Taking Notes or Playing Games? Understanding Multitasking in Video Communication

Jennifer Marlow
FXPAL
marlow@fxpal.com

Eveline van Everdingen
Vrije Universiteit Amsterdam
e.a2.van.everdingen@student.vu.nl

Daniel Avrahami
FXPAL
daniel@fxpal.com

ABSTRACT
This paper presents a detailed examination of factors that affect perceptions of and attitudes towards multitasking in video conferencing. We first report findings from interviews with 15 professional users of videoconferencing. Our interviews revealed the roles and potential link of technology and activity. We then report results from a controlled online experiment with 397 participants based in the United States. Our results show that the technology used for multitasking has a significant effect on others' assumptions of what secondary activity the multitasker is likely engaged in, and that this assumed activity in turn affects evaluations of politeness and appropriateness. We also show that different layouts of the video conferencing UI can affect perception of engagement in the meeting and in turn ratings of polite or impolite behavior. We propose a conceptual model that captures our results and use the model to discuss implications for behavior and for the design of video communication tools.

Author Keywords
Multitasking; Video mediated communication; Experiment; Video conferencing

ACM Classification Keywords
H.5.2 [Information Interfaces and Presentation]: User Interfaces - Interaction styles.

General Terms
Human Factors; Design; Measurement.

INTRODUCTION
In a connected digital world, in which notifications, communication, and immediate access to information all fight for our attention, the temptation to multitask during face-to-face and online meetings is great. Certainly, the modern workplace is full of distractions that can be difficult to manage. Multitasking often results from external events and interruptions, or it can be self-initiated [1, 10, 11, 13].

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Figure 1. Multitasking on a mobile device during a video conference (a keyframe from the experiment).

The pressure to multitask can be exacerbated by a workplace culture that requires employees to attend to multiple tasks or multiple projects at once [17]. With the proliferation of personal smartphones, tablets and other mobile devices in the workplace, opportunities to self-interrupt, be interrupted, or multitask have grown. Furthermore, with such personal devices, the delineation between personal and work activities in the workplace is blurring.

As distributed work teams become more prevalent, more and more meetings are being held over video conferencing. This can involve groups of people communicating via conference rooms with a specialized video setup, but another common scenario is one-on-one meetings with participants connecting to a video call from a personal laptop or desktop computer. This means that in some cases people are already using the computing device that they will also be using for multitasking.

While the effects of multitasking in face-to-face meetings have been previously studied, the perceptions and effects of multitasking in small, video-mediated work conversations – the focus of this paper – are not well known. Past research has provided anecdotal evidence that participants in video-mediated meetings and conversations both engage in multitasking behaviors and suspect others are doing so too (e.g. [6]). Building on these observations, the goal of the present work was to answer the following research question:

What factors influence perceptions of and attitudes towards multitasking behavior in video conferencing?

To investigate this question, we first interviewed people whose jobs involved remote collaboration about their experiences with multitasking during video conferences. These interviews uncovered parameters that influence the obviousness and acceptability of multitasking behavior. We then conducted a controlled experiment to tease apart the relative influence of various technical and social factors on perceptions of multitasking behaviors in a video conference-based meeting between two people (see Figure 1).

Through the combination of interviews and a large controlled experiment we make the following contributions to the field of CSCW: 1) An exploration of the context of multitasking in videoconferencing, uncovering the roles and potential link of technology and activity, 2) A controlled investigation of the effect of technology-related factors on observers' evaluations of multitasking behavior, and their assumptions about what secondary activity is being engaged in, and 3) A demonstration of the role that the design of the videoconferencing tool itself may have in influencing perceptions and outcomes. Our results have direct implications for the design of videoconferencing tools and device ecosystems for reducing the negative impact of multitasking on communication.

RELATED WORK

Multitasking in face-to-face meetings

Multitasking activities during a meeting can take many forms: they may be related to something that is going on in the meeting (e.g. verifying information, looking at the document being discussed), they may be related to other work that the participant needs to get done, or they may be personal and unrelated to either the meeting or work. Several lines of work have looked at the role of multitasking during in-person meetings.

One relevant area pertains to differences in the perceived politeness and self-reported frequency of using technology such as laptops and mobile phones for work or non-work purposes during meetings [5, 25]. Particularly, multitasking may not always be easy to detect. For example, when laptops are used during a meeting, speakers cannot be sure what a laptop is being used for (e.g. taking notes or browsing the internet), which may deter them from attributing disrespect [14]. Additionally, it is not always clear to an observer whether a multitasking behavior (for example, replying to a text message during a meeting) is necessary or not [17].

Finally, individual characteristics also influence the degree to which multitasking is viewed as acceptable. For example, an individual's own tendency to multitask [4], national culture [8], social and organizational norms [23] and gender [25] can influence perceptions of the acceptability and civility of doing other things during a meeting.

Video-mediated multitasking

Multitasking behavior over video conferencing has been described in both work-related [6] and personal conversations. For example, teenagers often divide their attention between multiple activities (like browsing the internet or social networking sites) while on a video call [7].

Several elements may contribute to a desire to multitask in online meetings: First, the communication itself most likely takes place on a computing device (a computer, tablet, phone, etc.) where other applications and information await. Next, unlike in face-to-face meetings, in video conferencing, only a small part of the user's body and surroundings are typically visible to other parties in the meeting allowing to potentially hide their secondary activity. Finally, it is even possible that participants would feel that in online meetings, even if it were known that they are multitasking it could be less obvious to other parties who are not co-located what it is they are doing.

One impact that multitasking can have on video communication is that it potentially affects gaze. People are fairly accurate at detecting when eye contact/gaze is being directed at them, and this feeling of direct eye contact can build trust [3]. For this reason, much research on building video conferencing systems has focused on finding ways to enhance the perception of direct eye contact (e.g. [12]). Multitasking can disrupt the feeling of direct eye gaze by causing an individual's attentional focus to be directed elsewhere. For example, when engaging in an unrelated chat or email during a video conference, attention and eye gaze will be shifted away from the webcam or video chat screen.

Therefore, the technology used for multitasking may play a big role in influencing perception. For example, a user performing the secondary task on their smartphone will appear different from a user performing the secondary task on the same screen where the videoconferencing software is running. People participating in meetings with a single device have greater obscurity with regards to what they are doing (they could be doing different things in different browser tabs, only one of which is visible at any given time.)

In addition to *where* a person is looking, the *reason* for the multitasking, or perhaps more importantly, the *reason assumed* by the other person, is likely to also influence perceptions of the appropriateness of the behavior. The effects of gaze are at least partly determined by a subjective interpretation [9]. Therefore, an observer's assumption about what a person is looking at could affect perceptions of behavior more than any absolute activity.

Consequences of multitasking

Multitasking in a meeting can be disruptive and counterproductive to other participants. For example, 51% of respondents to a recent survey about videoconferencing cited people who are multitasking – e.g., tapping on a keyboard – as a major distraction [21]. When there is a large group, there may be some expectation that not all participants need to be actively engaged. In one-on-one interdependent conversations, however, multitasking by one party all but guarantees a disruption in the flow of events [17].

The concept of actor-observer asymmetry [19] states that people often perceive their own behavior in a way that is different than how others perceive that behavior. This has been observed in the context of multitasking during face-to-face meetings [5], where respondents thought others were much more likely to be playing games, browsing their social network or browsing the web during meetings than they reported doing themselves.

Although individuals may think their own multitasking behavior is either unobtrusive or appropriate, they tend to evaluate others who are multitasking more harshly and see that behavior as rude [16]. Krishnan et al. [17] found that when a negotiation partner was receiving and checking text messages during a conversation, they were perceived as less professional and less trustworthy. It is possible that a similar phenomenon will also occur in video-mediated communication with regards to the perception of multitasking. A multitasker in a videoconference might also feel that their behavior is less obvious since their conversation partner does not have access to the full set of cues about what they are doing.

Ultimately, multitasking in a video conversation involves a series of tensions between a person's need or desire to perform multiple tasks, and a need to focus (and appear focused) on the video communication. The ambiguity of behavior that comes with multitasking in video conferencing could be beneficial or harmful to different parties in the conversation.

In this paper we examine the following general questions: *How is technology used for multitasking in video conferencing? What factors affect attitudes towards multitasking in video conferencing?*

To answer these questions, we first conducted a series of interviews with remote workers about their experiences with multitasking in video communication. We then used the insights gained through these interviews to design and conduct a controlled experiment that explores these factors in detail. In the remainder of this paper, we report the findings from the interview and experiment, then discuss implications for behavior and technology design.

VIDEOCONFERENCING IN PROFESSIONAL USE

To begin understanding the different instances in which multitasking might occur during video meetings, we conducted semi-structured interviews with professional users of videoconferencing technologies. These interviews were conducted as part of a larger study on videoconferencing practices. We interviewed 15 knowledge workers (11 male, 4 female) from a variety of industries and companies. In these interviews, participants discussed their use of video conferencing for both one-on-one and group video conferencing meetings. Across the cases, multitasking naturally emerged as a major theme when experiences with videoconferencing were discussed.

Participants mentioned engaging in multitasking themselves and suspecting that their meeting partners were doing the same. However, all multitasking was not the same, nor was the way in which it was performed. From the many examples given by the interviewees, the *nature* of the multitasking activity and the *device* on which the secondary activity occurred emerged as two key dimensions. We analyzed all examples pertaining to multitasking with these two dimensions in mind.

The nature of the multitasking activity

Comments about the multitasking activities fell into three main categories: First, the multitasking could be meeting related where a participant may wish to look at related documents, check facts, or engage in "sidebar conversations" related to the topic being discussed in the meeting. This type of behavior is related to the topic being discussed in the meeting, but may mean shifting one's attention to a different part of the screen, a different area of the screen than the video window, or to a different screen altogether. The second category of activities was other work-related multitasking in which a participant may be distracted by another important or urgent work-related inquiry, such as an IM message from another colleague or client. Finally, a third category was personal activities such as checking personal email, browsing Facebook, or playing with physical toys.

Meeting-related multitasking

Interviewees provided examples of cases where they (or their teammates) would multitask during meetings, but the multitasking behavior was relevant to the content being discussed. Typically this took place in large group conferences; this type of "sidebar" behavior has been frequently observed in other contexts as well (*c.f.*, [20]). As one interviewee said:

> *One thing that happens sometimes is we have IM chats, like side conversations going on during the meeting. Usually, I can't do that, because I am the chair, so I am usually sharing, so I can't.* (P9)

In cases where screen sharing of common referents like documents, photos, etc. was a main focus of activity, it was possible that a meeting participant would pull up the referent in a new browser tab or window and focus their attention on the artifact. This, however, was challenging because it meant that they were unable to focus on the video window showing the "talking head" of their conversation partner, but they were nevertheless engaged in the topic of the conversation even if their gaze was not directed at the other person.

> *I find it hard to engage [over videoconferencing] with people. I find I am not actually looking at them most of the time when I am video conferencing. It is the same way with the lesson. I am looking at the photo that he sent me, I am not looking at him.* (P7)

> *We weren't screen sharing or anything. I guess we just tabbed away from the video screen and then had the doc*

up. When we were referencing it, we could go through it together. (P1)

Other work-related multitasking

Another category of multitasking behavior was dealing with disruptions related to other work not relevant to the meeting. For example, responding to another colleague's messages or interruptions during a meeting (for example, if a question needed to be addressed). This meant that the focus would not completely be on the conversation.

> *Sometimes I have other interaction going on with other team members and side comments. I have another IM going on.* (P2)

This type of behavior would sometimes occur in videoconferencing meetings that involve multiple people at a single location:

> *There's two people remotely, three people in the room, and somebody asks a question and the people remotely are talking, and then somebody in the room thinks it's okay to ask me a question about something slightly different while they're talking.* (P4)

Personal and unrelated multitasking

Finally, a third category of multitasking behavior that was mentioned was doing personal or unrelated multitasking during a meeting, often not paying attention to the conversation.

> *If you're not in on the conversation, if it's something completely unrelated to you, you might be playing with Buckyballs or reading your email instead or something like that.* (P11)

In fact, being able to multitask without being seen was cited as a reason for preferring to meet over the phone instead of via a video call:

> *Usually, I don't like doing video because if you're working on something else, it would be rude to not look at the camera all the time, so personally I prefer voice calls...* (P6)

The same interviewee noted that when she was working on something else off-screen, audio cues could still give away the fact that she was otherwise engaged:

> *If I'm typing something, you can hear it in the chat, and I feel really bad because it's obvious sometimes.* (P6)

Technology used for multitasking

Another theme that emerged was that participants had different technical configurations for their work. The comments that they made suggested that certain configurations were more likely to be used for some purposes than for others. For example, laptops could be used for meeting-related multitasking:

> *If something's mentioned mid-conversation, I might actually look into it while other people are talking about it on my laptop but yeah, it's not consistent amongst all the employees whether we do or not... [Name], for instance, almost always brings her laptop to the table and is usually multitasking in the middle of the conversation.* (P11)

Having multiple monitors also enabled one participant to refer to relevant meeting-related material in the course of a conversation:

> *I actually have four monitors on my system, and most people have two. You can be sharing a couple of screens and looking at a third screen to look up stuff.* (P9)

Other activities were not tied to an exclusive configuration. For example, taking notes or accessing email could occur on either a laptop *or* a mobile device:

> *Yes, usually take notes on my iPhone or on Note.* (P7)

> *I'd say 25% of the time I am doing emails on my laptop and I'd say 70% of the time or 65% of the time I'm doing it on my phone. Then 5 to 10% of the time I'm doing it on my iPad.* (P5)

These initial findings give valuable insight into self-reported multitasking behaviors and the range of activities engaged in, and devices or technologies used. These insights also expose three important questions: How does the technology used for multitasking affect observers' assumptions about the secondary activity? How does technology affect evaluations of the appropriateness and politeness of the multitasking behavior? And finally, does the video conferencing tool itself influence perceptions of multitasking?

EXPERIMENT

To further understand how the factors elicited in our interviews influence perceptions of, and attitudes towards multitasking behavior in video conferencing, we designed a controlled experiment. In the experiment, participants viewed one of a set of short video clips depicting a part of a videoconferencing meeting between two coworkers. In the clip (except for a control condition), one of the coworkers engaged in multitasking (see Figure 1).

Participants then rated the behavior of the people in the clip along several dimensions of interest, including politeness, engagement, and the likely secondary activity of the multitasker. We focused on one-on-one interactions as a good starting point because this is a setting in which perceived attention should be most important (there is no plausible deniability or doubt about participation). We were interested in what influenced the perception of *what activity a person was likely to be doing*, *how engaged did they seem*, and *how appropriate or polite their behavior was.* The two key elements manipulated in the experiment were thus the technology used for the secondary task, and the layout of the videoconferencing tool.

Hypotheses

In our interviews, laptops, second monitors, and smartphones were all mentioned as technologies used for multitasking during videoconferencing. Given that these devices are commonly associated with different primary uses, we hypothesize that seeing a person multitask on different devices will influence what observers assume the person is doing:

H_1. The technology used for multitasking will have a significant effect on the assumed secondary activity.

The assumed activity should, in turn, affect how polite and acceptable multitasking behavior is judged:

H_2. The assumed secondary activity will have a significant effect on ratings of politeness and acceptability.

Furthermore, the technology used may make multitasking easier to spot and may have a direct or indirect effect on how polite or acceptable the multitasking behavior is judged:

H_3. The technology used for multitasking will have a significant effect on ratings of politeness and acceptability.

Still, if H_3 is supported, would more overt multitasking be considered more or less acceptable? On one hand, multitasking on a different screen or device may be seen as more forthcoming and less deceiving, and thus more polite. On the other hand, multitasking on the same screen may be seen as less egregious and more ambiguous. We thus pose two, contradicting, sub-hypotheses for H_3, expecting at least one to be rejected.

H_{3a}: Multitasking on one screen will be rated as more polite and acceptable than on a second-screen or mobile device.

and

H_{3b}: Multitasking on a second-screen or mobile device will be rated as more polite and acceptable than on one screen.

Finally, we were interested in whether the presentation of the parties in the videoconference influences attitudes towards multitasking. While in some videoconferencing tools the local and remote participants are both shown at the same size, in others, the video of the remote participant occupies the majority of the screen and the local participant is only shown a small video of herself. We hypothesize that a larger view of multitasking by a remote participant would reduce ratings of their engagement in the meeting and the acceptability of their behavior:

H_4: Seeing multitasking in a visually larger format will reduce ratings of the multitasker's engagement in the meeting and how polite and acceptable their behavior is.

Method

For the experiment, which employed a between-subjects design, we created a set of short 1-minute video clips depicting a part of a meeting between two coworkers. In these clips, one coworker ("Person A") describes three different locations in which an advertising campaign could be conducted. The second coworker ("Person B") passively responds to Person A's remarks with short comments such as "yeah" and "uh-huh". While the clips varied along several dimensions (detailed below), all clips without exception followed the script shown in Figure 2.

The video clips were created as follows: First, in order to control for differences that might stem from the gender of the coworkers depicted in the videos, we created two versions of each clip: one in which Person A and B were both male, and one in which Person A and B were both female. The script, timing, and behaviors were identical across the two versions. For simplicity, in the remainder of this section, whenever a clip is described, it should be assumed that two identical clips were created for both actor genders.

In order to maintain experimental control, we recorded the video of Person A once, and used this video in all the conditions. This novel approach prevents any difference in the behavior of Person A from influencing participants' judgment of the behavior of Person B.

To test the effect of the technology used for multitasking, we created three versions of the video with Person B multitasking (see Figure 3) and a fourth version with no multitasking. In all conditions, Person B begins by directing

A:	...Which is why we need it by next Thursday.
B:	I see… Should I talk to Don about it?
A:	Yeah. That's a good idea.
A:	So...the main thing I have for today is that I wanted to get your opinion on three potential locations where we ***[notification sound plays]*** could show the ads as part of the marketing campaign
B:	Uh-huh
	B begins multitasking
A:	So, looking at the pictures I took today, the first location is a bus stop downtown near the courthouse. The Northbound and eastbound buses all stop here so there should be lots of potential traffic.
B:	Mmmhmm….
A:	The second location is a billboard that is next to the highway
B:	Yeah
A:	The third location is near the baseball stadium
B:	Sure
A:	Now, if you look at the email I sent, you can see the relative costs and potential views for each of the locations.
	B looks back at A
A:	The bus stop is going to be the least expensive, the billboard is the most expensive, and the baseball stadium is somewhere in between.

Figure 2. Video script: An exchange between two coworkers (Person A and Person B).

a) Multitasking on the same screen **b) Multitasking on a dual monitor** **c) Multitasking on a mobile device**

Figure 3. Sample key-frames showing B's gaze when multitasking in three experimental conditions.

a) Side-by-Side UI layout **b) Big-and-Small UI layout**

Figure 4. Two UI layouts used in the study based on common layouts in video conferencing applications.

their gaze towards the webcam (straight ahead). However, after a short notification sound is heard, Person B starts engaging in multitasking. In the first version, the *Same Screen* condition (Figure 3a), Person B directs their gaze to a different window on the same screen on which the videoconference is taking place. In the *Dual Monitor* condition (Figure 3b), Person B directs their gaze to a secondary monitor set up next to the main screen. In the *Mobile device* condition (Figure 3c), Person B directs their gaze downwards to a mobile phone they were holding and interacting with in their lap.

In order to test hypothesis H_4, we created two versions of each video that varied in the presentation layout of the videoconferencing (see Figure 4). We chose two common layouts of videoconferencing applications. In the first layout, which we refer to as *"Big-and-Small"*, Person B is shown in a large window occupying the majority of the video and Person A appears in a small thumbnail (Figure 4a). This layout is similar to popular videoconferencing applications such as Skype and Google Hangouts. In the second, *"Side-by-Side"* layout, Person A and Person B are shown side by side with equal size video feeds (Figure 4b). This common videoconferencing layout is used most often in multi-person video meetings.

To summarize, the full experimental design was as follows:

× 4 Multitasking Technology (*Same Screen, Dual Monitor, Mobile Device, None*)
× 2 Layout (*Side-by-Side* vs. *Big-and-Small*)
× 2 Actor gender (*Female-Female* vs. *Male-Male*)

= 16 conditions in total

Measures

After watching the video, participants were asked to give open-ended responses describing separately what they saw each person in the meeting do. We used these open-ended responses both to confirm that participants had paid attention to the video clip and also to get an initial sense of their impressions of and reactions to Person A and Person B's behaviors.

To test hypotheses H_2 and H_3, we asked participants to rate the behavior of Person B (the multitasker). Since the participants in our experiment only observed the meeting rather than participated in it (not an uncommon situation in multi-person meetings), we asked them to rate the obviousness of the multitasking from their perspective, and the perspective of Person A. The following were rated on a 5-point Likert-scale ranging from "Completely Disagree" to "Completely Agree"

1. Person B's behavior was *polite* during the conversation
2. Person B's behavior was *acceptable* during the conversation
3. It was obvious to me that Person B was multitasking
4. It was obvious to Person A that Person B was multitasking
5. Person A was engaged with the meeting
6. Person B was engaged with the meeting

Next, in order to test H_1 and H_2, participants were asked to rate the likelihood that Person B was engaged in each of a set of 8 secondary activities on a 5-point Likert-scale, from "Very Unlikely" to "Very Likely". Two of the 8 activities were meeting related (*"Focusing on the document person A*

is talking about", and *"Searching for other locations for the advertising campaign"*), three were related to other work activities (*"Looking at a document for another project"*, *"Reading a work-related email from another co-worker"*, and *"Chatting with another co-worker"*), and three were personal activities (*"Browsing Facebook"*, *"Reading a personal email"*, and *"Chatting with a friend"*). The order of the list of activities was randomized for each participant.

Finally, we collected demographic information, including participants' age, gender, experience with video conferencing (Skype, Google Hangouts, etc.) and comfort with multitasking (using the PAI scale of polychronic-monochronic tendency [15]).

Procedure

The experiment was set up as an online experiment using Amazon Mechanical Turk. Participation in the task was limited to individuals in the United States. Upon accepting the task, participants were randomly assigned to one of the sixteen conditions described above. Participants were shown a 1-minute video clip of the videoconferencing meeting based on their assigned condition. We used a timer on the page to prevent participants from advancing past the video before the video was finished. Participants then answered the open-ended questions, rated the behavior they saw in the video, and finally provided biographical data and information about their multitasking preferences.

We recorded the time participants took to interact with each page of questions in order to filter participants who quickly answered all the questions or neglected the task for very long durations. We also included a "check question" about the locations discussed in the meeting (see Figure 2) to ensure that participants had paid attention to the content of the video. The full task took 3 minutes to complete. Participants were paid 30 cents for their time.

Participants

436 participants completed the task[1]. We excluded 18 participants who failed to answer the check question correctly or gave the same rating value to all questions. We also excluded 10 participants whose completion time was too short/long based on a Mahalanobis Outlier analysis. Thus, our full dataset for analysis included 408 participants, with an average of 25 participants per condition (Min=17, Max=36, SD=5.36). 48% of participants were women. Age was reported in bands with 50% between the ages of 25-34.

RESULTS

Overall, participants appropriately rated Person A as highly engaged in the meeting (M=4.4) and Person B as less engaged (M=2.6). A Wilcoxon Signed Rank test shows this difference is significant ($p<.001$).

Politeness ratings and Acceptability ratings were significantly highly correlated (r=.82; p<.001). Ratings of Person B's *engagement* in the meeting were correlated with the behavior seen as polite ($r=.71$; $p<.001$) and acceptable ($r=.67$; $p<.001$). On the other hand, the more *obvious* it was that multitasking was taking place, the less polite ($r=-.49$; $p<.001$) and less acceptable ($r=-.42$; $p<.001$) the behavior seemed. A comparison showed that participants thought it was more obvious to them that multitasking was taking place than to Person A (M=3.5 vs. M=3.0; $t(396)=9.4$; $p<.001$). In the remaining analyses, we look only at how obvious multitasking was to the participant.

Open-ended responses

Checking participants' open-ended responses to confirm our manipulations, it was apparent that overall, they perceived what was happening in the videos as intended. Many expressed an opinion that Person A was "*actively involved in the conversation and was leading it.*" For the multitasking conditions, many responses referred to Person B doing something else (whether it was explicitly noted or 'presumed' behavior). Participants also referred to noticing a change in Person B's gaze, body language, and behavior (e.g. "*Person B started off engaged and then kind of got distracted or drifted off*").

In the process of examining the open-ended responses, we also discovered that while participants in the Mobile Device condition easily identified that multitasking was taking place (and gave a high rating for multitasking being obvious, M=3.88), more than half of them thought that Person B's secondary activity was *taking notes* rather than interacting with their phone (as opposed to the Dual Monitor condition where multitasking was both rated as obvious (M=4.1) and correctly perceived as happening on a second screen). The fact that a downward gaze was as easily interpreted as being fully engaged in the meeting as it was as being completely disengaged is interesting. However, in order to understand attitudes towards multitasking in the context of technology use, we wanted to focus on exploring participants' reactions when they realized that Person B's activity was taking place on a phone, not on paper.

To address this, we recruited 49 new participants for the Mobile Device condition, this time clarifying that Person B's downwards gaze was directed at a phone. Specifically, prior to watching the video, instructions now stated that "During the meeting, one person is looking at their phone." Examining the responses of these new participants showed that while multitasking was rated just as obvious as before (M=3.87), ambiguity was reduced, with comments often referencing the use of a phone (e.g., "*Person B was distracted and checking his phone messaging. He wasn't offering any feedback to Person A except for a minimal 'mmhuh' etc. He was being rude, disrespectful and inattentive to Person A*", and "*She basically listened to*

[1] Nearly half (47%) of participants attempted to complete the task a second and third time; however, to keep the experiment as a between-subject design, only their first attempt was kept.

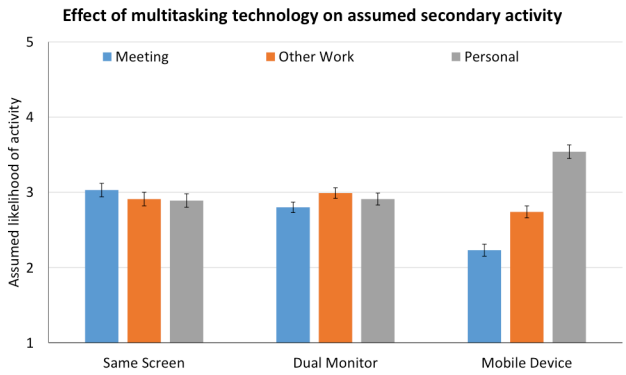

Figure 5. Effect of technology on assumed activity.

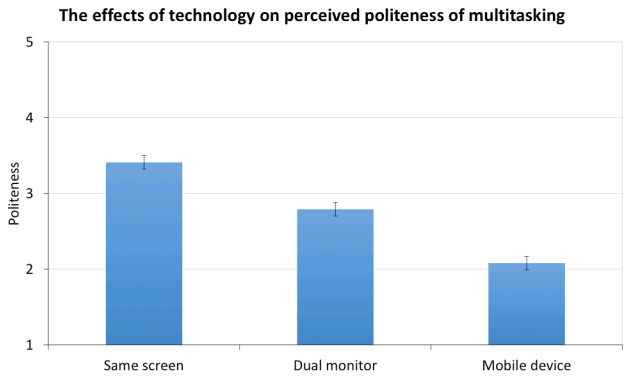

Figure 6. Effect of technology on politeness of multitasking.

Person A and then she started looking at her phone and not really listening. She was kind of rude."). In subsequent analyses, for the Mobile Device condition, we used the data from these new participants. The full data analyzed thus includes a total of 397 participants.

Multitasking vs. No Multitasking

To test the underlying assumption that multitasking is perceived more negatively than no multitasking, we align-ranked participants' ratings [26] and performed analyses of variance (ANOVA) of Multitasking Technology on Politeness, Engagement (of B), and Obviousness of the multitasking. We then compared ratings from the Control condition and each other condition.

As expected, participants in the Control condition rated the Obviousness of multitasking very low, significantly lower than any of the multitasking conditions (M=2.3 vs. M=3.9; F[3,393]=50.7; p<.001). Behavior in the Control group was also rated as more polite (M=3.8) than in any of the other conditions (F[3,393]=53.5; p<.001) and more acceptable (M=3.7) than the Dual Monitor and Mobile Device conditions (F[3,393]=36.4, p<.001). However, engagement in the meeting in the Control condition was rated significantly higher than the Dual Monitor and Mobile Device conditions, but not different from the Same Screen condition (F[3,393]=18.7; p<.001).

We were now ready to test our hypotheses. In the analyses described below, we describe results from the 285 participants in the multitasking conditions.

The effect of technology on assumed secondary activity

To test H_1, which stated that the technology used for multitasking will affect the assumed secondary activity, we first combined the list of eight secondary activities into three Activity categories: *Meeting-related* activities, *Other-Work-related* activities, and *Personal* activities. We used the average likelihood rating provided by each participant for each category. We then conducted a repeated measures mixed-model ANOVA on the align-ranked ratings, with Activity Likelihood as the dependent measure. We included Activity Category, Multitasking Technology, and the interaction between them as independent measures. The gender of people in the video ("Video-Gender"), UI Layout, and the Participant Gender were included as control. ParticipantID was modeled as a random effect.

As shown in Figure 5, the interaction between Multitasking Technology and Activity Category was significant (F[4,573]=20.6; p<.001). When a mobile device was used for multitasking, participant assumed that the secondary activity was significantly more likely to be personal (M=3.54) than related to the meeting (M=2.23; t(573)=7.4; p<.001) or to other work (M=2.74; t(570)=2.4; p<.05). This result is important given that, according to the findings of our interviews, phones are often used for meeting related tasks. In the Same Screen condition, on the other hand, meeting-related activities were assumed to be most likely (M=3.03), significantly more than personal activities (M=2.89; t(574)=4.3; p<.001). Specifically, it suggests that people will assume that someone multitasking on their phone is doing something personal and unrelated to the meeting, while someone multitasking on the same screen is likely doing something related to the meeting. **This confirms H_1.**

Looking at all eight activities for more detail, we again find a significant interaction between the technology used and how likely a secondary activity was rated (F[14,2017]=16.9; p<.001). The activity assumed most likely for the Mobile Device condition was "Chatting with a friend" (M=3.8). For the Dual Monitor condition it was "Reading a work-related email from another co-worker". "Focusing on the document person A is talking about" was the most likely assumed activity in the Same Screen condition, significantly higher than in either the Dual Monitor or Mobile Device conditions.

Effects on attitudes towards multitasking

To test our hypotheses on factors influencing attitudes towards behavior, we performed analyses of variance (ANOVA) with Politeness, Obviousness, and Engagement as dependent measures and Multitasking Technology, UI Layout, Video-Gender, and Participant Gender as independent measures. To test the effect of assumed activity, we also included participants' likelihood ratings of activities (Meeting-related, Other-work-related, and Personal). Having found no effects of Age-range, experience with

videoconferencing, or Polychronicity tendencies, those were not included in the models reported here.

Effects on Politeness and Acceptability

Testing our second hypothesis, our analysis found a significant effect of the assumed secondary activity on Politeness. The more participants assumed the secondary activity was Meeting-related, the more polite they rated the behavior ($F[1,276]=40.9$; $p<.001$) and the more acceptable ($F[1,276]=57.6$, $p<.001$). The more they assumed the activity was Personal or related to Other Work, the less polite they viewed the multitasking ($F[1,276]=30.0$; $p<.001$ and $F[1,276]=7.8$; $p<.01$). The more the secondary activity was assumed to be Personal, the less acceptable it was rated ($F[1,276]=40.72$, $p<.001$).

As shown in Figure 6, the technology used for multitasking also had a significant main effect on Politeness ($F[2,276]=18.5$; $p<.001$). Technology used also had a main effect on Acceptability ($F[2,276]=14.7$, $p<.001$). A post-hoc comparison showed that Same Screen was rated as significantly more *polite* (M=3.4) than both the Mobile Device (M=2.1; $t(276)=5.8$, $p<.001$) and Dual Monitor (M=2.8; $t(276)=3.97$, $p<.001$). We found no additional effects on Politeness. Similarly, the Same Screen was also rated as more *acceptable* (M=3.5) than both the Mobile Device (M=2.19; $t(276)=24.04$, $p<.001$) and the Dual Monitor (M=2.88, $t(276)=17.67$, $p<.001$).

These results confirm both H_2 and H_3 and suggest that the technology a person uses for multitasking, and what people assume they are doing with that technology, significantly affect how polite and acceptable that behavior is judged.

Effects on Obviousness of multitasking

Looking at the effect of the technology used for multitasking on how Obvious the multitasking was, we find a significant effect ($F[2,276]=3.7$; $p<.05$), with multitasking rated as significantly more obvious on the Dual Monitor than on the Same Screen (4.1 vs. 3.6; $t(276)=2.64$, $p<.001$). Since less obvious multitasking (Same Screen) was also associated with higher politeness ratings, we may **accept H_{3a} and reject H_{3b}.**

Effects on Perceived Engagement

Hypothesis H_4 predicted that seeing Person B multitasking in a visually larger format will make them appear less engaged in the meeting and, in turn, less polite. Our analysis found a main effect of UI Layout on ratings of Engagement. However, the effect was the opposite of what we expected; Person B was rated as significantly less engaged when viewed in the *Side-by-Side* layout (M=2.3) than in the *Big-and-Small* layout (M=2.8; $F[1,276]=15.8$; $p<.001$). Thus, **we must reject H_4**. We return to this surprising result in the Discussion section.

Perceived engagement was also affected by the technology used for multitasking ($F[2,276]=4.3$; $p<.05$). Engagement was rated significantly lower when multitasking on a Mobile Device compared to on the Same Screen (2.0 vs. 2.9; $t(276)=2.9$; $p<.01$).

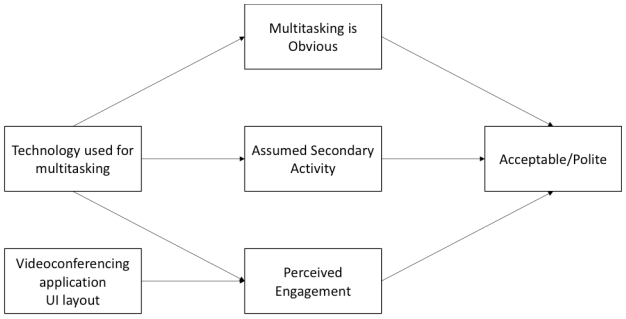

Figure 7. A proposed model of factors influencing perception of, and attitudes towards multitasking in video conferencing.

Effects of personal characteristics

As mentioned earlier, we found no effects of Age-range, experience with videoconferencing, or Polychronicity tendencies. We also analyzed the effects of Video-Gender as well as the participant's gender on attitudes and perceptions.

We found no significant differences between participants that watched a meeting between the two women and a meeting between the two men. We did find a small significant effect of the participant's gender on ratings of obviousness, with women perceiving multitasking as more obvious than men (4.0 vs. 3.7; $F[1,276]=4.5$; $p<.05$).

DISCUSSION

Our interviews and experiment give insight into multitasking during videoconferencing from the perspective of both the multitasker and the observer of multitasking. Our study also provides a first examination into how the unique affordances of video conferencing (such as UI layouts which show participants in different sizes, or a field of view that restricts what is seen) influence how such behavior is seen. In Figure 7, we propose a model summarizing the role of technology and UI layout on our outcome measures.

The results reveal that observers of video-mediated meetings use cues such as the technology used for multitasking to form assumptions about the secondary activity that is taking place. This relates to findings from studies of the use of laptops in face-to-face meetings where multitasking was ambiguously interpreted (e.g. [14]). However, as demonstrated by our work, ambiguity in the case of videoconferencing can be significantly greater. As Table 1 illustrates, first, in video communication, the device used for multitasking may be outside the camera's field of view, as in the case of a mobile device. Next, when activities all take place on a single screen, there will often be ambiguity about whether multitasking is at all taking place. Finally, even if the location of multitasking is apparent, as in the case of a dual monitor, the secondary activity is still unknown (similar to the face-to-face case in [14,17]).

Secondary activity on:	Is multitasking obvious?	Is the technology used obvious?
Single screen	No	Yes
Dual Monitor	Yes	Yes
Mobile device	Yes	No

Table 1. Variations in ambiguity of behavior and technology used for multitasking.

As discussed in [6], participants in videoconferencing may hope that this ambiguity allows them to hide their multitasking, while at the same time believe they are able to detect multitasking in others. Indeed, our study participants believed it was easier for them to spot multitasking than for the person in the video.

Our findings also highlight how observers' assumptions about the secondary activity will affect their reactions to that behavior. For example, when multitasking took place on a phone, activities were assumed to be of a personal nature. This finding is important since the secondary activity is rarely entirely known to the videoconferencing partner, and an incorrect interpretation will lead to incorrect evaluation. Consider, for example, our interview findings where individuals reported using mobile devices also for meeting-related activities; in those cases, an entirely appropriate behavior may be judged negatively.

Additionally, the technology used influences how apparent, or obvious, the multitasking behavior is. Engagement was positively correlated with politeness/acceptability, while obviousness had the reverse effect. As we show, these assumptions and interpretations of the secondary activity can negatively affect how behavior is viewed as more or less polite, engaged, and acceptable. This has implications for the behavior of people who participate in video meetings, as well as the design of future video conferencing technologies.

Our experiment also revealed a surprising effect of the videoconferencing tool itself on how engaged meeting participants appear. Our comparison of two popular videoconferencing UI layouts showed that, contrary to our expectations, the multitasker appeared *more* engaged when shown in a large window, and *less* engaged when appearing in a smaller side-by-side view at equal size as the other meeting participant. There are at least two explanations for this effect: One explanation for this finding is that being able to see a participant in a larger window gives extra emphasis when their gaze is directed towards the camera. An alternate explanation is that when presented side-by-side, direct comparison between meeting participants can be easily made, with a multitasker appearing much less engaged than their counterpart. This result may have direct implication for the design of videoconferencing applications.

Implications for behavior

Our findings hint at how behavioral cues may highlight or mask multitasking behavior and perceptions thereof. Clearly, the best course of action is *not to engage in activities unrelated to the meeting at all*. However, if multitasking is unavoidable, our findings suggest that multitasking on the same device appears less inappropriate than interactions on a second screen or device. Multitasking on a dual monitor was easy to spot and rated negatively (although at least secondary activities were assumed to be work-related rather than personal).

The case of interacting with a mobile device during a videoconference is interesting because the device itself is not seen in the video in most camera configurations. Thus, the multitasker may benefit from their behavior misinterpreted as paying attention (e.g., taking notes). However, if activity is correctly interpreted as interaction on a phone, their interlocutors are likely to assume that they are engaged in an unrelated personal activity, such as playing a game, texting, chatting, etc. Two potential recommendations emerge: First, hoping to rely on the phone being off camera to hide multitasking may prove risky. Second, users may wish to tell their meeting partners when they are using their phone for meeting-related activities, to prevent those from incorrectly assuming the activities are personal.

Implications for design

Our findings offer several implications for the design of video conferencing systems. Eye gaze and body language being directed elsewhere besides (relatively) straight ahead at the camera, are easy to detect and negatively perceived by meeting viewers. Therefore, design decisions may vary depending on whether they are geared towards helping a multitasker be perceived less negatively, or helping another participant have a better idea of what their conversation partner is doing.

In the first case, systems should be designed such that users can direct all incoming alerts and notifications from their smartphone and secondary monitors to a primary screen of their choice while they are in "in a meeting" status. This way, disruptive gaze re-direction can be minimized.

Second, in the case of multiple monitors and multiple cameras, a system could be designed to use face-detection to dynamically determine which screen or camera a person is facing and automatically switch to that camera. This may allow users to maintain a consistent impression of direct eye gaze, translating the apparent benefit of the single-screen condition to the case of multiple monitors.

Finally, video conferencing systems could allow for the layout and information about participants' behavior to be displayed differently based on individual tendencies/characteristics. The video window could also be supplemented with additional cues about the other's behavior, but such an option should be treated with care. Visualizations of others' behavior or psychological states over video conferencing have been explored in other contexts such as visualizing browser activity [18], stress or mood levels [22, 24]. While these can be useful, there are

well-documented social tradeoffs between increasing awareness of another person's activity and preserving privacy. Thus, more work is needed to know how cues related to meeting relevant and irrelevant behavior are perceived by both sides in a multitasking context where participants may have different motives and privacy concerns.

Limitations and future work

One limitation of our experiment is that participants were placed in the role of non-participating meeting observer watching two strangers converse. It is possible that participants' reactions or perceptions would be different if they were actively participating in a video meeting with people they knew well. It is important to note, however, that being a passive observer in a meeting is not uncommon, particularly in multi-person videoconferencing meetings. As noted by our interviewees, in multi-person video meetings, meeting participants will try to manage how their activities appear to others, and judge other participants' multitasking behavior. Furthermore, our results strongly suggest that participants understood the situation well; their open-ended responses often contained affective attributions stemming from the multitasking behavior.

Next, while our experiment focused on a handful of factors that emerged from our interviews (e.g., the technology used and the secondary activity), as we learned from our interviews, video meetings can take a variety of forms and be held between many different types of people. As such, other dimensions of multitasking in video meetings still need to be explored in future work.

One such dimension involves the nature of the meeting and the participants. As the number of meeting participants grows or the length of the meeting increases, attitudes towards one or several people's multitasking behavior could change. Social dynamics may also play a role: In our experiment, conversation dynamics suggested that one person was in charge and leading the meeting. Exploring additional status relationships could be important since this relationship may influence attitudes towards the multitasker (e.g. [25]).

Another interesting dimension to investigate is whether if a person verbally elevates their multitasking behavior to the foreground (e.g., by stating "*Hold on, I need to reply to this message.*"), their behavior could appear more appropriate or polite. Similarly, new technologies such as smartwatches and head-mounted displays are becoming available and present interesting new context for multitasking. Exploring the role of these and other variables in future work will give greater insight into additional factors (both social and technical) that influence the dynamics of multitasking in meetings held over video conferencing.

Finally, the videoconferencing itself, not only the secondary activity, can take place on a range of devices and setups, ranging from dedicated videoconferencing rooms to running on a mobile device. In particular when videoconferencing on a phone or a tablet, the ability and method for multitasking is different: applications typically occupy the entire screen, and since the device is completely mobile the camera also moves around, potentially breaking any illusion of eye contact. In future work we plan to explore the effect of multitasking in additional videoconferencing setups, and build and evaluate the effectiveness of tools that dynamically transition between cameras to follow the multitasker's gaze.

CONCLUSION

This paper addresses the tension between the growing use of video conferencing and meeting participants' desire for multitasking. Through a combination of interviews and controlled experimentation, we provide a detailed account of technological and video conferencing UI-based factors influencing attitudes towards multitasking in videoconference meetings. Given the nature of the modern workplace and the increasing proliferation of mobile devices, it is unlikely that workers' tendency for multitasking will go away soon. Our results indicate that all multitasking behavior is not perceived equally; the association of technology and common activities along with how the activity is presented through the video conferencing tool layout influences observers' assumptions and attitudes. While we do not pass judgment on whether or not multitasking should occur, our study provides insights into how the negative interpersonal perceptions that come along with it when it does happen can be accentuated or reduced using technology and social cues.

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