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Quit Playing With Your Watch: Perceptions Of Smartwatch Use

Christopher M. Gaeta
Purdue University, cgaeta@purdue.edu

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Mihaela Vorvoreanu
Chair

Colin M Gray

William G Graziano

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For my parents, who have supported me in my studies.

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ABSTRACT

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This study identified perceptions and social norms that may affect smartwatch adoption. Interviews were conducted to identify perceptions of smartwatch use and norms that might affect those perceptions.

Smartwatch use was found to activate norms associated with wristwatch use – specifically, smartwatch users' peers took offense to the users looking at their wristwatches. This study also found that norms prevent the use of smartwatches' voice controls in public and various perceptions of smartwatch use and ownership.

CHAPTER 1. INTRODUCTION

The user experience of any wearable technology will involve use of the technology in public and in social situations. Numerous papers have been published on the use of mobile phones in public, and looking at one's watch too frequently is widely agreed to be a rude gesture. Smartwatches, however, are a new technology that are both, wrist worn watches and extensions of one's mobile phone, and so can be misused in the same ways as both technologies - and perhaps new ways exclusive to smartwatches themselves.

Commercial smartwatches are a relatively recent innovation. The first digital watch was developed in 1972, and work on watches with embedded computers followed shortly. These watches pale in comparison to modern smartwatches.

Though not the first, Pebble would likely be the first recognizable, modern smartwatch. Today's smartwatches connect to smartphones and extend their functionality with the goal of simplifying users' lives, reducing distractions, and letting them experience the world without fussing with their phones.

Newer smartwatches have implemented touch screens, gesture detection, and wi-fi connections, among other functionalities. The technology is still immature, however, prone to unforeseen problems.

1.1 Significance

Smartwatches, like any other wearables, can impact the experience of not only those wearing them, but also other people interacting with them. If smartwatches are supposed to reduce the complexity and distractions in peoples' lives, then it follows that social interactions should be smoother and easier. If those same smartwatches distract their users, however, from their activities with their friends and families, then smartwatches are only aggravating the problem that they are intended to solve.

A number of technology acceptance models (Davis, 1989), including Venkatesh's (2003) Unified Theory of Acceptance and Use of Technology and Kim's (2015) Smartwatch Adoption Model point out the importance of social factors in whether an individual decides to adopt technology. On the macro scale, Roger's (2010) Diffusion of Innovations theory also identifies social structures as a factor in how technology spreads and is accepted across different groups. One of these social structures is norms.

Cialdini (1990) argues that norms are a powerful tool in influencing human behavior. Norms often take the form of loosely formed, informal rules, and breaking these rules can be punishable with social sanctions (Lapinski & Rimal, 2005).

If smartwatch users violate norms while flicking their wrist, looking at their watch too often, or interacting with their smartwatch in other socially unacceptable ways, they risk being punished for that behavior. One possible way to improve smartwatch designs, then, may be to identify what perceptions people have of smartwatch use. With this knowledge, smartwatch designers can try to develop watches and software that can minimize these social faux pas and improve the overall user experience.

1.2 Problem Statement

While smartwatches continue to mature, there is a chance that poor design decisions and unforeseen factors can harm smartwatch users in their interactions with their peers. One of these factors is the perceptions of smartwatch use in public contexts.

1.3 Research Question

What perceptions and social norms can affect smartwatch users and their peers when smartwatches are used in public contexts?

1.4 Definitions

Opinion Leaders

Opinion leaders are charismatic individuals within a group. Opinion leaders are capable of affecting the attitudes and opinions of their peers. As a result, opinion leaders can play a role in whether a group will accept or reject an innovation.

Smartwatches

Though smartwatches have a fairly long history in the field of ubiquitous computing, Cecchinato, Cox, and Bird (2015) define the modern smartwatch as “a wrist-worn device with computational power, that can connect to other devices via short range wireless connectivity; provides alert notifications; collects personal data through a range of sensors and stores them; and has an integrated clock."

Note that an increasing number of fitness trackers also fit this description, so I will limit new Fitbits and other devices that function primarily fitness trackers.

Social norms

Social norms are a set of socially constructed rules, created through interactions between members of a group (Bettenhausen & Murnighan, 1985). Social norms can be difficult to identify and measure, as they are not explicitly set (Lapinski & Rimal, 2005). In addition, because norms are not explicit, individuals can form their own perceptions of social norms - perceived norms.

Wearables

Wearable computers - or simply wearables - "can be anything from small, wrist-mounted computers to bulky backpack computers" (Billinghurst, 1999). Wearables are portable and worn on one's person. Wearables can include wrist worn activity trackers, rings, necklaces, shirts, and more.

1.5 Scope

For my research, I aimed to identify perceptions norms concerning the use of smartwatches in public contexts. I collected data on the use of smartwatches in social settings and their effects on social interactions. From this data, my goal was to identify potential problems with smartwatch use in social situations and develop a set of design recommendations for smartwatch software and hardware to help prevent or minimalize inappropriate use. This study focused on social situations where people are directly interacting with each other - for example, during conversation, on dates, or in meetings.

I did not set forth any form of guidelines for appropriate smartwatch use in social situations. My intent was not to call for changes in smartwatch owners' behavior, nor did

I want to change the perceptions of those who do not own a smartwatch. This study did not investigate the perceptions of people in public settings who are not directly interacting with a smartwatch user.

1.6 Assumptions

Below are the assumptions made for this study:

- Participants answered survey and interview questions honestly
- Participants will accurately represent at least one subgroup of early smartwatch adopters

1.7 Limitations

Below are the limitations of this study:

- The results of this qualitative study are not generalizable to all smartwatch users

1.8 Delimitations

Below are the delimitations of this study:

- This study does not examine the usability of smartwatches
- This study does not examine norms regarding fitness trackers or their use
- This study does not examine norms regarding phone use or wristwatches.
- People with no firsthand experience with a smartwatch (their own or a peer's) were not selected to participate in this study

1.9 Summary

To summarize, my goal in this study is to identify perceptions and norms affecting smartwatch use. This study is not intended to point out usability issues in smartwatches, and does not target wearables besides smartwatches or smartphones.

The findings of this study will be used for design insights for future smartwatches. The findings of this study are not intended to persuade smartwatch users to change behaviors.

To identify perceptions and norms, this study targets early adopters for participation, as they play a large role in technology diffusion.

CHAPTER 2. LITERATURE REVIEW

Smartwatches are not a new topic, especially in the field of ubiquitous computing. First, this section shares examples of the existing research on smartwatches, categorizing the research by goals, and giving an overview of the current research. I will point out now, however, that as of this writing, I was able to find only one paper regarding the adoption of smartwatches, proposing a technology acceptance model for smartwatches.

Second, I will discuss some frameworks about technology adoption. These include the Unified Technology Acceptance and Use Theory (UTAUT) and the Diffusion of Innovation (DOI) framework.

Third, both of these frameworks identify social structures as factors in technology adoption. For this reason, I will be discussing research on social norms and how they are formed.

I present these bodies of research in order to better explain the importance of perceptions and social norms affecting smartwatch use.

2.1 Smartwatches

Modern smartwatches connect to the user's phone and provide additional ways to interact with their phone. The first studies about smartwatch users I could find were simple

interviews about how users used their smartwatches and whether they felt they were useful. Searching further, I found several papers about smartwatches, looking for ways to interact with smartwatches, how smartwatches could be used to interact with other technologies, or activity tracking.

Schirra and Bentley (2015) conducted interviews with smartwatch users about how they used their smartwatches. For example, they noted in their research that the most commonly used smartwatch feature their participants reported was notifications on their smartwatches. One of their participants stated, "it's kind of more like an extra screen for my phone" (Schirra & Bentley, 2015, p. 2155).

Most of the existing research on modern consumer smartwatches detail attempts at innovative interactions and technologies. Some of these papers focus on user-smartwatch interactions. For example, Cho, Kim, and Seo (2014) at Korea University tried to develop a software technique for text entry on smartwatch screens. Oakley, Lee, Islam, and Esteves (2015), on the other hand, tried to develop an interaction based on taps and the timing in between touches. Other papers concern themselves with smartwatches as a tool to interact with other ubiquitous technologies - for example, in office settings (Bernaerts et al., 2014). There are also studies that consider smartwatches as activity detection tools (Liu et al., 2015).

Cecchinato's group (2015) and Schirra and Bentley (2015) have conducted interviews on how smartwatch owners use and interact with their smartwatches, but searching for "smartwatch adoption," I could not find any rigorous, academic studies on smartwatch adoption. Considering the obtrusiveness of wrist-worn devices - especially those as large as smartwatches, they are likely to affect smartwatch owners' social

interactions. These effects will ultimately impact the overall user experience of smartwatches and warrant investigation.

As smartwatch manufacturers announce their second-generation devices, smartwatch adoption is still limited largely to early adopters. These early adopters will be the first to experience the social impact of smartwatches and play a pivotal role in the diffusion of smartwatches. Before looking at how groups adopt technology and innovation, however, it is important to look at how individuals decide whether to adopt technology. For that reason, the next section will look at technology acceptance models.

2.2 Technology Acceptance Models

Technology Acceptance Models (TAMs) map various factors that influence an individual's decision whether to accept a technology. The first technology acceptance model, which Davis (1989) first proposed, identified perceived ease-of-use and perceived usefulness as possible factors in an individual's decision to adopt a piece of information technology.

Through additional research, technology acceptance models have been expanded and redefined, sometimes for specific technologies. For example, Kim and Shin (2015) adapted numerous technology acceptance models to propose a model for smartwatch adoption. This model maps factors affecting technology adoption decisions including affective quality, relative advantage, subcultural appeal, and their relations to perceived ease-of-use, usefulness, and intent to continue using smartwatches.

Another interesting TAM is Venkatesh's (Venkatesh et al., 2003) Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT, based on eight prior TAMs,

identifies three factors affecting behavioral intent - performance expectancy, effort expectancy, and social influence - and facilitating conditions as a factor directly affecting use behavior. Gender, age, experience, and voluntariness of use are also identified as moderators of the aforementioned factors.

The smartwatch adoption model and UTAUT both identify social constructs in their models - subcultural appeal in the smartwatch adoption model, and social influence in UTAUT. In addition, both studies reference Rogers's (1995) Diffusion of Innovations (DOI) theory. DOI combines several theories to model how innovations spread through groups, so I will discuss it in more detail next.

2.3 Diffusion of Innovations

Rogers (1995) defines diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 5). Theories regarding the diffusion of innovation (DOI) span across numerous disciplines to form a comprehensive framework to examine how technology is adopted. Rogers's DOI framework identifies four elements that affect how fast innovations spread - the innovation itself, communication, time, and social systems. For the purposes of this study, I focused on social systems and how they respond to the adoption of smartwatches, a less studied area.

Being a social process, diffusion is subject to the social norms of all the various groups the technology touches (Rogers, 1995). Kincaid (2004) explains that "Diffusion is a natural social phenomenon that happens with or without any particular theory to explain it" (p. 38). In a study in Korea, Rogers and Kincaid (1981) found that across 24 villages,

each village adopted different forms of contraceptives and family planning tools more readily than others based on existing social norms. As technology spreads, it might come up against social norms that prevent diffusion of the technology.

Members of social groups form collective social norms through their interactions with each other (Bettenhausen & Murnighan, 1985). At the center of these groups, however, are opinion leaders - influential individuals that can endorse or challenge the adoption of innovation (Rogers, 1995). Early adopters of innovation frequently play the role of opinion leaders, sharing their experiences with the new technology. So long as these early adopters can maintain their standing in their circles, they can grow their following until social norms begin to shift (Kincaid, 2004) and the adoption of the new technology is more palatable the larger group.

This process of shifting social norms and adoption is another element in Roger's DOI framework (2010), but this study is not concerned with changes in social norms. Rather, my goal is to identify the perceptions of early adopters and their peers concerning smartwatches. Comparing these perspectives, I can identify collective norms that smartwatches and their users violate. The norms that prevent diffusion of smartwatches may then provide insights on areas for improvement in smartwatch design.

Social norms play a powerful role in the adoption of technology, so next I will discuss them in more detail.

2.4 Social Norms

Social norms are an informal set of rules formed through interactions within a group (Bettenhausen & Murnighan, 1985). I will be distinguishing between two categories of

norms - injunctive norms, and descriptive norms (Cialdini, 2003). Injunctive norms describe what behavior is appropriate, and descriptive norms describe behaviors that are common or normal. Both of these can influence an individual's behavior, often in opposing ways (Cialdini, Reno, & Kallgren, 1990).

For example, in Cialdini's (2003) study on crafting environmental messages, he discusses a public service announcement known as the "Iron Eyes Cody PSA." To summarize, the PSA shows a Native American shedding a tear as a passing driver litters into a heavily littered environment. As Cialdini explains, the littering driver activates the norm - bringing the norm to the front of the viewer's attention. In this case, the norm is the injunctive norm - that it is wrong to litter.

The weakness in this PSA, however, is the descriptive norm. The driver litters into an environment that is already heavily littered. This delivers the conflicting message that, though littering is wrong, a lot of people do it. As a result, the descriptive norm undermines the injunctive norm, reducing the effectiveness of the PSA.

Norms often pose a challenge to the adoption of new technology. Smartwatches might violate social norms for watch use, phone use, or other social norms in unforeseen ways. Even if an individual is only contemplating buying a smartwatch, social influence plays a powerful role in deciding whether the would-be smartwatch user will buy the device (Venkatesh et al., 2003). Prospective smartwatch users can be influenced by the people they care about, their coworkers, managers, and people in their social circles who are seen to be particularly successful. If these people don't use a smartwatch, then it might be against the perceived norm to use a smartwatch.

If smartwatch users violate these norms - intentionally or not - they could be punished by their peers for their behavior (Lapinski & Rimal, 2005). These negative experiences would discourage smartwatch owners from continuing to use their devices, and when they share their experiences, they will remember the smartwatches as being problematic.

There is no straightforward way to measure or identify collective norms; if I ask participants about social norms, they will only give me their perception of norms (Lapinski & Rimal, 2005). These perceived norms - injunctive or descriptive - can vary based on the individual's experiences; this can be especially true when perceived norms are shaped based on conversations with one's peers or through TV shows (Lapinski & Rimal, 2005).

Another option is to collect these perceived norms and identify points of conflict between smartwatch owners and their peers. Through these conflicts in perception, I will be able to paint a better picture of the collective norms that might oppose smartwatch adoption.

2.5 Summary

First, I used Venkatesh's (2003) Unified Theory of Acceptance and Use of Technology and Kim and Shin's (2015) smartwatch acceptance model to model participants' thoughts about whether they would - or why they did - buy a smartwatch. UTAUT and the smartwatch acceptance model are refinements of Davis's (1989) Technology Acceptance Model. The original TAM is minimal, identifying perceived ease-of-use and perceived usefulness as factors that determine whether an individual will accept a technology. The

other models look at additional factors, including affective quality, subcultural appeal, and social influences.

Secondly, on a macro level, the Diffusion of Innovations theory (Rogers, 1995) identifies social structures as one of four factors that moderate the spread and acceptance of innovations.

Both of these bodies of research illustrate the importance of social factors pertinent to innovative technology. For this study, I chose to examine social norms, as they have been shown to influence individuals' actions under certain circumstances (Cialdini, 2003), as well as other perceptions of smartwatch use.

CHAPTER 3. METHODOLOGY

3.1 Research Questions

For this study, my primary research questions was as follows: what perceptions do people have of smartwatch use in public?

To help guide my survey and interview questions, I also tried to answer the following questions:

- How do smartwatch owners perceive their own smartwatch use in public? Or that of other smartwatch users?
- How do non-owners perceive the actions of smartwatch users in public?
- How do the perceptions of smartwatch use differ between smartwatch users and non-users?
- In what ways does smartwatch use violate existing norms?
-

3.2 Data Collection

For this study, I collected qualitative data through interviews. First, I used online questionnaires to identify potential research participants. Questions in this survey were used to screen smartwatch users, non-users, and to screen early adopters from other smartwatch users.

I also tried to recruit participants who do not own a smartwatch, but know smartwatch users. I recruited these participants to collect data on outside perspectives of smartwatch use and interactions.

I also asked all my participants about how their peers used smartwatches, keeping in mind whether the participant owned a smartwatch and how their perspectives can differ.

3.3 Analysis

3.3.1 Thematic Analysis

To analyze my data for this study, I conducted a thematic analysis as described by Braun and Clarke (2006). Thematic analysis, one of the simplest forms of qualitative data analysis, identifies "themes" in the data. These themes are identified through recurring patterns in the data, or sometimes through points that don't fit a pattern, but have some importance or represent a unique case. Through numerous iterations, researchers can begin to identify overarching themes.

Braun and Clarke (2006) describe various approaches to thematic analysis. Thematic analysis can be used as an exploratory tool, encoding the data with the expectations or propositions about what kind of results may appear. Thematic analysis can also be used with a deductive approach, encoding the data based on a theoretical framework. In this case, I will be encoding inductively.

Another point of consideration is whether one wants to encode on a semantic level, assuming that the text has no underlying meaning. For the interviews, I decided to encode for latent meaning (Braun & Clarke, 2006), identifying the underlying thoughts,

feelings, and motives of my participants. I used a reconstructive approach to identify these latent themes, using my experience and interpretation to infer underlying meaning to the best of my ability.

To conduct this thematic analysis, I recorded and transcribed my interviews. I encoded phrases in the transcriptions that gave an insight into their perceptions, their feelings, or their opinions regarding smartwatch use or another person's smartwatch use.

From these coded phrases, I identified patterns, looking for interrelationships between to find my themes.

3.4 Sample

Though it is possible to collect data from people of various backgrounds through online surveys, I was most interested in the perceptions of early technology adopters. To screen my criterion sample (Patton, 2002), I asked smartwatch users what smartwatches they own, and when they obtained them. These early adopters are the first to use smartwatches and possibly form unique perceptions of the new technology. I expected this population to consist largely of professionals in tech industries and students that have grown up with technology.

In addition, I selected another set of participants that have not used a smartwatch. Through these additional participants, I can identify an outside perspective of their peers' smartwatch use.

3.5 Sampling Strategy

I recruited participants for my interviews through a brief survey on Reddit. I screened these participants based on when they bought their smartwatches, if they have one, or

how frequently they see people with smartwatches otherwise. Using these criteria, I identified early adopters or people that have seen smartwatches in use.

3.6 Credibility

As this is a qualitative study using an interpretivist research paradigm, data analysis will subject to my own perspective. For that reason, in this section I disclose my relevant previous knowledge, biases, expectations, and how I tried to reduce or take advantage of my biases as I reflected on how my perceptions affect the analysis of my data (Patton, 2002).

3.6.1 Researcher Profile

I am a master's student at Purdue University studying human-centered design. My areas of interest include wearable technology and social impacts of technology. For my bachelors I studied web development in Computer Graphics Technology with a minor in Computer Science.

In my graduate program, I have studied qualitative methods, user experience research tools, human factors, and social psychology. I have also taken classes on statistical methods and data visualization.

3.6.2 Biases

I own two smartwatches running Android Wear – a first-generation Moto 360 and a Huawei Watch. Though I acknowledge that smartwatches don't have any unique, innovative functions, I often defend them as convenient tools. I often use wrist gestures to

control my watches, but I rarely use voice commands because I feel awkward talking to myself.

Despite (or because of) frequently using a Macbook, I am biased against Apple products and often favor Google products and software.

3.6.3 Expectations

I expect my findings will include a number of social norms commonly associated with wristwatches – for example, the assumption that somebody looking at their watch may be in a hurry to leave or uninterested in their setting.

Though I expect smartwatch user behaviors often associated with phones to be common – frequently checking notifications, for example – I suspect that many non-smartwatch users may not attribute these behaviors to phone notifications, but confuse frequent glances for disinterest.

Wrist gestures used in Android Wear watches will likely appear in my research, as these gestures – wrist rotations, covering the screen – are inconspicuous and likely to appear out-of-place in most settings.

3.6.4 Data Source Triangulation

For this study, I collected data from interviews with two different samples – smartwatch users, and non-users. Using different data sources, I can compare the data from each source and ensure that my analyses are consistent (Patton, 2002).

In addition, even if the findings from all the data sources are not completely consistent, the combined perspectives from all the data can yield a more complete picture of the social norms and perceptions concerning smartwatch use.

CHAPTER 4. RESULTS

4.1 Data Collection

Over a period of three months I conducted thirteen interviews. I conducted nine interviews with smartwatch owners, but two of these recordings were lost because a hard drive failed. I was only able to recruit four participants that did not use smartwatches. Interviews with these participants averaged about thirty-five minutes, and all participants were promised a ten-dollar Amazon gift card.

Table 1. Participants

Label	Smartwatch Model	Sex	Age Range
AW1	Apple Watch	M	19-29
AW2	Apple Watch	F	19-29
GV	Garmin Vivismart	F	30-44
MT1	Moto 360	M	19-29
MT2	Moto 360	M	19-29
MT3	Moto 360	M	19-29
MT4	Moto 360	M	15-18
LG1	LG G Watch	M	45-60
LG2	LG G Watch	M	19-29
NW1	N/A	M	19-29
NW2	N/A	M	19-29
NW3	N/A	F	19-29
NW4	N/A	M	19-29

I conducted a total of thirteen interviews (three female) – nine with smartwatch users (two recordings were lost to hardware failure) and four non-smartwatch-users. All smartwatch users but two obtained their smartwatch in 2014. Of the two, one participant

had an Apple Watch, which released in the summer of 2015. The other participant had mistakenly entered the year 2014 in his pre-survey. Each interview ran between 25 minutes and 45 minutes long.

Between the nine smartwatch users interviewed, the smartwatch models discussed were two Apple Watches, four Moto 360s (one participant owned two Moto 360s), one Samsung Gear Live, two LG G Watches, and one Garmin Vivosmart. All participants were also asked whether they knew what smartwatches they'd seen other people wearing. Participants named or described the LG Urbane, Moto 360, Apple Watch, and Samsung Galaxy Gear or Gear 2. The non-smartwatch-users struggled to name the smartwatches, but were able to give sufficient detail for me to make confident guesses at the model.

I transcribed all these interviews and encoded them as part of my thematic analysis.

4.2 Analysis Results

In my analysis, my goal was to identify patterns relating to the perceptions of smartwatches and their use, social influences and norms, and smartwatch usage and contexts. Though not directly relevant, I encoded smartwatch usage to establish the backdrop for participants' perceptions regarding smartwatches.

Table 2. Themes Identified

Theme	Exemplar
Familiarity with Technology	"Like, my friend returned hers, and uh, she told me to keep mine. She's like, "you're going to regret returning yours." She's like, "you're more tech-savvy than I am." -AW2
Smartwatch Use	

Table 2. continued

Theme	Exemplar
Notifications	"… I use it basically to check notifications throughout my day..." -MT3
Voice Commands	"...I usually use it to set timers or reminders..." -LG2
Wrist Gestures	"… I avoid most gestures because I find them to be not quite refined and not really useful for my purpose..." -MT3
Impolite Use	"… but then they look at me, like, 'Oh, are you in a hurry?' Or like they look at me like, 'You're rude. If you gotta go, then go.' And I'm just like, no, I always have to explain myself…" -AW2
Voice Commands in Private	"… like, if I'm sitting in a group of friends, I don't want to look like I'm talking to one of them when I'm talking to my watch…" -MT2
Curiosity	"… in the nicest way I've been asked about it once or twice, what you doing..." -LG1
Form Versus Function	
Fashion	"… they like to have different things that are new and in fashion, and they found that the Apple Watch has been seen on a lot of luxury goods items, things like that…. I have a friend that wears [an Apple Watch], and she has no idea what to do with it, but, um, she likes wearing it around…." -MT4
Looking Better	"He thought about a smartwatch but always thought, umm, these pieces are really ugly, and then I showed him a pic of uh... of the LG Watch Urbane, and he was like that one actually looks great..." -LG2
Discreetness	"… literally every ten minutes, popping out from the other guys in the ward, and it was real pleasant to not have my phone ring or beep or make weird phone noises at all…" -LG1
Other	
Expensive	"… in general, I say, if you spend at most 150, maybe 175 dollars, yeah, I'd say it's worth it. For me, that's a price point beyond which it's not as useful…" -MT3
Abuse	"… the high school banned smartwatches for use at school... because people would have PDF readers or they'd send each other texts on voice and pull it up…" -MT4
Urgency	"… I'm constantly receiving, like, notifications and things I have to act upon right away…" -AW2
Apple – Industry Leader	"Is that an Apple Watch?" – several participants' peers
Recognition	"... So if I don't see a watch face on it, I'm not sure if they make digital watches that are actually just that…" -NW2

Table 2. continued

Social Influence	"... that was just like a random purchase for her, she was just like, 'I think I want this, too...." -AW2
Distraction	"... I don't want to be constantly, like, barraged with notifications... I think it would be more distracting with the watch..." -NW3
Few Security Concerns	"... I remember I read an article about [Bluetooth vulnerability] as well, but it doesn't really concern me..." -LG2

4.2.1 Familiarity with Technology

Of my smartwatch-using participants, only one did not self identify as a "techy," "tech savvy," or a "nerd." Of the seven smartwatch using participants, all but one reported working in a technology field – for example, IT, growing up with technology, or keeping up with technology news.

The one smartwatch-using participant that did not explicitly self-identify as being tech savvy implied her experience in a brief story.

> "Like, my friend returned hers, and uh, she told me to keep mine. She's like, "you're going to regret returning yours." She's like, "you're more tech-savvy than I am."
>
> -AW2

4.2.2 Smartwatch Use

Participants detailed various ways that they used their smartwatches, including music controls, sleep tracking, taking notes, and finding misplaced phones. Participants reported however, that several of these functions were only used in private –in their homes or cars. As this study is focused on perceptions of smartwatch use in public and in social situations, I will be focusing on usage cases that I found most relevant to public settings:

notifications, voice commands, and wrist gestures. I will also be discussing some of the contexts participants talked about using their smartwatches in.

4.2.2.1 Notifications

"… I use it basically to check notifications throughout my day..."

-MT3

The most frequently reported and used smartwatch function reported in my interviews was the mirroring notifications from one's smartphone to the smartwatch. Notifications can come from various smartphone apps and can include text messages or phone calls. When mirrored to the smartwatch, information in the notification is typically condensed to a single line of text.

Several smartwatch users reported using this function as a filtering mechanism. On receiving a notification, they could quickly look at their watch and decide whether to interrupt their current activity to respond to the notification.

"… it's a really nice way to quickly see who's calling, who sent me a message..."

-LG1

Nearly all participants, regardless of having owned a smartwatch, reported having observed their smartwatch-using peers use this function. All four non-smartwatch-using participants were aware of this function at the time of their interview, but only one of the four participants said that they found it appealing.

Of the non-smartwatch-users, one did not seem to have strong feelings about mirrored notifications, and two were concerned about being distracted with notifications

during class or gatherings. Neither of the latter two seemed to be aware of the ability to mute their smartwatches or filter notifications.

4.2.2.2 Voice Commands

"...I usually use it to set timers or reminders..."

-LG2

The second most discussed smartwatch use case was voice commands. Users can interact with their smartwatch using their voice to take notes, make lists, start playing music, perform searches, and perform various other tasks.

Though some of my smartwatch-using participants claimed that they found voice controls helpful or convenient, none of them used it extensively in public, if at all. Some participants claimed that their concerns were primarily with usability – that the microphone wasn't accurate, or didn't recognize their accent. Public voice command use was often limited to brief text messages, especially when using their phone would be inconvenient – for example, in cold weather or while riding a bike.

When asked about features that they didn't use – or wouldn't use, hypothetically – participants most frequently mentioned voice commands. Of the four non-smartwatch participants, one said if the microphone were sufficiently accurate, they would not be opposed to using voice commands in public. Two of the other non-smartwatch-users were certain that they would not be comfortable using voice commands in public.

4.2.2.3 Wrist Gestures

"… I avoid most gestures because I find them to be not quite refined and not really useful for my purpose..."

-MT3

Though there is variation between watches with different operating systems, several watches allow for some wrist gesture-based controls. Android Wear watches – which six out of nine of my smartwatch-using participants used – offer as many as six gestures to control one's watch to navigate the interface.

Almost all of the smartwatch users with Android Wear watches used one particular gesture, used to turn on the watch's display. This gesture is an arm raising gesture that often requires users to raise their watch to around chest- or eye-level. A similar gesture is available on Apple Watch. All smartwatch users that couldn't use an always-on ambient display said that they used this gesture.

Of the other gestures, which include rotating one's wrist or raising and lowering one's arm, only two smartwatch users said that they used these gestures. One of these two made an off-hand comment,

"… sometimes I use it, just kinda when I'm bored and wanna show off…"

-MT2

Another smartwatch owner, who said he did not like using these gestures, said that when seeing others use these gestures, they got the impression that these people were showing off their watch.

4.2.2.4 Common Contexts for Smartwatch Use

"… sometimes I'm just sitting here in class..."

-MT2

From my interviews with smartwatch-using participants, one of the most common locations one might use their smartwatch is at work, with school and classes a close second. Participants pointed out that they or their peers appreciated the convenience and discretion of smartwatches in quiet offices or at jobs were they couldn't use their phones.

Non-smartwatch users were concerned that, if they had smartwatches, they would struggle to pay attention in class. Smartwatch using students, however, did not express such concerns. As stated earlier, they said that they would quickly check their notifications to see whether they needed to respond.

One smartwatch user said a friend takes their smartwatch when they go jogging, but three other participants mentioned that they didn't wear their smartwatches when participating in physical activity. Such activities included wall climbing, skiing, and hiking. Yet another smartwatch user explained that they would prefer to wear a Fitbit – a fitness tracker – when going on hikes. All three of these participants were concerned about damaging their watch, and two felt that they would prefer a more accurate fitness tracker, if anything.

"… I definitely don't wear it when I go to the gym...."

-MT2

4.2.3 Perceptions of Smartwatch Use

Now that I've established some context for our participants' smartwatch experiences – firsthand or observed, I will detail my findings that are most relevant to smartwatch use in public or social situations.

4.2.3.1 Impolite Smartwatch Use

Through almost all of my interviews with smartwatch users, I found one common experience: on at least one occasion, while looking habitually at their smartwatch, the participants had been asked if they were in a hurry or if they needed to leave. From one interview:

> "… but then they look at me, like, 'Oh, are you in a hurry?' Or like they look at me like, 'You're rude. If you gotta go, then go.' And I'm just like, no, I always have to explain myself…"
>
> -AW2

This pattern seems to reflect norms involving the use of wristwatches. One participant noted that several people they know use their phones to keep time, but this norm still seems to be prevalent.

One smartwatch user expressed frustration that their friends criticized their smartwatch use, but completely ignored the same behavior with their phone. None of the smartwatch users claimed to have any such problems when using their phones. Several participants acknowledged that frequent interaction with one's phone, though rude in some situations, is incredibly common, especially among younger people.

To avoid this confusion, one participant explained that they would try to be as discreet about looking at their notifications as possible. They learned to lift their watch just enough to peek at their notifications. One non-smartwatch-user said that, as with their iPod, they would ignore their notifications while speaking with a friend, but check them when their friends change topics or talk to each other. Another smartwatch user simply silences his watch around new people, noting that this "defeats the purpose" of having the smartwatch in the first place.

4.2.3.2 Voice Commands Are Better Enjoyed in Private

One participant mentioned that he didn't like using voice commands because,

> "… like, if I'm sitting in a group of friends, I don't want to look like I'm talking to one of them when I'm talking to my watch…"
>
> -MT2

This participant also expressed concern with looking like a nerd in the group. His concern is likely not unfounded, though, as another participant had experienced this very same situation.

> "… I've also had this situation where I had someone turn around and try to answer the question I'm asking…"
>
> -MT4

Two smartwatch users pointed out that they felt embarrassed trying to use voice commands in public, worried that they will appear to be talking to themselves. Other participants also discussed the use of Bluetooth headsets and earbuds with

microphones. Though they recognize that people using these headsets are making phone calls or sending voice messages, participants' explanations suggest that they need a moment to recognize that a person is talking to their phone, and not to themselves.

There does, however, seem to be a place for voice commands. As mentioned earlier, some smartwatch-using participants found voice commands helpful, especially for settings timers and taking notes.

4.2.3.3 People Are Curious

All smartwatch-using participants but one had been asked questions about their smartwatches or demonstrated their smartwatches to others. Though several people recognized that the watches were not simply digital watches – often asking "is that an Apple Watch?" – participants said that they often received questions about what they do with their smartwatch and whether they are worth buying.

> "… in the nicest way I've been asked about it once or twice, what you doing..."
>
> -LG1

That people would assume that these smartwatches were Apple Watches also seems to be an interesting point. Though these people may not recognize other brands and models, they are still aware of the technology and interested in it.

I'd also like to emphasize the often-repeated question of whether smartwatches are worth purchasing. Smartwatch users reported that the most common questions they received were whether the smartwatch was worth buying, and what they used their

smartwatch for. Part of an individual's decision to adopt a technology can come from whether other people close to them think that the individual should adopt the technology (Venkatesh et al., 2003).

4.2.4 Form Versus Function

In this study, I chose not to identify usability issues in smartwatches. While talking about smartwatch use, however, participants, regardless of smartwatch usage, saw an aspect of discretion in certain use cases.

Several participants also seemed to care about whether smartwatches were attractive. Almost all participants talked about how their smartwatch looked, and for some participants or their peers, how the smartwatch looked was a deciding factor on which on they purchased or whether they purchased one at all.

4.2.4.1 Smartwatches as a Fashion Statement

There seems to be a consensus that the first wave of smartwatches are big, ugly devices. Comments on the attractiveness of smartwatches and their relevance to purchasing decisions, however, suggest that smartwatches have always been a fashion technology.

One participant with an LG G Watch – a boxy watch considered to be ugly – talked about a friend who was interested in buying a smartwatch, but only if it looked good. When this friend was introduced to the LG Urbane, they quickly bought it, and the participant was jealous of the more attractive watch.

Another smartwatch user explicitly explained that he saw smartwatches as a fashion statement, at least in his school, especially among classmates from wealthier families.

> "… they like to have different things that are new and in fashion, and they found that the Apple Watch has been seen on a lot of luxury goods items, things like that…. I have a friend that wears [an Apple Watch], and she has no idea what to do with it, but, um, she likes wearing it around…."
>
> -MT4

4.2.4.2 Smartwatches Are Looking Better

Many of my smartwatch-using participants – especially those with the earlier smartwatch models, like the first LG G Watch or Samsung Gear Live – pointed out that the first modern smartwatches were ugly. Motorola's Moto 360, the first Android Wear smartwatch with a round face, escaped this flak, partly because it wasn't as obvious and box-shaped as other early watches.

The Apple Watch owner, whose watch was made available in April, 2015, said that they'd received several compliments on their watch. Participants also found more recent Android Wear smartwatches, like the LG Urbane and Fossil Founder Q, more attractive than the first wave of smartwatches.

> "He thought about a smartwatch but always thought, umm, these pieces are really ugly, and then I showed him a pic of uh... of the LG Watch Urbane, and he was like that one actually looks great..."
>
> -LG2

4.2.4.3 Discreetness

Smartwatch users seem to appreciate how discreet smartwatches can be. Most smartwatches have an option to silence their phone when connected to the watch. Between a silenced phone and vibrating smartwatch, users can stay informed without disrupting quiet environments, like offices. One participant at least enjoyed the silence of his phone during a hospital stay.

> "… literally every ten minutes, popping out from the other guys in the ward, and it was real pleasant to not have my phone ring or beep or make weird phone noises at all…"
>
> -LG1

Smartwatch users in offices and classes also appreciate the ability to stay connected to their phones without disrupting their workplace or lectures. Most smartwatch users reported using their smartwatch to filter notifications during class, at work, or observing peers using smartwatches where phone use is disallowed. One smartwatch user also mentioned using a smartwatch alarms to avoid waking up other people at sleepovers.

4.2.5 Other Interesting Themes

In my analysis, I found other themes that were interesting in their own right or stood on their own.

4.2.5.1 Smartwatches Are Too Expensive

Disregarding the price of the hardware, most of the smartwatch-using participants felt that, regardless of how satisfied they were with their smartwatch, current smartwatches are too expensive. To be clear, all but one of the smartwatch-using participants were still consistently using their smartwatches.

One participant's friends returned an Apple Watch, saying it wasn't worth the price. When the watch was put on sale for 100 dollars less December, 2015, however, this friend bought the Apple Watch again.

Other smartwatch owners who did not obtain their smartwatches within the first year of release also pointed out that part of the reason they bought their smartwatch was that they could buy it at a fraction of the original price. One LG G Watch owner obtained his smartwatch for 60. Another participant with two Moto 360's pointed out that he could buy two of these watches for 100 dollars each – cheaper than most new smartwatches.

> "… in general, I say, if you spend at most 150, maybe 175 dollars, yeah, I'd say it's worth it. For me, that's a price point beyond which it's not as useful…"
>
> -MT3

Three participants that do not own a smartwatch said that they'd thought about getting one, but the price point was prohibitive enough that two of the participants hadn't given it any serious thought.

4.2.5.2 Smartwatch Abuse

One smartwatch-using participant said that in their school, smartwatches were banned.

"… the high school banned smartwatches for use at school... because people would have PDF readers or they'd send each other texts on voice and pull it up…"

-MT4

A non-smartwatch-using participant talked about a friend with a Samsung Galaxy Gear, which has a camera built in. This participant was uncomfortable with the camera in the watch and felt that it was discreet enough to be abused.

4.2.5.3 Urgency

One participant strongly felt that smartwatches were only useful to people that are frequently receiving information or feedback. They gave examples including students receiving numerous emails, or workplaces where doctors or office workers need to be able to respond to information quickly.

"… I'm constantly receiving, like, notifications and things I have to act upon right away…"

-AW2

4.2.5.4 Apple as an Industry Leader

To the frustration of several Android Wear watch-users, people tend to assume that their watches are Apple Watches. A number of them had given up on explaining that their watch is not an Apple Watch or explain the difference.

This suggests that among smartwatches, the Apple brand is the strongest. The smartwatch-using participants, who are all immersed in technology, were able to name at

least other companies producing smartwatches, but most non-smartwatch using participants struggled to name, describe, or recognize smartwatches other than Apple Watches.

4.2.5.5 Recognizing Smartwatches

Most participants felt confident that they would be able to recognize a smartwatch if they saw one. Few participants were confident, however, that they could identify specific models of smartwatches.

Most participants were sure that they could recognize a smartwatch based on a blank or brightly lit screen or the watch face. A number were familiar with the Apple Watch as being a rounded rectangular, and the Moto 360 having a round face.

> "... So if I don't see a watch face on it, I'm not sure if they make digital watches that are actually just that"
>
> -NW2

4.2.5.6 Social Influence

Among all my participants, I only found one case where somebody bought a smartwatch because of social influence. When buying an Apple Watch, one participant went to the store with a close friend. This close friend was not even interested in buying an Apple Watch, but bought one anyway.

"... that was just like a random purchase for her, she was just like, 'I think I want this, too....'"

-AW2

4.2.5.7 Distraction

Two participants – one of them a smartwatch user – were concerned with smartwatches as a distraction. The non-smartwatch-using participant was concerned that smartwatch notifications would be distracting during class.

"... I don't want to be constantly, like, barraged with notifications... I think it would be more distracting with the watch..."

-NW3

The smartwatch user talked about seeing drivers with smartwatches on the road. They were concerned that smartwatches would be more distracting while driving than phones are.

4.2.5.8 Few Security Concerns

Among smartwatch participants who were aware of possible security issues – for example, Bluetooth vulnerabilities – none of my participants were concerned about people hacking their smartwatches. Two participants reasoned that vulnerabilities couldn't be identified until smartwatches were out in the wild. Another participant reasoned that if a malicious hacker wanted to steal their information, the hacker would find a way to do so regardless.

"... I remember I read an article about [Bluetooth vulnerability] as well, but it doesn't really concern me..."

-LG2

4.3 Relevant Norms

Here I will list a number of the norms I identified as relevant to smartwatch use in public context. Note that these norms are not exclusive to smartwatch use, nor is this an exhaustive list of relevant norms.

4.3.1 One checks their watch frequently because they are in a hurry or disinterested

There is a pre-existing descriptive norm commonly associated with wristwatches. When one frequently looks at their watch, this communicates to others that that person is in a hurry or has another matter on their mind. This can activate or aggravate the following injunctive norm.

4.3.2 One should not appear disinterested in one's company

As we can see from my smartwatch-using participants' experiences, smartwatch use can activate existing norms relevant to regular wristwatches. When looking at notifications on their smartwatch, some participants noted that their friends or peers took offense, possibly because they felt they were being ignored.

These two norms together are interesting because, from my participants, it seems that the previous norm – that checking one's watch is an indication of disinterest – is salient in social contexts and activates this norm.

A number of smartwatch-using participants noted, however, that over time, their friends and family stopped talking offense to their smartwatch use. This may be an indicator of a normative shift; though the injunctive norm likely remains unchanged, the understanding of what it means for a smartwatch user to be looking at their watch would constitute a shift in the descriptive norm. Looking at one's watch may not be an indicator of hurry or disinterest, but that the smartwatch user has received a notification.

After this shift, smartwatch-using participants noted that their friends and family no longer took offense when they looked at their smartwatches.

4.3.3 One should pay attention in class or at work

Though a number of participants commented on their use of smartwatches or phones during class, they seemed to be aware that distracting themselves during class or in meetings is inappropriate behavior.

This norm is functionally similar to the previous norm – one should not show disinterest in one's company – but is more salient in the company of authority figures. My smartwatch-using participants avoided violating this norm. This is likely because the changed descriptive norm – that one looks at their watch because of notifications – would still activate this norm and offend the authority figure.

4.3.4 One should not disrupt quiet spaces

Related to the previously named norm, smartwatch using participants noted that they appreciate the discretion of smartwatch use. LG2 said that they use smartwatch alarms to

avoid waking up others at sleepovers, and LG1 told a story about a hospital ward where phones kept ringing and troubling them.

This norm is most salient in contexts where people are in quiet locations. These participants felt that their smartwatches' vibration notifications helped them avoid violating this norm.

4.3.5 People don't talk to themselves out loud

Two participants noted that they often see other people talking into Bluetooth headsets or into earbuds with a microphone. One of these participant's comments hinted that, were these people not using these devices, these other people talking to themselves out loud would seem crazy.

From participant LG1's story on a bus, this norm may be most salient in crowded spaces. This norm does not seem to be activated, however, if the speaker can be seen wearing a headset or similar device. This norm makes it uncomfortable for smartwatch users to use voice commands.

4.3.6 Fashion norms

There is an entire set of fashion norms that can be applied to various scenarios. For example, participant M4 pointed out a descriptive norm that several classmates were wearing smartwatches at their school. Fashion norms can also include injunctive norms, influencing what people are allowed to wear, or in what circumstances.

Relevant to smartwatches, there seem to be injunctive norms stating that one should not wear unattractive accessories.

CHAPTER 5. DISCUSSION AND FUTURE WORK

5.1 Summary

The goal of this study was to identify the perceptions of smartwatch use and norms that affect smartwatch use. In identifying these perceptions and norms, I hope to find insights in ways to improve smartwatch design to improve the experience for the user and their peers.

To summarize the results of my analysis, though I could only identify a few norms that affect smartwatch use, I found various insights into people's perceptions of smartwatch use.

There seems to be some confusion that comes with smartwatch use. Wristwatch norms conflict with the frequent use of smartwatches for notifications, but these norms seem to be malleable. There also seems to be some confusion and embarrassment with the use of voice controls.

People do, however, seem to be interested in smartwatch technology and are curious about it. Furthermore, more recent smartwatches seem to have been designed with more thought put into aesthetics and fashion.

5.2 Discussion

From my interviews with smartwatch owners, there seems to be a consensus that the earliest smartwatch models are unattractive. Some participants point out that these watches are rectangular, large, or just "nerdy." Smartwatch designers seem to have taken note of these criticisms of early smartwatches, and as a result, watches like the LG Urbane or Fossils Android Wear smartwatches were designed to be more attractive.

What particularly resonated with me was the common misunderstanding that came with looking at one's smartwatch. When smartwatch users received numerous notifications and looked at them, their friends or peers often assumed that they were checking their watches because they were in a hurry.

This misunderstanding interested me because, as one participant pointed out, several people take their phones out of their pockets and place them on a table or desk before taking a seat. During conversation, people can check their phones, and from what my participants said, this is normal and – at least among younger people – often overlooked.

The same behavior with smartwatches, however, activates a norm (Cialdini, Reno, & Kallgren, 1990). If the use of traditional wristwatches is decreasing, as one of my participants believes, then this smartwatch use can activate two norms – the descriptive norm that nobody wears wristwatches, and the injunctive norm that looking at one's wrist during a conversation is rude. The combination of these norms could make the smartwatch behavior more prominent and the rude impression stronger.

These norms are subject to change, and my participants demonstrated this in their explanations that, over time, their friends and family didn't notice their smartwatch use

anymore. Where these people initially thought that the participants were checking the time, they learned that the participants were looking at their watches to check their phone notifications. This interaction and learning between the participants and their family and friends is how norms are formed (Bettenhausen & Murnighan, 1985). This suggests a possible shift in norms within these groups.

Norms against talking to oneself, on the other hand, seem to be more resistant to change. Some of my participants mentioned the use of Bluetooth headsets, earbuds with microphones, and voice commands on phones. Even when they felt that voice controls are useful, almost none of the participating smartwatch users use voice controls in public, or at least not extensively.

Another point I found worth discussing is the value of smartwatches as a fashion piece and a discreet tool. Though one smartwatch user called smartwatches an "anti-fashion statement," the fact that smartwatch users care about how their smartwatch looks indicates that there are fashion concerns. All of my smartwatch-using participants except two Moto 360 owners an an Apple Watch owner said that their smartwatches were ugly, gaudy, or "nerdy."

On a related note, I found it interesting that two smartwatch users indicated that they found the use of wrist gestures "showy." One of these participant said that they sometimes used wrist gestures to show off and start conversations. The other described a situation explaining this perception:

> "It's only when people are trying to be showy or show off their watch using their wrist gestures, it's like…they want to get someone else's attention about what

they're wearing…. People will, like… pull off their sweatshirt, flip their wrist in front of them as fast as they can…"

-MT4

I found this interesting because smartwatch users also reported using their smartwatches to check notifications in work, class, and other contexts where phone use might be disruptive. One smartwatch user talked about a friend working as a valet, who couldn't use their phone while working, and another talked about a nurse that used an Apple Watch the same way.

I would like to point out that in this study, I struggled to recruit female participants and non-smartwatch-using participants. I do not know whether the scarcity of female participants is related to my recruitment methods in Reddit, or whether this sample is representative of early smartwatch adopters. I also do not know whether my non-smartwatch-using participants' views were representative of other non-adopters.

On a related note, MT4 noted that several of their classmates had newer smartwatches, including the second generation Moto 360. The Apple Watch is also more recent than the first smartwatches, including Pebble watches, LG's G Watch, or the Moto 360. With the release of newer, more fashion-conscious smartwatches, there may be more to learned studying more recent smartwatch adopters, including user groups other than technologically-inclined males.

These are important to note, as the results of this study may only be transferable to a single user group – for example, technologically-inclined males. As smartwatches evolve, there may be other user groups to whom the findings of this study are less

transferrable. A user group of fashion-conscious young adults, for example, may be less interested in discrete smartwatches, or may prefer flashier designs.

5.3 Design Implications

The biggest problem I found in this study is the confusion that comes with seeing a smartwatch user repeatedly look at their watch. When people unfamiliar with smartwatches first see this, they will likely assume first that the smartwatch user is looking at the time, drawing the conclusion that the smartwatch user is disinterested or in a hurry.

In order to avoid this confusion, these non-smartwatch-users need to either be notified about their peer's notifications, too. Otherwise, they need to be taught that their peer is using a smartwatch, and that they will be receiving notifications on their watch.

On the other hand, smartwatch designers need to keep fashion and discreet use in mind. Smartwatch users want their watches to be attractive, but they also want to be able to use them without attracting the wrong kind of attention.

For example, a common feature in smartphones is an LED that flashes when the owner receives a message or a notification. This light signals to the owner that they have a pending notification, and if a peer sees this light, they will also be informed that the phone demands the owner's attention.

Most current smartwatches vibrate upon receiving a notification, and some will light up their screen and show the notification. Though waking the screen can notify others about the owner's notification, this is not only indiscreet, but can also allow bystanders to see the owner's notifications.

An example of a possible alternative would a dull, colorful glowing light that slowly turns on when the user receives a notification for the first time in ten minutes. This would be more discreet than a blinking or flashing light, but it would be a clear signal to the owner's friends that when they look at their watch, they might be looking at a notification. Such features should, however, be turned off when the watch is muted.

5.4 Conclusions and Future Work

From my findings, I suggest four possible directions for further research on smartwatch perceptions: smartwatches as fashion technology, smartwatch designs with feedback for the user's peers, and voice controlled technology in public.

Though not listed as one of my major findings, smartwatches were viewed as accessories – according to some participants, even as a luxury. Seeing the introduction of more fashion-conscious smartwatches, there is an opportunity to investigate how these new smartwatches compare against the earliest models.

Another possibility is to test new smartwatch designs to inform a smartwatch user's peers of incoming notifications. If a smartwatch can be designed to discreetly inform the user's peer that the user is receiving a message, those peers can recognize that something wants the user's attention. This could create a learning opportunity for the peers without the confusion concerning whether the user is looking at the time or a notification.

Thirdly, voice operated technology users' experience with it could benefit from a study of the contexts in which users are comfortable using voice controls in public. Two of my participants said they enjoy using voice controls to set timers and make notes through their smartwatches, but are much less inclined to do so outside their homes. Such

a study could help developers identify the contexts and functions most useful to their users for voice controls.

Finally, in this study I was able to identify my smartwatch-using participants as technologically-inclined and mostly male. Future research may be able to find other user groups among early smartwatch adopters, or else try to identify other user groups among more recent smartwatch adopters. Research identifying new user groups may be especially valuable as newer smartwatch designs put more focus on smartwatch aesthetics.

In conclusion, I recommend that smartwatch designers consider not only experiences and workflows of the individual wearing a smartwatch, but also the experiences of the people around them. Smartwatch and wearable technology could benefit from further research beyond just usability studies.

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APPENDIX

APPENDIX

Interview Questions

- Usage questions
    - How do you use your smartwatch on a typical day?
    - Have you ever used [a feature] in public before?
    - What have you seen other people do with their smartwatches?
    - Tell me about a time when you used [a feature] in public or with friends.
    - Tell me about a time when you saw somebody use [a feature or smartwatch].
- Perception questions
    - How do you feel about using [a feature] in public?
    - How do people react to you when you use [a feature]?
    - How do you think people feel when they see you using [a feature]?
    - How do you feel about [other people using smartwatches or a feature]?
    - What kinds of questions do people ask you about smartwatches?
    - How did you decide whether to buy a smartwatch?
    - Have you ever thought about buying a smartwatch?
- Brand / Model familiarity questions
    - How familiar would you say you are with technology?
    - How confident are you in your ability to identify smartwatches

    - How confident are you that you could identify specific smartwatch models or brands?
    - Do you know what smartwatch [another person] has?

- Concern questions
    - Are you aware of any security issues associated with smartwatches?
    - Are there any features or apps that you avoid using?
    - Are there any concerns that you have about using a smartwatch?