100 Days of iPhone Use: Understanding the Details of Mobile Device Use

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ABSTRACT
Internet connected mobile devices are an increasingly ubiquitous part of our everyday lives and we present here the results from unobtrusive audio-video recordings of iPhone use – over 100 days of device use collected from 15 users. The data reveals for analysis the everyday, moment-by-moment use of contemporary mobile phones. Through video analysis of usage we observed how messages, social media and internet use are integrated and threaded into daily life, interaction with others, and everyday events such as transport, delays, establishment choice and entertainment. We document various aspects of end-user mobile device usage, starting with understanding how it is occasioned by context. We then characterise the temporal and sequential nature of use. Lastly, we discuss the social nature of mobile phone usage. Beyond this analysis, we reflect on how to draw these points into ideas for design.

Author Keywords
iPhone; Screen Recording; Device Use; Video Analysis

ACM Classification Keywords
H.5.1. Evaluation/methodology

INTRODUCTION

The growth of the mobile device as the paramount platform for computing is increasingly difficult to dismiss, with growing sales and usage, as well continuous innovation in hardware and applications. Indeed, the range of applications and services available through the Android and iOS app stores already compete with the range available for desktop computers, and with the web as a general online interface for services and goods. New technical opportunities such as near field communication, barcode scanning and Bluetooth LE (low energy) also offer increasing opportunities for integrating mobile devices into the environment.

Yet integration of devices goes beyond the tangible and technical: devices play an ever increasing part in our everyday activity and conversation, interrupting but also augmenting our lives in new ways. Some have gone as far as to claim that our human sociality is being damaged by the spread of internet connected devices [22, 21] (drawing us into shallow online interactions at the cost of more valuable face to face ones) yet there is little empirical data here. Indeed, more broadly, there is only a schematic understanding of user behaviour on modern internet connected mobile phones – one of the most important contemporary sites of technology innovation.

We present here results from a study of iPhone use, using video recording to gain a more empirically informed understanding of mobile phone use in everyday life. We developed a software application (app) that ran on our participants' own iPhone to record all screen interactions. The app also recorded ambient and device audio, GPS location and app launches. We used this to collect naturalistic data from 15 iPhone users in Sweden, the UK and the USA. The corpus collected consists of 1,695 video clips of use – over 70 video hours of iPhone use. The videos present a distinctive view, allowing us to study device use in situations as diverse as workplaces, bars, transport, outdoors, shopping malls, dinner parties, even toilets.

Our analysis is framed by the concept of the 'occasioned' nature of device use – how context influences the initiation of device at particular point in place and time. We explore the temporality and sequentiality of device use through what we call episodic organisation. Thirdly, our data revealed interaction with others while using a mobile phone to be surprisingly common. To conclude, we discuss the potential opportunities in using video to study mobile device usage.

LITERATURE

Some of the first attempts to understand mobile device usage involved logging software. One of the most notable long-term deployments of such a mobile logging application is Cenceme [15], an application that used context sensing to automatically update social networking sites with each user's current activity. Initially developed for the Nokia N95 and trialled among 30 locally based participants, the software was then ported to the iPhone when the App Store was first launched. Other apps include AppAware [9], which allows users to share, via existing social networks location-tagged information on which applications they are installing. In doing so, users are able to explore applications being used in their current location and the popularity and lifecycle of mobile applications are trackable for research.

An alternative approach was adopted in [2] where interview data documented some of the ways in which mobile phones are used as part of communication and work tasks. While Church et al. [7] use a diary study augmented by interviews

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to document the situations in which mobile Internet was accessed. They reported that more than 70% of search on the mobile devices was *not* carried out in a mobile context (out of the house), and that only 17% of recorded searches were directly related to the location of the search. Church et al. [6] also examined reasons for engaging in mobile search.

One related approach has been to use video to study mobile device use. Video recordings has been one longstanding method used in HCI for a range of different analytic purposes, but particularly to document interaction with and around technical artifacts [10]. Video has proven valuable in illuminating aspects of activities neglected by previous methods, particularly drawing on conversation analysis to understand mobile device use [5,14]. Video can focus attention on the moment-by-moment production of technologically mediated action. These papers make use of interactional analysis to study the details of interaction that takes place either through or around a technology with an ethnomethodological orientation deployed to understand the details of particular usage situations.

METHODS

In this earlier work a predominant method of studying phone use has been through analysis of log data from large numbers of participants, [11]. While these methods are powerful in identifying failings in form factors relating to specific physical attributes of the phone (such as errors in touch or keyboard input), for this study we wanted to design an approach to provide us access to the details of activities undertaken concurrent to any interaction with the phone, as well as the immediate contextual environment.

We adopted video methods to study screen recordings of phone use and also audio recordings of surrounding talk in interaction [10]. The data collection system consisted of a local recording application installed on participants' iPhones, and a website that allowed participants to review and annotate their data recordings (figure 1). The recording application itself was designed to run in the background on the phone and capture the screen of the device, it's location, the apps used during each session, and the surrounding audio from the microphone. Recording would stop during phone calls or when the device was put into sleep mode. The video data and associated meta-data were uploaded opportunistically when the device was locked and simultaneously connected to both a power supply and wifi.

During the use of applications (except full screen apps such as games), a red bar was shown at the top of the screen reminding users that recording was taking place. Participants had multiple options to hide data both before and after it was recorded; one option being to simply turn the recording application off. After the data had been uploaded, the participants were asked to review the videos and annotate them with diary entries providing the reason for each device use. Here they also had the opportunity to hide confidential recordings from the researchers. Exit interviews with all participants were conducted at end of each week either face to face or over Skype, to discuss interesting behaviour or ambiguities captured in their video data, and extracts included in this report were all discussed

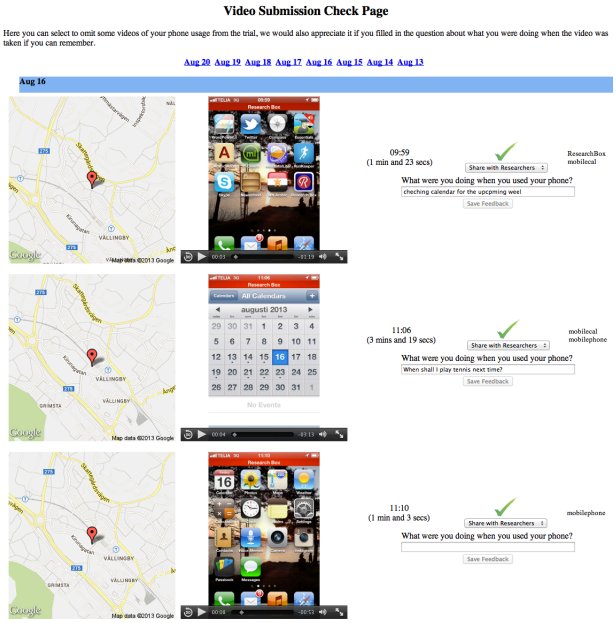

Figure 1: Participants' video review and diary entry

in exit interviews. Alongside the diary entries, these interviews clarified areas of uncertainty in the recorded data. Lastly, audio analysis techniques were used to establish the number of speakers on each recorded video.

Our analytic approach is built upon the lengthy and detailed examination of video recordings of actual use in focused analytic sessions. The purpose here is to remain anti-reductionist and avoid coding for patterns, as this leads to an analysis of the general not the specific, and loses the nature of the phenomena being investigated. This is the approach we have taken in previous work, such as [5], where video data of phone use was collected using wearable cameras during a 'day trip' in a city. While that paper presented rich video of device use, the usage was to an extent influenced by frequency of map use, navigation, and searching for establishments to visit – as would be expected on a 'day out' in a city. In contrast, here our method allow the capture of a broader range of usage data.

In total, 15 mobile phone users participated in the study; 10 of whom were recruited through adverts on social media and student websites, and the remaining participants were recruited using Mechanical Turk. All participation was rewarded with either gift tokens or Mechanical Turk payment. Of the 15 participants, six were female and nine male – all participants fell within age range 22-50 years and lived in Sweden, the UK and USA. They were recruited with the request that they be regular iPhone users and they use their phones naturally throughout the period of the sessions. Eight of the participants were first language English speakers, and all interaction with and surrounding the phone was conducted in English – while seven participants used a mixture of Swedish and English throughout their sessions. In terms of occupation, our participants represented a diverse range including: opera producer, lecturer, actuary, creative director, massage therapist, nanny, HR consultant and student.

DATA AND ANALYSIS

The corpus we collected consists of 1,695 video clips of use, with additional 62 videos hidden by our participants. There was a total of over 70 video hours of iPhone use. The median clip was 38 seconds long, although 10% of our clips were over 277 seconds (4 minutes 37 seconds) long. Participants each contributed from 22 to 440 video clips of use, with a median of 123 clips submitted per user. 40% of our clips have user entered diary entries.

A large corpus like this presents challenges for analysis. Some of the clips only have the video of the device available – there is no talk, ambient noise, or user's diary entry that might help identify surrounding activity. For other clips, while there is no talk there are aspects of the audio which, when combined with the location data, can identify the use as being on public transport, driving or walking. For the clips with diary entries, however, it is possible to reconstruct more of the situation of use. Moroever, often analysis is supported by talk around the clips in that the reaction of others provides a rich source for understanding the context of use.

All the video clips were logged and watched soon after being uploaded. The corpus was categorised broadly by the activity, apps used, and by the number of people co-present. We did not count numbers of clips in each category but rather moved analytically between the rough categories, comparing and refining the categories as we investigated further video clips. Through this grounded process 55 interesting clips were identified for further investigation. Over two days all three authors watched these clips and selected twenty for transcription and in-depth analysis which, combined with understanding of the broader corpus, forms the basis for results given here.

Communication Apps	**43,30%**
Messages	23,40%
Mobile Mail	11,50%
Phone	5,20%
Skype	0,80%
Google Hangouts	0,70%
Whats App	0,60%

Internet, News, Search	**18,90%**
Mobile Safari	12,10%
BBC News App	1,30%
Chrome	1,10%
Feedly	0,60%
Youtube	0,50%

Social Media	**16,30%**
Facebook	7,60%
Instagram	5,80%
Pintrest	1,30%
Twitter	1,10%
AlienBlue	0,30%
LinkedIn	0,10%
Grindr	0,10%

Maps and Geoinfo	**5,00%**
Google Maps	2,8%
Stockholm Subway Info	1,1%
Apple Maps	0,5%
Yelp	0,3%

Productivity and Admin	**8,97%**
Preferences	2,58%
Calendar	1,30%
App Store	1,11%
Clock	0,96%

Music and Sound	**4,94%**
Spotify	2,16%
Podcasts	1,46%
Music	0,71%
Pandora	0,28%

Games	**1,14%**
Temple Run 2	0,23%
Talking Tom	0,11%
Candy Crush	0,11%
Cave Man Feast	0,10%

Photo and Camera	**1,39%**
Photos	0,74%
Camera	0,65%

Other (98 apps)	**2,21%**
Total	**100%**

Figure 2: App usage as % of total phone use time, Categorised by type of application. Only the top applications from each category are listed

A number of video clips are included in this paper, represented by screenshots and written transcripts of the audio. The transcripts make use of simplified notation to indicate [overlaps], ↑raising and ↓falling tone and pauses (length in brackets). Asterisks [*] show when screenshots displayed alongside the transcription were taken.

RESULTS

It is clear that modern mobile phone use – iPhone use in our study – is incredibly varied. There is a variety of different situations of use, and ways in which context is hooked into and connected with use. The first rather broad question we asked of the data was simply what are mobiles used for? To answer this question in we categorised the apps used by function, analysing time spent by users in each application and category and figure 2 provides the high level statistical results.

Further, and digging deeper, we attempt to address the *Temporality of mobile device use*. We examine why a device is used at a particular time and how the use integrates with concurrent activity. We explore with the data how task and situation create temporal 'slots' of sorts for a user to interact with their device, and how the resulting usage emerges to an extent from the nature of its slot. We ask what in the environment 'occasions' any given phone usage.

Nearly all our sessions of use are relatively short and although there are longer, more complex examples there are clearly certain time constraints that can influence device use. Within those time constraints, usage is further shaped by the episodic nature of the completion of different tasks.

This led us to characterise different 'styles' of phone use that were common in the data: *Micro-breaks* are user-initiated instances where the phone was checked for messages or social media – relatively short and frequent, often during the working day or another task. We see *Filling time* as similar, yet temporally motivated behaviour, which is more acutely determined by the amount of time available. We describe the type of mobile reading in relation to the temporal 'slot' available for it.

Finally, we address *Sociality of use* – one of our most surprising findings is the prevalence of multi-party interaction during device use. *Digital knitting* describes a mode of use we observed, where the phone was used for a longer period of time while the user was also involved in another activity such as conversation with those around; we describe situations in which the device is central to the current co-present conversation, and others where the phone is used for complex, multi-party communication and collaboration.

Application Use

The first question is simply what was done on the mobile devices during the video recordings we captured. Figure 2 shows the percentage of seconds of use for each application, based on its duration in the foreground during recorded usage. Since we tracked a relatively small sample (15 users), these numbers perhaps give only a rough picture of broader application usage. There are also gaps in

recording time when users turned off the application or did not share usage videos with us. Also, applications which are used mainly in the background – such as the music and sound applications – will be under-represented. This said, these results are broadly in line with other reported application usage, such as [3].

Communication, internet and search, and social media comprise 78.5% of the time that our participants were on their mobile phones – clearly demonstrating that mobile phones are heavily used for these activities. A surprisingly small percentage of time was accounted for by games, given that games are top sellers in the application stores on both the Android and iOS store. This, however, may be explained by the age demographics of our participants who were all over the age of 20.

Perhaps most striking is the relatively small amount of phone calls on what are, after all, still "mobile phones". Indeed, there was more Instagram use that phone calls taken or received in the study. A related statistic is the average number of application launches per day – Messages is launched on average 11.6 times a day, Mail 7, Phone 3 and Facebook 3.5. While this shows frequent use of Facebook, even when combined with the other social networking applications it does not entirely fit with the notion of out of control, compulsive social media consumption.

Temporality of Use

One way of looking at the application use is by clock time. This shows the lowest usage at 4am, and phone usage peaking between 3-4pm. Around 7am usage jumps with a spike both in messaging and social media use, corresponding with typical waking up time. Looking at the length of use, participants used their phones for an median of 37 minutes per day, with a max of 14 hours and a minimum of 3 seconds.

However, since we have a relatively small number of participants, perhaps a better approach is to dig deeper and look at what actually was involved in usage at particular times. In particular, we started with the question: what actually made a participant use a phone at a particular time?

Occasioning use

Perhaps the most straightforward example of use being initiated is when a notification (such as a message) arrives (figure 3). This is an example of the device 'occasioning' use – the arriving message creates a slot where a user can then naturally attend to their device, perhaps by replying to the message. Of course, this is not to say that the device *compels* a user to initiate use – many messages go ignored. It is that an occasion has been created where device use is natural and likely. This does not mean usage is determined or produced, but rather that one of the most basic resources needed for mobile phone use – something to do with the phone – is made available by the incoming message.

Participant receives a notification of a message and unlocks their iPhone, seeing a message from a relative. The participant then exits the SMS app and opens their email, the participant reads the email, then clicks on a link in the signature of the message to call the sender directly on their mobile telephone number.

Figure 3: A simple form of occasioned use – a message arrives, leads to reading email then a call

More broadly, context can occasion many different forms of use. One straightforward example of this is when there is a need for some sort of information that can be found using the phone. A common example of this was searching for directions using the map. We noted many of these sorts of location and information searches at the transitions of events – such as when leaving home or work, or about to arrive at a public transport. Searches seen at this point could be for another establishment to visit, public transport times, or navigation information to the next destination.

Circumstances outside a participant's control can also occasion the use of the device. In figure 4 a delayed train leads to a search for information. The participant's train has stood still at a station for longer than she expected. Not understanding the announcement made in Swedish, she searches on the Internet, eventually turning to a popular

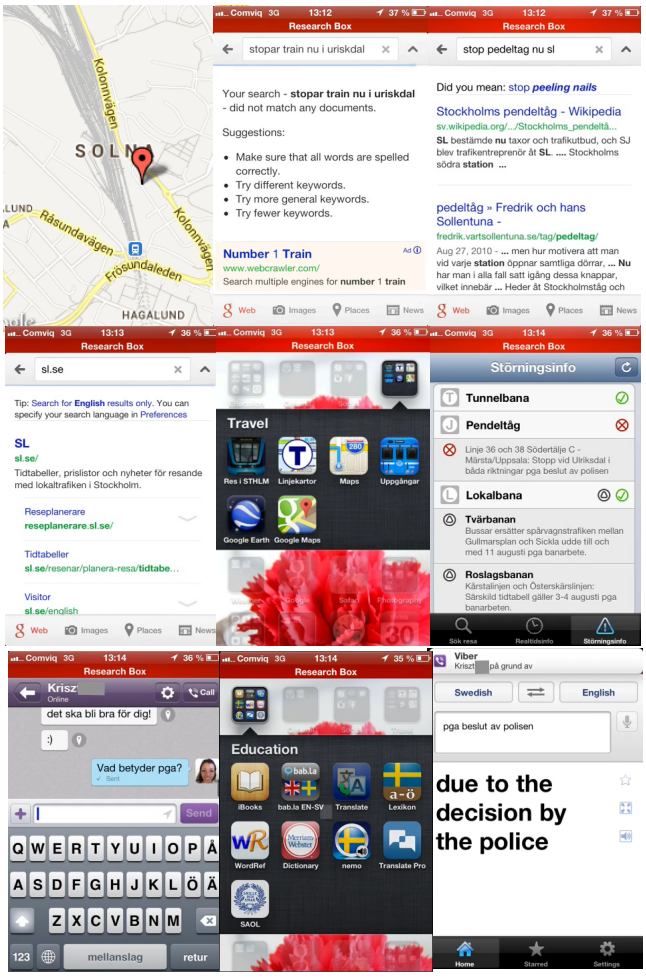

Figure 4: Diary entry reads: "in the train going home - try to figure it out why the train was stopped at the station." The train is a reason to search – it occasions use.

Stockholm transport information app (RES i STHLM). The information page explains that the pendletåg (commuter train) is delayed, but uses the abbreviation "pga". The participant messages a friend to ask what "pga" means, and also uses google translate – with a reply to her message and the translation arriving at the same time. In this clip there was no conversation, so we include screenshots from the recording of the mobile phone use.

There are also cases in which the the use of a device makes it possible to exploit a feature of the situation itself. For example, in one clip a son plays a video game while talking with their mother in the car. The mother is driving and the two converse about how television shows change as they become popular. As the mother's secondary involvement is driving, the son themselves also takes up a secondary involvement by playing a video game. In another extract, a participant at a dinner party finds the conversation drifting onto family issues that do not concern them directly, so they pull out their phone and start browsing YouTube videos, while still monitoring the conversation and engaging with it sporadically.

These are situations where the user has some 'free' attention, even if they are engaged in one activity, and thus can interact with their device and another activity simultaneously. This was seen during television watching – commonly know as 'second screen' activity.

Filling Time

A related – and commonly familiar – variant on this situation is using the mobile while waiting in some capacity, such as for a friend or an event (such as a train to arrive). These sorts of 'filling time' events are common in the data – echoing early data on the use of phones by mobile workers [17], the phone enables otherwise 'dead time' be put to some use. Rather than simply killing time though, it is more the case that these short intervals can be put to something useful, be it enjoying a quick video game or browsing social media.

One interesting feature of this sort of 'waiting' device use is that it is often time constrained, and as such users thus tend to take up activities which can be completed very quickly or abandoned easily, such as browsing social media. So, in one extract a participant browses potential partners on Grindr dating app while waiting to meet a friend – an activity which takes him only a minute or so, before the device is put away. As Licoppe puts it [14], the 'temporal projection' of cellphone activities is such that the decision of what to do with the device relies to an extent on how long the 'gap' that the user has to fill can be reasonably expected to be.

Micro-breaks

Another common, yet related, situation of use was that of 'Micro-breaks' – where, in contrast to the user employing free attention or free time to engage with the mobile device, the user actively carves time for their mobile device use from their ongoing tasks. Examples of this use are often quite short and distributed throughout the day in short bursts. Looking more closely, we find that much of this short use was checking the mobile for updates, at times triggered by a notification or incoming message, but at other times this is simply a check of social media, or that check is combined with reading incoming emails or messages. This echoes Oulasvirta et al's [18] discussion of 'checking behaviours', which still seem prevalent despite the advance in technology to support push notification rather than pull modes for media.

One example of this was a participant who worked at a newspaper designing websites. Even though she was at her computer for much of the day, we noticed a pattern of intermittent small 'snacks' where she would check her phone, navigating between Facebook, messaging, her work and personal email. These clips would often be less than a minute, and although similar to figure 3, they would be self-initiated rather than in response to a notification. The applications that would be accessed during these micro-breaks also seemed to be fairly habitual – a favourite website, a news application, social media or messaging. Since micro-breaks were frequent this could lead to these applications being checked many times.

Interestingly, the ergonomic literature has long advocated taking 'micro breaks' to prevent posture issues. While the management literature [1, 13] is more mixed on the productivity value of micro-breaks, their adoption as a method for dealing with work appeared common in our data. Related literature concerns 'self interruptions' [12] – daydreams, thoughts about bodily state (e.g. hunger) or simply one's mind wandering from the current task or activity. These micro-breaks on the mobile device can be viewed as a form of self-interruption, possibly helping concentration in the long term by the short change in task and attention.

Episodic task completion and sequences of use

Pulling back from individual types of use, our videos also give us a view of the overall structure of device interaction. In particular, individual user actions can be seen to fit together into 'episodes' of use – multiple actions with the phone that complete a single task. To a competent user there is a natural sequence to interaction – a 'next' action which follows what has been done previously. In searching for a route home, for example, there is a sequence that proceeds through entering the destination and then reading off the route. If one is searching for information, not finding the correct item leads to a repeat search. These sequences of actions bind together in what we characterise as an 'episode' of use. These discrete episodes encourage their completion, with the end of an episode of use acting as a natural point to end device use. This leads to a certain "I've started so I'll finish" nature of device use – a compulsion to complete an activity before putting the device down.

A 'compulsive' aspect of use can be seen in the nature of communication on mobile devices; messages often demand a reply. Within conversation analysis this is referred to as 'adjacency pairs'; questions demand answers, and so conversationalists make use of questions to manage participation. This does not determine or control behaviour but again acts as a structure that can be used by those interacting with a device – messages can be replied to (although again, frequently, they might not be).

The episodic and sequential nature of use might explain some other compulsive aspects of mobile device use; that there is a desire to complete particular actions and to answer messages received. Sometimes this is in conflict with other requirements such as politeness to those who are co-present. In figure 5, for example, a participant is in conversation with someone they have met in a local pub. While the conversationalist is telling a story, the participant has started to enter their contact details into the phone. They get to the 'email field' and ask for the storyteller's email four times, interrupting the story being told. This clip gives a sense of the 'compulsion' that the sequentiality of the task of creating a new contact can produce. This clip is also one of the clearest examples we have of "disruption" to the conversation caused by the device. Despite being engrossed in their phone (and asking so many times for the email address) the participant does properly engage in the story telling, offering their own evaluation "I'm not surprised..." at a suitable point in the conversation.

'Episodes' of task-oriented use like this can be contrasted with others which are more open-ended. Some activities, such as reading social media, can continue almost indefinitely – for as long as there is new content available. These are activities which can be dropped quickly and without consequence. Yet even here there is a sort of 'mini-episodic' nature in that there are natural breaks to reading at the end of a sentence, paragraph or status update.

Mobile reading

While video and music are fairly common media types; the dominant media consumption activity on mobile phones is *reading* in some form or another. Our video of use are full of text of different sorts: news, messages, emails, websites, games, reviews, maps, notes and so on. The majority of smartphone use, then, is textual in some form, even though it may be supplemented with rich graphics.

The forms of reading we identify entail different commitments by the reader. These differences lie in the length of time required and the concentration involved. One of the most demanding reading commitments is book reading – only one participant read books, using both the Kindle application and iBook on their iPhone, reading for twenty minutes or so during their commute to work. This sort of intensive reading requires a commitment that can be considered long when compared to the average device session of only 38 seconds. Social media, however, can be enjoyed with a much smaller time commitment – the same participant later spends 4 minutes on social media reading (Twitter and Facebook) during a lunch break. Reading Twitter she then switches to a third form of reading – a webpage review of a new film. Lastly, when at home that evening she checks the BBC news application, (figure 6).

Media consumption on mobile devices has been the subject of some attention previously. Yet we are not simply saying that mobile phones are used sporadically, or as Dimmick et al. [8] put it, during 'niches'; "the utilization of media in the interstices of people's schedules, those odd crevices of time/space that routinely occur in our daily lives where no common assumptions or norms exist with regard to how to spend time". The model proposed by Dimmick is a passive model of media consumption in that mobile phone use is something that fits into the interstices in our life. We argue that dedicated slots – micro-breaks – are proactively created in which media can be usefully consumed, but with the media use selected to fit the constraints of the particular micro-break.

Moreover, drawing again on Licoppe [14], we would argue for the importance of the temporal organisation of activity in choosing the reading activity to be undertaken. The reading should fit with the expected time interval that the user has free. So a micro-break at the work desk, for example might only be 5 minutes and so the type of reading chosen will fit with that time slot. A lunch hour might support a different, longer, reading session – or time spent relaxing in the evening different again. The media type, then, will be chosen not just because of its intrinsic interest, but also because of the demands it makes on the user. To this we might add the nature of the attention demanded, and the opportunity to thread this into other activities such as conversation with others. The granularity of social media, with its small snippets, fits well with other tasks since it can be stopped and started, and each snippet can possibly

B: I'll tell you what was absolutely classic. At the time I was talking, eh, first started talking to an [*]--------- agency about Daewoo I was also talking to another agency about Nissan - they've got a place out at Guildford. And they wanted to do the same
A: What's your email address [*]----------
B: And the last I heard from them (.) was that (.) that um that they wanted a crowd of engineers to go in there and blitz the place basically and then-
A: What's-what's your email address
B: And the last I heard from them was the agency rang me said just to sort of keep me up to date, they've come back and said none of the people you put forward have, they said that none of the people that we put forward would be suitable but also it turns out that they didn't realise that SEC were in charge of it, and apparently have been sacked from the job as well now
A: I'm not surprised, they're shit
C: heh heh heh
B: I know, I know-
A: what's your email address?
B: I mean I was (.) ...I was working for SEC at eh network rail and that's why I had to leave
A: yeh
B: because they're a bunch of fuckin idiots they really are
A: They're almost, they're worse than the computer centre and that's sayin, that's saying something
B: I know, I know-
A: what's your email address?
B: (.) keith underscore hotmail dot com

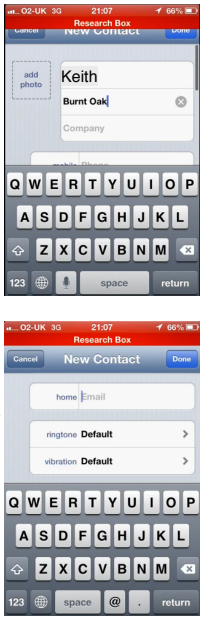

Figure 5: Entering new contact details vs. the conversation

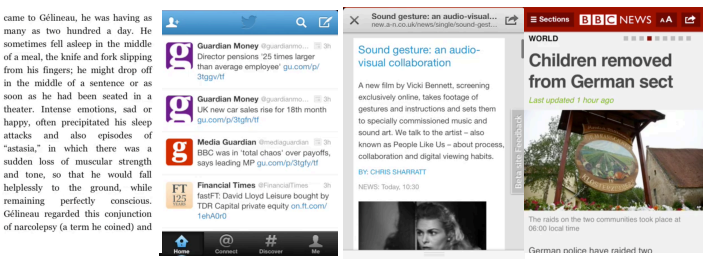

Figure 6: Four forms of mobile reading

contribute to conversation, while books (although they have other advantages of depth and immersion) require a greater level of temporal commitment.

Using the phone with others

One of the clearest aspects of the data is how social use of mobile devices was. We describe this in three ways, first how much co-present conversation went on around the phone, second how the phone itself allowed users to maintain complex multi-party collaborations, and lastly a form of use we have named "digital knitting".

Talk around the phone

The frequency of multiple parties talking around the phone in our data was a considerable surprise. In particular, the ways in which devices came to be used and brought into conversational settings. While it is impossible to obtain exact results due to the ambiguity of the audio data, we identified that 25% of our videos had more than one voice speaking while the device was being used, indicating some sort of interaction taking place around the phone. While in many cases this was just a device being used alongside an interaction, in our analysis it was surprisingly common for the mobile phone to be brought into the interaction in some way – such as occasioning a use of some sort. In figure 7, for example, social media consumption leads to a short conversation between the participant and their partner, with a short question, and explanation, then followed by discussion of a message received from a relation.

We are reminded here of Sacks' [20, vol ii, p92] comments on the ways in which 'local resources' (he meant physical objects in the environment) provide topical resources for conversation. What we find here is talk sparked off by something that (once it is found) is common to the conversationalists. Indeed, we were struck by how much co-present social media consumption there was in the data – with social media offering an array of topic resources to be introduced and discussed. The device then acts as something that can rather naturally be brought into conversation or discarded – it supports a form of multi activity, conversation and device use.

A related common multi-party interaction in which the mobile is brought into the interaction is search – social search having been remarked upon and researched in other publications [6]. That is, a conversation topic which generates some sort of object which can be found on the internet (such as a video or an answer to a question). This all said, the majority of our clips are actually of individuals using their devices on their own. Of course the iPhone is, by design, a device intended for single party use with a small screen and a form factor making it difficult to maintain multi-party interactions over a long period of time. Nevertheless it is also, by design, a device made for communication. The top application usage on the device is communication and socialising with others – as can be seen in figure 2. The iPhone then is still a device predominantly for sociability and communication, even if it is no longer predominantly used for voice calls.

```
[A opens Facebook app on phone and scrolls through New
updates]

A: We? [*]-------------------
B: °What's that↑°
   ((Participant B responds from
   the other side of the room,
   where they can be heard typ-
   ing on a keyboard))
A: we:e:e↑ ((A repeats the ques-
   tion about B's status up-
   date))
B: we wha:at?
A: You said WE
B: oh (.) Whee↑eee
A: oh my gawd
   ((muffled groans as partici-
   pant A gets the joke))
   ((A opens a FaceBook message
   from his aunt)) (12s) [*]----
A: Aunt Jo-leen wants us to move
   to Bakersfield
   ((While telling B about the
   message, A closes Facebook,
   opens Mail and begins to
   review and delete, without
   opening, a number of emails
   in the inbox))
A: you're too far away ((Adopts
   an 'Aunt' accent while continuing to explain the
   Facebook message)) (.) to which I would have to
   say, something to the effect of, we:e:ell you
   haven't seen me in fortee (.) no, thurty eight
   years
```

Figure 7: Conversation around a Facebook entry

Multi-party collaboration

Although we commented above on the relatively small number of phone calls made we would not want to downplay the importance of communication in our videos. As one would expect much mobile communication took place (in particular using Facebook and iMessage – the iPhone's messaging system). In figure 8, for example, a participant is booking cinema tickets for a group, and manages the details of the time of the showing, and how many tickets are to be booked simultaneously. The extract starts with the participant asking on Facebook if anyone wants to go to see the film, Pacific Rim. After a Facebook discussion he gets ready to book three tickets with the cinema app. He stops and checks if a third friend would like to go. He asks him, waits, does not receive a definite reply but eventually reserves four tickets. This communication takes place through Facebook direct messages, Facebook group messages as well as comments on a Facebook status message. Moreover, the asynchronous nature of the message allows the participant to move between the cinema booking application, the message itself as well as playing a game on the phone while waiting for replies.

Digital Knitting

While micro-breaks are relatively short episodes of use, we also observed longer episodes where content was consumed or games played while the user was also involved in some other activity. Above we mentioned cases where use exploits some 'spare attention' made available by the situation. In this category we see instances where the use of the device is combined with another activity, with attention moving between the mobile and the other activity dynamically, and where the device itself is at times connected to that activity.

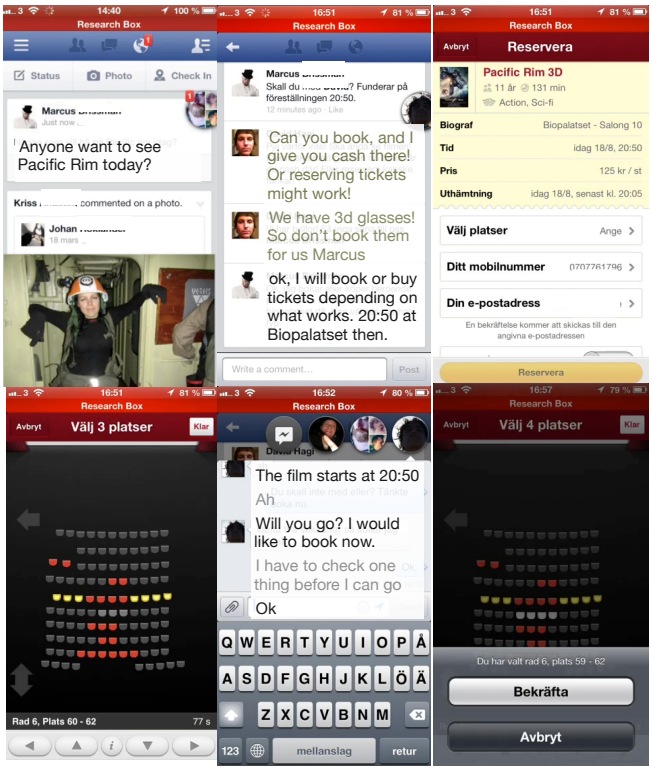

Figure 8: Cinema ticket booking
(Translations from Swedish have been superimposed)

So, for example, in figure 9 a massage therapist finds herself with a spare time slot as her customer has not turned up for their appointment, allowing her time to start a Solitaire game with a fellow therapist. However, the game is also combined with a conversation – centering on a story about two colleagues. We draw an analogy with conversations in knitting circles, where conversation can continue alongside and around the knitting. In this clip concentration moves from the Solitaire game to sporadic conversation around television, and a story about their boss, finally ending when both players admit to being stuck.

> *Participants at knitting groups are participating in handwork – their hands are busy but their minds can easily stray to other matters. In this way knitting is conducive to chatting, and chatting is justified because participants are still being productive. For this reason, knitting groups are increasingly termed "Stitch & Bitch' since participants can use the gathering to share not only skills but everyday life information.* [19]

In this case the two therapists are playing a shared game on their phones, while other examples include editing photographs with Instagram, or browsing and reading webpages while jointly watching television at home. What is interesting here is that as well as supporting enjoyable or creative activities, the mobile phone also allows for that activity to occur simultaneously with a secondary activity. The device also provides topics which can be brought up in conversation – such as the game itself.

DISCUSSION

The results here gives us a start on understanding how mobile phone use has developed beyond phone calls and SMS. A key focus has been on how context occasions use, and how use is managed to fit circumstances. We have tried to document the 'why' of use, how it is that usage itself is structured, and the differences between different styles of use. In discussion we relate three lessons we can draw from this work. First we address the issues of distraction around mobile phone use, and popular discussion that mobile phones are distracting or interfering with ordinary life. Drawing on the results here we can see how mobile phones usage has been shaped to fit with, and become part of our everyday interactions and life and we have some scepticism towards the notion of disruption. Second, we discuss the

A: Playing solitaire? [*]
B: Su:re
A: I'm gonna be really surprised if this girls comes back in like em not kidding
B: Really
A: yeah like cos she has been on the shit list and I'm trying to remember I've got a feeling she's no-showed on you before, lemme look, i swear she has (8)
A: it doesnt say-euw
B: she's never actually successfully been in
A: nope
B: she was physically here this morning, so that gives me hope that maybe she'll be here, [maybe]
A: [wouldn't count on it]
B: you wouldn't count on it↑
A: not gonna count on it
B: dang
((fanfare music to start the joint game of Solitaire))
A: oh my gawsh that was like in stereo i heard it from over there and here
((A and B play a 5-min game of 'Multi-player Solitaire'. Each of them play on their own phone, and are able to see the other's score at the bottom of the screen, while the time counts down at top)) [*]
B: shoot player down, okay (16s)
A: beep
A: beeep (8s)
A: figure i'll watch emperors new groove tonight
B: aw maaan
A: I'm like in that mood heh heh heh
A: and what is that music, s'not even music (3s)
B: it's very slow kind of thing
A: slow and annoying
B: h-h-h heh slow and depressing
A: yes (20s)
A: Alex was like so funny he was like cos when Melinda was like up here the other day like she was like now quiet we can't have fun while she's around (.) and he like comes in from lunch and walks through here and we're like Melinda's here and he like scurries off to his room. And then like whenever she's went to the back he came up and he was like I knew Melinda was gawn and I'm like how and hes like cos you two started having fun again
B: hah hah awww
A: he wis like really quiet
B: can't believe I'm stuck
A: I think I'm stuck too, quite frankly [*]
A: shit
A: where did I go wrong, it was going so well

Figure 9: Diary entry reads: *"Almost 1 hour of solitaire with one of my favorite therapists Sue ^_^"*
In this extract, attention moves fluidly between the game and conversation between the two therapists

importance of availability in the temporal structuring of mobile phone use. Finally, we touch briefly on the role of research design in this study – we argue that this paper supports the power of video as a technique for studying and understanding distributed mobile device use.

Distraction and mobile phone use

As with any new technology, the advent and adoption of the 'smartphone' has generated concerns over its effects on sociality and interaction. The New York Times, for example, commented on politicians in the recent mayoral race as suffering from 'distracted campaigning' in reaction to them checking their mobile phones at electoral hustings; "The phenomenon is in part a fact of contemporary life – people everywhere check their cellphones constantly" [16]. Slade goes further and writes of the mobile phone effects: "Human relationships are still in decline. We no longer have the time to take time even with those closest to us. [...] our focus on the tiny devices that fill the void left by social connection has surprising consequences." [21]. Even Turkle writes: "Our face-to-face conversations are routinely interrupted by incoming calls and text messages [...] When someone holds a phone, it can be hard to know if you have that person's attention. A parent, partner, or child glances down and is lost to another place" [22, p161].

Few seem to compliment the mobile phone's impact on our lives. Yet to these worries we can bring two aspects of our data. The first is the shared nature of much of the device use we recorded – as we mentioned above, 25% of our videos involved a conversation that took place around the activities on the smartphone. As can be seen in the examples above mobiles can also enhance sociality, with the device brought into the conversation and interaction. Device use becomes managed as any other aspect of the interaction. One might take the opinion that device use distracts from conversation, and that using a phone simultaneously is likely to be detrimental to that communication. Yet human interaction is something that is nearly always connected with the surroundings (with the exception of phone calls). Objects offer a set of rich resources that support not only conversation but also joint activity. So it is with mobile devices, in that they themselves are just objects in the environment that may be shared or ignored.

Secondly, it is worth remarking the majority of the use of mobiles is in a sense social – either communication or social media consumption. While there are those who would argue about the status of such sociability *vis a vis* face to face contact, it is worth remembering that while we might see people looking down at their phone screen there is an engagement with others through the device itself.

Portability and ubiquity

One of the key questions raised in our analysis above was the question of 'why now' – why would a mobile phone be brought out and used at a certain point in time. We described this in terms of the 'temporality' of device use. Yet one rather simple answer is that devices are brought out because they can be – they are actually carried on the person, or are available locally, so that for much of the time the effort involved in getting them out is low. This might seem a trivial point – that mobile phones are mobile – yet it sets a context of 'low threshold' use that other technologies might not have – iPads and laptops still need to be brought out of containers and carrying bags, or found in the environment. While the mobile makes some demands, it is remarkable to the extent that it is available in the settings where people find themselves, rather than having to have a place carved out for itself where it can be used.

When we are waiting to meet someone, we pull our phones out. The device is available and can be brought into situations determined not by the device, but by the requirements of the context. The importance of the mobility of the mobile device then is that it can be threaded into such a wide range of settings and activities because of its physical portability, stash-ability and pocket-ability. This a form of local computation that can be easily brought into whatever situation an individual might find themselves in. A related temporality that we have only touched on briefly is in turn how the routines of daily life figure in the use of the device. It is not that these devices change our daily routines as such. We, after all, have to go to work and care for our loved ones under the same temporal regimes as before. Rather, the mobile exploits these existing regimes, such as in post-waking and pre-sleeping use, or micro-breaks during the working day.

Designing from understanding use

This paper has focused on analysing use rather than specific design implications. A positive development in recent years has been the growing acceptance in developing the HCI field through both empirical and theoretical work, before the need to jump to specific design takeaways. This said, there are a few aspects of our analysis above which are worth mentioning. The first concerns the question of the temporality of usage. Predicting when and where a device will come to be used could have implications for battery life and the frequency of network updates. This can be done to an extent through time statistics, a system could also potentially attempt to work out the 'situation of use' – to predict situations in which a particular form of usage might dominate. So, for example, predicting waiting situations, or matching modes of transport with usage patterns.

Alternatively, phones could detect situations from talk around the device – potentially activate aspects of the system to fit better with the device being 'presented' to others. If modes of use (such as waiting or using an app while only partially involved in another interaction) could be identified, app usage clusters of those used in certain contexts of use might be identified, and a phone OS could update the content in these apps in the background. Broader inputs to this process again might include transport mode, time of day, if there is conversation and so on to produce an approximation of the likely 'situation of use' – watching for clusters such as morning social media updates, second screen television watching or reading messages at work.

More broadly however, this paper points to the role of video as a data collection method for understanding and improving the design of mobile applications. While the goal here has been on understanding usage more holistically, it

seems to us that the trend for automated testing could be usefully augmented by video data that could explain particular mobile use outcomes, as well as developing understandings of how the context of use has such a major role on mobile device use. Video could potentially help us move on from understanding that a particular design is more popular to understanding why it is more popular.

CONCLUSION

We have presented analysis of an exciting new corpus of data on naturalistic mobile device use. Through recording software deployed on end users' iPhones, we collected a library of over one hundred days of ordinary iPhone use. Analysing this data allowed us to answer key questions about actual usage: What is done on mobiles? When are mobile used? Why are mobiles used? Who is present when mobiles are used? In discussion we focused on the temporal and sequential aspects of use, the opportunities of the sociality of mobile phones, before briefly commenting on how to draw these points into broad ideas for design.

The paper contributes to the growing interest in understanding end-user mobile behaviour. That the context of use is a major characteristic of mobile device use is clear, and existing research techniques where usage is represented artificially in some way miss out on much of this.

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