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Towards a Better Understanding of Availability and Interruptibility with *Mobile Availability Probes*

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Abstract. In cooperative work shared awareness on mutual availability is important for the overall performance of the team. There has been great research on quantitatively analysing users' behaviour and automatically detecting their interruptibility. In this paper we present our approach towards a better qualitative understanding of availability of users. Leveraging on experience sampling and cultural probes we developed a mobile tool to collect Mobile Availability Probes. We motivate the need for a better qualitative understanding of availability, introduce our approach and the Mobile Availability Probes, and present and discuss initially collected availability data.

Introduction

Interruptibility is a vital research topic in computer-supported cooperative work (CSCW) and human-computer interaction (HCI) research. It can be broadly defined as the condition of being willing and able to handle interruptions—even if this interruption might be disturbing an active process. Particularly with the introduction of notifications as a prime interaction mechanism in current smartphones (Sahami Shirazi *et al.* 2014), the topic recently started to attract a wider audience. In the realm of awareness research (Gross 2013) there has been an on-going discourse on how to optimise the balance between the benefits of being informed and the costs of being disrupted (Hudson & Smith 1996). Furthermore, understanding the use of computer-mediated communication (CMC)

technologies and their implications for users' interruption is a central and constant theme.

Especially instant messaging (IM)—which introduced a novel, brief and spontaneous communication style—became a prime research strand (Cutrell *et al.* 2000) for understanding interruptibility. The more holistic perspective that often underlies CSCW research goes beyond a binary distinction of being interruptible or not interruptible. Also, researchers started looking beyond the assessment of the "physiological ability to switch focus" or the "cognitive affect on task performance", and began to investigate the "user sentiment" towards interruptions (Turner *et al.* 2015, p. 802) as well. The notion of *availability* in IM and beyond promotes a more dyadic perspective on interruptibility that aims at considering attitudes towards the communication of the recipient as well as the sender—the interruptee and the interrupter. Managing one's availability in CMC is a complex act (Birnholtz *et al.* 2010) that goes far beyond managing one's general interruptibility, as it includes aspects of social roles and norms, and their individual interpretation and resulting expectations. For instance, it might make a fundamental difference if during a work meeting a user of a mobile phone—and, additionally, other attendees of the meeting—is interrupted by an important urgent message of a family member versus by a notification on an outstanding software update. Thus, when looking at recent research on predicting interruptibility, the majority of current research seems to target at a simplified conceptualisation of interruptibility in order to be able to better quantify and statistically compute interuptibility, yet at the same time neglects these nuances (Turner *et al.* 2015).

When asking users, *availability* is often inverted in the sense that it is explained with examples of personal *un*availability (e.g., talking about the personal unavailability while participating in a meeting, operating a car, or writing a report on a computer). Rarely, examples are given that describe situations in which persons are explicitly available. We believe that such a bias also restricts the potential for analysing the solution space. Moreover, designers and developers of interruption technology often focus on *un*availability when developing sensors that capture data that might be indicators for unavailability (e.g., capture voice activity to infer a person is speaking) or non-interruptibility (e.g., analyse calendar entries to infer a person is in a lecture). It seems that we developed a workable understanding of when people are not available, but do not fully understand what good indicators are for a person being available. Another reason, is that non-interruptibility often seems to be more generalisable and absolute, and therefore more graspable, while availability tends to be more selective and fragmented—for example towards different contacts (Fetter *et al.* 2010). Therefore, we see a research opportunity for developing a better understanding of how to support humans managing their availability. A key challenge thereby is the question, on how to better research interruptibility and availability in daily life. Both concepts

seem to be very volatile, erratic, and unobservable for an external person (Avrahami *et al.* 2007).

A prominent approach has been to use the *Experience Sampling Method* (ESM) (Hektner *et al.* 2006) in order to collect self-reports of users on their current interruptibility or availability (Fetter *et al.* 2010; Fetter *et al.* 2011; Horvitz & Kapoor 2008; Hudson *et al.* 2002; Rosenthal *et al.* 2011). The results of such studies are detailed time-series, spanning a few days or weeks, in which participants assess their personal interruptibility or availability on some form of linear scale. Often additional information is logged (Turner *et al.* 2015) in these studies. Sometimes this happens to reflect about the general nature of influencing factors (Hudson *et al.* 2002), but most of the times the logged data is used to simply compute statistical models that should be able to forecast a user's current interruptibility or availability in a given situation.

That said, an undeniable quality of ESM is, that through its repetitive nature it manages to grasp a good cross-section of people in different states of availability. However, the results from many interruptibility and availability studies are often very prosaic and analytical, and fail to grasp the richness of human social interaction. The results allow us to understand the 'if' and 'when', but seldom the 'why' of people's availability, as such studies often miss to record the underlying texture of human life. Other approaches seem to be much better in capturing these underlying textures of daily live, providing new insights and thus allowing for novel perspectives. For example *cultural probes* (Gaver *et al.* 1999b)—small packages filled with maps, postcards, cameras, booklets, and other material, that can be distributed among members of smaller communities to provoke inspirational responses. While others have successfully used cultural probes to break up stereotypes of domestic research (Gaver *et al.* 1999a), we think they can be used to question our preconceptions about availability. However, the data cultural probes deliver is very fragmentary and incomplete (Boehner *et al.* 2007; Gaver *et al.* 1999b).

In our approach of *Mobile Availability Probes* we aim to combine and complement ESM and cultural probes as a means to better understand how people construct their availability. In the following we provide more background information and take a look at related work before lying out our concept. We report on an early exploratory study and reflect on the collected data. From these reflections, we draw our conclusions on the viability of our approach and provide an outlook.

Background and Related Work

In this section we narrow down the term availability and have a closer look at the methods ESM and cultural probes, and reflect on related work.

From Interruptibility to Availability

In the following we outline where the concepts of interruptibility and availability overlap, and then show up where they differ in respect to CMC.

There is a plenitude of definitions for interruption in the literature (e.g., Iqbal & Horvitz 2007; Jett & George 2003; McFarlane & Latorella 2002; Ritter *et al.* 2014) that often broadly defines the term, for example as "a synchronous interaction which was not initiated by the subject, was unscheduled and resulted in the recipient discontinuing their current activity" (O'Conaill & Frohlich 1995, p. 262).

Yet, in order to be able to relate the term interruptibility to the term availability, it is necessary to further break down this broad concept (cf. Figure 1). To achieve this, we categorise the source and nature of the interruption. Two overarching groups in this respect are whether the interruptions are stimulated externally or internally (Mark *et al.* 2005). Thereby *external* interruptions result "from events in the environment" whereby *internal* interruptions come "from our own thought processes—new ideas that draw attention from the current activity." (Miyata & Norman 1986, p. 268). Hence, internal interruptions are "self-initiated" while for external interruptions it is "a condition in the environment that motivates switching" (Gonzalez & Mark 2004, p. 118). In Figure 1 on the highest level we accordingly differentiate between interruptions that origin from an internal source as the "Self" and those that that origin from external sources as for example "another person, computer, other animate object, [or] inanimate object" (McFarlane & Latorella 2002, p. 19).

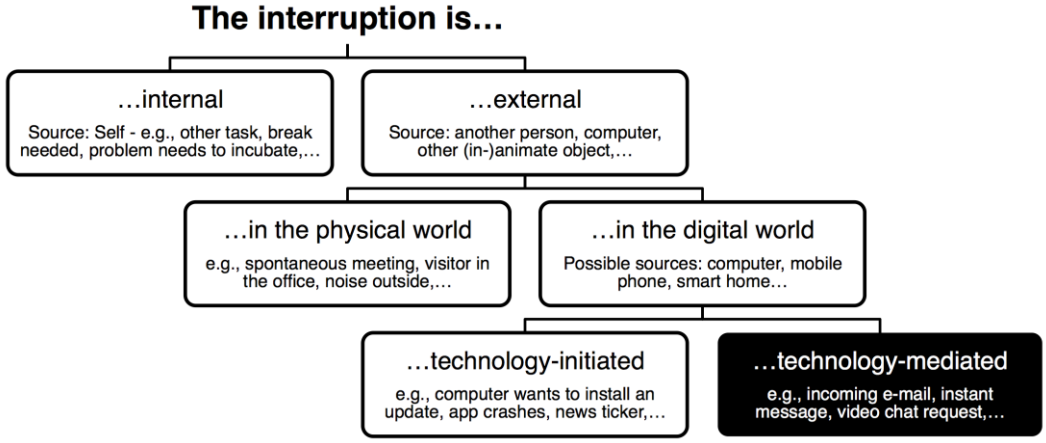

Figure 1. Categorising interruptions based on the source and nature of the interruption.

As this work focuses on *availability*, we further want to break down only external interruptions. We do that by differentiating between interruptions that are originating from the *physical* and those that are originating from the *digital* world. Interruptions in the physical world can have multifarious causes: a colleague

coming into the office with a question, some noise from a construction site outside that makes us close the window, etc. In the digital world, many of the interruptions are originating from notification systems (McCrickard *et al.* 2003b)—that is, hard- and software systems that inform users of events of interest, thus satisfying their multitasking information demands. In this context, an interruption is "an event within the notification system prompting transition of attention focus from a primary task to a notification" (McCrickard *et al.* 2003, pp. 551). Today, such notifications not only originate from computers and phones, but also from in-vehicle information systems in cars, reminding us that we need to go to an inspection, as well as from a smart speaker in our living room, telling us our parcel is out for delivery.

Furthermore, it is important to distinguish between interruptions *initiated* by technology and those *mediated* by technology. The first category often consists of scheduled or automated notifications informing about an outstanding software update, some outstanding maintenance task, a headline from the news app, or an automated newsletter. In many cases the presentation of these notifications is not even time-critical, if it is not a warning or an error. The latter category refers to personal contact mediated through technology such as somebody writing a text message to a mate from the soccer team, sending an email to a customer, or starting a video call with the grandparents. From our perspective, these two categories need to be treated fundamentally differently.

So, when talking about *availability* in CMC, persons wanting to contact each other makes up only a fraction of all interruptions that might occur to users. Yet, this social availability is a very interesting and relevant aspect. It is affected by our social roles, our tasks, our expectations, and the expectations of others. It is often selective towards different audiences, and not towards one singular status (Fetter *et al.* 2010). One of the definitions for availability provided in literature is described as "a state of mind (whether an individual is receptive for communication or not)" (Harr & Wiberg 2008, p. 244). The complexity of availability also becomes evident from a design space analysis of availability sharing systems (Hincapié-Ramos *et al.* 2011) that shows how differently the topic is approached in terms of solutions.

We therefore argue that the topics of interruptibility and availability need to be more disentangled in future research, and availability should not be treated as a specificity of interruptibility.

Experience Sampling Method and Cultural Probes

In the following, the two methods underlying our approach are introduced and discussed. They are very different, but have in common that they capture data *in-situ*—that is, in the moment and not retrospectively.

The Experience Sampling Method (ESM) is a research methodology developed in social psychology (Hektner *et al.* 2006) that has been successfully adapted for

the purpose of research in HCI. Over the course of usually several days or weeks each participant in an ESM study is required to record their inner states, experiences, feelings, or attitudes towards an overarching research question several times a day. Towards this end the participants repeatedly fill out an ESM form—a short questionnaire including anything from open-ended questions to psychometric scales. The method has shown to achieve two things. First, it is able to capture detailed and in-depth data of individual participants through repetition in a form of time-series. Secondly, it is able to capture fine-grained subjective assessments of a person's inner states or feelings in the wild. In HCI and CSCW research it has been applied often to study the interruptibility of different groups of people (Avrahami *et al.* 2007; Horvitz & Kapoor 2008; Hudson *et al.* 2002; Rosenthal *et al.* 2011; Turner *et al.* 2015). While the method generally can be used to collect qualitative data (Hektner *et al.* 2006), the repetition of the same qualitative questions over time often tempts researchers to quantify qualitative data by coding and counting the qualitative answers. Furthermore, such studies can be quite laborious and intrusive (Mehrotra *et al.* 2016) for the participants, which can leads to challenges with drop-outs.

Cultural Probes (Gaver *et al.* 1999b), on the other side, were introduced as a ludic methodology to serve the understanding of certain settings and situations while at the same time embracing the uncertainty and fragmentation of its finding. Study participants receive small probing packages including different materials like postcards, maps, single-use camera, and diaries that aim to "provoke inspirational responses" (Gaver *et al.* 1999b, p. 22) which are later analysed and discussed in interviews, focus groups, or workshops. Originating from a design context, cultural probes were conceived to inspire rather than to inform. Cultural Probes do not aim to find a singular truth, but to provoke novel thoughts and shake up existing preconceptions. In academia and industry this method has been quickly adopted, yet the way it was interpreted often deviates from its intention (Boehner *et al.* 2007; Gaver *et al.* 1999a). A major critique on the adoption is that an originally open and interpretive methodology is often put into a straitjacket of formalism and objectiveness.

Related Work

In many studies in CSCW and HCI interruptibility and availability needs have been analysed. However, there seems to be an underlying trend. Earlier studies often tried to get qualitative insights in order to deeply understand the users' attitudes, needs, and coping strategies. For example, Nardi et al. (2000) qualitatively analysed the IM use of 20 people through interviews and observations, and only supplemented their result with logs of IM messages. Hudson et al. (2002) used an ESM based approach to understand availability and interruptibility attitudes of twelve IBM managers. They also used the results as a

base to conduct qualitative interviews, to develop a deeper understanding of availability.

Today many of the studies use a rather quantitative approach in combination with machine learning (Turner *et al.* 2015). For example, in a large study by Yahoo Japan (Okoshi *et al.* 2017) 680,000 people used an application that detected interruptible moments. However, such approaches are often limited when it comes to capturing the peculiarities of human needs and subtleties of human practises. In many cases all notifications are treated equally—yet, as we already pointed out: a message from a loved one is not treated differently from the request to update a rarely used app.

The basic idea of transferring the concept of mobile cultural probes to mobile phones has been explored before. With Mobile Probes (Hulkko *et al.* 2004) others previously explored the usage of phones to collect qualitative data in a digital manner. The concept of mobile cultural probes was explored in two studies on the two overarching topics of shopping and mobile work. In the shopping study with 13 participants they used a J2ME application to collect the data. In the mobile work study, short messages (i.e., MMS and SMS) were used to send questions to the participants. However, it was only possible for the participants to send text and images. Others have used Digital Cultural Probes (Iversen & Nielsen 2003) in an application that allowed children to collect photos and audio clips on a mobile phone. The material was used to inform the design of digital technology for kids. They concluded that an application is able to motivate kids to spontaneously use it and also commented on the richness of the collected material.

Mobile ESM Probes for Understanding Availability

With our concept of *Mobile Availability Probes* we aim to combine the unremitting persistence of the *ESM* with the ludic and inspiring quality of *cultural probes*—yet not replacing them. Mobile Availability Probes are designed to signal participants at a specific interval to record qualitative data in a format that illustratively captures their current situation and practices, with respect to an overarching research question.

We hope that the combined method is able to record inspirational insights in a specific rhythm, and not only in the few moments a study participant deems something is of particular interest and thus worthwhile reporting. When investigating availability, this is an important quality for two reasons: first, if a person is unavailable, the additional effort of capturing the situation for a study might be too high and therefore participants might skip it; secondly, if a person is available, this situation might not seem relevant from participants' perspective and therefore not reported.

Hence, we moulded our concept of Mobile Availability Probes into an application for studying availability needs in everyday life. The application

notifies the participants throughout their day in a random interval (one random prompt per 90 minutes with min. 15 minutes between two prompts) to answer a short ESM form. Answering the form requires the participants to complete several steps—as depicted in Figure 2—with each step basically representing a single screen.

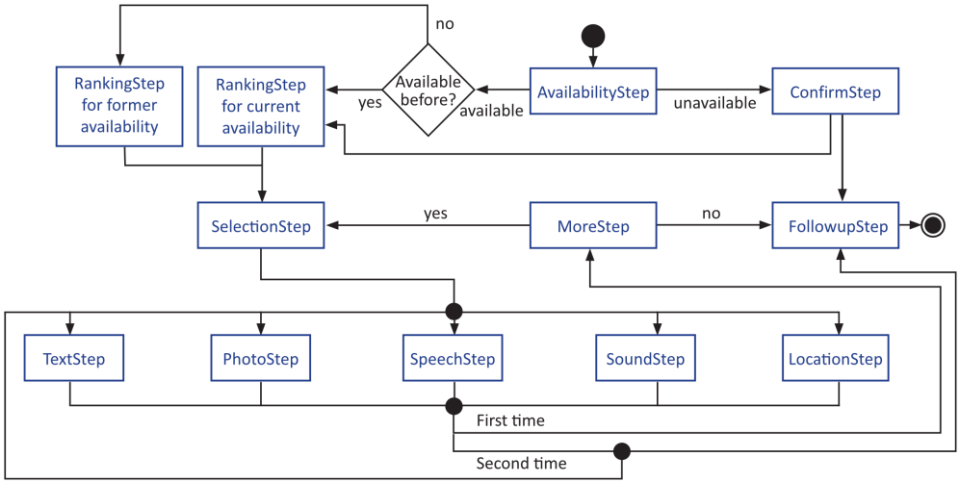

Figure 2. An overview of the participants' path through the ESM form when responding to a sampling request.

First, participants are asked to state their current availability on a scale from "*very available*" to "*very unavailable*" (see *AvailabilityStep* in Figure 3). If participants state that they are *unavailable* or *very unavailable*, we assume answering the full ESM form is inappropriate, yet ask if the person wants to take the survey anyway (*ConfirmStep)*. If the participant decides against taking the survey, they can acknowledge or adapt the time for the next sampling in the *FollowupStep* (cf. Figure 3) and are done with their task. The time for the next sampling is pre-set according to the sampling interval, but can be altered by the participants, if they have a longer period in which they do not want to be interrupted by the ESM Probe.

If the participants in the *ConfirmStep* decide to take the survey despite being unavailable, or while being *very available*, *available*, or *neither available nor unavailable* in the *AvailabilityStep*, they are directed to the *RankingStep* (cf. Figure 3). There, participants are asked to indicate sources of influence on their availability. The question is either related to:

- their current *availability*,
- or if they previously did not fill out a full ESM form, because they were *unavailable* or *very unavailable,* their last *unavailability* (as depicted in cf. Figure 3).

Participants therefore rate the factors that mostly influence—or previously influenced—their availability, on a scale from 0 (no influence) to 9 (very strong

influence). This way, they implicitly rank the factors: *people around them*, their current *location*, their current *task*, or *other factors*.

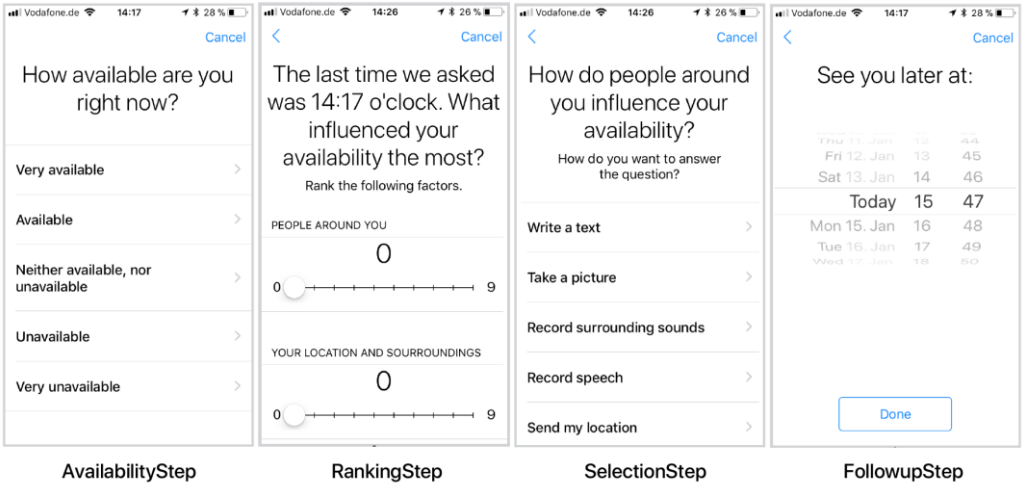

Figure 3. *AvailabilityStep*, *RankingStep*, *SelectionStep,* and *FollowupStep*—screenshots.

After obtaining such a preliminary understanding on how available participants are and what influences their availability, the next steps collect more detailed qualitative insights. In a first step (*SelectionStep*), participants can choose from five different media formats, in which they want to collect the data. They have the possibility to type a short text (*TextStep*), take a photo (*PhotoStep*), record a spoken short text (*SpeechStep*), record surrounding sounds (*SoundStep*), or save a location as GPS coordinates (*LocationStep*). The idea is to allow participants to select the most fitting format in order to capture their current situation with respect to their availability and the influencing factors. The choice of the format is typically determined by individual aspects such as convenience, effort, descriptiveness, social or situational appropriateness, privacy, etc.

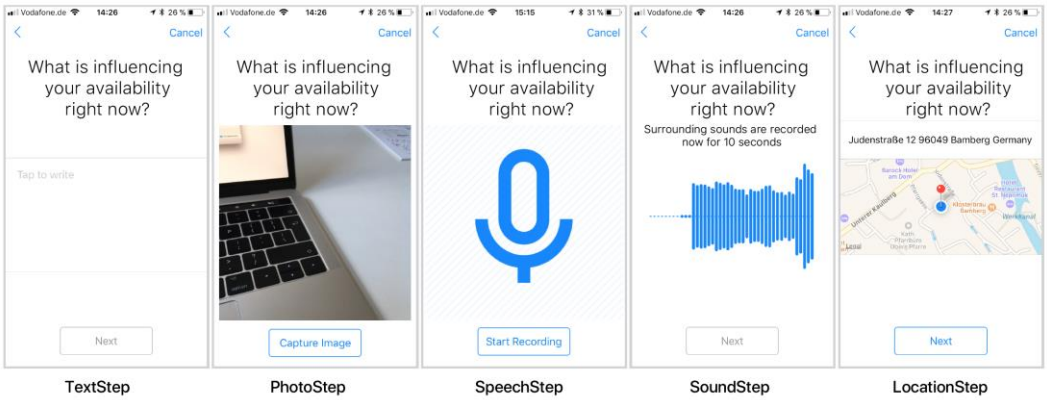

Figure 4. The five possible media steps for recording qualitative answers: *TextStep*, *PhotoStep*, *SpeechStep*, *SoundStep*, and *LocationStep*.

As can be seen in Figure 4, the user interaction with *TextStep* and *PhotoStep* is straight-forward. Participants either type a short text or take a picture with the phone's digital camera. While the *SoundStep* records for a fixed interval of 10 seconds, the recording of the *SpeechStep* is started and stopped by the user. Finally the *LocationStep* uses the current location as default, but allows users to change the recorded location by interacting with the displayed map and pin.

After this step, participants have the possibility to either conclude their ESM form or to choose a second media step in order to collect further qualitative data (cf. Figure 2).

The resulting dataset for each participant comprises snapshots of different moments. The collected meta-data like time, availability, and ranking of the influencing factors help the researcher in analysing and contextualising the qualitative responses in form of written and spoken texts, photos, recorded soundscapes, and locations.

In order to allow the investigator to infer on the collected material, we provide an interactive data exploration tool that allows different views and sorting of the data (e.g., sorting by participant, availability rating, media format). It also provides a detailed look at individual samples (cf. Figure 5 below). It can be used to analyse the data after the study, or to go through the data together with the participant in a post-hoc interview.

Our Mobile Availability Probes concepts was integrated in our application based on the SensQKit—a software framework developed by our group that eases the development of context-aware experience sampling apps based on ResearchKit (Apple Inc. 2018). It was developed for Apple iPhones running iOS 10 or higher. The exploration tool is implemented with Node.js.

Exploratory Study

In order to test the feasibility of the approach, we conducted an exploratory study. Our aim was to investigate, whether our tool and method is able to engage participants in collecting continuously rich data, and to receive some feedback on the tool.

Participants and Procedure

12 participants (6 female and 6 male) between 23 and 56 years old (M = 28.9, SD = 9.0) took part in our study. Nine of them were full-time students, two working in a company, one self-employed. All were recruited through convenience sampling for this pre-study. The study lasted seven days, and the users had at the beginning the possibility to set their personal daily start-time and end-time directly in the application. The times could be chosen without any restrictions. On

an average the participant's choices for times resulted in 11.8 (*SD* =3.3) hours per day, during which they received 42.1 (*SD* = 16.9) sampling requests over the course of the week—so roughly six requests per day in average.

The participants were remotely briefed by reading an instructional PDF document that was sent to them via mail, together with a link to the application. The document also narrowed the conceptualisation of availability, as social availability for all forms of spontaneous computer-mediated communication via smartphones or computers (e.g., instant and mobile messaging, audio and video chats, phone calls).

Seven of the participants used their private iPhones and installed the application via Apple's TestFlight[1]. Five picked up an iPhone 5S with the pre-installed application that we supplied. The participants needed to sign a consent form, clarifying further details on the study and the data usage, directly inside the application before the data collection started. At the end of the study, the users sent the collected data directly from the app via email to us.

Exploratory Results

Overall the participants collected 405 samples. In the following we discuss the general answering behaviour as well as the quality and expressiveness of the collected data.

Answering Behaviour

Participants received 505 sampling notifications in total and reacted to about 86.1% of the notifications. In 29 cases, the participants marked themselves as *unavailable* or *very unavailable* and chose to answer later. This led to an overall number of 405 completed self-reports, ranging from 8 to 66 per user (*M* = 33.75, *SD* = 18.41). Thereby 381 of the reports included one (337) or two (44) qualitative responses (i.e., text, photo, location, etc.). Of the 24 reports that only included the meta-data like the availability assessment but no qualitative responses, 14 were from one participant and the remaining 10 were from 5 participants. Accordingly, half of the participants always used at least one qualitative answer format. 381 of the reports were related to the current availability, while only 24 were related to a previous unavailability. 13 of the 24 answers included a text or a photo, while 11 did not include a qualitative response. The obvious choice for documenting influencing factors of previous unavailability is text. We presume that photos were used, when the general situation did not change much (e.g., watching TV for a longer period of time) and a photo could still be taken at a later point of time.

Table 1. Overview of the use of the qualitative responses.

1 https://developer.apple.com/testflight/

Response Format	Overall	Max. per User	Median per User	Used By
TextStep	276	56	18,5	12 of 12
PhotoStep	69	20	4	11 of 12
SoundStep	40	19	0,5	6 of 12
LocationStep	37	23	0	3 of 12
SpeechStep	3	1	0	3 of 12

Looking at the types of media, we can see that the *TextStep* was used by all participants, and with 276 responses, most often. The *PhotoStep* is the second most used media type; it was used 69 times and by all except one participant. The *SpeechStep* was the least popular format, and only used by three users one-time. While the rationale for including this step was to allow capturing longer descriptive responses that would be too tedious to type in a *TextStep*, we found two of the recorded audio clips were quite similar to the written responses of the *TextStep* (i.e. "I am at home cooking" and "At home, working on some stuff"). The clips had a length of 2 and 3 seconds respectively. The third participant repurposed the *SpeechStep* and treated it like the *SoundStep* to record an 11 second snippet of a lecture. The *SoundStep* with 40 and the *LocationStep* with 37 responses were used almost equally often. While the *SoundStep* was used by half of the participants, only 3 participants used the *LocationStep*.

Quality and Expressiveness of the Material

Analysing the returned data in our exploration tool (cf. Figure 5), showed a wide variety of rich and expressive material. On the one hand, we found material that is confirmative, yet less inspirational. For example, a photo of an unavailable person hurrying to catch a train is more in the line of expected results. On the other hand s, a photo that shows parts of a participant in a bubble bath indicating to be very available stimulates reflections on our conception of what makes up availability. In the same line the texts we received for unavailability more often confirmed our preconceptions (e.g., "Being in a lecture" or "I am working and constantly having customers in front of me[2]"), then those we received for availability (e.g., "Resting after lunch and waiting for the child to finish her nap" or "Tidying up the flat with my roommates").

2 We received written and spoken responses in German as well as in English—for this paper all German responses are translated into English. The translation aims at conserving the content and tonality of the original response.

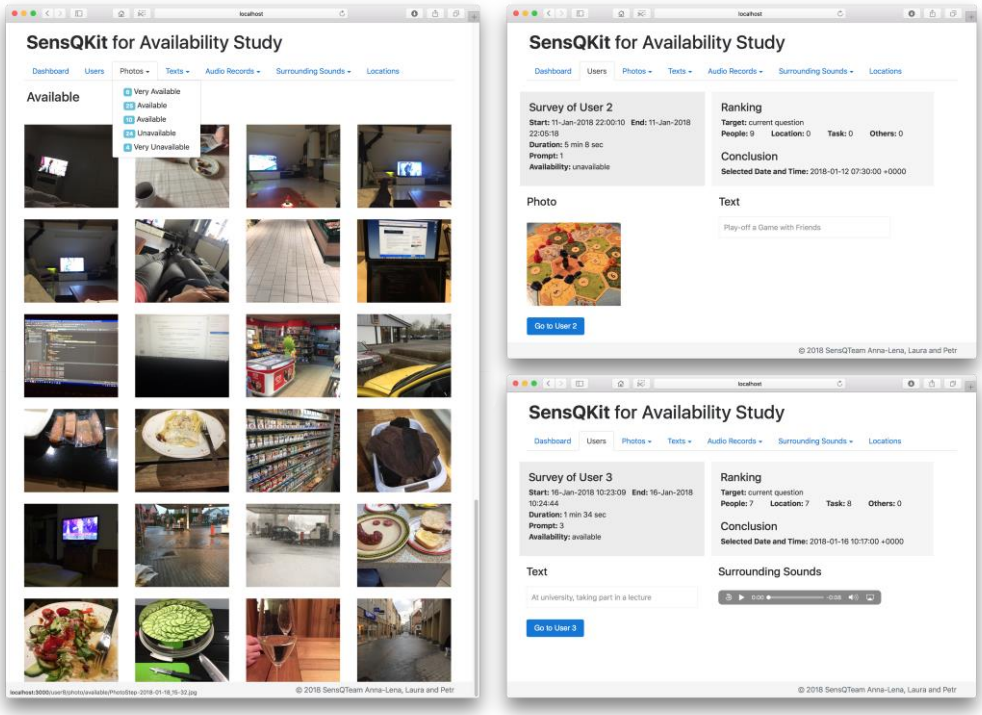

Figure 5. Examples of views of the data exploration tool. Overview with all collected pictures for situations where the participants responded to be available (left); individual sample with meta-data presented together with the collected qualitative data either photo and text (upper right); individual sample with text and surrounding sound (lower right).

We saw reoccurring motives in the photos, texts, and audio responses, like watching television, using a computer, eating or preparing a meal. However, the same motives were associated with rather heterogeneous availability needs—in-between subjects, but also for the same subjects at different times. While many of the received texts were very concrete (e.g., “at work unpacking goods with a colleague”) others were quite vague (e.g., “carnival preparation”) and thus gave much room for interpretation. In the texts we saw the most reoccurring elements, especially when the general situation did not change over several samplings the inserted texts were quite similar.

From the photos we saw that the participants tried to be very privacy preserving—not only with their own privacy, but also that of others. For instance, only one of the 69 photos showed a face of another person; and the body parts (mostly the knees) in the bathroom were also totally anonymous. Yet, by showing the hands, feet, chest area, or backs of co-present people, the participants could still convey the importance of the social interaction for their unavailability or availability. Sometimes the combination of formats (e.g., photos and texts) helped to better understand the reasoning. A close up photo of a board game, with the text “[…] a Game with Friends" hints at the importance of a present person for the current availability. Especially in their photos, it seemed that participants enjoyed

the expressiveness and playfulness of the approach, as for example the depiction of the preparation of a salad showed. Overall the photos tended to provide much richer impressions than the other media types and are also much easier to absorb by the researcher.

The responses from the *SoundStep* were the most difficult to absorb and make sense of. They need to be played one after another, which made them generally harder accessible and it was more difficult to infer the participants' intentions than from other formats. In eight of the recordings it was clear that the person was currently attending a lecture. These recordings perfectly reflected our indented use for the *SoundStep*: to easily capture situations in a socially acceptable manner in which a user might be less interruptible. For other audio clip responses, it was way harder to grasp what is going on—they reached from outside noises to mouse clicking sounds.

Finally, the *LocationStep* was used almost as often as the *SoundStep*, but by fewer users. We assume that the *LocationStep* felt more privacy invading for some of the participants than the *TextStep*, *PhotoStep*, or *SoundStep*. While the other response formats—most prominently photos—also had the potential of being privacy invading, they offered participants more control (e.g., by framing their shots). From the researcher perspective, the pure GPS coordinates—even when displayed on a map—were hard to interpret without further knowledge of the users' significant places and general knowledge of the respective area. Users also revealed locations explicitly. For example, they wrote "[…] at home […]", "[…] at the university […]", "[…] at the gym", "[…] in the office […]", but also various verbal formulations from being on the go. The texts even allowed capturing locations on a more fine-grained level, which would not always be possible with GPS sensor data (e.g., "In the kitchen […]" or "on the sofa"). And also some of the photos revealed details about the current location, such as in a supermarket, the driver's seat in a car, or the passengers' seat in a car.

Conclusion and Future Work

Overall our approach allowed us to collect a considerable amount of expressive and inspirational material. From our first sighting of the material of our exploratory study, it became clear that discussing the captured material with the participants has the potential to convey considerably more information. This can be done either in one-on-one or in focus group sessions. Especially for the locations or recorded sounds, it seems very important to discuss and distil the personal meaning of the recordings with the participants.

The data corroborate our claim that it is far easier to understand what influences *un*availability or even only non-interruptibility than to actually understand when people are available. Yet, with respect to both—availability and *un*availability—the tools helps capturing qualitative responses of potential

meaning to the participants. Going through these responses with participants can shed light on factors that are seen as: (1) one-directional indicators of unavailability (e.g., being in hurry always indicating that one is unavailable); (2) one-directional indicators of availability (e.g., a rest after lunch always indicating that one is available); or (3) bi-directional indicators (e.g., a bubble bath that for the same person on one day is an indicator of unavailability and on the other day is an indicator of availability). In order to build better systems, we are now even more convinced that it is important to understand what determines *availability* above the absence of factors that influence that we are currently not interruptible.

At the moment, the tool and the collected data are primarily used to get a better understanding of the availability of the individual participants as well as availability in general. In the future, it could be extended to be used as a source for training a system that might—after a training phase—better adapt to its user's availability or unavailability.

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