Smartphone Use Does Not Have to Be Rude: Making Phones a Collaborative Presence in Meetings

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ABSTRACT
Our personal smartphones are our daily companions, coming with us everywhere, including into enterprise meetings. This paper looks at smartphone use in meetings. Via a survey of 398 enterprise workers, we find that people believe phone use interferes with meeting productivity and collaboration. While individuals tend to think that they make productive use of their own phones in meetings, they perceive others as using their phones for unrelated tasks. To help smartphones create a more collaborative meeting environment, we present an application that identifies and describes meeting attendees. We deploy the application to 114 people at real meetings, and find that users value being able to access information about the other people in the room, particularly when those people are unfamiliar. To prevent users from disengaging from the meeting while using their phones, we employ a gaming approach that asks trivia questions about the other attendees. We observe that gameplay focuses attention within the meeting context and sparks conversations. These findings suggest ways smartphone applications might help users engage with the people around them in enterprise environments, rather than removing them from their immediate social context.

Author Keywords
Meetings; trivia game; social; mobile; smartphones.

ACM Classification Keywords
H.5.3. Information interfaces and presentation (e.g., HCI): Group and Organization Interfaces – *computer-supported cooperative work*.

INTRODUCTION
Smartphones are ubiquitous. We use our phones throughout the day to keep in touch with friends and family, to record important events, and to learn about the world around us. We use our phones so often that most people notice their phone is missing before they notice their child or wallet are missing [17]. As our daily companions, our smartphones come with us everywhere, including to work, our offices, and enterprise meetings.

MobileHCI 2013, Aug 27–30, 2013, Munich, Germany.

Currently, people view smartphones as hindering face-to-face social interactions [11]. Individuals are isolated by their phones even when they are surrounded by other people [19]. It is ironic that this happens given the devices are explicitly designed to support social interaction. However, a phone's focus on facilitating remote connections comes at the cost of immediate social interactions. People try to mitigate the cost of phone use in social settings by restricting their use when others are around. A meeting organizer may, for example, make request that attendees not use their phones during the meeting. However, the creep of smartphones into our face-to-face interactions provides an opportunity to build solutions that augment social situations much the same way smartphones augment so many of our other daily activities.

We explore how smartphones can be used to enhance face-to-face interaction in enterprise meetings, helping co-located people get to know each other and encouraging direct interaction. Currently most meeting attendees use their phones to complete tasks not related to the meeting at hand [8]. Our goal is to instead help them use their phones to engage more deeply in their immediate surroundings. We investigate how smartphones can be used to stimulate fun during corporate meetings, since fun is believed to positively impact working environments [6]. To this end, we examine current smartphone use in meetings by presenting the results of a survey of 398 people, show how these findings are used in the design of a getting-to-know-you smartphone application called *Meetster*, and discuss how several variants of Meetster are used in real meetings.

The Meetster application identifies the people attending a meeting, fetches information about them from various corporate sources, and creates a directory of that information that is available to all attendees. Attendees can browse this directory to learn about the people in the room. To encourage people to engage with the application and learn about their colleagues, we also created trivia questions from information in the directory. These questions were developed to reflect topics that are important when getting to know people in corporate environments, including other attendees' job roles, relationships, and relative status.

To study Meetster, we deployed several variants of the application to 114 people in 9 meetings. We observe how people engaged with the application, and, more importantly, how people used the application to engage with the people around them.

RELATED WORK

Our work builds on related research from three different areas: technology use during corporate meetings; use of social networks at work; and social-network based games.

Use of Technology in Meetings

Iqbal et al. [8] investigate the causes and impacts of multitasking during lecture-style meetings with laptops and smartphones. They found that only 8% of smartphone owners solely use their devices for lecture-related tasks (e.g., taking notes, looking up references, communicating about lecture), the rest using them for consuming and producing lecture-unrelated content. The main reason for this kind of multitasking was participants seeking a distraction when the lecture was not meeting their expectations. However, Iqbal et al. also report that most participants believe that missing some content is acceptable when it comes with the benefit of productivity even in the face of some social costs. Kleinman [12] studies why and how such technologies are used in meetings. She found that smartphone use during meetings might be perceived as rude and impolite, but also as efficient when using it as a tool, or even as a proxy for a person's importance. Further, group norms have been found to have a higher impact on smartphone use in meetings than organizational culture. Leshed et al. [13] present the GroupMeter system for visualizing language use during team meetings. Similarly, DiMicco et al. [5] suggest that peripherally displaying social information may improve certain types of group interactions like discussions.

Social Networks at Work

DiMicco et al. [4] investigated social networking in corporate environments. They found that for enterprise social networks, users' behavior and motivations differs from public social networks. In particular, on corporate social networks, people are more motivated by making connections to unknown people rather than those they already know. Skeels and Grudin [18] analyze the heavy use of public social networks (Facebook and LinkedIn) behind enterprise firewalls. They discover that work-related benefits are on creating and strengthening ties, but also that tensions arise, e.g. when mixing personal and professional personas or disclosing confidential information.

Social Games

Powell et al. [16] presented SNAG, a game helping conference participants to get to know each other and track contacts. Players have to solve missions that cause them to meet each other and stimulate conversations. Meeting new people was found to be the favorite activity of players during an evaluation of the game. Li and Counts [14] investigate the creation of the feeling of community among players of mobile games. In particular they focus on casual games for filling interstitial time (e.g., playing during lunchtime at work), and find that participants knew fellow gamers after the game better than before. Kirman et al. [10] investigate the impact of embedding socio-contextual information into a non-task-driven game on social interactions between people on a social network. They found that showing information about the social context of individuals increased the social interaction between players of the game. Bernstein et al. [1] introduce a social networking game that encourages friends to tag each other with descriptive terms, called Collabio. Leveraging an incentive system Collabio was able to gather information about people that were not available elsewhere on the Internet previously. Similarly, Guy et al. [7] present GuessWho, a crowdsourcing game for corporate environments that aims on enriching and expanding social networks. GuessWho gathers tags of people, which have been shown to be valid, and peoples' relationships, which were significantly better than data from internal social networks. In contrast to these social games, the goal of our system is not to enrich digital databases or social networks online, but rather to enrich the in-situ social interaction during meetings. Acknowledging that the information gathered through GuessWho [7] and Collabio [1] is a contribution to the general databases and information of social graphs, the game we present is designed to have an immediate benefit to the group of people who are playing: getting to know each other and having fun.

SURVEY OF SMARTPHONE USE IN MEETINGS

To learn about the use of smartphones during meetings we conducted a web-based questionnaire. Here we describe the survey method and then present the results. We show that people take their phones to meetings and use them, but that phone use is generally perceived as interfering with the meeting. While people often use their phones for productivity reasons, they also use them to bypass meeting downtime, particularly during large or long meetings. Individuals perceive others as being less likely to use their phone productively than they are themselves.

Survey Method

We sent out a survey asking people how they use their smartphones during meetings, including what applications they use and how often their phone use is meeting-related, work-related, or neither. Because we were particularly interested in how phone use impacts meeting quality, we also asked participants about the perceived impact of phone use on social interaction and productivity, and how they thought others used their phones during meetings.

Since it can be hard for people to give an accurate general picture of phone use, in addition to asking about their behavior during a "typical meeting," we also asked specifically about their behavior in the most recent meeting they attended. By collecting the size (rough number of attendees) and type of the last meeting, we are further able to study how different characteristics of the meeting impacted phone use. We asked participants to self-categorize their last meeting as one of the following four types:

- **Conversation**: A short, ad hoc, and informal interaction that happens multiple times a day between two people or among a small group,
- **Status update**: A recurring pre-scheduled session that happens at regular intervals,

- **Presentation:** scheduled session with higher level of formality and importance of maintaining presenter's image,
- **Brainstorming**: An informal and highly interactive session that results in creating new information and artifacts or resolving conflicting information, and
- **Training**: A scheduled formal interactive event that helps to develop knowledge, skills and attitudes across expertise levels or disciplines.

We randomly invited employees at the headquarters of Microsoft, a large US-based software company, to participate via email. Requests were distributed over different weekdays and different times of the day to get a natural sample of usual corporate meetings. In total, we received 398 responses. Of those, 85 were women and 298 men (rest unknown), with a mean age of 39 (min 22, max 66, SD 8.14) which roughly reflects the demographics of the company. On average, participants' most recently attended meeting had 11.81 attendees (median 7, SD 35.02). Among those meetings were 44.7% status update meetings, 19.3% conversations, 16.2% brainstorming meetings, 15.9% presentations, 0.5% trainings, and 3.3% other meetings.

Survey Results

Most participants reported taking their smartphones into meetings, with 71.9% saying they always had their phone with them. Most also used their smartphones at least sometimes during meetings, but not at the same rate at which they brought them. For example, only 43.2% of respondents reported having used their phone at the last meeting they attended. Some people appraised the advantage of using smartphones in meetings as *"essentially a replacement for laptops"* and *"helpful in reminding me of the next meeting"*. We now look more closely at how smartphones are used in meetings, focusing in particular on their impact on productivity and social discussion, and differences in behavior by meeting size and type.

How Smartphones Are Used

When we asked participants how often their smartphone use in a meeting was meeting-related, participants reported significant productivity focused use. Results are shown in Table 1. Most participants said that in a typical meeting they would always use their phones for meeting-related things (61%), frequently use them for meeting-related things (38%), and seldom use them for things unrelated to work (51%). However, participants' comments evince that they would occasionally drift away. For example, one participant reported moving to *"non-productive things (like social networks) esp. when [he starts] to get bored", "when things unimportant or unrelated are being discussed", "for low time during certain meetings",* and to *"check out of an unnecessary meeting and do something useful"*.

Participants reported using a variety of applications on their phones, as Table 2 shows. The most common uses included email, calendar updates, and SMS. The uses of some applications were correlated. For example, taking notes during the last meeting attended was correlated with setting reminders and to-dos during that meeting (Contingency Coefficient Phi 0.27, $p<.001$). When people said they used their phone in a work-related manner, they were likewise more likely to use the notes app (Spearman's rho 0.32, $p<.001$) and the reminders/to-do app (Spearman's rho 0.22, $p<.01$).

The use of other applications, such as social networking applications, was correlated with using the phone in a non-work related manner (Spearman's rho 0.29, $p<.01$). Participants who used their web browser during a meeting were also more likely have browsed their social network (Phi 0.27, $p=.01$) and tended to play games (Phi 0.18, $p<.05$), which is consistent with previous findings of general mobile application use [2]. In general, however, people were very unlikely to report using their phone for entertainment purposes, like browsing the web, viewing their social network, or playing games (see Table 2).

Impact of Smartphone Use on Productivity and Discussion

Only 20% of respondents agreed with the statement that *"usage of smartphones during meetings hampers productivity."* Rather than hampering productivity, participants were much more likely to find that smartphone use hampered social interaction and discussion, with 47% agreeing that it did, and only 24% disagreeing. We got strong comments stating that smartphone use during meetings was considered *"impolite and counterproductive", "rude unless very obviously related to work", "frustrating when people use their*

	Meeting-related		Work-related		Not work-related	
	Last	Typical	Last	Typical	Last	Typical
Never	4%	5%	20%	10%	36%	15%
Seldom	8%	8%	26%	28%	47%	51%
Frequently	20%	26%	27%	38%	13%	20%
Always	68%	61%	27%	24%	4%	4%

Table 1: The reason people used their smartphones in their most recent (171 people) and typical meetings (398 people).

	Last Meeting		Typical Meeting		Others in Meeting	
	#	%	#	%	#	%
Email	148	86.0	340	85.0	375	93.8
Calendar	105	61.0	278	69.5	245	62.3
Short messaging	39	22.7	152	38.0	224	56.0
Looking up things	39	22.7	166	41.5	193	48.3
Reminders & to-dos	29	16.9	107	26.8	121	30.3
Taking pictures	22	12.8	128	32.0	87	21.8
Taking notes	20	11.6	71	17.8	68	17.0
Browsing the Web	16	9.3	62	15.5	181	45.3
Phone calls	8	4.7	42	10.5	64	16.0
Social networks	6	3.5	37	9.3	146	36.5
Playing games	5	2.9	12	3.0	70	17.5

Table 2: For what respondents use their smartphones in their last meeting and a typical meeting, and how they think others in meetings use their phones. Percentages for last meeting based on the 172 people who reported such use.

smartphones during meetings", "overall hampering productivity and human interaction". One reason for this may relate to how smartphone use is perceived. Although the applications people reported using themselves were relatively consistent across an individual's most recent meeting and typical meeting, people perceived other people's use of phones very differently. As can be seen in Table 2, respondents thought others were much more likely to be playing games, browsing their social network, or browsing the web than they reported doing so themselves.

Respondents who thought that smartphone use hampered social interaction in meetings were also more likely to agree that smartphone use also hampers meeting productivity (Spearman's rho 0.69, $p<.01$). It could be that participants believed meeting productivity is related to the social interaction that happens during the meeting. We also observed that people who viewed smartphone use more negatively were less likely to use their phone in meetings. Participants who reported using their smartphone in meetings more often disagreed that smartphone use hampers social interaction (Spearman's rho -0.24, $p<.01$) or meeting productivity (Spearman's rho -0.24, $p<.01$). People used their phones differently depending on the type of meeting they attended.

Smartphone Use by Meeting Type

The type of the meeting impacts the probability that our participants used their smartphones during meetings (Pearson Chi-Square test 14.38, df=5, $p<.05$). Smartphones have most likely been used in presentation meetings (51.6%), followed by status updates (48.3%), brainstorming (42.2%), conversations (26.3%), and trainings (0%). Further, we found that the type of meeting also impacts the use of apps for taking pictures significantly (Chi-Square test 21.30, df=4, $p<.001$); participants took pictures in 35% of brainstorming meetings, in 17% of presentation meetings, in 15% of conversations, and only in 3.5% of status update meetings. This suggests that for brainstorming people actively make use of the smartphone for productivity reasons (e.g., as in taking photos of whiteboards).

The size of the meeting also impacted how the phones were used. There is a small effect that the more people were in a meeting, the more likely people searched for something on the Internet (Spearman's rho 0.2, $p<.01$). Further, we found that the more our participants engaged in Internet browsing during meetings, the more likely they were to consider their smartphone use to be non-work related (Spearman's rho 0.3, $p<.01$). This suggests that as the number of people in a meeting increases, people are more likely to mentally wander and use their phones for doing non-work related tasks.

Summary

In summary, we found that people think smartphone use hampers their interaction with other people and productivity. Although individuals think they are being productive on *their* phone, they think *others* are just messing around.

MEETSTER DESIGN

Given these findings, it seems important to leverage the smartphones that people take with them into meetings to provide a meeting-productive application as an alternative to engaging with applications that are unrelated to the meeting. In this section we present *Meetster*, a social-mobile meeting application designed to support social interaction in corporate meetings. The top-level hypothesis motivating Meetster is that *people will have better face-to-face meetings if their smartphone augments their experience with information about meeting attendees.* We describe the system components, including a cloud-based "people engine" and the Meetster mobile application for people's phones.

People Engine

Upon starting Meetster, users are asked to enter their corporate username. For each meeting, the *People Engine* keeps a list of people using Meetster as well as anyone scheduled to attend the meeting (as recorded by the corporate calendaring system). The People Engine collects information about meeting attendees from different corporate internal data stores and public information on the Internet. Content pulled from internal resources mainly cover the company organizational chart, personal data (e.g., portrait picture, self-describing text, keywords about the person, expertise of the person, job role, department, time being in current position), office related data (e.g., office address, phone number), and bug tracking system (e.g., number of bugs a person has reported or has assigned to them). External resources comprise search results for that person such as the first picture found when searching on the person's name.

Meetster Client Application

There are several ways a phone could present the information collected by the People Engine to meeting attendees. The most basic way is to lay out key information about each attendee in an organized list that contains a snapshot of each person. Users could quickly skim though the list to get a picture of the people in the meeting, or dive into individual profiles. However, such an approach can be dry and uninteresting. Therefore, we also explored using the information in the Person Engine to generate trivia-game style questions about attendees. The game draws from a large question pool to slowly reveal information over time.

Attendee List

The *Attendee List* shows the information collected about people accessible through a list of meeting attendees. Attendee names and a small picture are shown in a list, as can be seen in Figure 1(c). When a user name in the list is clicked, it pulls up a contact card for that user (see Figure 1(c)) that provides all of the facts about a person the system knows. This is comparable to a corporate address book that provides contact-card like information about the people who are attending a meeting.

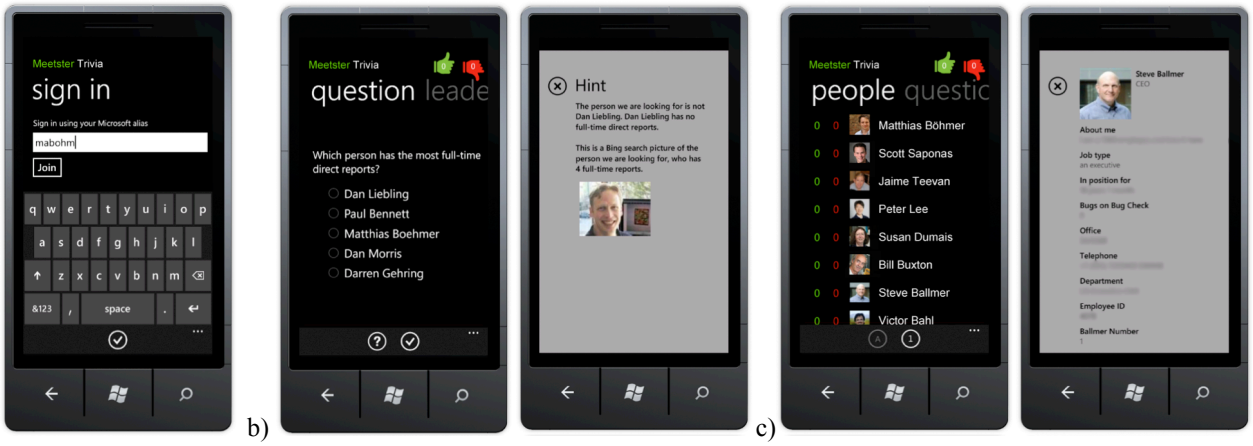

Figure 1: Screenshots of a) the login screen, b) a question and a hint, c) the people list and person info card.

Trivia Game

To draw people into exploring information about the attendees, we augmented the attendee list with a trivia game. Users can easily change between the game and the Attendee List. Since interstitial games can have the potential to create a community feeling among players [14], the game screen asks questions about the people, in the form of a trivia game. Another motivation to create a social game was that playing co-located games against other people results in higher engagement and fun than playing against a computer, particularly when that other person is a friend [3]. The question screen and the people list screen are shown in Figure 1.

Beside a small picture of the person and the person's name, in the Trivia version we list the person's trivia game performance. The user is able to sort the list in alphabetical order or in the order of questions answered correct and wrong. This list acts as a combination of a leaderboard for the trivia game and a listing of meeting participants.

Based on the people who are participating in the meeting and the information collected from various directories the system creates questions that are shown to meeting attendees. Questions are intended to interrelate information about multiple people and drive face-to-face interaction about the content in the game. The system has a set of question templates, out of which it randomly generates question instances by filling in facts about the participants. The implementation used for this study comprises 21 templates. Some examples of these templates are: who works together in the same group; who is known for a certain expertise; who is shown on a picture pulled from a search engine; or who is highest in the company's hierarchy. Questions vary in the number of correct answer options (one out of many vs. several out of many), the representation of answer options (e.g., pictures of people vs. names of people), whether the question is about one person (e.g., *"For how long has John Doe been in his current position?"*) or several people (e.g., *"Who works in the same building?"*).

Trivia Hints

For every question the game also provides a hint. In informal pre-studies we found that sometimes people have a hard time answering some questions, leading to frustration and surrender. For every question template we also added a template for a hint that gives information that might help people answer correctly more easily. However, based on pre-tests we also removed questions that one might only answer correctly by chance, if the answer is unknown. For example, initially the game asked users to guess the employee number of a particular person, providing four random reasonable integers in addition to the correct one.

MEETSTER STUDY METHOD

We conducted a study to understand how information about meeting attendees impacts meeting productivity and participation. We studied the Meetster system in naturally occurring corporate meetings at Microsoft. We were interested in how meeting participants would use the application, how it would contribute to different types of meetings, impact on social interaction between participants, increasing fun at the meeting, and increasing knowledge gain about other meeting attendees. We explored a basic version of Meetster, with just the Attendee List, the potentially more engaging version that included Trivia questions, and a version that included Trivia with Hints.

The study was conducted in the wild, to study the application in a natural context. We did not force our participants to use the application during the whole meeting, we rather gave them a very brief introduction describing the application as a meeting application (without disclosing its purpose) and provided a short printed tutorial that described general steps and screens of the application.

Data Collection

We collected a broad variety of data to understand how Meetster was used in meetings, including log data, manual annotations by an observer, and survey data.

Log Data

All of the participants' interactions with the application were logged, including when users joined the system and when people cards were shown. When game functionality was available, we tracked users' movement between different views, which questions were displayed, how the questions were answered, and which ones they skipped. Additionally, we tracked hint use when available. Since the duration of the meetings in the study varied, we normalized the timestamps of events in the logs by the length of the meeting. For example, when looking at the timing of answers, we studied answers per normalized time-period.

Manual Annotation

In addition to logging data automatically within the application, we also manually logged meeting events. A member of our research team attended each meeting as an observer and kept track of: people using their personal devices, when there was laughter, whether laughter was related to the Meetster system, and when people showed the test devices to other people. The observer also assessed the degree to which people seemed to have fun. Additionally we manually kept track of the duration of the meeting and the meeting's type.

Survey Data

Meeting participants were also asked to fill out several surveys. Before and after the meeting, participants were asked via email to report how well they knew the other attendees, on a 5-point scale using a list of attendees provided by the meeting organizer. This survey was optional, and filled out by relatively few participants. Additionally, at the end of each meeting participants were provided with a paper-based questionnaire that asked them about their Meetster use during the meeting. Participants were given the option to provide their corporate ID, which allows us to their link survey responses with the log data.

Participants

We studied the three different Meetster variants (Attendee Lists, Trivia, and Trivia with Hints) following an A/B/C study design with between subject tests. We deployed each variant in three meetings, for a total of nine meetings. We distributed the conditions over a mix of four status update meetings and five presentation meetings. On average, 12.7 people attended a meeting (min 5, max 29, SD 8.2). We recruited participants by reaching out to people who were organizing upcoming meetings within the research department of a large software company. We provided a small gratuity in the form of snacks we brought to the meeting. The study was conducted in July 2012.

Not every meeting attendee in every meeting used the Meetster system. This was because we were not able to provide a phone to everybody in the largest meetings, and because some people only attended a small part of meetings. As such, we did not collect any survey or log data from these people, even though they might have had an impact on the social context of the meeting. Since we made it optional for participants to enter their personal ID into the survey form (due to privacy concerns) we cannot relate every log record to a participant. For our study we have collected survey and log data from 63 people, only survey data from 17 people, and only log data from 31 people. We have data from participants who filled out the survey from 22 people for the Meetster Attendee List application, 29 people for the Meetster Trivia and 29 people for the Meetster Trivia with Hints.

	Attendee Lists	Trivia	Trivia w/ Hints	Total
# of meetings	3	3	3	9
Total meeting time	220 min	170 min	185 min	575 min
# of participants	34	39	41	114
# views people cards	679	12	31	722
# of answers	-	971	1,214	2,185
# of hints viewed	-	-	46	46

Table 3: Characteristics of Meetster usage during study.

We had 62 male and 13 female participants (rest unknown). One participant was younger than 20, 27 were in their 20s, 25 in their 30s, 14 in their 40s, 6 in their 50s, and one person older than or equal to 60 (rest unknown).

MEETSTER STUDY RESULTS

Overall, participants used the Meetster system in their meetings to get to know other attendees, learning more about each other the more they used it. Game elements increased participants' engagement, both with the system and with each other, but also tended to distract people from the meeting content. In this section, we dive more deeply into these findings to show which features were most successful for helping people learn about one another, engage in the meeting content, and engage in social interaction.

Overview

Table 3 gives a general overview on usage of the Meetster applications during the study. In total, we studied 575 minutes of meeting time. During these approximately 9.5 hours of meetings, 114 participants opened more than 720 people profiles, answered more than 2,100 trivia questions, and peeked at 46 hints.

As can be seen in Table 3, Meetster functionality use varied by condition. The Attendee List was primarily viewed when it was the only functionality available. Participants in this condition viewed the Attendee List almost 20 times each, which is larger than the number of meeting attendees. Many contact cards were viewed more than once.

When the game was available, participants interacted with the system more, but did so by answering questions versus by visiting the Attendee List. Each attendee in the Trivia condition answered 25 questions on average, and each attendee in the Trivia with Hints condition answered 30 questions on average. Answer speed differed significantly between the game without and with hints (Independent-Samples Kruskal-Wallis Test, $p<.05$), with a mean of 0.65

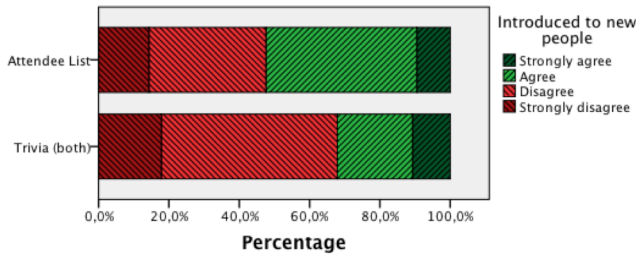

Figure 2: Introducing people to new people

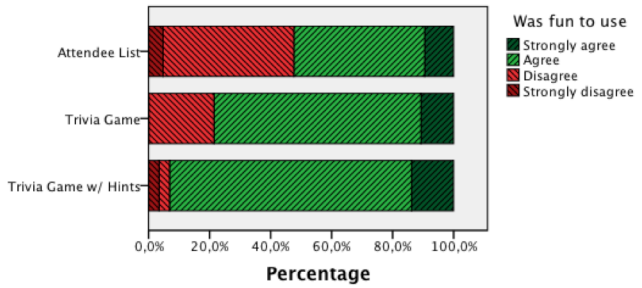

Figure 3: Fun people had with using the different conditions.

(SD 0.45) questions per minute for the game without hints and 0.41 (SD 0.42) questions per minute for the game implementing the hints. The slower answer speed with hints may arise from the use of the hints, but likely also stems from the fact that, as we will see, hints changed the way people interacted with the game and other attendees.

The Meetster application was used most heavily at the beginning of the meetings, with most everyone playing for some period. During the primary content of the meeting (e.g., the main presentation or group discussion), most people stopped using the application. However, our log data and our observations revealed that some people continued to use the system when the trivia game functionality was available. Those people might have used their smartphones regardless. It may be that by providing game functionality, we were able to keep distractible participants in a meeting-related context since they were interacting with information about attendees. We did not observe continued use for the version where we only provided Attendee Lists.

We also observed that there was a peak in application usage when the meeting was interrupted, by, for example, a change of presenter or technical problems with the projector. We assume that this typically would be the point in time when people start using their personal mobile devices. Once distracted, these people may not change their attention back to the meeting after the interruption [15]. By providing them with an application that keeps peoples' attention within the context of the meeting, dealing with the same people, it might be easier for users to focus on the meeting context again after the interruption. After looking at what people learned about other attendees while using Meetster, we will look more closely at how the application supported engagement and distraction.

Learning about Other Meeting Attendees

A primary question for evaluating the system was whether people learned either about new people or learned new details about people with whom they were already familiar. Participants generally agreed that they learned about the other people in the meeting while using Meetster. Those using the Attendee List agreed with the statement 71.4% of the time, those using the Trivia game agreed 86.2% of the time, and those using the Trivia game with hints agreed 70.5% of the time.

When playing the game, we observed that the more questions people answered in the trivia game, the more they agreed on having learned something about other people (Spearman's rho 0.57, $p<.001$). This suggests, that the more people interacted with the system, the more they learned about other people. Likewise, the more hints people used, the more they agreed that they have been introduced to new people (Spearman's rho 0.40, $p<.05$). This suggests that the content we have shown in the hints helped people to get to know others. One participant playing *Meetster Trivia with Hints* described it as a "fun way to learn about colleagues and bring people closer."

To see whether Meetster helped participants learn about new people in the meeting, we filtered out those attendees who knew everybody already before the meeting and studied the 43 participants left who did not know every attendee of their meeting. Figure 2 shows these participants' opinions on whether they got to know new people or not. Interestingly, it appears that among those people who reported that they did not know everybody before the meeting, the Attendee List application seems to be a better tool for them to learn about other people. While this effect is not significant, we find the trend interesting because we initially expected this to be the other way around. It may be that when a person knows nothing about another meeting attendee it is more useful to first get an overview of that person before learning the specific details that come up in the trivia game.

Engagement with Meetster and Distraction from Meeting

While the Meetster application seemed to help meeting attendees learn about other people in the meeting, the primary purpose of a meeting is not to learn about others but rather to get things done. For this reason, we also looked at how engaging the application was and whether it distracted attendees from the meeting content. We found that the two Trivia variants of Meetster were more engaging than the Attendee List version. Comparing participants reported engagement in the application, we found that people were more engaged with the Meetster Trivia games (median 1, agree on engagement effect) compared to the Attendee List (median -1, disagree on engagement effect). This effect is significant (Mann-Whitney U test, $Z=-3.477$, $p<.01$).

We also observed that people had more fun when playing the two versions with Trivia than when using the Attendee List. On a 4-point-Likert we found a significant effect (Mann-Whitney U test, Z=-2.533, $p<.05$) that people had more fun playing the game than using the Attendee List application, tough both medians are 1 (agree). Figure 3 shows that while for the Attendee Lists the agreement on having had fun was nearly balanced out, for the two game conditions most people agreed that they had fun using the application. Unsurprisingly, the more fun people had, the more engaging their experience was, as their opinions on fun and engagements significantly correlate positively (Spearman's rho 0.73, $p<.001$).

Earlier we saw that when people used more hints they learned more about the other people in the meeting. We also observed that the more hints people used, the more they agreed that the application was fun to use (Spearman's rho 0.35, $p<.05$). It could be that people have more fun when they perceive the game to be easier, or that hints make the game more fun because they provide even more interesting information about other meeting attendees. In the next section we will see that hints increase social engagement, and this may be another reason the condition with hints was viewed as more fun.

However, in addition to being more fun and engaging, the Trivia game application was also more distracting than the Attendee List application. On a 4-point-Likert scale (-2: strongly disagree / -1: disagree / 1: agree / 2: strongly agree) our participants considered the Trivia game with a median of 1 (agree) to be more distracting than the Attendee List application with a median of -1 (disagree). This effect is significant between these two conditions (Mann-Whitney U, Z=-2.75, $p<.01$). Figure 4 shows these results graphically. Most of the people who used Trivia agreed on having been distracted (52% agreed, 8% strongly agreed). Whereas in the Attendee Lists condition, most people did not agree on having been distracted (71.4% disagreed, 23.8% agreed). We found that this is a significant effect related with the Meetster version (Chi-Square test 8.22, df=3, $p<.05$).

For those people playing Meetster Trivia with Hints we found that the hints drew participants' attentions and required them to put more focus on the application: the more hints people used, the more they felt distracted (Spearman's rho 0.36, $p<.05$), and the more they agreed the application was engaging (Spearman's rho 0.40, $p<.05$).

Social Engagement

We also looked at how the Meetster system impacted the face-to-face social interaction of attendees during the meeting. Communication, and, in particular, voice communication, has been shown to have a significant positive impact on cooperation and trust [9], which is essential to productive meeting experiences. Overall, we found that social interaction increased when game components were added to the system, and increased further in the presence of hints.

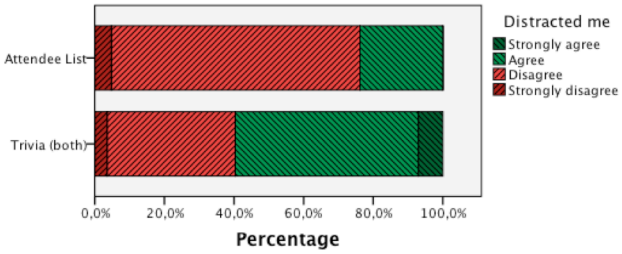

Figure 4: Meeting distraction the of two Meester versions

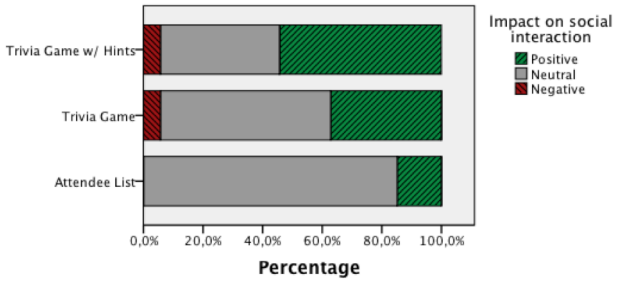

Figure 5: Impact of Meester versions on social interaction

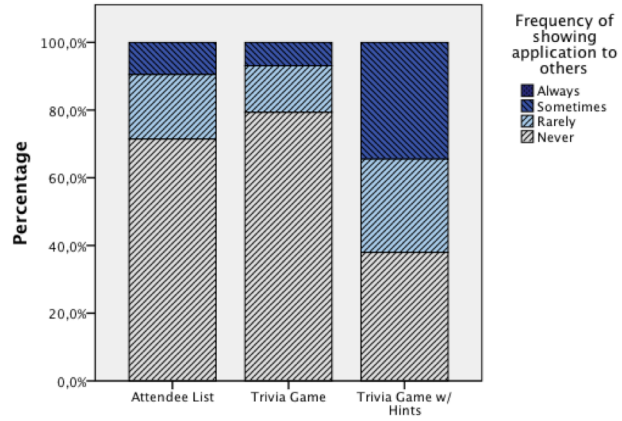

Figure 6: Frequency of showing the different Meester versions to other meeting attendees

Adding the trivia questions to the Meetster system increased social interaction during the meeting. To study the application's impact on social interaction happening during the meetings, we asked people whether the application's impact on social interaction was decreasing (-1), neutral, (0), or increasing (1). For the Attendee List application the majority of 81.8% thought that the application has no impact on social interaction during the meeting. For the Trivia game without hints the majority of 58.6% assessed the impact of the application as neutral, whereas 34.5% think that the application had a positive effect on social interaction. For Trivia game version that provides hints the majority of 54.5% of participants judged the application to have a positive effect on social interaction, and 36.4% did not see any effect on the social interaction. This suggests that by introducing the game and further by adding the hints to the game we were able to have a positive impact on the social interaction during the meeting. As Figure 5 shows, the implementation of hints shifted the impact on social interaction towards the positive side. This effect was significant (Chi-Square test 0.80, df=4, $p<.05$).

We further found that peoples' opinion on the games' impact on social interaction correlated with how often people have shown the application to other meeting attendees (Spearman's rho 0.32, $p<.01$). Further, they have ascertained the application to be more social if the application has introduced them to new people (Spearman's rho 0.30, $p<.05$), and if it made them talk to other people (Spearman's rho 0.39, $p<.01$). This is inherent to the design of our social trivia game that leverages interesting information about other people and tries to make them talk to each other. Further, the more participants agreed that the application was fun, the more they agreed that the application had an increasing impact on social interaction.

Another potentially important form of social engagement is physically showing the applications to others. We saw that people who played the game with hints were more likely to show the application to other attendees of the meeting, as can be seen in Figure 6. On a 4-point-Likert scale (0: never / 1: rarely / 2: sometimes / 3: always) we asked people how often they had shown the application to other attendees of the meeting. While the majority of 71.4% participants of the Attendee List application and 79.3% of the trivia game without hints never did show the application to anybody else, the majority of people who played Trivia with hints (40.9%) did show the application sometimes to other people in the meeting. This effect is significant comparing the no-hints version with hints version of Trivia (Mann-Whitney U test 234.5, $p<.001$, with median of 0 (never) for without hints and 1 (rarely) for with hits). One reason for this might be that there is simply more content available to show to others. Another reason might be that the hints changed the game's character from competitive to more entertaining. One group playing Trivia without hints reported that they thought they would have to solve all the questions alone, since they thought it was a competition.

People who played the version with hints also had an increased feeling that the application made them talk. This relates to showing the application to other people, as we found that showing the device most often goes along with a conversation (e.g., asking, "Is that you?" when showing a picture). However, we assume that the reason is that this additional content is interesting and stimulates conversations; otherwise people would not talk about the content. Further, this effect serves as a possible explanation for why our participants experienced the game with hints as more social, as described previously. Introducing hints might also have changed the character of the game from a more competitive experience into a more entertaining one, since providing hints might have made the game less competitive.

The more answers people entered per minute, the more often they also asked others for help (Spearman's rho 0.35, $p<.05$). This is an interesting phenomenon suggesting that people have a higher pace entering questions when they consult others rather than trying to answer on their own.

Based on our observational data we can say that introducing our apps to the meetings did not hamper social interaction and conversations between people. We saw that apart from talking about the game content, people had their usual conversations and chit-chat. The exception is one group where everybody was focused on their own devices and used Meetster without talking. After the study, several of this group reported a belief that their task was to answer as many questions as possible without discussion.

Summary

We found that people used Meetster to learn about other people. Including game elements in the system caused people to interact more with the system and with each other, and to have more fun. Fun has been found to have a positive impact on work environments (e.g., increasing productivity [6]). Contact cards, in contrast, seemed valuable for getting to know new, unknown people. The more people played the Meetster Trivia game, the more they learned about other attendees. When hints were provided in the game, people learned more about each other, interacted more, and had more fun. The benefits of Meetster, however, came at a cost; participants reported greater distraction from the meeting content the more they engaged with the system.

DISCUSSION AND OPPORTUNITIES

These findings suggest opportunities and design implications to improve Meetster, and give insight into how we might incorporate Meetster into general enterprise systems.

Opportunities to Improve Meetster

We found that people mostly used Meetster during meeting downtime. It was primarily used at the beginning of a meeting and during interruptions of the meeting. In addition, some participants also asked whether the game would have an end, or if the question asking would be never ending. This leads to the idea of introducing levels to the game, for instance one level that can be played before the meeting starts and other short levels for breaks.

For this version of Meetster we intentionally kept the data separate from public online social networks, since related work suggests that tensions might occur [18]. Yet, one might image incorporating data from corporate social networks like Yammer. While staying in an enterprise-focused context, one can easily imagine advantages like generating questions for meeting attendees of more than one company. However, the goal of getting to know other people and engage with them is common also for non-corporate environments. One could easily image extending the game with new questions to a party scenario, using social networks as a data store. The game might come up with questions like *"Whose recent trip to San Francisco is this a picture of?"*

Most of our participants already knew each other very well, since most of the meetings have been recurring meetings and the meeting attendees are mostly working in the same groups, sometimes mixed with visitors or people who are joining the group for a few months. Interestingly, among those who reported they did not know everybody before the

meeting, there was a trend to prefer the simple list view. It may be that it is hard to answer questions about people you know nothing about, particularly when just given a person's name. To support getting to know entirely new people while maintaining the game's fun, it could be augmented to only introduce new people one at a time, with each question including mostly people the user knows. The hints infrastructure could further be extended to include an introduction to new people when they first appear in the game.

We also experimented with interactive tasks based on face recognition that might increase people's ability to get to know entirely new people. The idea was to leverage the smartphone's camera to increase interaction between people. We discarded this scenario because informal pre-studies revealed that people find it rather annoying when other people are pointing cameras their faces for taking pictures. However, one could imagine this experience being less awkward if the experience mandated both people to point devices at each other simultaneously. Further, one can image leveraging other sensors of smartphones for interactive tasks, by, for example, giving players tasks like, "Bump your phone against John Doe's phone." We think this has the potential to foster even more interactivity between people than simply showing around devices. Meetster relies on knowing both the scheduled attendee list of a meeting and who actually showed up at the meeting to present information about the right people.

The trivia questions could be more complex. One participant suggested that the meeting organizer should be able to add questions to collect information from attendees. Likewise, default questions with information about the enterprise could be incorporated into the game. Such questions may be particularly useful for small meetings where it is possible to exhaust the questions about attendees quickly.

We first focused on smartphones since we thought people might want to play Meetster on their way to meetings (e.g., in the elevator). Future versions might also consider other devices that people bring into meetings, like their laptops.

Opportunities to Improve Enterprise Support Systems

Questions serve a side benefit in that they also have the potential to tell us something about the people in the meeting. Similar to the Collabio [1] and GuessWho [7] systems, the questions could be designed to collect targeted information. One might think of an approach where somebody enters new information about a person (e.g., labeling a person's picture) or adding personal information (e.g., hobbies, or who drinks the most coffee a day) and the system leverages questions for verifying the new data.

Participants expressed interest in where the information was retrieved from and how they could edit it. People remarked that some questions were wrong. This was mostly related to missing data where some people entered information into the corporate intranet and others did not. For example, some people were not related to the keyword "machine learning" simply because it was not in the person's profile, yet everybody knew that this person was working in that field. One user suggested adding an edit function into Meetster itself to fix errors and omissions in corporate data.

CONCLUSION

In this paper, we studied how we can leverage the smartphones people bring into meetings as a platform for providing people with background information about other meeting attendees. Our survey revealed that people do bring their phones into meetings, that meeting type impacts their smartphone use, and that people are aware of smartphone use's impact on a meeting's productivity and social fabric. Our findings informed the design of Meetster, a smartphone application designed explicitly to positively impact face-to-face social interaction in meetings. Meetster presents information to meeting attendees either in the form of a contact card, or using trivia questions. We presented results of our study that showed that while the Attendee List version helped people better to get to know new people, game elements created greater engagement with the system and others, especially when attendees already knew each other.

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