local interactions, and switched channels when interacting with the same people over time.

Channel blending can be seen as the opposite of multitasking, which is the switching between multiple *unrelated* tasks or conversations conducted in parallel or in rapid succession, often across multiple media [4]. The challenge for multitaskers is in managing interruptions that divert attention from one task to another. In contrast, channel blending involves *combining* different activities into one interaction, and the challenge involves keeping people informed about content or communications from other channels so that everyone can maintain common ground. The following sections describe the ways our participants channel blended and discuss ways technology could better support this phenomenon.

Integrating local people into remote interactions

Perhaps the most compelling example of channel blending occurred when small groups attempted to carry on a synchronous interaction with both local and remote participants. This happened many times with a variety of technologies, and it generally involved one person playing the role of a "pivot person," integrating the contributions of local and remote participants. Since current technology doesn't support this configuration, it required skill and finesse to avoid breakdowns and pull off a satisfying interaction for all.

In many cases, the pivot person was focused on a remote conversation while a local person (or people) intermittently participated in the interaction. During phone and video interactions, the local parties could overhear the conversation, and with IM, texting, or email exchanges the pivot person read aloud the message being exchanged. The local people (who might have existed at both ends of the

mediated connection) contributed to the interaction through the pivot person.

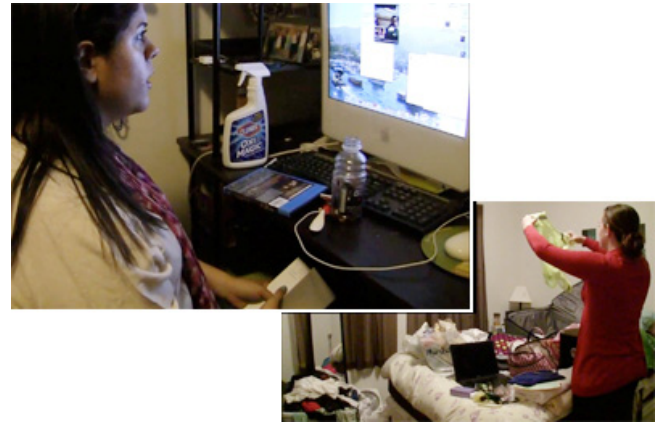


Fig 1. Anita (left) video chats with friends in her room as Cathy (right) eavesdrops while packing for a trip in her room.

One example of this situation occurred among two roommates in California (Anita and Cathy) and their friends in New York (Bo and John). Anita was in her room video-chatting with Bo and John, while Cathy was in the adjacent room packing for a business trip to Dublin. Cathy could hear the exchange, and during a topic transition she called out a question about whether to bring her pepper spray. This led to an exchange regarding movies involving danger in foreign cities, with Anita shuttling the comments back and forth between Cathy and the men. (We present transcripts in a simplified format. Square brackets in color indicate overlapping speech, and numbers in parentheses indicate pause lengths.)

Over video conference

Anita: Cathy wants to know if she should bring her pepper spray
Bo: Yes. Eh has she seen *Taken*?
Anita: eh heh actually she hasn't seen *Taken*, I asked her and she said no
John: Okay, that's good
Bo: Has she seen *Hostile*?

Calling between rooms

Cathy: Should I bring my pepper spray?

Anita: Have you seen *Hostile*, Cathy?

Cathy: No I I [refuse]

Anita: [she doesn't] like scary movies

Cathy: I refuse (0.4)

Bo: Is she gonna drink a lot of beer in Dublin?

Anita: Wait, she can answer that.

Anita: Are you going to drink a lot of beer in Dublin?

Cathy: Uuum, (0.2) probably.

Anita: Probably

In this interaction, Anita acted as a pivot person, sometimes relaying the comments back and forth between the video participants and her roommate and sometimes answering on her behalf. A short while later, Anita conveyed Cathy's comments by simply incorporating them into her own, as

John wondered why Anita's upcoming business trip was to LA instead of a more exotic location.

John: Why don't *you* go abroad?

Anita: Yeaphhh

Cathy: I love when they ask you like that, like you have a choice

Anita: (laughing) I know, I don't really get a choice too much in the ma-, she's like 'I like how they ask you like you have a choice.' I don't really have too much of a choice,

Bo: What do you mean, I thought you could [\[pick a different program\]](#)

Cathy: [\["Anita loves LA"\]](#) (as if quoting their bosses)

Anita: They're just like, "Anita loves LA, we should just put her there."

Cathy found John's question amusing, as it implies they have a choice about where they are sent on business, and Anita incorporated this reaction into her responses, first suggesting the comment came from Cathy ("*She's like, 'I like how they ask you'*") and then simply mimicking Cathy's personification of their bosses as if it were her own response. Anita thus showed great skill in blending the two separate channels to create a four-person interaction.

It's worth noting how Cathy moved in and out of the interaction during the video chat. She easily could have stopped packing and joined Anita in her room, but even when she called out she continued packing and made no gesture, or even glance, toward Anita's room. She clearly did not want to become a fully ratified member of the conversation but instead preferred to play a peripheral role.

We saw other configurations of this type of channel blending, and they weren't always handled as smoothly. In this excerpt, Lee and Alana were walking down the street as Lee spoke with Scott over the phone. Several times Alana interjected to make a suggestion or ask a question of Scott (through Lee), causing Lee to miss Scott's utterance and leading to breakdowns in the phone conversation. In one case, after Lee had just given Scott the combination to his locker (where he wanted him to return some sheet music), Scott confirmed the number just as Alana suggested another way to get the music.

Over phone call

Walking side by side

Scott: Four [\[forty-two \(.\) one eight three eight?\]](#)

Alana: [\[or you know what, he can bring it\]](#) when we do the gig, (0.2) the China gig

Lee: Uh huh, wait, what? (0.4) hello?

Scott: What did you (0.2) hello? (0.4)

Lee: Yeah, what's up?

Scott: Four forty two, one eight three eight?

Lee: Yeah. (0.2) Or you can just bring it on Friday at the China gig.

In this case, Alana's comments during the locker combination confirmation sequence caused a breakdown, but Lee still managed to incorporate her suggestion into his next turn. In another example of this type of channel blending, Alana was instant messaging (IM) with Scott when Lee picked her up for dinner. She read aloud Scott's messages and then incorporated Lee's comments into her responses. Other cases involved different combinations of media, such as video chatting while using IM to consult with others as questions arose, and including local others while responding to email messages.

Other studies have also reported cases when overhearers became engaged in remote interactions through video and audio media spaces [5, 26], and through phone calls [21]. Some have also reported on troubles encountered when connecting remote and local spaces via home video conferences [14], mobile video calls [19], and mobile phone calls [21]. However, no one has highlighted this activity as a phenomenon in its own right and shown how it occurs over a variety of media, including text-based ones. The fact that we saw so many types of examples suggest that channel blending may be becoming more commonplace with the prevalence of mobile devices that allow people to connect from anywhere over multiple channels.

Technology implication: This finding indicates that there is a compelling opportunity to better support such small-group synchronous interactions among both local and remote participants. Even though there are many communication technologies available, none embraces the idea that when people connect remotely, they are often sharing a space with other parties who may also want to become engaged in the interaction. Instead, most such technology is designed to support one person at either end (phone calls, texting, IM, video chat) or many remote participants (social media, email). People adapt these technologies to incorporate local parties (to various degrees of success), suggesting that they would welcome a technology that explicitly supports multichannel sharing.

It is natural to assume that what's needed is something like a speakerphone that can provide a full connection to everyone in the conversation. But we saw how people don't necessarily want to become fully engaged in all the interactions around them, so the solution needs to take a subtler approach. Group membership is fluid, as people engage to different degrees at different times. Such a technology needs to let people vary their degree of participation over time and connect asynchronously, while letting distributed participants interpret and smoothly adjust to others' varying level of engagement. Some researchers have explored ways to support small, distributed groups where their level of participation varied over time [6, 24], but those did not incorporate local interactions.

Integrating remote content into local interactions

People also channel blended by integrating into their local interactions information from remote communications

received through a mobile device. It was common for participants engaged in F2F interactions to check for updates in their text exchanges, Twitter feeds, status messages, emails, turn-based games, and so on. When they did, they frequently introduced into the local conversation information from these remote exchanges, again attempting to bridge their remote and local worlds. What often emerged with this type of interaction was an *episodic conversational style* in which a succession of unconnected or loosely related topics were each discussed for a short period. What fascinated us was how this F2F episodic conversation mirrored exactly the style of interactions people were simultaneously carrying on remotely with a multitude of others through their devices.

One example of this pattern occurred when Cathy and Anita went out to dinner. Both of them alternated their attention between their phones and each other, sometimes entering text while also in conversation. Figure 2 diagrams the 9 minute 16 second period after they sat down and before ordering. They briefly discussed 17 topics, 9 generated from mobile phone communications and 8 from the local environment, with long gaps in between. The longest topic was discussed for 1 min 20 secs and the shortest for 4 secs.

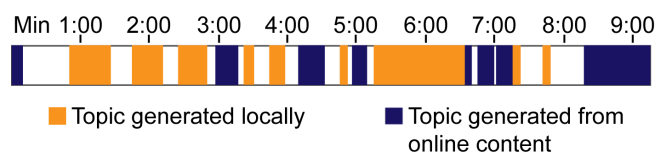


Figure 2. Duration of topics generated from local and online sources over a 9-minute period.

Examples of topics based on online content included Cathy’s comment, “Eric texted, ‘Oh my God, are you being followed yet? What are you guys doing? Are people staring at you like you’re a celebrity?’” and Anita’s report on the weather in New York, “Arnold tweeted, he’s like ‘It’s like Florida.’ I wish it were, the weather’s like blah here.” As for locally generated topics, Cathy asked about a work colleague, “Didn’t Evan look so upset when he came in this morning? Like did you notice that?” and she complained about the slow service at the restaurant, “I feel like they’re ignoring us.” Each topic was discussed briefly and the discussion ended with minimal or no explicit closure. Often when Cathy or Anita responded to the tweet or text message, they read aloud their comment as they typed.

This interaction is notable for several reasons: First, their F2F conversation integrated multiple channels of remote interactions carried out on their phones, some synchronous (text messages) and some asynchronous (Twitter and FourSquare updates). Second, as noted, their conversation had the same episodic flavor as their online interactions. Third, neither of them gave any indication that this style of interaction, with its many gaps and lack of sustained shared focus, was problematic. They treated this multichannel style of interaction as normal.

This last point is interesting because it suggests how this activity again contrasts with multitasking. Adults and teens alike have reported that they consider it rude to carry on other activities while engaged in F2F or phone conversation – even though they sometimes do it themselves [1, 2, 21]. Yet in this case, the two treated it as unremarkable, likely because, as they simultaneously surfed their phones, they shared their finds with each other, thus turning their individual actions into a joint activity.

Technology implications: Although these two friends smoothly shared their remote interactions with each other, there may be ways to better support this activity. We might let remote members become aware of the local interaction or allow local people to easily join in the remote interactions through their own devices.

Integrating remote content into local interaction

When co-located, people also channel blended by sharing recorded content from multiple devices at the same time or in quick succession. It was interesting to us that these interactions usually followed the classic three-phase structure of storytelling [22], even though the stories were based on recorded content: (1) a *preface* in which someone introduces the story, foreshadows the expected response (e.g. “the funniest thing happened to me”), and reserves a block of time to tell the story; (2) the *telling* where the story is told; and (3) the *response*, where people react (ideally by expressing the expected emotion) and discuss the story. It is common for others to follow up with stories of their own that share a common point or theme [22].

This pattern was nicely illustrated by the group of three musicians who got together with another friend (Jeff) for an evening of socializing. Rather than telling their own stories, they shared a steady stream of videos, music, and websites, displayed on their phones, a laptop, and a TV being used as a computer monitor. One of them would preface a “story” by introducing the content (e.g., “Have you seen the dancing cockatoo?”), then after searching for it they watched the video, which constituted the story. Then they responded with laughter or jokes, after which someone brought up another related video or song. This pattern of sharing a sequence of loosely related content can be seen as *episodic content sharing*, similar to our previous example except that the sharing is of pre-existing content rather than ongoing communications with others.

Because this type of content can be experienced in a short period of time and accessed from anywhere, people can now have this sort of media-sharing exchange of previously viewed content. They don’t need to plan in advance what they want to share but instead can introduce media-based “stories” spontaneously based on the flow of conversation. In effect, they can create their own “collaboratively curated experience” on the fly.

It’s worth noting that this pattern of sharing recorded content is different from earlier times when people got together to watch a two-hour movie – typically one that no

one had seen previously. Here, people experienced a series of short videos or songs that were familiar to at least one of them. Indeed, this type of storytelling-through-media worked well as long as people were sharing content they had previously seen or heard. It became awkward as soon as they sought out new content. For example, when the musicians ran out of previously viewed content, they attempted to explore other music-related websites. This led to awkward interactions because the content was not always of interest or easily experienced together, especially when they landed on text-only web pages. At one point when Alana read aloud the highlights of a web page, Jeff teased her, saying, “*We have eyes*,” implying they could read for themselves, and the others rebuked him for being rude.

Another type of channel blending occurred during that same evening when they shared technology-based documentation of their lives rather than content produced by others. In one example, Alana showed the others a graph of her sleep cycle that had been recorded by a smartphone app. Upon establishing interest, Alana, who was seated between Lee and Scott on her right and Jeff on her left (see Figure 3), handed her phone to Lee, who remarked on how late she woke up. At the same time, she and Jeff interwove a related conversation in a style reminiscent of Anita and Cathy’s dinner interaction. Then Scott responded by sharing his own sleep cycle on his phone, which he happened to have recorded with the same app.



Figure 3. Alana turns her phone toward Lee and Scott as Jeff looks on. Scott has just taken his phone out of his pocket.

<p>Lee, Scott, and Alana Alana: (Turns toward Lee) Do you want to see my sleep cycle? Lee: Yes Alana: (Hands phone to Lee, Scott looks too) Jeff: Oh, do you have that app Alana: Yeah Jeff: that wakes you up at an intelligent time? Alana: Yeah (Scott takes out his iPhone, opens his sleep cycle app) Lee: [You woke up at ten?]</p>	<p>Alana and Jeff</p>
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Jeff: Hjee, that’s like the only re- not the only re- that’s [been the reason why] I [didn’t want to buy] that app
Alana: [It’s not that great]

Alana: Yes, it was amazing
Lee: heh heh heh (Passes phone back to Alana)
Alana: It was the greatest thing ever. Actually I woke up at noon (0.2) to be- (turns phone toward Lee and Scott) I turned it off
Lee: heh heh
Alana: And then I was like, *screw this* (emphasizes by swiping phone down twice in sync with words)
Scott: (Shows his sleep cycle to Alana) I- I didn’t sleep long enough last night for it to record, actually the past [two nights]
Lee: (Points to Scott’s phone, takes out his phone) [What happened] did you like die for like three hours?
Scott: No this one, I had dropped my phone off the bed

What struck us about this interaction (beyond Alana’s agility in managing the two related conversations) is how the technology was seamlessly introduced by both Alana and Scott as a way to “tell the story.” Alana prefaced her story in the usual way by introducing the topic of her sleep cycle, but then she didn’t tell a story at all but instead handed her phone to Lee, so the app *became* the story. The response came when Lee teased her about sleeping so late, which led her to elaborate on how she slept even later after she turned off the app. Then Scott followed up in the classic style by sharing his sleep cycle on his own device, which again became the story, leading to Lee’s response joking about a flat portion of the graph that occurred when the phone fell off the bed.

The technology can become the story because it is a physical representation of a prior experience and because it is readily available at a moment’s notice without any prior preparation. People have long used photographs to tell the story [7], but now it happens with many other forms of bite-sized captured experiences accessible from anywhere.

In contrast, we saw similar cases where the participants were remotely connected over multiple channels but were unable to achieve this seamless sharing across channels. In one particularly painful case, a pair of sisters (Drina and Clarisse) were on the phone and Drina told Clarisse how she had been Facebook “friended” by a grade school teacher who was the father of a boy she had had a crush on, Benny Bordick. Clarisse wanted to see the photo of Benny so Drina told her to look in the father’s “Easter pictures” album on Facebook. As Clarisse struggled to find it, Drina got distracted by an IM from a friend and so provided little help to Clarisse, who eventually realized she couldn’t see the photo because she wasn’t friends with the father.

<p style="text-align: center;">Over phone call</p> <p>Drina: Easter pictures.</p> <p>Drina: Go under Easter pictures. Clarisse: A- the album’s called Easter pictures, right? Drina: Mmhmm (crooks phone into her neck, moves hands to keyboard)</p>	<p style="text-align: center;">Over Facebook chat</p> <p>Drina: (receives text message)</p>
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Clarisse: Yeah, I don't see it, it just says Rainbow and Profile pictures (Clicks on Rainbow album)

(6.0)

Drina: Ohh

Clarisse: I don't see it, let me look under Benny Bordi- what is his name? (Enters 'Benny Bord' into search field).

(4.0)

Clarisse: What does he go by, Ben? What's his real name?

Drina: (typing) Ah, I love

Drina: No it's not him. It's hi- it's a picture on his dad's thing

Drina: (typing) that song [Enter]

Clarisse: Let me see.

(3.0)

Clarisse: I guess cuz I'm not his friend maybe I can't- I mean

Drina: (typing) That should be his theme song [Enter]

Clarisse: yeah, I don't see any pictures.

(2.0)

Clarisse: But I can't believe he's in contact with you, that's good.

(4.0)

Drina: (Switches to another tab, enters search term.)

Drina: That's funny.

This painful struggle to share a simple photo contrasts sharply with the musicians' easy spontaneous sharing of their sleep cycles on different devices.

Technology implications: Through this last interaction we see how poorly technology supports channel blending. Even though the sisters had a real-time connection through their phones, their computers were unaware of it. Had they been face-to-face, Drina could have simply shown Clarisse the photo without running into permissions problems. If technology recognized that people carry on interactions over more than one channel, it could enable the sharing of content across them. Face-to-face interactions might also be improved by making it easier to share content with a group. In the first example, rather than passing around their phones to view them one at a time, perhaps the musicians could have projected the app onto the TV they were already using to display content for shared viewing.

Channel blending content over time

Norrick [18] discusses a variation on the practice of storytelling in which people tell each other the story of an experience they all participated in. He shows that people tell these "twice-told tales" to (a) foster group rapport, (b) ratify group membership, and (c) convey group values. We observed similar cases where participants re-told a shared "story" by re-experiencing together content they each had viewed separately. These shared re-experiences seemed to function in much the same way as twice-told tales, and they can be seen as channel blending over time.

In one example of this type, Alana and Lee were at dinner with another friend, Peter, who had previously emailed

them a link to a recording by a 15-year-old violin prodigy (Sean) in which he played a difficult concerto but missed a few high notes in an amusing way. The concerto comes up in conversation, so Alana asks:

Alana: Do you guys want to listen to Sean's recording of it?

Peter: YES! (laughs)

Alana: (Picks up phone) Okay, okay, okay, okay, okay!

Peter: (laughing) Yes, I can listen to that as many times as hah hah hah

Alana: I listened to it yesterday

Since they had all listened to the recording earlier, they now shared the anticipation of the humor of the missed notes. Once Alana located the recording (more on this later), she played it, and as the bad notes approached they looked at each other smiling in anticipation. Once the squeaky notes played they all broke out in laughter as Alana tipped over from the waist and Lee put his head in his arms.

Alana: I love that, like "eeaaawww" (mimicking the bad notes). Let's listen to that again.

(Laughing continues, she restarts the music just before blooper, and all laugh as music ends)

Alana: Baa, duuh huh, that's really good

Lee: That's so funny

Alana: That's so sad

Lee: He just like went up three octaves just in the middle of it. (Brings arm up as if holding violin) There's a note up so far there. (Peter and Lee laugh)

Peter: No, maybe not

Alana: (Mimicking the squeaky playing) dah, dah, dah dah dah dah dah

Lee: Ahhhh

Alana: It's sad.

Even though they had each listened to the recording many times on their own, they still wanted to listen to it again – twice in fact – so they could share the experience together. Perhaps this local re-experiencing of prior remotely-shared content played the same role as twice-told tales in that it fostered group rapport, ratified membership into the group of people who can appreciate the humor of the bad note, and conveyed their shared value of respecting the prodigy's skill even though he made a glaring mistake.

This example also shows an interesting way in which the technology affected the storytelling process. Using her phone, Alana initially had trouble locating the recording from Peter's email. While she waited for the email to load, Peter used the time to tell a story related to the clip: that a friend of Sean's played that concerto at Sean's wedding a few years later and re-enacted the very same mistakes from that recording. Peter explained, "*He like, like apparently listened to it over and over so he could get, like exactly the same mistakes.*" After they laughed about this, Alana concluded that she couldn't find the clip, but Peter said she could get it from Sean's website. This led to a discussion about how impressed they were that Sean would make it publicly available, that he wasn't "traumatized" by it.

These topics were discussed *before* they listened to the clip together. In the standard sequence, this sort of discussion

would occur in the response phase, *after* the telling. This reversal was caused by Alana's difficulty in locating and downloading the piece, which took about five minutes. As technologists, our instinct is to try to "fix" the problem by making it easier for her to find the clip, a good goal, but it's also worth noting that the delay allowed them to build up a rich context for the playing that enhanced their appreciation of it. Once they knew Sean's friends re-enacted his performance at his wedding, errors in tact, the replaying was even funnier.

Finally, we note that for about five minutes, Alana split her attention between the conversation and her phone as she searched for the music, but again her behavior was not treated as rude because it was in service of a joint activity.

Just as people wanted to share content multiple times with the same people, they also attempted to share the same content with different people as the opportunity arose. In one such case, Drina was listening to music on her laptop while on the phone with her other sister, Carmen. Carmen asked what the song was and after discussing it, she reciprocated by sharing her own song: "You know what song I can't get out of my head?" Once she got Drina's interest she looked for the song, but just as she found it Drina got another call and so disengaged before hearing the song. A short while later, Carmen was on the phone with her brother, who told her about his plan to buy a guitar for their other brother. She responded by saying, "Teach him this song, bro," and played the same song. In a similar pattern, Lee played a recording of a Schubert cello quartet to Scott on his laptop, noting that he didn't like the composition's last two notes. Later, when the rest of the group arrived, he played it for everyone, looking for further agreement that the last two notes "are so messed up."

In these cases, the person had a recorded piece of content they wanted to share and they did so with multiple people over different channels as opportunities arose, both remotely and in person using mobile technology. We see these as cases of channel blending over time.

Technology implications: These examples indicate that technology could better support serial sharing across remote and local channels by keeping track of the content people have previously viewed or shared and making it easy to re-access, possibly via a different device. Since the topic of conversations is unpredictable and flows dynamically, it should be easy to re-find previously viewed content, even without saving or tagging the item in advance, without breaking the flow of conversation. The first interaction further suggests that asynchronous sharing of content can be less satisfying than real-time sharing, and so people may re-share the same content with the same people when they get together in person or establish a synchronous connection. Thus, we should make it easier to re-access content shared through other channels.

Channel blending interactions over time

When we think about storytelling or content sharing, we tend to think of it as happening in a single interaction in which the story is told and people respond in that same "session." Social media and email support asynchronous sharing, allowing one person to share at one point and others to express their response later. However, we saw cases where even synchronous sharing happened serially, that is across multiple sessions over different channels.

In one type of "serial sharing," people told the story of an experience over a series of interactions, perhaps starting the story in a phone call or text exchange and continuing it F2F. In one example, Clarisse went with a friend to a farmer's market at which she fell in love with chocolate mint plants. When she next spoke on the phone with her older sister Carmen, she enthused about it, ("*We got mint, oh my goodness!*") explaining that she would try to grow it in a pot. Later when Carmen came over to visit, Clarisse showed her the mint and asked her to taste it, emphasizing how it tastes just like a real mint candy. ("*It feels like you're eating a mint, it feels like a mint!*")

In this example the sharing is of a physical object rather than a recording, but we also saw cases where people carried out social acts serially. Invitations and subsequent coordination activities were especially likely to occur across multiple sessions and channels. In one example, Lee was instant messaging simultaneously but separately with Alana and a friend Peter, whom he was meeting for dinner. He invited Alana to join them, but she hedged in her reply.

Alana: i don't know if i want to come
Alana: ...
Lee: you just want to sit in your room and be lame on film?
Lee: come come come
Lee: dinner's on me
Alana: OH HAYYY
Alana: well if you're paying
Alana: haha
Alana: just kidding
Alana: yeah I don't know
Lee: ok
Lee: ::hug::

Lee dropped the subject and they briefly discussed something else, and he updated Peter that Alana was "being flakey." A few minutes later, without ending the IM conversation, he called Alana while walking to his car, surprising her with the shift in media:

Alana: Lee
Lee: Hey
Alana: We're talking online!
Lee: uh, I'm outside, do you want to come to dinner or no?
Alana: (drawn out) Iiii dooon't knooow
Lee: I can come pick you up
[6 more turns]
Alana: Do you wanna walk? It's so nice
Lee: Okay, we can walk, do you wanna come?
Alana: Okay

After clarifying the reason for calling, Lee re-invoked the invitation, which Alana finally accepted. Here, the interaction took place over two sessions and two media. In other cases, the agreement to get together was only the beginning, as people then had a series of exchanges through different media to coordinate meeting up. Ling [16] characterized this phenomenon of micro-coordination in which people don't make firm plans but instead use texting and phone calls to coordinate as they converge. What was new for us was the large number of interactions that were carried out over multiple channels with multiple people as their plans changed and problems cropped up.

In one case, Drina made arrangements with her friend Brent to pick her up and drive to a coffee shop where they would meet up with another friend, Barton. Brent was more than an hour late, so they were delayed in meeting Barton. Drina's coordination effort with both friends involved a total of 18 interactions, 8 with Brent (5 phone calls, 2 phone text exchanges, and one Facebook post) and 10 with Barton (2 Facebook chats, 3 phone texts, and 5 phone calls).

Interestingly, 18 years ago, Whittaker, et. al [25] discussed intermittent interactions, noting that they mainly occurred F2F where people have many opportunities to run into each other. They stated, "the challenge for future technology is in supplying this type of information for geographically distributed groups." As technology developed, researchers noted cases when people carried on similar intermittent interactions over IM, or even across media by using IM to arrange a phone call [17]. Our examples show how technology has developed even further to support this activity. People are now continuing the same conversation across a wider variety of media (texting, voice calls, video calls, websites), sometimes crossing channels multiple times, and sometimes incorporating multiple people.

Technology implication: From the participants' point of view, these exchanges were part of one ongoing activity (telling a story, issuing an invitation, meeting up in person) even though they were carried out over time over multiple channels. Yet each technology treated them as a series of unrelated connections, with no history and no context. Each time the participants had to re-establish the status of their plans. Some of these interactions involved multiple people, again some local and some remote, who all needed to stay updated on the current state of the activity. Future technology could be designed so that context is maintained when people switch channels within a conversation, and support multiple participants who may participate over different channels to different degrees.

CONCLUSION

Together, these examples demonstrate a phenomenon we are calling channel blending, the fluid and coherent integration of interactions and content over multiple channels, often involving both local and remote participants. We also saw cases of people channel blending over time by carrying out one coherent interaction over a series of interactions using different media. We have shown

that although it often involves the simultaneous use of multiple devices and communication streams, channel blending contrasts with multitasking in that people attempt to merge them into one shared activity, rather than switching between separate, unrelated activities.

To be clear, we do not claim that all these channel blending examples are newly discovered behavior. As noted, others have reported cases we are including in the notion of channel blending – conversations being conducted over multiple sessions [17, 25] or including people in the remote and local environment [5, 21, 26]. We are proposing that these instances are part of a larger phenomenon in which people attempt to blend their local and remote worlds into one coherent interaction when sharing content and experiences with friends through their devices. Further, these behaviors are becoming more varied, and possibly more common, because of the prevalence of ubiquitous devices and bite-sized content.

It is notable that we saw this activity among a generation that is touted as the ultimate multitaskers, people who think nothing of watching videos, doing homework, texting, checking status updates, and listening to music all at the same time [1, 2]. In light of our findings, it would be useful to study how often such people are in fact integrating those activities into a channel-blended interaction rather than simply switching among them as separate activities. We saw evidence that our participants didn't find it rude to focus on multiple channels when they were doing it in service of a shared activity. Perhaps at least some of the time, people are channel blending rather than multitasking, and therefore not inspiring others' frustration.

Our findings indicate that channel blending is not always easy to coordinate through current technology. It required great skill for a pivot person to smoothly integrate comments from both local and remote participants, and for people to monitor and smoothly introduce remote content into ongoing local conversations. People who were remotely connected over multiple channels had trouble sharing information across channels. It was difficult to re-access previously experienced content for re-sharing. Problems also occurred as people lost track of context when a conversation traveled across channels over time.

To address these difficulties, we might think differently when designing future communication and content-sharing technology:

- Rather than imagining people using a system alone, we should remember that people often use it in social settings with others who engage with them and the technology to different degrees over time. Rather than just connecting remote parties, we might find ways to integrate other co-present people who may be actively or passively engaged in the interaction.
- In addition to making it easier for people to access content from anywhere, we might find ways to facilitate the sharing of that content with others on another channel or device, whether co-located or

remote. Further, the response to a storytelling can become part of the story as it is retold a second and third time to others, perhaps through other channels.

- Rather than thinking of sharing as a one-time event, we can expect repeated sharings, sometimes with the same people and sometimes with others, remotely or F2F.
- Rather than thinking in terms of technology-based sessions, we might think about coherent social acts that may take place over time and across channels (including F2F), and allow people to build on the context created during the ongoing interaction.

We were able to detect channel blending by studying groups of people rather than one particular technology, and by directly observing each person carrying out their activities. The video recordings allowed us to review the interactions repeatedly until we understood them in all their richness. This method showed us that communication and content-sharing technology should be designed with the expectation that people share the stories of their lives over multiple interactions, using multiple devices and media, with different overlapping sets of people, as they converge and separate and come together once again.

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