

Always On(line)? User Experience of Smartwatches and their Role within Multi-Device Ecologies

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ABSTRACT

Users have access to a growing ecosystem of devices (desktop, mobile and wearable) that can deliver notifications and help people to stay in contact. Smartwatches are gaining popularity, yet little is known about the user experience and their impact on our increasingly always online culture. We report on a qualitative study with existing users on their everyday use of smartwatches to understand both the added value and the challenges of being constantly connected at the wrist. Our findings show that users see a large benefit in receiving notifications on their wrist, especially in terms of helping manage expectations of availability. Moreover, we find that response rates after viewing a notification on a smartwatch change based on the other devices available: laptops prompt quicker replies than smartphones. Finally, there are still many costs associated with using smartwatches, thus we make a series of design recommendations to improve the user experience of smartwatches.

Author Keywords

Smartwatches; wearable; autoethnography; context-aware; notifications; user experience; device ecologies; multi-device experience; cross-device interaction.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI); Miscellaneous.

INTRODUCTION

Users now have access to a wide ecosystem of devices, including desktop, mobile and wearable technologies that enable them to stay in contact with others and keep up to date with information. Smartwatches have seen an increase in popularity over the last few years, particularly since Pebble's successful crowdfunding campaign in 2012 [24]. Market figures show that worldwide shipments of smartwatches are expected to grow from 15.1 million in 2015 to

25.95 million by 2019 [41]. The appeal of the smartwatch is the promise of swift delivery for timely information straight to the wrist, and consequently this paper focuses on the communication use of smartwatches (e.g. email notifications, social media, messaging). Because smartwatches are worn, they enable people to be notified in situations where other mobile devices, such as smartphones, would be typically switched off or put away in pockets and bags. They therefore have the potential to increase expectations of being always available. However, it is still unclear what the added value is of having notifications on the wrist rather than on another mobile device. More importantly, how does this influence our always online culture?

Research on smartphone notifications has shown that users deal on average with more than 60 notifications per day, and attend to them within minutes, primarily due to social pressure [33]. Other work has highlighted the addictive nature of checking smartphones [43] with people even reporting checking their email on the toilet [6]. However, smartphones are not used in isolation, rather they are often part of a multi-device ecology that involves parallel or sequential use of different devices [23]. As these device ecologies grow, what effect will this have on expectations of availability? Our understanding needs to be updated to include recent technologies and uncover their role among device ecologies.

Most smartwatch research has focused on hardware and software improvements (e.g. [2,20,36,44]). Work exploring the user experience of smartwatches has primarily relied on survey responses from non-smartwatch users [40] or observing the interactions of users who are provided with a smartwatch for only a brief period of time [35]. However, with some exceptions [5,39], little has been done to understand the user experience of *existing* users for whom novelty effects are less prominent. We argue that it is important to update our understanding of smartwatch use among existing users, as well as understand the role of these new devices in shaping expectations in an increasingly always online culture. Moreover, we strongly believe that when studying a particular device, researchers must consider the broader use context in which the interactions take place, by taking into account other devices and applications.

Therefore, this paper reports on the first extensive study investigating existing users' situated experience with

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smartwatches within a wider ecology of devices. We used a mixed method qualitative approach, combining an autoethnographic diary study and semi-structured interviews with 17 early adopters (average use: 8 months) to uncover perceived benefits, issues and unmet needs when using a smartwatch, along with how it is used in combination with other devices. Our findings help to understand the benefits and drawbacks of owning a smartwatch within a multi-device ecosystem, and inform future improvements for its user experience. Finally, we make a number of contributions that confirm and extend previous work:

- We provide an understanding of existing users' situated smartwatch use in the context of communication device ecologies. By doing so, we discuss how having a smartwatch *always on* the wrist can lead to expectations of being *always online* and how users manage this.
- Extending previous work [5,39], we provide insight into users' preferences regarding *what, how, when* and *where* notifications should be delivered on wearable devices and how wearing habits affect these preferences.
- We consider how the design of smart wearable devices could be improved to better support users' values and preferences around notifications and availability.

RELATED WORK

We live in an age where being always online, not only is the norm, but can also be expected [28]. One of the many consequences is the sense of addiction we can get when checking our phones at all times [43]. In fact, research on mobile notifications has shown that we receive around 60 notifications per day [33], that communication notifications hold a highest value to users [38], and that subsequent task resumption is slower [4] and can reduce productivity [32].

This idea of being constantly connected is strongly linked to the ability to access information on any device, however, little work has been done to understand multi-device experiences in the real world. Jokela *et al.* [23] found that different devices are used in parallel or sequentially, depending on the task. Some work has also looked at the use of smartwatches in combination with other devices, yet this is limited to input and output modalities, where the watch is just considered "an extra screen" ([39] p. 2155). This is the case of Duet [9] where the watch is used as an input or output display to interact with a smartphone. In fact, most smartwatch research has focused on hardware and software improvements (e.g. [2,20,36]), and two questions remain unanswered: (i) how do smartwatches fit in the existing plethora of devices users have access to, and (ii) how do smartwatches affect constant connectivity.

Research on smartwatch use in the wild and with existing users is still very limited. Pizza *et al.* [35] found that attending to notifications was the second most popular use of the device (17% of interactions), after checking the time (50% of interactions). In their study, the physicality and materiality of the device showed that interactions could be hands free, but also that the device has an "always-available na-

ture" ([35], p.5462) (i.e. it is always on the user). Interestingly, they found that only 3% of the watch uses were followed by phone usage. Interactions with the watch were reported as a way of reducing time spent on the phone, and also as a way to balance availability to others with one's own concerns and demands. However, these were not *existing* users, and thus the types of interactions recorded may have resulted from novelty effects [17] and inexperience.

Only two studies discuss preliminary findings from interviews with existing smartwatch users. Cecchinato *et al.* [5] discuss the importance of aesthetic choices for wearables, use of smartwatches in everyday life, and the added value of glancing at notifications. Similarly, Schirra and Bentley [39] focus on purchase motivations, application use and smartwatch use in public spaces. They also noted that notifications were pushed to the watch "without using filtering options provided by the smart watch to further limit the amount of notifications they receive" ([39], p.2154).

More recent work has specifically looked at the use of notifications on smartwatches, however, findings are generally not based on existing users. Shirazi and Henze [40] found that the importance of a notification depends on both the app it comes from and the device it is delivered to. The authors come up with the interesting concept of differentiating notifications based on the device the user wants to view them on, but lack a discussion around what this may entail and the granularity of notification controls. Giang *et al.* [16] looked at the impact of smartwatch notifications compared to smartphone ones in a driving scenario. Their findings show that smartwatches may be more detrimental to driving performance compared to phones, highlighting potential differences in interactions with the two devices. However, this may only apply to drivers or specific contexts.

Smart wrist-worn devices introduce the opportunity to explore new research areas of mobile user experience because, unlike mobile devices, wearables are more discreet and can allow minimal interference between the user and their current activity. To the best of our knowledge, this is the first study that reports findings on *why* and *how* existing smartwatch owners use the device in real life, as well as uncovering the role smartwatches have in increasing the expectation that users are always online. Therefore, our study answers the following research questions:

- What are the benefits and challenges of wearing a device that is always online?
- How do smartwatches fit into users' wider multi-device ecologies?
- How can the design of smartwatches be improved in order to better fit user needs?

METHOD

We relied on mixed qualitative methods to answer our research questions, combining a diary-based autoethnography and semi-structured interviews with existing users of smartwatches. These two methods were chosen because of

their in-depth qualitative nature and the ability to provide insight into user experience. As advocated by [12,30], conducting an autoethnography allowed us to gain first-hand situated user experience of a device that is not (yet) widespread or researched, as well as provide a more nuanced understanding of the insights coming from interviews.

Autoethnography. The first author conducted a two-month autoethnography starting from when the device was first unpacked (from mid November 2014 to mid January 2015), in order to cover a broad sample of everyday activities. Data was collected through daily diary entries using the One-Note app, and included descriptions of use and non-use of the smartwatch, pictures of interaction with the device, short captions of the researcher's feelings and comments received from friends and family. Reactions and comments were prompted when possible and reported as quotes. Given the lack of literature on the topic at the time of data collection (2014), in addition to providing insight into realistic user experience, the autoethnography was also used to inform the question for interviews.

Interviews. We conducted 17 explorative semi-structured interviews between winter 2014 and spring 2015 with smartwatch users and stopped once saturation was reached [15]. Recruitment used a variety of media: flyers, social media paid advertisements, local meet-ups, a stand-up comedy event, and by word-of-mouth. When signing up for the study, potential participants completed a recruitment survey to screen for type of smartwatch and length of ownership. Interviews lasted on average 50 minutes and took place over Skype, with the exception of two, which took place in person in our offices. Questions covered motivations for purchase, initial set up and changes made over time, everyday use and non-use, specific use of notifications, aesthetics and form factor, reactions and social context, perceived benefits of smartwatches, issues and unmet needs.

Participants

As part of the autoethnography, the first author – a woman in her late twenties – collected comments from 60 people (friends and family) The median age was 32, ranging from 12 years old to 78 years old. Of them, five had a smartwatch and several were aware of what a smartwatch was through knowing someone who had one or via the popular press. Comments and quotes were recorded to gain a richer understanding of the perceived usefulness of smartwatches among a wider sample of users and non-users. We will report findings from the autoethnography using A0 to refer to the diary entries of the first author, and using A1-A60 to report comments from friends and family.

Interview participants (n=17, referred to from here on as P1-P17) were all male, with ages ranging from 23 to 68 (median: 31). All participants were or had been knowledge workers and had a technology-related job. Occupations included: four students (three PhDs, one MSc), three UX researchers, three commercial managers, a facilities manager, a software engineer, a chief innovation officer, an imple-

mentation consultant, a digital producer, a professor, and a retired teacher. Most participants (n=15) were educated to undergraduate degree level or higher. Fourteen participants lived in the UK, two lived in the USA, and one lived in Australia. All interview participants were entered into a prize raffle for one of three Amazon vouchers.

Despite our efforts in trying to reach out to women to take part in our study, the only woman who signed up opted out before the interview took place. As many articles in the popular press discuss, the majority of smartwatches, and particularly those available at the time of the study, are generally criticised as being too “masculine” and “bulky”, suggesting that their appearance may have made smartwatches less attractive to women (e.g. [14]). However, the gender balance of our sample is not so surprising given that market researchers found that in 2014 71% of smartwatch users were male, and average age was skewed towards the 18-34 years old bracket [42].

Analysis

Interviews were transcribed and diary entries were collated for data analysis. Initial findings from the interviews can be found in [5]. Both the autoethnography and the interviews were coded and analysed using thematic analysis [3] to find consistencies in themes and patterns of use across the two data sets. Initial themes from the autoethnography were organised in preparation for the interview analysis, to uncover overlapping codes, themes, and experiences.

Findings from the autoethnography were generally confirmed in the interviews, thus, to avoid redundant explanations, we will primarily report interview data, which provides more grounded evidence. However, where more relevant, we will use autoethnography data to provide evidence.

Although participants did mention other use cases (e.g. fitness tracking, time keeping, etc.), we will focus the following section on the use of smartwatches for communication. After describing general motivations for wanting a smartwatch, we will present our findings following the pipeline of how users interact with smartwatches for communication: receiving a notification, managing availability, and replying to messages. Throughout, we will highlight those aspects that users considered a benefit. Finally, we will discuss costs associated with having a smartwatch.

FINDINGS

In the initial survey, participants were asked to list all their devices, categorised by type (smartphone, smartwatch, tablet, laptop, desktop PC, activity tracker, other wearable). On average participants had 5.59 devices each (min: 3, max: 9, median: 5). All interview participants owned one smartwatch, with the exception of P17 who owned two: a Pebble and an Apple Watch. Models owned by participants included: Pebble (n=8, of which only one Pebble Steel); Samsung Gear (n=3, two Gear S and one Gear Fit); two Moto360s; one LG G watch; one Apple Watch; and one Basis Peak. On average, participants had owned their smartwatch for

almost 8 months (min: 3 weeks, max: 25 months, median: 5 months) and wore them “always” (n=8) or “most of the time” (n=9). Thirteen participants also owned traditional watches (i.e. non-smartwatches), of which seven owned more than one and only five had stopped wearing them all together. Based on a 5-point Likert scale survey answers, P6 still wore all his watches “most of the time”, alternating between them, P9 and P1 wore traditional watches “sometimes”, and the remaining five participants wore them “rarely” (e.g. only for formal occasions such as weddings).

Motivation for Wanting a Smartwatch

Findings from both the interviews and people talked to during the autoethnography suggest that users are interested in owning a smartwatch “because it’s cool to play with” [A21] or because they want to be one of the first ones to try a new technology, “because it was promising things that we never experienced and we are not clear how it will make our life easier or more difficult.” [P8]. Through the autoethnography we were able to collect reactions from non-users of smartwatches and their reasons for not wanting one. The latter were usually motivated by scepticism and related to not feeling the need to be constantly connected or not perceiving the added value compared to a smartphone: “why would I need it if I could use my phone?” [A19]

Interview participants identified themselves as early adopters and often recognised the limitations that go along with this. Despite having curiosity as their main motivation and few expectations, participants did find value in the smartwatches, as P8 explains: “After getting it, I found it’s a lot more useful than I thought.” However, three participants did have particular motivations that went beyond the appeal of a new device, and were looking forward to “being more connected” [P2]. For example, P9 wanted to be more responsive to his girlfriend: “I guess the main reasons was curiosity. [...] But also the secondary motive my girlfriend used to keep calling me and I would never pick up ‘cause I keep my phone on silent so I thought it could be handy to make notifications easier to get hold of.” [P9]

Receiving Notifications

Overall, receiving notifications on smartwatches was considered the main benefit, as P2 explains: “I like the idea of being more connected generally [...] everything is just a little bit of a convenience, [an] improvement of what you have before”. The types of notifications allowed on smartwatches by participants were primarily communication-related (e.g. email, SMS, iMessage, WhatsApp, Facebook messenger, calls, Skype) but also included social media (e.g. Twitter, Facebook), news and information (e.g. BBC, weather, Google Now cards), health data (e.g. Fitbit), and other (e.g. calendar events, alarms, to-do lists, IFTTT [21]).

Participants from both the interviews and the autoethnography had a clear idea of *what* sort of notifications they wanted, *how* they wanted to be notified, *when* they wanted notifications and *where* they were happy to be notified. We discuss each below.

What: Priority Notifications

Participants wanted to be in control over *what* they were notified about on their smartwatch, and this was generally *different* from notifications on their phone, as expressed also in the autoethnography: “I’d like to be able to control on which device [phone vs. smartwatch] I see the notification. It’s becoming redundant like this” [A0]. Despite initially allowing most or all notifications on their smartwatch, mirroring those on the phone, more than half our participants (n=9) turned off at least some notifications after an initial novelty period (which varied between an hour and a few weeks). Seven participants disabled email notifications on their smartwatch altogether; four allowed only personal email, one of whom enabled only priority personal emails; and six participants had both work and personal email notifications enabled, one of whom only had priority emails coming through. Overall, the reasons participants reported for turning off these notifications mirror those found in the autoethnography: they found them annoying, or wanted to be less distracted.

However, participants not only wanted to be able to select the types of notifications they received, but also wanted to specify which people could notify them or the topics they could be notified about. P6 explained:

“Twitter sort of lets you enable notifications for a certain few people [...] that’s good. On the other hand with WhatsApp [...] I would have to go to WhatsApp and [disable] the notification, but what if I had something important come in? [...] The way you adjust notifications and the way it is right now is really high level, you just switch off notifications for a certain app and switch it on.” [P6]

Specifying subsets of notifications from different applications were something participants desired but were not able to achieve with the current devices. For example P10 only wanted email notifications from certain people because “customising your wearable and making it actually yours, whatever you want to receive, it gives you control. It feels nice to have control over technology”. However, smartwatches do not support this level of customisation yet, as he goes on to explain: “still I don’t have the luxury to decide I want emails only from this specific person.” [P10]

How: Glanceable Information

Participants found that the major benefit of having a smartwatch was that by quickly glancing at their wrist they could decide whether to interrupt their current activity or not deal with the notification (be it reading the whole message, replying, deleting, etc.). This was consistent across the different models of smartwatches and apps used, ranging from those that allow seeing the whole message to those that only preview the first few lines.

“It’s made my life easier in terms of managing notifications and seeing which ones are duds and which ones are actually ones I want to deal with.” [P9]

“I don't let myself be interrupted. [...] So the Pebble serves as an extension of the phone that lets me know that something is going on and has the added benefit of finding out in a more convenient way what that something is. It gives me a little bit of distance; [...] I can't answer it because I have no microphone, but at least knowing what's going on can be useful. I can decide if it's worth running to grab the phone.” [P13]

All participants bar one [P6] also agreed that glancing at their smartwatch was less rude and more socially acceptable than looking at their smartphone. In particular, being able to check the smartwatch without interrupting the flow of any on-going social interaction or being too distracted from the current task was seen as a major benefit.

When, Where and Wear: Contextual Alerts

Another feature participants desired were contextual notifications, whereby they could retain control of *when* and *where* they received notifications, something that current smartwatches do not fully support. Participants had different interpretations of what they considered contextual. For example, some (n=5) were more keen on having location-based notifications, such as knowing about the next train when nearing the station, while others (n=6) wanted to have different types of notifications enabled depending on the activity they were involved in (e.g. not receiving social media alerts when working). As a result, participants created rules around when and where to be notified, some of which were automated using the existing settings, while others were manually enabled at the time of need.

The most frequent automated setting used was muting the watch at certain times, such as at night. As P11 puts it, being able to mute your device is an important feature that is not always advertised, probably for fear of reducing engagement with the device:

“it's quite inconvenient if you forget to put it in sleep mode and then people start talking to you on Facebook and then your wrist vibrates, that's quite annoying! [...] If you put it in sleep mode the only thing that will interrupt you is your alarms. [...] They don't tell you that you need to do that, but you do need to do that basically. It's on the watch from the beginning.” [P11]

Some participants (n=5) preferred having a more active role in deciding when notifications should be disabled and thus manually changed the settings from time to time. For example, P4 would disable his notifications whenever he went on holiday, but also if he went out for dinner with friends: *“I have from time to time stopped certain notifications... [for example] when I've been out for dinner with a friend or something like that.”* [P4]

The Case of Meetings. Meetings were a particular context that participants frequently mentioned when discussing notifications. Although smartwatch use in formal meetings (e.g. job interviews) or when giving a presentation was dismissed for fear of it being distracting, participants were

very keen on using a smartwatch for day-to-day meetings for several reasons.

For example, checking the time in a meeting is considered socially acceptable, especially if this is done on a smartwatch rather than a phone: *“People will think that you are just possibly checking the time, or looking at something as opposed to actually getting some information through it. I think it's a little less rude I guess.”* [P17]. Getting useful information such as emails or when the next appointment is due seems crucial for staying on time and up to date: *“It makes sense to check the time and contemporarily see how long until the next meeting.”* [A0]

More interestingly, during meetings other people could take advantage of a user's smartwatch and send timely and contextual messages. This was the case of P8, who considered his colleague *“smart”* when they sent a message during a customer meeting so it would appear on the smartwatch. Although this may not have been as intentional as the participant led us to believe, it still portrays a realistic scenario:

“So normally we mute our phones and my phone is in my pocket, but when I was discussing something with the customer [...], a colleague of mine wanted to remind me of something to mention [...]. So he simply sent me an SMS to my phone, my phone is in the pocket, in my [hung up] coat, but then I got the message simply on my watch, and looking at the watch is never rude, or never offending compared to looking at a mobile phone, while in a meeting. So because he was not actively participating in the discussion, he managed to send me that SMS so just with a glimpse on my watch I knew what he wanted to remind me of and then I picked it up and managed not to forget it.” [P8]

Wearing habits. Depending on the context, deciding whether to wear the smartwatch was another way to control *when* and *where* to be notified. While not wearing the smartwatch could sometimes be a result of aesthetics and fashion preference on certain occasions (e.g. *“I had taken it off a couple of days ago because [...] I didn't want to look too much like a techno-nerd [for an event]”* [P1] and *“if I'm attending an event or a place that's a little more dressy I've got more of a dressy watch which I wear”* [P3]), some participants (n=6) purposefully decided not to wear it because they did not want to be constantly connected. For them, having the smartwatch *on*, meant they were also *online* and potentially available. P8 provides a detailed account:

“I try to use it while I'm driving [or] I'm in the office, but once I'm home I can just disconnect from my smartwatch. I think I'm one of the people who fell into the trap with the ability to work really remotely and have business emails on my mobile phone. It makes me keep checking it when I check my personal email. [...] and then I start to get worried [...] when it's not the time for it at all. I should wait till tomorrow. [...] [Interviewer: So why do you take your watch off?] It's just to decide to stay away from the phone,

so just to keep [the watch] off, put it on the table. Just keep it far from my hand. That's it." [P8]

In a similar way, when P5 reached home, not only would he take his watch off, but he would also turn the Bluetooth off on his phone, cutting that 'always connected' thread between devices: *"I'll turn the Bluetooth off on my phone, start charging the Moto360 - the minute I come in the door I'm done with it. If I go out again I'll turn it back on."* [P5]

A few participants (n=3) found that the watch itself was something that reminded them of work, so they did not wear it at the weekend. P17 compared his wearing habits with his two different smartwatches. He originally had a Pebble, which he wore most of the time, until he got the Apple Watch which he then wore all the time. When probed about the reasons, he explained: *"you know, funny I didn't [wear the Pebble all the time]. I wore it during the week, but weekends and holidays I would wear one of my normal watches."* [P17]. He goes on to explain how he only used it for notifications and he did not receive as many at the weekend. While his notifications may not have changed much since owning the Apple Watch, he now used his new device to replace the Fitbit he owned and track his physical activity. In this case, the affordance of the watch clashed with one of the participant's values: despite not wanting to have a connection to the online world at the weekend, tracking his physical activity superseded his previous habit of not wearing the watch.

Those participants who did not necessarily want to take off their smartwatches would instead turn off the connection or even the device from time to time to get some distance from the online world. For example, P11 stated, *"Sometimes I wear it while it's turned off [...] because I don't want to get any notifications at all."* P15 provides more explanation of a similar behaviour: *"Sometimes if I'm at work I'll turn my Wi-Fi off on my phone, so if I turn it on and I get everything stacked up then I find that quite distracting, but [...] over the weekends I don't find it distracting at all."* [P15]

Managing Availability

Once a user receives a notification, he or she is faced with deciding between three options: ignore the notification, dismiss it, or read it. In addition, reading a notification can be done on the watch or on another device, depending on the app. Deciding which device to use, in turn, opens different options for further actions, such as replying. With smartwatches generally offering limited reply functionalities (depending on the model), we found participants took advantage of not always being able to reply to help them manage their availability.

Participants used notification settings to gain not only a sense of control of how, when, and where to allow interruptions, but also a sense of increased flexibility and control over when to reply, as notes from the autoethnography exemplify:

"Having the watch has also changed my sense of availability: despite having a notification device strapped to my wrist which could potentially make me feel more compelled to reply, I feel it buys me time. [...] Being on the watch could help me decide if I needed to reply." [A0]

Other participants, like P5, shared similar thoughts and explained how the smartwatch prevented them from mindlessly completing habitual actions:

"[having the smartwatch means] I spend less time on a device. You know what happens... if I open the phone to check email then there are other things that you could very easily get into doing. You know, replying. Whereas on a smartwatch you can't reply, so it's very much just reading and then dismissing a notification, so it's actually made technology less intrusive." [P5]

Awareness Cues

This gained flexibility in when to reply to messages was particularly welcomed when it allowed participants to view messages without having the sender being notified that the message had been read. Information such as when a person was last online or whether a message has been read is known as an awareness cue [31]. Particular communication apps mentioned by participants, such as WhatsApp and Facebook Messenger, include read receipts. For example, WhatsApp introduced this feature in the fall of 2014, by which a message is marked as 'read' by two blue ticks appearing next to it [10]. However, when viewed on a smartwatch, WhatsApp messages are not marked as 'read' on the sender's phone, and the same happens with similar features in other apps. Most smartwatches work in the same way as the notification centre in a smartphone, where the user can preview a message without actually opening it. The only difference is that while on the phone the user can only see part of the message, on the watch one can scroll through the entire conversation, depending on the app. Because of this difference between devices, participants were more aware of these cues and expressed mixed feelings about them.

With messaging platforms, and particularly those integrated with awareness cues, there is an underlying expectation that people will reply as soon as they read a message. As P11 explained, *"[when the person does not reply to the call] I prefer going online on Skype, or sending [a message] on Viber or WhatsApp because I can see the other person is actually online. So [...] on WhatsApp they will reply to me when they see it. I think it's much faster compared to an email."* [P11]

Another participant, P6, expressed his absolute dislike for awareness cue features in messaging apps that tell the other person when a message is read, complaining about how they create or increase the expectation of being constantly available. In fact, he reports on being criticised, *"I receive a lot of flak from my girlfriend and other people"* for not being responsive and quick enough: *"I would stay away from Facebook Messenger and WhatsApp [...] and the reason*

for that I HATE the online available thing with the tick marks... ARGH! It's just so annoying! It's just added pressure to have all of that" [P6]. He then goes on to compare messaging systems with emails, in relation to the added pressure of availability and connectedness.

"The best part of email is that you don't have that kind of pressure. For some reason, [...] email just comes there and you know how important an email is, but with messages it's not like that, it's just so instant, in case if you don't get back to them now, the context is lost. If they sent you a message now, if you got back to them in a week or two then it sorts of defeats the whole purpose of instant messaging. So I think that's the reason why you have that added pressure and I really don't like to have the pressure. In case if you don't reply to them that's a bad thing to do socially." [P6]

During the autoethnography, the first author discovered that knowing that the sender would not know whether she had read the WhatsApp message made reading the message on her watch suddenly more appealing than taking out the phone, just in case she decided she did not want to reply there and then. Another participant, P11, explicitly mentioned awareness cues with respect to the watch. His experience somewhat contrasts with that of P6 above, as he explicitly used his smartwatch to avoid sending awareness cues to the other person:

"another nice feature of it, is that you can read the message without... like Facebook Messenger and WhatsApp... the other person can see that you've read the message, so (laughing) you can read the message without them seeing that you've seen it so then they don't feel offended that you are ignoring them. [So I can reply] when it's convenient for me, rather than [feeling pressured]." [P11]

However, although the smartwatch could be used to decide a more appropriate time to reply and to moderate what cues are, or are not, sent out, the mental models associated with smartwatch use created by non-users are still unclear. A4 commented, *"I know you have this watch and you see my messages!"* in reaction to not having received a response in a timely manner. However, as noted in the diary, *"what [A4's name] doesn't know is that I don't receive notifications from all apps, yet, because of the watch, he now expects me to be even more responsive."* [A0]. We found that non-smartwatch users did not have a clear mental model of how the device could be used by its owner and thus may pose a challenge in how smartwatches can help manage users' availability and moderate expectations of reply.

Replying to Messages and the Cross-Device Experience

After receiving a notification on a smartwatch and deciding to reply to a message, a user has to select which of their devices they will use to compose a reply. Different smartwatches afford different degrees of reply, ranging from no reply (e.g. Basis Peak), using canned messages (e.g. Pebble), relying on voice interaction (e.g. Moto360), or even full QWERTY-keyboards (e.g. Samsung Gear S). Other

devices can be used to reply to messages received on a smartwatch: of course smartphones, and occasionally other devices such as tablets and laptops/PCs can also be used if the app that sent the notification works cross-device. These are becoming more frequent: for example email and IM channels like WhatsApp, Facebook messenger, and Slack.

Smartwatches generally prompted short replies to urgent messages, or negotiating a better time to communicate. As P3 explains, *"I usually only reply on my watch if it's an element of urgency or it's very short and easy to reply. Usually if I reply from my watch it's just a couple of words."* Other participants (n=3) felt that while prior to owning a smartwatch they were not good at replying to important messages, they have since improved, like P9: *"I'm a lot more timely in replying to her now to text and WhatsApp."* The distance that a smartwatch provides from a smartphone extends also to the ability to make interactions politer or simply negotiate availability by letting someone know when is a better time, without having to pull out the phone, which would either interrupt the current task/social interaction flow or draw the user into checking other things.

"It makes those communications simpler and in some cases more polite. [...] I've programmed you know a few quick responses for text, like 'ok', 'I'm busy I'll get back to you', [...] I don't have to pull the phone out in a number of situations [...] where it's just physically awkward, but also situations where it's socially awkward. [...] I mostly reply from the watch in situations where the reply is either simply acknowledgement or letting people know I can't reply. [...] Just because someone wants to be synchronous doesn't mean that I am going to be." [P13]

In contrast, when the message was not considered important or urgent, participants' responsiveness using other devices such as smartphones and laptops depended on their availability and initialisation time (i.e. the time to boot a device and start an application). In the following quotes, P1 nicely explains reply behaviour, comparing smartwatches, smartphones, and eventually laptops:

"The way notifications work, I see text messages in a more timely fashion, but I don't actually respond to them. It means I'm quicker at seeing them, but I'm probably less likely to actually write a response. If you have to take your phone out to look at it you're already there, whereas... if I see with it on the watch I'll think "ok I'll deal with it later" and then never do it. So in some ways it probably reduced my text message response rate. It means that if I see something that is urgent I'm more likely to respond to it, but if it's not urgent I'm less likely to respond to it." [P1]

Generally, smartphones generated slower responses to non-urgent notifications because the burden of pulling out the phone and unlocking it to respond was not justified. This selective responsiveness across devices can help users align their behaviour to their values (e.g. not being constantly available), such as delaying a reply to a more appropriate

time. However, we observed how users' behaviours and values could be challenged if there was a readily available device. P1 explained how he was less likely to respond on his phone when he saw a notification on the watch, but "*actually, I'm far more likely to respond if I'm on my laptop and it's way more easy to type on that. So if it bumps up on my watch 'this happened' then I'll flip open the iMessage on my laptop and respond. Whereas if I'm away from my laptop I can't be arsed to get the phone out and send something.*" [P1]

However, this cross-device experience can also cause issues. In our case, P6 found himself with redundant notifications on several devices and ultimately disengaged with the smartwatch: "*so what I ended up doing was to mute all that came in. When I did that, it pretty much ended all the smartness about it. I stopped looking at the device, it was just the time.*" [P6]

Costs Associated with Smartwatch Use

Along with smartwatches providing the benefit of *buying* time by enabling users to decide whether to delay a response and thus *save* time by not pulling out their smartphone, smartwatches are also associated with negative *costs*. In addition to the monetary costs associated with purchasing an aesthetically pleasing smartwatch (and a data plan for some models), and 'battery costs' with having "*another thing to charge?!*" [P7], smartwatches can also pose a threat to privacy and attention.

Privacy Cost

Despite most participants (n=14) not being disturbed by having personal information displayed on their wrists for others to potentially view, some (n=5) did voice concerns that this could make the information visible to other people. For example, P5 stated: "*sometimes when I text my family member in a work environment that made me think that actually the notification could be seen if my wrist is turned outwards, a personal message could be seen by someone across the table from me, when I don't really want it*". P7 described a friend who had a Pebble and did not wear it at work precisely because he did not want others to read his messages and "*it has been an issue.*" [P7]

One participant found it weird that his friends could read his messages on his wrist, but explained: "*it's a risk you take if you wear your screen on you that someone is going to see your screen*" [P11]. However, another participant (P6) experienced some issues with a friend as a result of messages being visible on his smartwatch:

"The ex of my friend was messaging me – we've been good friends for the last 10 or 15 years [...] – when he saw the messages [...] he was really... his first question was 'why are you messaging her - what's the need? We have broken up now, so you shouldn't be friends' [...] the reason why it happened was because he happened to see what those messages are, and in a social context I guess you value your privacy and when it's all there for everyone to see it's not the best. [...] you should have a way to tweak that." [P6]

These findings suggest that privacy settings should be better considered in the design of notifications on wearables.

Attention Cost

In addition to being distracting to the user, smartwatches may be distracting or attention grabbing for others as well, and the autoethnography was valuable for uncovering these situations. On several occasions, real-world interactions were interrupted by somebody pointing out something that was happening on the watch, mainly out of curiosity for the novel device. This was also the case for P3's friend who also owned a Pebble: "*sometimes [...] his work mates know he's got it, they'll say 'you've got a call' and he's like 'yeah I know'*". In the autoethnography, one person explicitly mentioned how the watch had distracted her during a seminar: "*I found it distracting during the seminar. You were playing with it and then you were resting your head on your hand and the screen was lit up.*" [A1]

DISCUSSION

In this paper, we provide insights into how smartwatches are used by existing users, how they fit within existing device ecologies, and how they can impact both the smartwatch owner's sense of availability as well as other people's expectations of availability. By combining qualitative methods, we confirm and extend previous findings, along with presenting several novel insights.

Designing Smartwatch Notifications

Receiving notifications on a smartwatch was considered the major benefit by the existing users recruited in our study, confirming previous findings [5,35,39]. However, we also extended existing findings in a number of novel ways.

Previous work on mobile notifications identified how users are aware of their disruptive nature, yet want to maintain awareness nonetheless [22,26]. However, not all mobile notifications are treated equally, with some (primarily communication ones) being considered more valuable [38]. Whereas Schirra and Bentley [39] found that *all* notifications in their sample were being pushed to the watch, we found that once novelty effects wore off, most participants disabled at least some notifications on their watch, but left them on their phone. This in turn allowed them to create some distance from their phone, rather than just being "an extra screen" ([39] p. 2155). As smartwatches are worn, it is not a great surprise that users want to limit the amount of notifications they receive and the implications of this preference need to be considered carefully.

Pielot *et al.* [34] uncovered how smartphone users find it hard to not have notifications, even though they can have negative effects. Their study on disabling notifications for one day made people aware of wanting more control over their settings. Similarly, we found that additional notification control can be gained by using a smartwatch that helps filter out notifications and distractions, and even completely helps them disconnect when the device is taken off. As a way of exercising control over notification settings, we

found that participants removed their watch, strengthening the idea presented by Pizza *et al.* [35] of a smartwatch having a distinctive affordance and materiality to it. Taking off the watch is a physical act that can have a strong metaphorical meaning to the user, almost as if he or she were taking off the *digital handcuff* that as long as it is always on, it keeps them connected to the online world. This in turn can enhance the expectations of availability. Future smartwatch designs should leverage on the device materiality and affordances to support users' values. For example, allowing modular components that separate communication functionalities with other features (e.g. activity tracking).

Ultimately, our participants wanted smartwatches to have three specific features to make them feel in control of notification they received. Specifically, they wanted notifications to be (i) glanceable, (ii) priority-filtered, and (iii) contextual. Most commercial smartwatches already support glanceable information, however this is not the case for other smart wearables such as jewellery, which often only offer haptic alerts and no screen [8,37]. More importantly, we have seen how the smartwatch screen can be distracting for bystanders and therefore the type of glanceable information displayed on the screen needs to be considered carefully. Alternative solutions have been proposed, such as creating more intimate notifications that can come in the form of vibrations [18] or subtle peripheral light alerts [36], but these type of alerts still lack salient information such as sender and topic.

Priority and contextual notifications are considered a desirable feature not yet fully supported by existing devices. We found that participants prioritised and filtered the notifications they received by creating manual and automatic rules around what and how to be notified. While smart and contextual notifications have been suggested before (e.g. [13,29]), our findings go a step further and point towards the usefulness of geo-fenced notifications on a smartwatch, based on virtual fences around physical locations where alerts can be enabled to determine where one should, or not, be notified. For example, this could be introduced in future smartwatch designs by allowing users to be notified based on sender, topic, or even location. To optimise this, notifications settings should be decentralised from specific apps, and perhaps leverage instead on starred contacts.

Delivering the Cross-Device Experience

Previous work identified the importance of apps providing some cross-device features, such as differentiating notifications based on the device the user wants to view them on [40] or keeping track of where they were first viewed [7]. Building on this line of work, we found that responsiveness depends not only on the level of urgency, but also on the devices available and the type of awareness cues sent or not sent to the sender. Viewing a notification on a smartwatch allowed a delay in replying, depending on the importance of the message and devices available, but independent of the degree of reply allowed on the smartwatch (e.g. using

canned responses vs. full-QWERTY keyboard). While smartwatches afford a specific kind of response – short and urgent – replies on smartphones and laptops depend on many more factors. We found that the initialisation time [27] was a major barrier to switching [23] from a smartwatch to compose a reply on another device. Matthews *et al.* [27] found that smartphones' initialisation time was generally quicker than laptops' and therefore users preferred completing a task on their phones if possible. However, our results suggest that this is not always the case and more importantly, that device switching also depended on the application in use. As Jokela *et al.* [23] point out, and our study confirms, being able to access the same application across multiple devices is a strongly desired feature.

However, our study suggests that this cross-device experience needs to be delivered appropriately to avoid negative consequences, such as overall disengagement. On one hand, designers need to avoid occasions for abandonment, such as in the case of P6, who decided to stop using the smartwatch for notifications due to redundancy issues. On the other hand, designers should keep in mind users' values and needs. Nudging the user to respond on the nearest device might not always be the best solution, or one that is in line with their values. It can not only cause further interruptions, but also provide situations that further challenge one's desire to disconnect.

Managing Availability through Frictions

In a society that encourages people to be always online and available [28], smartwatches facilitate people receiving notifications in more contexts than any other mobile device. Although they have the potential to be digital handcuffs that increase other people's expectations of availability, they can also enable users to connect more selectively to only those things they consider important and can reduce users' compulsion to reply immediately to notifications. Our findings suggest that using smartwatches help users manage their availability and can reduce the time spent on other devices and consequently helping with issues of mobile addiction [43]. Pielot *et al.* [34] suggest that it is those same notifications we cannot live without that create expectations towards timely responses. By focusing on smartwatches among multi-device ecologies, we found that seeing notifications on the smartwatch reduces feelings of missing out, but also helps users meet their values by being in control of when to reply. This is partly due to the limited interaction capabilities, which are seen positively as a means to create some distance, and partially to the greater control over the kinds of awareness cues sent out. It should be noted that these benefits were not always perceived by those communicating with smartwatch users: for example, some people expected even more timely replies once they knew notifications were being delivered to the other person's wrist, not thinking that users might prioritise alerts.

Building on the concept of *microboundaries*, as presented in [7,11], we now characterise the kinds of strategies our

participants used in order to regain control over their availability. While some users did welcome the notifications and interruptions, regardless of time and place, others wanted to shield certain situations from any notifications. Therefore, we see how these strategies can relate to *social microboundaries* (e.g. disabling notifications when out for dinner); *temporal microboundaries* (e.g. enabling 'do not disturb' mode at night); *digital microboundaries* (e.g. disabling selected notifications only on selected devices); and *physical microboundaries* (e.g. deciding when not to wear the smartwatch or carry a device).

These strategies, or microboundaries, are examples of *design frictions* [11], user-designed strategies that help users shift from mindless interactions with technology (e.g. addictively checking emails) to more conscious ways of engaging with a device and the information it provides. While microboundary strategies have been noted across a number of devices [7] we identified a large number of them being used by our participants with their smartwatch. This might suggest that the use of a smartwatch can nudge users to think more carefully about their interactions or perhaps our sample is particularly aware of work-life boundary issues (e.g. not wanting work notifications during non-working hours). Thinking about these aspects can help inform how new smartwatches or smart wearables should be designed.

LIMITATIONS AND FUTURE WORK

Although our sample primarily consists of male early adopters, by confirming previous work, our findings around the use of smartwatches for communication purposes open the floor to future work with a more heterogeneous sample. We tried to recruit a diverse sample and have provided evidence of that, including sampling users with a diverse set of smartwatches owned for varying amounts of time. Future work should investigate long-term use of smartwatches and instances of abandonment, as previous work has observed that phenomena in other kinds of wearables [19]. Efforts to include a more gender-balanced sample should be made when investigating aesthetics and form factor, given the proliferation of wearables and their highly personal value.

We call for further work to investigate specific contexts of use and behaviours. For example, studies could use logged data across devices to understand reply times. Some initial work to see if viewing notifications on smartwatches are faster than on smartphones has been done simulating driving behaviour [16], and smartwatches were found to require longer glances. As smartwatches become more popular and the novelty effect wears off, these findings need updating. More importantly, as cross-device applications become more prominent, whole device ecologies, including laptops, tablets, smartphones and smartwatches should be studied.

Other interesting contexts of use are meetings and working environments. Our findings support the idea that there is a strong value in using smartwatches during meetings to keep up with information. Some research has already been done in this area, for example using smartwatches to provide

peripheral awareness during videoconference meetings [25]. Other work has explored the use of smartwatches to augment interactions in office environments, with implications for managing one's availability [1]. This work points towards a new level of cross-device experience and we call for further research in this direction.

CONSIDERATIONS FOR DESIGN

Although our findings are not representative of all smartwatch users, they provide useful insight on what existing smartwatch users see as the major benefits and drawbacks. As new models are released and sales figures grow, we believe our insights can help inform how new models should be redesigned, before adoption becomes more mainstream. In particular, to help users have more control of their notifications and availability, we make some suggestions.

- *Decentralising Notification Settings.* Notification settings should leverage on users' existing contacts lists and starred contacts, rather than on single apps, in order to select when, where and how to be notified by certain people. For example, different level or category of priorities could be assigned to a user's contacts (e.g. always notify me for this person, or notify me only during working hours/days for this person).
- *Designing Smartwatch Affordances.* The materiality of the smartwatch and the symbolism of wearing it can be used to inspire new shape shifting or modular wearables that align with users' values and behaviours. For example, having modular components that help users disconnect from notifications but still track steps, could cater for users like P17 who changed his wearing patterns when he upgraded his smartwatch and abandoned his activity tracker. This has important implications also for managing availability and shifting general expectations that people might have or perceive.

CONCLUSION

The wearable nature of smartwatches enables people to be notified even when other mobile devices might not be at hand. As a result, users can feel always online and more available. For some this may increase their productivity and enhance their social lives but for others smartwatches may appear like digital handcuffs. In this paper, we investigated how existing users manage smartwatches and how they use them in conjunction with other devices. The main finding is the value perceived in being able to quickly glance at information, without it being considered rude or too disruptive, and deciding whether to interrupt the current task. For most users, wearing a smartwatch led them to carefully manage people and information streams that were able to contact them and when, where and how they could be notified: having a device that enabled them to be 'always on' made them aware of when they wanted to be 'off'. We have suggested features for future smartwatches to facilitate greater user control over their notifications.

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