UNIVERSITEIT TWENTE.

Article, March 2021

Investigating the effect of customization on engagement with wearable activity trackers.

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Abstract:

Background: Over recent years, mobile digital devices have become increasingly commercially available and adopted by people. Though wearable devices can help record users' physical activities, people often stop using their wearable tracking devices within the early weeks of purchase. Customization of the smartwatch usually attracts individuals to project their personality, values, and preferences onto a product. With this research, I explored the challenges and choices the users faced when they use a Fitbit and if the customizable wearable interface affected the impact on the user's health data.

Methodology: This research consists of a two-part study. The first study's goal was to understand the different preferences that current Fitbit users have for their watch faces. For this part of the study, a questionnaire was created using the online tool Qualtrics. Participants were recruited via various social media platforms. The second study's goal was to understand the impact of a customizable wearable interface and if this increases people's engagement with their health data. Five participants used the Fitbit Versa 2 for six weeks. During the six weeks, they received every week a TWEETS questionnaire, which they needed to fill in. After six weeks, the participants were interviewed, as this allows presenting diverse expectations and perceptions of participants.

Results: In the first part of the study, 93 participants participated in the online survey. More than two-thirds of our participants had been using the same watch face for at least three months. Participants found it essential that their watch face displayed a range of different metrics related to their physical activity and that their watch offered them the possibility of choosing and transitioning between different watch face metrics. The second part study results showed that the participants score on average higher on all the TWEETS questions when they have personalized their watch face than the first two weeks, where they used the default watch face. The physical activity of the participants did not seem to increase their physical activity levels.

Conclusion: I found out that if the users find the right personalized watch face, they will use the watch for an extended period. However, in our study, I found out that while engagement with the watch face increased, physical activity did not. Therefore, future

studies with a bigger sample size and long-term engagement with the watch face are needed to investigate if people are more engaged with their watch face and less with their health data.

Keywords: wearables, health, Fitbit, engagement

1. Introduction

Over recent years, mobile digital devices, such as smartphones, tablet computers, iPods and wearables, have appeared on the market and become widely adopted. Berg Insight estimates that shipments of connected wearables reached 96.5 million units in 2016. The market is expected to grow at a compound annual growth rate of 22.2 percent to reach shipments of 262.5 million by 2021 (Insight, 2014). According to Levine, wearables are currently a 1-billion-dollar business (Levine, 2016). CCS Insight predicts that worldwide wearable sales are expected to become a 27 billion-plus dollar market (Lamkin, 2018).

Many medical and public health professionals have been using 'mHealth' ('mobile health') technologies to promote public health. For example, mHealth can be used to monitor and share health information via mobile technology – such as wearables and health tracking applications, or monitoring symptoms and allowing physicians to make diagnoses quicker and with fewer errors. According to Cummiskey et al., one specific aspect of mHealth that has received attention is the use of mobile and wearable digital devices to collect data on one's bodily functions (e.g., blood glucose, body temperature, breathing rate, body weight, blood pressure, heart rate) and everyday activities (Cummiskey, 2011; Kirwan et al., 2010; Swan, 2012). Smarr et al. have described the terms' self-tracking and 'the quantified self' as the use of wearable devices (Smarr, 2012; Swan, 2012). There is a growing movement in self-tracking to manage and improve one's life (Lupton, 2013). Most people use wearables to enhance their lives because self-tracking devices can be effectively used as tools for supporting people to deal with medical conditions and improve public health (Harrison et al., 2015).

As we can see, wearables are getting more and more popular. However, what do we mean by the word 'wearable'? According to Rhodes (Rhodes, 1997), a wearable computer is ‘a computer that is always with you, is comfortable and easy to keep and use, and is as unobtrusive as clothing’. Dehghani, Kim, and Dangelico defined the terms ‘smart wearables’ and ‘wearable technology’ as ‘seamlessly embedded portable computers which are worn on the body’ (Dehghani et al., 2018). Wearables can take many different forms, including smartwatches, jewelry, accessories, medical devices and clothing. According to Bieber, smartwatches are defined as ‘wrist-worn devices with computational power, integrated sensors, connectivity to other devices or Internet and integrated clock’ (Bieber et al., 2012). Wearables can range from simplistic step-counters to complicated, intelligent fabrics. Fitness trackers are also called wearables and track different aspects of personal data, including tracking steps, heart rate, sleeping patterns, daily diet tracking and more. Therefore, wearable health trackers have become a way to track aspects of our daily activities. Among popular examples, individuals have been found to track their step count, heart rate and dietary intake across multiple goals such as improved health and wellbeing. Tracking personal data can support people in becoming more aware of their habits and behaviors, changing their behavior, or reaching specific goals, such as spending less money or being more physically active (Choe et al., 2014). Several studies support the potential health care value of the measured data from wearables (Tana et al., 2017). Wearables have been associated with increases in physical activity and decreases in blood pressure and body mass index (Bravata et al., 2007). Takahashi et al. found that more steps

were associated with lower readmission rates and reduced risk of cardiovascular events in cardiac surgery patients (Takahashi et al., 2015). Nowadays, patients with chronic disease want more comfortable ways to self-manage their conditions and maintain their health. Wearables have provided a way to living a more leisurely life with chronic conditions. The benefits of wearables are that they can monitor critical vitals, gather relevant data and send reminders that make it easier for them to monitor their disease.

Although wearable devices can be helpful for recording, monitoring and user's management, people often stop using their wearable tracking devices within the early weeks or months of purchase. For instance, a 2016 survey from Gartner market research suggests that over a third of owners of commercially available wearable trackers are discarded within three months of use (Inc., 2017). These results are resembled by other studies, which have found around 30% of users stop wearing their tracker within six months (Hammond, 2014). Reasons for stopping the use of the tracker is that the activity data concerning the daily step count are so simple that users tend to lose their interests in wearable devices quickly (Hammond, 2014). Users try to receive information about themselves while doing self-tracking, but simple numbers and charts are not enough to sustain wearing the wearable (Lazar et al., 2015). According to previous studies, users stop using wearable device devices because of difficulty in setting reasonable goals and frustration when they cannot be achieved (Epstein et al., 2015; Gulotta et al., 2016). Also, short battery duration or unattractive appearance compared with the fashion accessories do not satisfy the user expectation on spending the expensive cost (Hammond, 2014). One crucial factor that affects the use of a wearable is people's understandings of the usefulness of those systems (Hammond, 2014). It can be difficult for people to understand how to interpret the information presented to them by a system (Epstein et al., 2015; Lazar et al., 2015) or evaluate the information accuracy (Yang et al., 2014). Further, people have identified a mismatch between their goals and the goals that were recommended by the system, or a person's goal changes over time (Clawson et al., 2015; Lazar et al., 2015; Smarr, 2012). Some people have stopped using wearable because they have obtained their goals.

Another essential reason for tracker abandonment is the limited options for customizing the watch interface (Clawson et al., 2015; Harrison et al., 2015; Lazar et al., 2015). Providing individuals with a higher number of customizations features to tailor their wearables could increase people's engagement and behavioral responses towards the customized product (Harrison et al., 2015; Meyer et al., 2015). Kang et al. found out that a high level of customization of the smartwatch usually attracts individuals to project their personality, values, and preferences onto a product. In contrast, a zero-customization capability discourages user engagement with a tracker (Kang et al., 2017). Also, the number of customization features can influence how users and people around them perceive a given product. However, the research on smartwatches in visualization is still limited. The few available publications focused either on studying representations for smartwatches or designing representations for these small displays. For example, researchers studied low-level perceptual tasks to understand the clarity of smartwatch visualizations (Blascheck et al., 2018), the impact of visual parameters (e.g., size, frequency, and color) on reaction times (Lyons, 2016).

Others' visualization research described new visualization designs specifically for smartwatches. Examples include research on designing health and fitness data on smartwatches (Amini et al., 2017), charts (Neshati et al., 2019), temporal data (Suciu, 2018), activity tracking more broadly (Gouveia et al., 2016), and even for integrating visualizations in watch straps (Klamka et al., 2020). In contrast to these works, our study contributes information on people's current representation types on watch faces and the challenges and choices the users face. The results can be used to inform future research, such as reported above.

1.1. Engagement and digital health

In eHealth, the use of technology to support health and wellbeing is a much-bespoken issue related to a lack of engagement. People who use an eHealth solution often do not use the offered technology how the developers intended (Christensen et al., 2009; Saskia M Kelders et al., 2012). In order to gain more insight into how engagement can be defined and conceptualized within the context of wearables, recent reviews looked at the definitions and components of engagement. Gulotta et al. defined engagement as the active use of a system that matches with practices that support a person's ability to achieve a goal using that system. Engagement is not an activity or situation but a collection of actions that a person may undertake over time, such as commonly sharing data to a system, accessing and reflecting on the data, or making an attempt to understand the information it provides (Gulotta et al., 2016). According to Perski et al., engagement can be defined in two ways: "engagement as subjective experience" and "engagement as behavior". The engagement has been imagined as the subjective experience that develops in the short interaction with a system. Engagement in behavior terms has been seen as the usage of digital behavior change interventions or their components. The engagement has been defined as the extent of use over time (Perski et al., 2017). Chapman et al. have suggested that engagement consists of users' activities, attitudes, goals and mental models, and motor skills, and it shows itself in the sort of attention, intrinsic interest, curiosity, and motivation (Chapman, 1997; Kappelman, 1995; Said & Said, 2004). This definition of engagement clearly describes that engagement is more than only the usage of a system. Therefore, engagement is essential to consider.

In order to measure the engagement for this study, the TWente Engagement with eHealth and Technologies Scale (TWEETS) will be used (Saskia Marion Kelders et al., 2020). The scale employs a definition of engagement that incorporates behavior, cognition, and affect. In the TWEETS, engaged behavior includes a routine in which individuals use the technology, low effort required to use the technology, and technology usage that is not fixed but may fluctuate to fit with the needs of the current moment. Cognitive engagement is linked to the technology being able to support and motivate people to reach their goals, such as improving one's health. Affective engagement is related to emotions that people feel when seeing their progress in the technology, or a lack thereof, and related to enjoyment when using the technology itself.

All this information together raises questions we want to research. This research aims to answer the following question What is the impact of a customizable wearable interface, and does this increase people's engagement with their health data? In order to provide the proper knowledge to answer this question, the question is split into the following subquestions:

Research questions:

- What are the challenges and choices the users face when choosing a certain watch face (Fitbit)?
- What is the effect of a customizable wearable interface, and does this impact user's engagement with their health data?

2. Materials and Methods

This chapter provides an overview of all methods used for analyzing the research question and sub-questions. First, the research design will be discussed, then the study population, materials and procedures will be described, and the data analysis is explained.

2.1. Research design

This work aims to investigate the impact of customization on engagement with wearable activity trackers. For this, a two-part study was conducted. Qualitative and quantitative research methods were applied, as this allows presenting diverse expectations and perceptions of participants (Hammarberg et al., 2016).

The goal of the first study was to have a general understanding of the different preferences that current Fitbit users have for their watch faces. For this part of the study, a survey was conducted among 102 users to determine their preferences.

The goal of the second study was to understand the impact of a customizable interface of wearable and if this increases people's engagement with their health data. For the second part, I have recruited 5 participants who used Fitbit Versa 2 for six weeks. During the six weeks, they received every week a TWEETS questionnaire, which they needed to fill in. After six weeks, the participants were interviewed, as this allows presenting diverse expectations and perceptions of participants.

Ethical approval for the study was obtained from the BMS ethics committee of the University of Twente (application number: 200412 and 201070). Data collection took place from August to November 2020. As per ethical requirements, the cover page of the survey contained detailed information about the study, and completion of the online survey was regarded as informed consent. A complete copy of the survey instrument is provided in Appendix A.

2.2. Study 1

2.2.1. Participants

Participants were recruited via social media (Facebook) and from the Fitbit website community forums. These recruitment methods were chosen as they are a quick and easy way to disseminate information to a widespread audience. The inclusion criteria were that participants needed to be wearing a Fitbit or have owned a Fitbit.

2.2.2. Materials and procedure

A survey was developed and deployed using the online tool Qualtrics. The survey link was open for four weeks (from 1th of June till 30th of June), after which time the survey was closed. The questionnaire started by collecting general information about the individual (i.e., age, gender and education). It was then split into three different sections; basic wearable questions, information about the background of the wearables and the social role of the wearables (see Appendix B). The survey was designed to lead participants through a series of logical progression questions. All the questions were designed to be filled in. Otherwise, the participants could not proceed further.

2.2.3. Data analysis

Questionnaires were answered online through the website Qualtrics. The users could access and complete the questionnaire, “Customization wearables questionnaire”

(https://utwentebs.eu.qualtrics.com/jfe/preview/SV_dosbMcqcLBs1SSx?Q_CHL=preview&Q_SurveyVersionID=current), on a PC or mobile device, and then, the data were analyzed.

During the questionnaire, there have been three different types of questions used—open-ended questions where the participants have the opportunity to give their feedback through a text box, multiple-choice questions where the participants are provided with multiple answer options and Likert scale questions, a five and ten-point scale has been used for this questionnaire. The participants can express how much they agree or disagree with a particular statement.

Analyzing open-ended questions has been done by analyzing all the answers and categorizing them. For example, in the questionnaire, we have the following open-ended question: 'What do people like the most and the least about their watch face'? First, all the answers have been analyzed. After that, all the answers have been divided into categories. For this example, there have been four categories created; metric, visualization, easiness and clearness. This procedure has been used for all the open-ended questions.

All the data were analyzed using Excel, SPSS (version 26) and R (version 3.6.1). Descriptive statistics (e.g., means and SDs) were used in the initial data analysis.

2.3. Study 2

2.3.1. Materials and procedure

In the second part of the research, the participants have been recruited through social media (Facebook community). For the recruitment process, a short survey was created where the participants were asked regarding their physical activity level. Gouveia et al. have shown that activity trackers work best for people that either has the motivation to change or have already started changing their behaviors (Gouveia et al., 2015).

The following questions were asked:

- Do you track your physical activity? (e.g., Up to what extent do you track your levels of physical activity?)
- What is your current physical activity condition?

Both questions were multiple-choice questions, where the participants are provided with multiple answer options. With this survey, the intention was to recruit participants who are or want to become physically active. I choose participants who want to become physically active because, according to Mercer et al., wearable activity trackers are an emerging solution for motivating people to improve their physical activity levels and reduce sedentary behavior (Mercer et al., 2016).

Participants were recruited via social media (Facebook community) and from the Fitbit website community forums. Five participants were recruited (three women, two men). Their age ranged from 21 to 64, with a mean age of 34.1 years (SD= 13.6). All participants received inform consent regarding their participation in this research. After that, the participants were given a new Fitbit and asked to use it for six weeks. At the end of each week, participants were sent a questionnaire by e-mail. For this survey, we used the TWente Engagement with eHealth and Technologies Scale (TWEETS). This scale applies a definition of engagement that incorporates behavior, cognition and affect (Graffigna, 2017; Kelders et al., 2020). In the TWEETS, the behavior aspect is about people having a routine in which they use the technology if the technology is easy to use and the usage of

the technology is not fixed. Cognitive engagement is about technology if it supports and motivated people to reach their goals. However, also, if the technology helps them to get more insight into their behavior related goals. Affective engagement is about the emotions that people feel when seeing their progress. However, also if they enjoy using technology. Lastly, it necessitates identity: engaged users seem to identify themselves in some way with the technology or the technology's goal (Saskia Marion Kelders et al., 2020) (see Table 1).

Item	Thinking about using [the technology] the last week, I feel that:	Construct
1	[this technology] is part of my daily routine	Behavior
2	[this technology] is easy to use	Behavior
3	I'm able to use [this technology] as often as needed (to achieve my goals)	Behavior
4	[this technology] makes it easier for me to work on [my goal]	Cognition
5	[this technology] motivates me to [reach my goal]	Cognition
6	[this technology] helps me to get more insight into [my behavior relating to the goal]	Cognition
7	I enjoy using [this technology]	Affect
8	I enjoy seeing the progress I make in [this technology]	Affect
9	[This technology] fits me as a person	Affect

Table 1 Twente Engagement with eHealth Technologies Scale (TWEETS)

Participants were asked to fill out an online questionnaire at six-time points (T1 = after one week, T2 = after two weeks, T3 = after three weeks, T4 = after four weeks, T5 = after five weeks and T6 = after six weeks).

At the end of six weeks, the participants were interviewed. For the interviews, a structured approach was used, consisting of a sequence of questions. All the questions have been grouped into themes (current watch face, customization of the watch face, and the watch face social role). Therefore, the interviewer can use a logical sequence. This way, it is possible to compare and analyze the interviewers' data and answer the research question.

2.3.2. Data analysis

The results of the responses were analyzed from Qualtrics in SPSS and Excel form. Descriptive statistics and cross-tabulation from IBM SPSS v.25 and Microsoft Excel used to investigate descriptive statistics and relationships between variables (Field, 2009). For analyzing the interviews, I did not use coding because of the low number of participants. Instead, I manually analyzed every question and answer of every respondent and tried to find comparisons and differences between the respondents.

3. Results

3.1. Study 1

One hundred and two participants took part in the survey. Of these, only 9 (8.8%) did not complete it. This resulted in a total of 93 participants, 14 male and 79 female – with an average age of 41years (SD=15) (see Table 2).

Characteristics	(n=93)	
Age, mean (MIN-MAX; SD)	40.8 year (15-77; 14.2)	
Gender, *n (%)*		
Male	14	15%
Female	79	85%
Education, *n (%)*		
Bachelor's degree (e.g. BA, BS)	35	38%
Doctorate (e.g. PhD, EdD)	3	3%
High school degree or equivalent	25	27%
Less than a high school diploma	5	5%
Master's degree (e.g. MA, MS, MEd)	18	19%
Other	7	8%
Weeks using the Fitbit, *n (%)*		
1 to 10	22	48%
11 to 20	10	22%
21 to 30	6	13%
More than 30	8	17`%

Table 2 Characteristics

Approximately half of the participants had been using their current Fitbit recently, for up to ten weeks (see Table 3). The Fitbit Versa 2 was the most used version among participants (51%, n=47), followed by the Iconic (18%, n=17) and Fitbit Versa (16%, n=15). The remaining participants (11%, n=10) owned other versions of the Fitbit. Most participants kept their Fitbit on for the whole day (62%, n=49).

3.1.1. What type of watch face did people have?

In the questionnaire, participants were asked to upload a picture of their current watch face. These pictures were categorized in terms of the information and visualizations they conveyed. Overall, two main categories for watch faces were found, namely watch faces which displayed:

(a) Metrics of health data. 61% of the watch faces (n=11) displayed at least one health metric. Most watch faces had the number of steps that people had taken in a day, with information on their heart rate and calories burned (see Figure 1).

(b) Personally, significant visualizations. 39% of the watch faces (n=7) displayed some type of personally significant picture. Examples included having a picture of one's dog as a background, a personal avatar or a picture that one had taken (e.g., sunset/sunrise or flowers, see Figure 2).

Figure 1 Metrics of health data

Figure 2 Personal visualization

3.1.2. How often do people customize their watch face and why?

Most participants had been using the same watch face for more than 3 months (n=32, see Table 3). Only 17% (n=8) mentioned changing their watch face at least once during this time, with even less participants changing their watch face even more frequently (e.g., only 4%, n=2 mentioned changing their watch face 2-3 times a week). When asked about the reasons for not changing their watch face, more than half 56% (n=19) mentioned being happy with their current watch face.

Approximately half of the participants (46.7%, n=20) had obtained their current watch face through the Fitbit app, while 35.6% (n=16) received it from the pre-installed gallery on the watch itself. Another 11.1% (n=5) mentioned getting their watch face from Google or Facebook. Only a minority of participants (4.4%, n=2) designed their own watch face.

'How many times have you changed your watch face in the past three months'		
Never	32	70%
Once a week, Never	2	4%
Once a week	8	17%
2-3 times a week	2	4%
4-6 times a week	1	2%
Daily	1	2%
What is the reason you don't customize your watch face?		
Takes too much time	4	12%
Usability problems	1	3%
Connectivity problems	1	3%
None	9	26%
Other	19	56%

Table 3 How often do the participants customize their watch face and why?

3.1.3. What did people think of their watch face?

More than half of the participants (61%, n=28) find their watch face highly or very important, with a mean score of 7.15, and a standard deviation of 2.74 (see Figure 3).

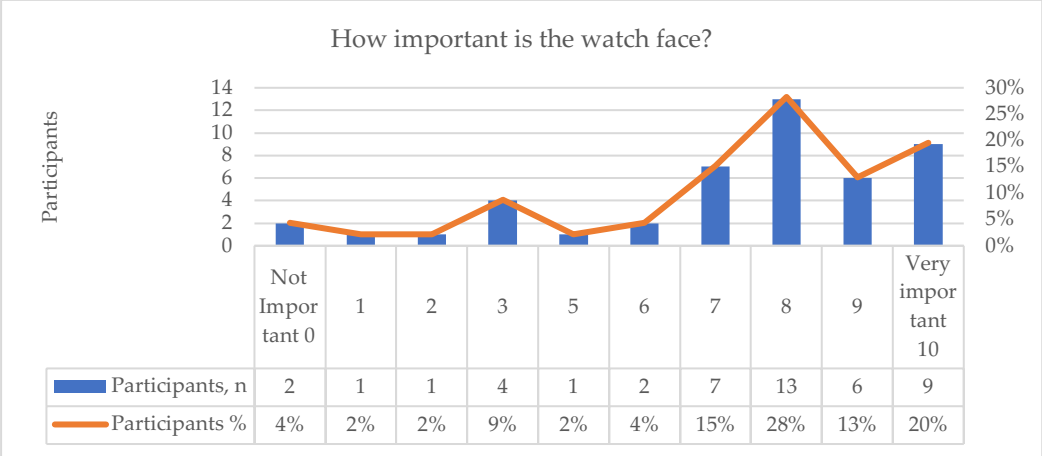

Figure 3 How important is the watch face?

In addition to the previous question, the participants received a follow-up question: 'Do you think the watch face matches you as a person'. More than two-third, 72% (n=33) thinks that the watch face matches them as a person, 13% (n=6) believes that the watch face does not match, and 15% (n=7) said 'maybe' it matches them as a person.

3.1.4. What do people like the most and the least about their watch face?

One of the things participants liked most of their current watch face is the ability to see metrics related to their physical activity, as mentioned by 41% (n=11) of participants. This was mostly for self-monitoring and having awareness of one's physical activity, such as seeing how many steps one had taken; or gaining awareness towards how far away one was from reaching one's goal. Another important aspect of participants' watch face

was the way they were stylized (41%, n=11). Participants frequently mentioned being proud and happy to have certain images (or themes) as the background of their watch faces. An additional aspect is 'Clarity of Information'. 34% (n=9) of participants mentioned liking a watch face that provides them with much information which is easy to see, but clear and straightforward (see Table 4).

	Participants, N	Participants %
Physical activity metrics	11	41%
Visualization	11	41%
Ease of use	9	34%

Table 4 What do the participants like the most about their watch face?

We also asked participants what they least liked about their current watch face (see Table 5). Most participants, (42%, n=16) noted that the numbers and the font size on the watch face are too small, the metrics (e.g., battery level) is not shown, or there is not an ability to select your stats like the number of steps the participants have walked. However, most did not report any issues with their watch face (42%, n=16).

	Participants, N	Participants %
More details	16	42%
None	16	42%
Boring	4	11%
Visual problems	2	5%

Table 5 What do you like the least about your watch face?

3.1.5. How important is it for you that other people see your watch face?

When looking at the wearable's social role, we have tried to research this by asking the participants "How important is it for you that other people see your watch face?". Most participants did not find it important that others viewed their watch face (see Figure 4). Besides this, participants also did not seem to care what others thought of their watch faces (see Figure 5).

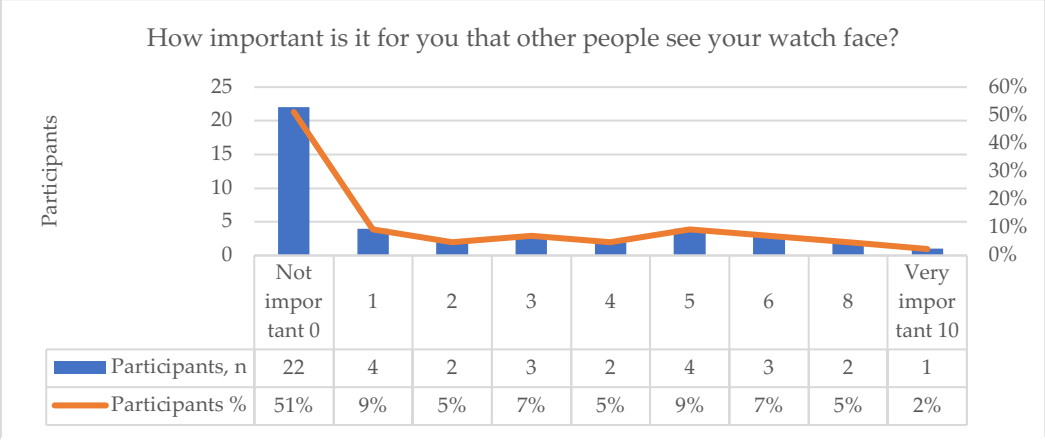

Figure 4 How important is it that other people can see your watch face?

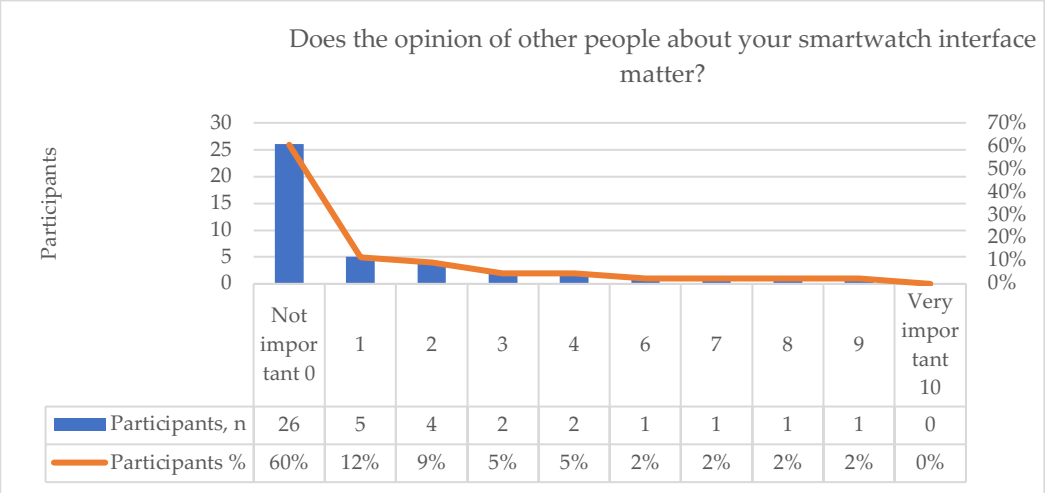

Figure 5 Does the opinion of other people matter?

3.1.6. Creating own watch face, what would it look like?

Participants had a variety of desired preferences for an "ideal" watch face. We categorized these into six groups (see Table 6). First, around one third of participants (34%, n=11) wanted to be able to fully personalize the details of the watch face – such as changing the font size and type, selecting specific metrics (e.g., Heart rate, battery life, number of stairs and active minutes), choosing more color pallets. As mentioned by two participants: 'At the moment, I would prefer the watch face I use (colors, style: simple white font, dark background with thin/tiny but colorful flowers) with a few more details (heart rate, battery life, perhaps stairs and active minutes)' (P8). 'I would make a completely customizable watch face, down to the font of the numbers/letters, where everything is located, what the background photo is, etc.' (P9).

Participants also wanted to have easier ways of changing how one's watch face was stylized (26%, n=9). Some participants wanted to create an avatar and use this as their watch face, or use personal photos but did not know how to (e.g., a picture of children or a pet), e.g.: 'Maybe customize it with your photos. Probably a picture of all my grandbabies' (P30).

Some participants would create a watch face with more health metrics on their watch or specific metrics on their watch face (e.g., oxygenation, blood pressure, number of steps on stairs) 9% (n=3%), e.g.: 'It would contain more health info than is currently available; e.g., oxygenation, blood pressure, etc.' (P31). 'I think a diabetes awareness watch face' (P42). 'I just need the medical alert, the heart monitor, time and steps on their' (P25).

Other categories are 'Would not change current watch face' 16% (n=5), people are happy with their current watch face and 13% (n=4) said 'None'.

	Participants, n	Participants %
Details (font, color, metrics)	11	34%
Personal visualization	9	28%
Would not change current watch face	5	16%
Health information	3	9%
None	4	13%

Table 6 Creating own watch face, what would it look like?

3.2. Study 2

3.2.1. Descriptive characteristics

In study 1, the main focus was to understand participants' preferences for choosing a specific watch face. In this second, complementary study, we studied the effect of these watch faces on users' engagement with their health data.

For this study, five participants were recruited by convenience sampling (three women, two men). Their age ranged from 21 to 64, with a mean age of 34.1 years (SD= 13.6) (see Table 7). Two participants 40% (n=2) considered themselves as quite physically active, for longer than 6 months. The other two participants did not consider themselves very physically active but were thinking about increasing their activity in the next month. As for participants previous experience with trackers, 40% (n=4) mentioned tracking their physical activity 'very often', 20% (n=2) 'never'', 20% (n=2) occasionally, and 20% (n=2) tracks their physical activity always. (see Table 8).

Characteristics	(n=10)	
Age, mean (MIN-MAX; SD)	34.1 year (21-64; 13.6)	
Gender, *n (%)*		
Male	5	50%
Female	5	50%
Age, *n (%)*		
21-30 years old	5	50%
31-40 years old	3	30%
41-50 years old	0	0%
51-60 years old	1	10%
61+ years old	1	10%

Table 7 Characteristics study 2

Current physical condition		
I am currently not very physically active and I do not intend becoming more physically active in the next 6 months.	0	0%
I am currently not very physically active but I am thinking about increasing my activity in the next month	1	20%
I am currently not very physically active but I am determined to increase my activity in the next month.	1	20%
I am currently quite physically active, but I have only begun to be so in the last 6 months.	1	20%
I am currently quite physically active and I have been so for longer than 6 months.	2	40%
I used to be quite physically active, but in the last few months I have been less active.	0	0%

Table 8 Current physical condition of the participants

3.2.2. What were participants reactions to the default and personalized watch faces?

During the first two weeks of study, participants were asked to use Fitbit's default watch face. When asked what they felt about it, all described the watch face as simplistic or basic. This because there was not much to see, and the participants did not identify with what was being shown. Therefore, the participants got bored with it: *'In the beginning, it was ok, but after a while, I got bored, and it was too simplistic' (P1). 'I did not like the basic watch face; it was too simple and had not much information displayed' (P2). 'Not really, it was quite boring' (P3). 'No, for me, this is too basic. No fancy colors or background, just too basic' (P4). 'I like simple backgrounds, but this one I do not because the time aspect is not that good displayed' (P5).*

During the remaining four weeks of study, participants were encouraged to change the default watch face. During this time, participants changed their watch face, on average, 1.4 times, with all watch faces being chosen from the Fitbit store. No participant created their watch face, either because they did not know how to (P2, P3) or felt the store had enough options on the Fitbit store (P1, P4).

When asked what they liked about the chosen watch face, some participants mentioned that they like a watch face with a simple background, where the icons are visible and where the metrics are visible displayed (number of steps, time and date): 'The current watch face is black, with the necessary information. I like the most about this that it has a neat black background, the icons are clear to see, and it gives little light in the dark' (P1) (see figure 6). 'It is a watch face with a clean analogue look. I have a black background with white number pointers. This background is quite easy, it has a black background, it is analogue, and it has a classic look without too many icons or other things' (P5) (see figure 6).

Watch face participant 1 | *Watch face participant 4* | *Watch face participant 5*

Figure 6 Watch face participant 1, 4 and 5

Other participants mentioned that they prefer to choose a theme watch face. For example, two participants choose a fall theme watch face*: 'A fall theme with all kinds of leaves in different colors. The variety of colors that I can see everything I want to see in one look and that it is the same as the season outside' (P2) (see figure 7). 'The watch face has a fall theme. It differs in-between seasons. The reason why I have chosen this watch face is that it has a little bit of color. All numbers on the screen should be readable. The size of the letters in a couple of watch faces was too small to read. It is essential to keep it simple. Too many things on the screen and everything becomes unorganized and not fun to use' (P3) (see figure 7).*

Figure 7 Watch face participant 2 and 3

To answer the second research question 'What is the effect of a customizable wearable interface, and does this impact the user's engagement with their health data?' the participants were asked the following question. If they could personalize their watch face, would they use their wearable more often? Four out of five participants agree on this; if they can adjust or create their background, they will use the wearable more often. *'If I do not like the watch face, I will not be using the Fitbit that often. So, I think it is very important that you have a background which you like. If you want it yourself and you feel comfortable with it, you will use it more often. This makes it easier to wear and not to forget it '(P1). 'I already use it a lot. I work-out multiple times a week and walk a lot. So, I am not sure how I would start to use it more, but I agree that if you can personalize your watch face, you will use it more often'(P2). 'Yes, because it will become more interesting to look at it. The more you can modify it to your liking, the more you will use it' (P3). 'I think I would use my watch face more often if I can personalize it more. Make it more my own with colors and insert the icons/functions which I only need. And remove all the unnecessary stuff' (P4).*

Only one participant does not agree with the statement. *'I do not think so. For me, a watch is a watch, so I am using it specifically for the time and sometimes to see how much steps I have taken on a day. But this feature is already available on my watch face' (P5).*

3.2.3. Did participants walk more after being able to customize their watch faces?

Participants took, on average, 5503 (SD=1110) daily steps in the first week and 4545 (SD=764) daily steps in the second week of the study (i.e., while using the pre-default watch face from Fitbit). This increased to an average of 5981 (SD=1526) daily steps after changing their watch faces, which is an increase of 19%. However, when looking at the weekly number of steps, there seems to be variability. For example, in the third week, participants took on average 5022 (SD=3926) daily steps, comparing to the fourth week, where the participant took 7690 (SD=2742) daily steps.

The participants with the most considerable variety of steps are participant 2 with 32% more active and participant 4 with 36%, compared to the first two weeks (see table 9).

Table 9 Average amount of steps

3.2.4. Results from TWEETS

Next, the TWEETS questionnaire was analyzed to understand how participants' engagements with their activity trackers changed. The results are divided into three categories; the behavior aspect (Q1, Q2 and Q3), the cognitive engagement (Q4, Q5 and Q6) and the affective engagement (Q7, Q8 and Q9) (see table 10).

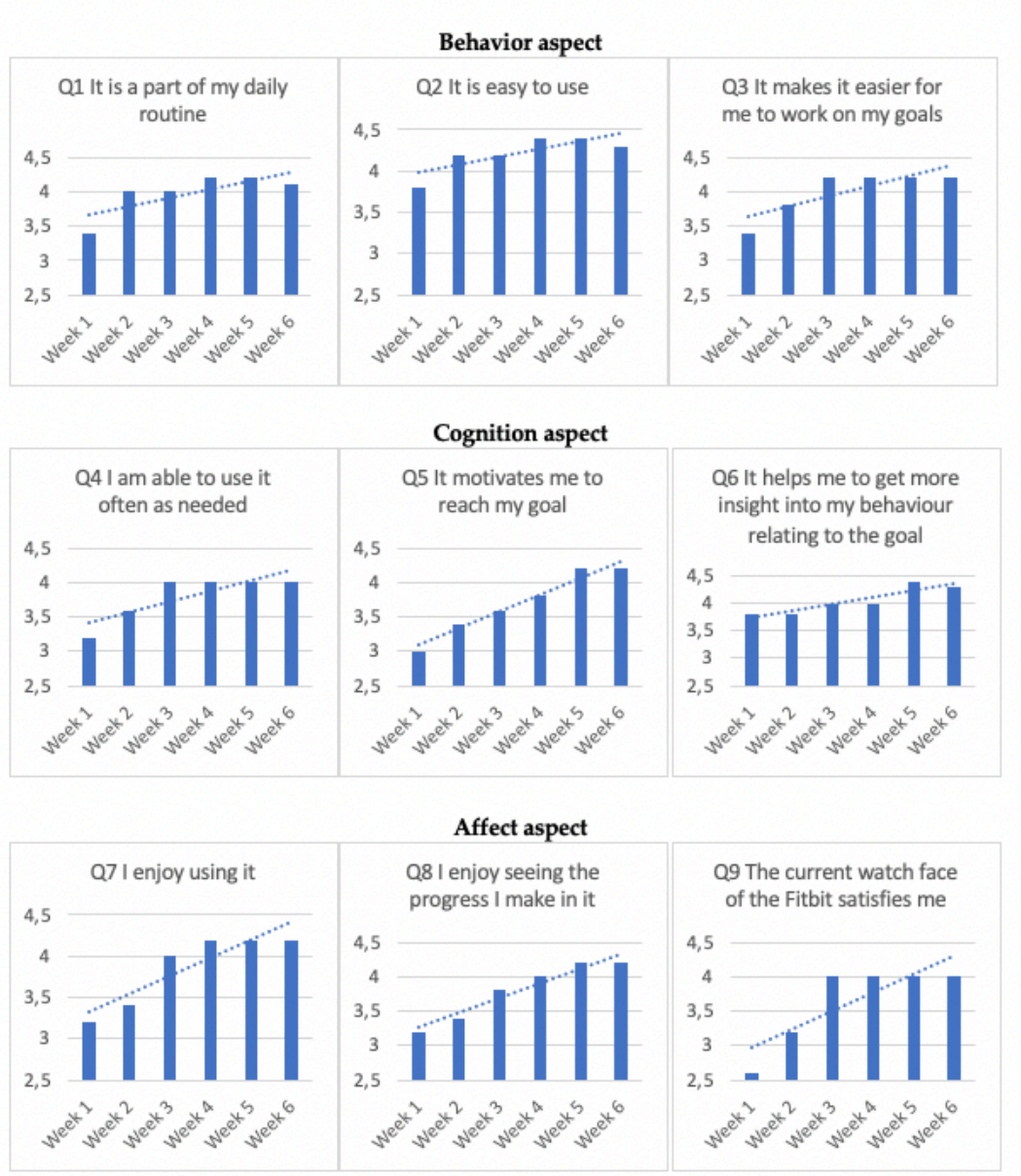

Table 10 Results TWEET

Analyzing the TWEET questions, we can see that the participants score on average higher on all the TWEET questions when they have personalized their watch face than the first two weeks where they used the default watch face.

When asked if the current watch face of the Fitbit Versa 2 satisfies. There was an increase of 38%. This means that the participant finds a personalized watch face more satisfying than a default watch face. Next to this, the participant enjoys using a Fitbit with a personalized watch face, with an increase of 26%, more than a default watch face. When asked if the participants enjoy seeing the progress, they make with a personalized watch face, there was an increase of 23% compared to a default watch face.

The least amount of increase is when the participant where asked if the Fitbit is easy to use. There was an increase of 8% when the participants used a personalized watch face, compared to the first two weeks, where they used the default watch face.

4. Discussion

I now discuss the results in terms of my two research questions.

RQ1: What are the challenges and choices the users face when choosing a particular watch face (Fitbit)?

To answer this research question, I conducted a qualitative survey study with 93 owners of Fitbits and asked them several questions regarding the challenges and choices when choosing a wearable watch faces.

First, I found that more than two-thirds of our participants had been using the same watch face for at least three months. More than half mentioned being happy with their current watch face. This means that when users find the right personalized watch face, there are chances that they might use it for an extended period. With that in mind, it is important to understand what makes an ideal watch face. First, participants found it essential that their watch face displayed a range of different metrics related to their physical activity, as mentioned by more than one-third of participants. This was mostly for self-monitoring and having an awareness of one's physical activity, such as seeing how many steps one had taken; or gaining awareness towards how far away one was from reaching one's goal.

Another essential aspect was how a watch face was stylized. Participants frequently mentioned being proud and happy to have specific, personally significant visualizations as the background of their watch faces. Participants also found it essential that their watch offered them the possibility of choosing and transitioning between different watch face metrics. These insights resemble findings from previous work. Kang et al. (Kang et al., 2017), for example, suggest that a high level of customization of the smartwatch usually attracts individuals to project their personality, values, and preferences onto a product.

Therefore, the designers need to know that when they design a certain watch or watch face, there needs to be an ability to customize choosing and transitioning between different watch face metrics. As I mentioned above, these are the main challenges the users face when choosing a particular watch face. However, when the participant obtained a watch face that they are satisfied with, the results are showing that they will use it for an extended period.

It is also essential that developers consider what the participant likes the least about a watch face. Most participants in my study noted that the numbers and the font size on the watch face are too small, the metrics were not shown, or there is no ability to select their stats like the number of steps the participants have walked. This result ties well with previous studies wherein Clawson et al. suggested that people abandon their trackers because of the limited options for customizing their watch interface. Providing individuals with a higher number of customizations features to tailor their wearables could increase people's engagement and behavioral responses towards the customized product (Harrison et al., 2015; Meyer et al., 2015).

Another interesting finding of this study is the wearable's social role. All the participants were asked: "How important is it for you that other people see your watch face?" The results have shown that most participants did not find it essential that others viewed their watch face. Besides this, participants also did not seem to care what others thought of their watch faces. Overall, these findings are in accordance with Chuah et al., where they indicated that consumers who perceive smartwatches as a technological attribute had a higher level of usefulness (rather than visibility) to them. In contrast, respondents who perceive smartwatches as a fashion accessory identify visibility as more valuable (rather than usefulness) (Chuah et al., 2016). Alternatively, it could simply mean that in my

research, most of the participants saw the watch face as a technological attribute with a high level of usefulness rather than a fashion accessory and therefore did not care about the visibility aspect.

RQ2: What is the effect of a customizable wearable interface, and does this impact users' engagement with their health data?

To identify the effect of a customizable wearable interface and if this impacts user's engagement with their health data, I conducted a qualitative and quantitative study with 5 participants to answer this research question.

In this second complementary study, participants received during a period of six weeks a TWEETS questionnaire with nine questions, where I measured participants behavior, cognitive engagement, and affective engagement. From these TWEETS questionnaire results, the main finding that I found is that behavior, cognition, and affect have increased after the participants started using the personalized watch face. A possible reason for this is that the participants used a standard watch face in the first two weeks. After that, the participants were allowed to adjust their watch face to their personal preferences, which lead to increased behavior, cognition, and affect behavior.

Compared with the first study, I also saw in the second study that if the participants choose a particular watch face they like, their engagement seems likely to increase. Therefore, designers must create various options for watch faces from which the participants can choose. Offering various options for watch faces is important because people's tastes differ, and by offering a wide variety of quantities, everyone has something that he or she likes. The results lead to a similar conclusion where Kang et al. (Kang et al., 2017) suggest that a high level of cosmetic customization capability encourages user engagement with a wearable health tracker via an enhanced sense of identity. In contrast, zero cosmetic customization capability discourages user engagement with a tracker via a lowered sense of identity.

Today's behavior-change technologies, in our case a watch face, rely fundamentally on the principle of self-monitoring. The idea that monitoring our behaviors makes us more likely to engage with behavior change, such as walking the extra steps, reducing energy consumption, or other changes. However, research has frequently revealed that individuals quickly fall into their old manners once self-monitoring stops (Gouveia et al., 2015).

I have tried to research self-monitoring and what the participants find important about customization for supporting engagement. My research's main findings show that the participants mentioned that a customized watch face, where the icons are visible and where the metrics are visible (number of steps, time and date) are essential for self-monitoring. When this is not present, the participants will discard their watch. Therefore, designers need to think about the self-monitoring aspect, how to change this when designing a particular watch or watch face. Otherwise, the watch's owners will discard their watch, like Kang et al. mentioned in their study, approximately one-third of users stop wearing their tracker within six months (Kang et al., 2017).

Another aspect I have tried to research is the physical activity level of the participants. If I look at the participants' physical activity, participants did not increase their physical activity levels. Overall, only two participants increased their level of physical activity. The remaining participants either had fluctuations in their activity levels or even seemed to decrease their physical activity.

The most interesting thing I have found is that the participants' engagement seemed to increase when I analyzed the TWEETS questionnaire. Still, there is no increasement noticeable when I look at the participants' physical activity.

A possible explanation could be that this study took place during the COVID-lockdown, which means the participants were limited in their daily activities, which can correspond to no increase in their physical activity levels. However, the participants could still use their watch and felt engaged with their watch face.

Limitations:

There are several limitations in this study that should be acknowledged. The first limitation of this study regards the process. This research was conducted by only one researcher, which means that the coding and analyzing procedure can be biased as the results depend on only one person's assessment. The implementation of more than one researcher and the charge of inter-rater reliability can avoid this in future research.

The second limitation of the second part of the study is the relatively small sample size. According to Jeremy et al., a sample size of a minimum of 20 is needed to have a reliability study and 80 for validity study (Cano et al., 2012). Therefore, in the future, a bigger sample size is needed to have reliability and validity study.

The third limitation of this study is that the participants wore the Fitbit for six weeks. In the introduction I have mentioned that over a third of owners discard their commercially available wearable trackers within three months of use. Future research is recommended to track the participants for a more extended period (e.g., longer than three months).

The last limitation of this study is the initial appearance of COVID-19 during the period of this study. The COVID-19 pandemic may elicit unhealthy changes in movement behavior. Lower physical activity, higher and more prolonged sedentary behavior are the main features of the behavioral changes. Some participants had tested positive for the COVID-19, which influenced this study's results. Therefore, further studies with a higher number of participants are needed.

5. Conclusions

In this paper, I have investigated the effect of a customizable wearable interface and if this impacts users' engagement with their health data. My findings point out that if the users find the right personalized watch face, they will use the watch for an extended period of time. But if the users cannot find a right watch face, they are not satisfied, which can lead to discarding the watch, like Kang et al. concluded in their research (Kang et al., 2017). Therefore, the designers' job is to know what attracts individuals and project their personality, values, and preferences onto a watch face.

In my study I also found that while engagement with the watch face increased, physical activity of the participants did not. The participants in this study are more engaged with their watch and watch face, but not necessarily with the health data displayed on them. I cannot make strong claims with such a small sample size. Future studies with a bigger sample size and long-term engagement with the watch face are needed.

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Appendix A

Hi (name of participant),

I am glad to inform you that you have been selected to participate in the activity tracking study that was shared on (…). This study attempts to understand how activity tracker owners use and adapt to different visualizations of their physical activity.

Procedure: For this research, you will be given a Fitbit Versa 2 and be asked to use it for **6 weeks**. During this time, you are encouraged to use the Fitbit as frequently as you desire (we do not require you to keep it always on). You will also be asked to **keep the settings of the Fitbit as given to you**. After six weeks we will ask you to return the Fitbit to us.

Every week, you will be asked to reply to a short questionnaire, regarding your experience using the Fitbit Versa 2, which will be sent to your e-mail account. This questionnaire consists of 12 questions which will cost you approximately 3 minutes to fill in.

You will also be asked to take part in an interview, for approximately 10 to 15 minutes, **at the end of the six weeks**. With the interview, we want to get an idea about the experience from the participants about using the Fitbit.

Data logging: During the study, we will be logging your levels of physical activity for the next six weeks. All data obtained will be kept confidential and will only be reported in an aggregated format (by reporting only combined results and never reporting individual ones).

In order to apply, please fill in this inform consent.

The study is conducted by Maxim Vnoutchkov as part of his Master dissertation at the University of Twente. If you have any questions regarding this study, please contact: m.s.vnoutchkov@student.utwente.nl

ELECTRONIC CONSENT: Please select your choice below.

Checking on the "agree" button below indicates that:
• you have read the above information
• you voluntarily agree to participate. ”

Select the option:
☐ Agree
☐ Not agree

Appendix B

Wearable	Interface	• What is your current watch face? • For how long have you been using this watch face? • Did you create it by yourself or did you select it somewhere? • What do you think about the basic background of Fitbit? • Can you tell us three different things you like about this watch face? • Do you think it matches you as a person? • Can you describe one cherished memory that you have of this watch face (a memorable story)? • How important is the watch face for you (on a scale 1 to 10)? • Do you customize your watch face (clock watch face)? - If yes, how often have you customized your interface in the past 3 months? - If no, why not? • If you could create any watch face, how would it look like? Can you describe it to us? don't let any technical restrictions hinter your creativity (think about: colors, pictures/photos, moving avatar)? • Do you miss features about the customization of your smartwatch? - If yes, which one? What would you like to see? • As a part of this research, you are allowed to change your watch face. What do you like the most about this watch face? • What do you like the least? • Do you think that you would use your smartwatch more often if there would be more possibilities to personalize the watch face? And why would that be? • Do you show your watch to others? • Do you think other people notice your watch face? How does that make you feel? • How important is it for you that other people see your watch face? • Does the opinion of other people about your smartwatch interface matter? - If yes, why? - If no, why not?
Conclusion	Introduce end	Tell the person that all questions are answered, you start with the last part of the interview and repeat their answers and tell them again that the information will be anonymous.
	Last additions	Ask if the person has anything to add to these questions and answers.
	Experiences	Ask about how they feel about and how they experienced this interview.
	Thank the person	Thank the person for their answers and the opportunity to interview them.