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Continuously Healthy, Continuously Used? – A Thematic Analysis of User Perceptions on Consumer Health Wearables

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Abstract

Along with the miniaturization of digital devices, consumer health wearables (CHWs) further decrease the distance between users and devices, allowing users to continuously track their personal health information (PHI). While this provides more control to users, history has shown that users' potential concerns (e.g. privacy) can lead to devices not meeting users' expectations and failing market diffusion. The existing literature has mostly focused on particular aspects that could foster or hinder adoption of CHWs but the big picture is still missing. Drawing upon the previous literature, we use a rigorous iterative thematic analysis to provide a comprehensive picture of any potential benefits and deficiencies that users associate with CHWs. We take the example of fitness trackers and conduct 16 semi-structured interviews that help understand the determinants on which users assess the benefits and deficiencies of CHWs related to their continuous usage. We identify 11 subthemes that we can attribute to three main user determinants (perceived benefit, deficiency, and privacy). Our results not only show the failure to meet privacy expectations as a particular potential hindrance factor, we further propose a new theoretical construct (perceived relativity) as well as a novel tracking motive (social tracking), both of which can benefit future research on PHI disclosure. We enable both researchers and practitioners to uncover and visualize user perceptions of fitness trackers, on which future design decisions can be oriented and user expectations be better met.

Keywords: Consumer Health Wearables, Thematic Analysis, Fitness Trackers, Continuous Use, Thematic Map.

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Introduction

The development of more powerful and ever smaller IT has enabled the integration of computers into many devices of our daily lives (such as smart homes or cars), which traditionally did not have a significant IT basis. Along with this, the impact of such devices has become more pervasive and the distance between devices and users has decreased. While smartphones are an earlier example of powerful IT that users could carry with them over a longer time without substantial effort, the idea of wearables is that users can continuously carry them on their body and profit from their functionality. It is particularly the physical proximity that leads to new forms of interaction between technology and users (Benbunan-Fich 2017). In Asia market diffusion of such wearables has seen major growth in recent years, and it is expected to grow by an average of approximately 16% in the next five years (Medgadget 2018). This growth is even expected to partly compensate for the attenuating sales of smart phones (Bloomberg 2018). The increasing diffusion of wearables could even be the basis for substantial transformations in entire industry sectors, such as the digitization of healthcare.

In this study, we focus on consumer health wearables (CHW) which can grant users more control over their health by providing them with the continuous tracking of personal health information (PHI). Through CHWs, users and patients can obtain more functional independence through medical feedback, receive more information and increase their physical activity to reduce the risk of diseases such as diabetes or osteoporosis (Shih et al. 2015). CHWs can improve users' quality of life and serve as a more convenient means to connect them with medical care, especially when living in remote areas (Baig et al. 2013; Park and Jayaraman 2003).

Despite these health-related benefits, there are potential disadvantages that can make the continuous use of CHWs a difficult trade-off decision (Wieneke et al. 2016). As well as functional limitations or the potential complexity of usage, there are also privacy concerns. By continuously monitoring a range of personal health issues from chronic illness to fitness, users become a real time "walking data generator" (McAfee and Brynjolfsson 2012, p. 5). Some health insurance companies have already developed their own self-tracking apps to integrate PHI with regular patient information (e.g. frequency of doctor visits). First insurances in Asia already use CHW data as a basis for reward-based health protection (IDC 2017). Apart from the commercial interests of insurance companies, users' privacy might be threatened by the seamless integration of trackers with social networks and GPS-tracked runs, which could, for instance, reveal if a person is not at home. As a consequence, more than 80% of respondents were worried that wearable health devices would invade their privacy (PwC Health Research Institute 2014).

Wearables are one of the technology-driven trends that present magnificent opportunities for business research (Chen et al. 2018). Previous research on CHWs has mostly focused on particular factors that enable or hinder adoption or usage of CHWs (Jeong et al. 2017), for instance consumer innovativeness as a determinant of continuance intention (Hong et al. 2017). In a broader context, the adoption of different wearables in particular fields, such as rock climbing (Kosmalla et al. 2016) or disaster applications (Cheng and Mitomo 2017) has been analyzed. The user side on wearables has also seen substantial research; for instance, concerning psychological perceptions of applications for the elderly (Fang and Chang 2016), or by identifying different user types for wearables in corporate wellness or security programs (Mettler and Wulf forthcoming).

However, despite the increasing popularity of CHWs for individuals and their importance on a societal healthcare level (Kari et al. 2016), no study has yet offered an integrated, comprehensive overview of the main factors that determine their continuous use. In this context "it is surprising that the transaction nature of a privacy cost and privacy benefit evaluation has been largely ignored" (Tam et al. 2015, p. 2). Understanding why individuals use CHWs and investigating the particular role of privacy in the sensitive field of perceived benefits and costs is essential for the future development of CHWs and will not only affect individuals, but also entire industries and institutions that depend on them. Consequently, we pose the following research question:

What are the determinants of individuals' decisions to continuously use CHWs?

Studying new technology phenomena that deviate substantially from previous technologies might require new research methodology (Prasopoulou 2017). We conduct qualitative interviews and apply a rigorous iterative thematic analysis to answer our research question and understand users' perceptions of the benefits and cost of fitness trackers. Thematic analysis is a "method for identifying, analyzing, and reporting patterns (themes) within data" (Braun and Clarke 2006, p. 6) that has been successfully employed in various fields of IS research (Babar et al. 2018; Jiang et al. 2017). In the local context, it has been used to uncover user perceptions of health apps (Anderson et al. 2016), or critical experiences with self-tracking devices (e.g. Kari et al. 2016). By constantly reviewing the conducted codes, subthemes and themes on literature, we provide researchers with a full overview of the main determinants of continuous use of fitness trackers as a particular type of CHW. We enhance the theoretical understanding by proposing a new construct *(*perceived relativity) and a new tracking motive (social tracking)*.* The visualization of our thematic map provides researchers with the main determinants of continuous tracker use and enables practitioners to obtain a comprehensive overview of the factors that govern the continuous use of their products. We enhance the theoretical understanding of perceived privacy in the context of mobile health technologies. We also provide practitioners with workable suggestions on the implementation of self-tracking devices in new markets or healthcare systems by identifying the primary determinants of their continuous use.

Theoretical Background

Characteristics of Consumer Health Wearables and Fitness Trackers

There is a variety of nomenclature on CHWs without a clear standard. We therefore define CHWs based on three constituting characteristics: they are designed for private users worn on the body as small digital devices; they are equipped with biometrical sensors to continuously generate personal health information; and they can be used without the need for health professionals. CHWs are offered in various shapes, such as wristbands, watches, glasses, or textiles to track, analyze, communicate, and "to monitor the minutiae of our everyday lives" (Newell and Marabelli 2015, p. 3). Despite certain differences in functionality and appearance, they are seamlessly integrated into the outfit, or worn directly on the body (Berghaus and Back 2015). Most CHWs have similar technical properties, such as integrated sensors, storage and software applications (Wieneke et al. 2016). Embedded biometrical sensors can unobtrusively collect human physiological data, such as physical activity or sleep patterns. These biometrical sensors can also be integrated into clothing and accessories to enable the acquisition of PHI during users' daily activities (Zheng et al. 2014). Their small size makes it easier to wear such devices continuously (Piwek et al. 2016). Owing to advances in sensor capability in comparison to smartphones, health apps, or health websites, CHWs can collect additional types of physiological data that it is difficult to be collected in other ways (Meng et al. 2011). Thus, users receive personalized, immediate, and goal-oriented feedback based on specific tracking data obtained via biometrical sensors (Soar et al. 2005). With the further seamless integration in users' everyday life, CHWs can be classified as calm health technologies (Weiser and Brown 1997). Users can independently interact with

CHWs and analyze their PHI on other IT devices, often using advanced data analytics or benchmarking to generate insights into their health status without the need for professional health staff (Varshney 2014). In contrast, clinical health wearables generate data primarily used by health professionals to diagnose and evaluate patients' medical situations in real time (Paschou et al. 2013).

Fitness trackers are a specific type of CHWs that are directly worn on the body to unobtrusively collect human physiological data related to users' fitness activities. Hence, instead of actively diagnosing or preventing diseases, fitness trackers monitor users' physical activity and collect PHI with an oximeter, or electrodermal sensors to measure users' stress levels (Sandulescu et al. 2015). Such devices can often be programmed with fitness goals and incorporate GPS to track individual sport activities, calories burned or workout intensity (Coorevits and Coenen 2016). By continually gathering PHI, fitness trackers allow individuals to monitor a range of medical risk factors and provide them with direct access to their PHI (Becker et al. 2017b). The analysis of users' PHI usually takes place on connected devices such as tablets, mobile devices, or PCs. These applications use advanced data analytics or benchmarking to generate insights into different aspects of individuals' health status without the need for health professionals. Owing to the wide diffusion of fitness trackers in recent years, and given that research in this field is still at an early stage (Lunney et al. 2016), we use them as an exemplary type of CHW for our research.

The Continuous Use of Fitness Trackers

Fitness trackers differ from most other consumer electronics. By representing the body as "a repository of identifiable, storable and processable data" (Lupton 2014, p. 6), they give rise to a complex interplay of the PHI data and its subjective interpretation by the user (Sjöklint et al. 2015). This interplay does not delineate a simple "human-machine interaction, but […] a reflexive one" (Pfeiffer et al. 2016, p. 3), since fitness trackers not only collect data, but also provide users with the ability to react upon health-related feedback. Because of this reflexive interaction, the body and the data representing the body often become central to continuously using the device. Based on Limayem et al. (2007), we define continuous use as the long-term usage of fitness trackers originating from either a consciously built intention or an unconsciously driven habit. This continuous use depends on an individual's trade-off decision between the beneficial and adverse properties of tracker use (Wieneke et al. 2016). As no study offers an integrated, comprehensive overview on the main factors that influence the continuous use of fitness trackers to date, we have based our study on the two prevailing research streams, which highlight either the perceived benefits or the perceived costs in the field of tracker use.

The first research stream investigates motives for the continuous use of fitness trackers but disregards perceived cost factors (e.g. Gimpel et al. 2013). For instance, Nelson et al. (2016) examined the attributes of fitness trackers, which can help make people stick to their personal health goals. Their study suggests that gamified tools largely contribute to users' willingness to continuously use fitness trackers. Other research on continuance usage has identified different self-tracking types (Rooksby et al. 2014), or focused on particular adoption groups, such as older people or those with chronic illnesses (Mercer et al. 2016). Taking a broader, marketing-based perspective, Canhoto and Arp (2017) identify several user and device-related characteristics that impact continuous use of health and fitness variables. It has also been found that fun, impact and usefulness of activity trackers are important determinants in that respect (Ilhan and Henkel 2018). Gimpel et al. (2013) identified five motivational factors to explain the individual's activity of self-tracking, while Sjöklint et al. (2015) explored how individuals use self-tracking devices and how they cope with PHI provided in everyday life. Continuous use has been shown to be connected with an enhanced feeling of control over one's life due to the ability of processing the own body as an information system (Lupton 2014). Fitness trackers have been shown to increase users' willingness to attain fitness goals (Sjöklint et al. 2015), to contribute to users' health, facilitate preventive care, and support the handling of ongoing illness (Lunney et al. 2016; Mercer et al. 2016).

The second research stream investigates perceived cost factors of fitness trackers but often disregards user motives for their continuous use (e.g. Coorevits and Coenen 2016). Most prominent in these studies is the investigation of users' privacy concerns. For instance, Miltgen et al. (2013) claim that users of fitness trackers exhibit stronger privacy concerns relative to other technological devices due to the high sensitivity of PHI. By contrast, Motti and Caine (2015)) conclude that – compared to other health wearables, which incorporate microphones or cameras – users viewed fitness trackers as relatively inoffensive to their privacy. Literature on cost factors other than privacy concerns is very scarce. Some factors have been brought to light by Coorevits et al. (2016), who found that users were deterred by social features, a lack of reliability or a limited fit of their trackers. Shih et al. (2015) investigated user experiences with fitness trackers in a study among 26 students. The students had issues with remembering to wear their tracker, and voiced complaints on the design of their trackers and on a perceived lack of data accuracy.

Taken together, while most of the previous studies focus *either* on the positive or the negative aspects of fitness trackers, we seek to provide a comprehensive overview of both as well as the effects of these aspects on continuous use.

Methodology

Data Collection

We chose a qualitative approach to examine the factors that influence the continuous use of fitness trackers and investigate the particular role of privacy concerns in this tension field. To obtain rich insights, we decided to conduct semi-structured interviews with users of fitness trackers. As suggested by Kim and Park (2012), we based our interview guide on a multidimensional research model. We based our initial interview questions on constructs from several established models on continuous use, namely the Unified Theory of Acceptance and Use of Technology 2 (UTAUT 2), the Health Information Technology Acceptance Model (HITAM), and the Health Information Privacy Concerns Model (HIPC), and derived the following questionnaire (Table 1). Often framed as closed Likert-style type questions in many studies, these constructs served as the main qualitative frame for our interview questions in our semi-structured interview guide, based on which we post further elaboration questions whenever necessary. This theoretical framework should allow for cross-disciplinary relevance, and provide a broad theoretical grounding for exploratory research on consumer perceptions, perceived benefits and risks associated with using wearable devices for monitoring their health.

From UTAUT 2 (Venkatesh et al. 2012), we included the constructs performance expectancy and effort expectancy to investigate user motives for tracker use (e.g. Chen and Shih 2014). Furthermore, we integrated the established constructs hedonic motivation and habit into the interview guide. Since fitness trackers are "vibrant and controversial new technologies" (Buchwald et al. 2015, p. 6), we also included social influence to account for the extent by which social peers influence users' perceptions as well as their purchasing and usage decisions.

Secondly, while we acknowledge that established technology adoption models partly explain the continuous use of mobile health technologies (e.g. Holden and Karsh 2010), they are not entirely responsive to the specific characteristics of fitness trackers. As privacy concerns are commonly named a primary cost factor (e.g. Wieneke et al. 2016), we integrated parts of the HIPC model to investigate the particular role of users' privacy perceptions. HIPC investigates privacy concerns with health information technologies. Its six constructs (collection, secondary use, improper access, errors, control and awareness) draw on the two established privacy models concerns for information privacy (CFIP) and internet users information privacy concerns (IUIPC) (Kenny and Connolly 2016). Thirdly, fitness trackers are often used in a medical context (Mercer et al. 2016). Consequently, we took users' health status into account to obtain a better picture of user motives. HITAM is a technology acceptance model especially developed for healthcare settings (Kim and Park 2012). Despite its recent appearance and its leading position in healthcare, HITAM has already been applied in the context of fitness trackers and mobile health apps (e.g. Anderson et al. 2016). We included HITAM construct perceived threat to inquire about users' health status, i.e. to analyze whether trackers were used to counteract existing conditions, or in prevention. In this way, HITAM helped us to ascertain the subjective suitability of fitness trackers for the treatment of medical conditions.

By incorporating specific constructs of the theoretical models UTAUT 2 and HITAM, we developed an integrative model to account for the multidimensional nature of user interaction with fitness trackers. To investigate the particular role of privacy, we applied the HIPC model. Therefore, we enhanced the generalizability of our implications across several research fields and paved the way for cross-disciplinary research on other health technologies.

The interviews were conducted with 16 current users of fitness trackers (eight male and eight female). The average age of the interviewees was 36 years. The youngest was aged 22, the oldest 62. Seven had a university degree; nine a degree from high school or middle school. On average, interviews lasted approximately 25 minutes. The participants used various functions of fitness trackers; for instance, to monitor the number of steps taken and floors climbed, calories burned, sleep duration, sleep quality, and food consumption. The interviews were audio recorded and transcribed verbatim with the software ATLAS.ti.

Data Analysis

We based our interview evaluation on the thematic analysis approach as a well-established method of qualitative data analysis (Braun and Clarke 2006). Thematic Analysis (TA) is a type of qualitative analysis (Braun and Clarke 2006; Miles et al. 1994) and can be applied with different theoretical frameworks. TA is commonly used to identify, report, and analyze data for meanings and perceptions produced in and by people (Braun and Clarke 2006; Patton 2002). Therefore, TA is suitable to illustrate detailed user behavior and experiences with health wearables and it enables a better and wider understanding of their potential (Braun and Clarke 2006; Crawford et al. 2008). This is particularly useful to discover common themes and thoughts from more than one consumer to analyze patterns in user experiences. The concept of TA was developed, in part, to see beyond observable material and to investigate more implicit themes and thematic structures, especially latent constructs such as privacy concerns (Braun and Clarke 2006).

A thematic map is a graphical tool for "organizing and representing knowledge […and included] concepts, usually enclosed in circles or boxes of some type, and relationships between concepts" (Novak and Cañas 2006, p. 1). It is used for identifying, analyzing, and reporting themes within data (e.g. Patton 2002), and has, for instance, been successfully employed to uncover user perception of health apps or critical experiences with self-tracking in information systems research (e.g. Kari et al. 2016). To ensure quality standards, TA should follow a systematic approach, in which it takes account for the main quality criteria credibility, criticality, integrity, and authenticity (Jorgensen 2006; Whittemore et al. 2001). Credibility relates to whether the results reflect the experience of the participants in a believable way (Lincoln and Guba 1985). Therefore, the research team discussed the extracted themes with participants who were willing to be involved in further inquiry. By retaining a reflective awareness of the preconceptions, authenticity was addressed. Criticality and integrity reflect the variety of possible interpretations depending on the assumptions of the researchers (Jorgensen 2006). To achieve this, the members of the research team independently reviewed the emerging themes, and discussed the results with other researchers. Thus, the resulting data set should be plausible, being based not only on the authors' interpretation, but also on that of participants and fellow researchers.

Table 1 – Interview Guide and Underlying Theoretical Constructs

Main Questions	Elaboration Questions	Construct
How long have you been using your fitness tracker? (Anderson et al. 2016)	If discontinued: Why did you stop using your fitness tracker? Have you used another fitness tracker prior to your current one? If yes, for how long?	Fitness Trackers Experience
On what occasions do you use your fitness tracker? (Anderson et al. 2016)	Which functionalities do you use regularly? Do you use your fitness tracker in combination with your smartphone / tablet?	Descriptors Of Use
Do you currently suffer from an illness / the side effect of an illness / Do you suffer from physical complaints? (Kim and Park 2012)	Do you use your fitness tracker in order to counteract your medical condition? Do you consider yourself susceptible to health issues? (Kim and Park 2012) If yes, would those diseases have a severe impact on your quality of life?	HITAM – Perceived Threat
Is your fitness tracker useful in achieving your fitness goals? (Kijsanayotin et al. 2009)	Does your fitness tracker measure your activities precisely? Does your fitness tracker support you in achieving your fitness goals? Has your performance increased due to tracker use?	UTAUT 2 – Performance Expectancy
Do you perceive your fitness tracker as being easy to use? (Kijsanayotin et al. 2009)	If yes, what makes the interaction with your tracker easy for you? If not, which functions are too complicated in your opinion? Are there functions, which you do not use due to their complexity?	UTAUT 2 – Effort Expectancy
How does your social environment react to your tracker use? (Venkatesh et al. 2012)	Do you evaluate their reactions? Do you consider your fitness tracker a lifestyle symbol? (Yang et al. 2016)	UTAUT 2 – Social Influence
Does it bother you when the provider asks you for PHI? (Li and Slee 2014)	Are you concerned that the provider collects too much information about you?	HIPC - Collection
Should your provider be allowed to use your PHI for other purposes than the ones authorized by you?	Hints: Unauthorized purposes might be the transfer of data to health insurance companies or physicians (Li and Slee 2014)	HIPC – Secondary Use
Should the provider devote more time and effort to the inhibition of unauthorized access to PHI? (Case et al. 2015)	Should databases, which include private information, be protected against unauthorized access irrespective of costs incurred? (Li and Slee 2014)	HIPC – Improper Access
Should the provider devote more effort to the verification of the accuracy of the PHI? (Case et al. 2015)	Hints: Double check of PHI on its accuracy; More time and workforce should be applied towards the verification of sensitive data. (Li and Slee 2014)	HIPC – Errors
Does having only limited control over the PHI that you provide bother you? (Hong and Thong 2013)	-	HIPC – Control
Does being unaware of how your PHI is used by the provider bother you? (Hong and Thong 2013)	-	HIPC – Awareness
Do you use your fitness tracker habitually? (Venkatesh et al. 2012)	Have you changed your usage behavior and your attitude towards your fitness tracker over time?	UTAUT 2 – Habit
Usage Enjoyment: Do you enjoy using your fitness tracker? (Yang et al. 2016)	*Novelty Enjoyment:* Do you enjoy tracker usage because fitness trackers are a fairly new technology? (Slade et al. 2013) *Visual Attractiveness*: Does the design / user interface of your tracker appeal to you?	UTAUT 2 – Hedonic Motivation
Do you have the resources necessary to use the technical support of the provider? (Slade et al. 2013; Venkatesh et al. 2012)	Have you gained experience with the technical support of the provider? What is your impression of the technical support's quality? Is your fitness tracker compatible with applications on your phone / tablet/ PC?	UTAUT 2 – Facilitating Conditions

By adapting established constructs we followed Anderson et al. (2016) to enable a high comparability with previous research. As part of this rigorous iterative TA approach, we matched our interview codes, subthemes and themes by constantly reviewing literature. Figure 1 provides a detailed illustration of our recursive methodological approach, which included moving back and forth between the different phases of the analysis. First, we transcribed the interview audio recordings and then repeatedly read through the transcript to obtain a comprehensive understanding. Concerning the three theoretical frameworks and the deductive approach, we sought to give the participants more freedom to elaborate on our initial interview guide by conducting semi-structured interviews. Interviews are a suitable approach to determine subtle views and perceptions that influence behaviors (Yin 2014). The use of individual interviews not only offers a high degree of privacy, but also enables the researchers to explore each user' s interaction with their identified wearables in detail.

Afterwards, we generated initial codes by searching for recurring patterns in the raw data, which helped us aggregate the data to workable items. 28 different codes were identified in the data set. In the next step, we merged different codes to subthemes. For instance, users based their willingness to disclose information on the identity of the data recipient or the perceived sensitivity of their data. Consequently, the two respective codes *recipient-specific data retention* and *sensitivity-specific data retention* were matched to the subtheme *perceived severity.* The process of matching codes with subthemes and then subthemes with themes was accompanied by a constant review of literature. For instance, we removed *technological experience* from our thematic map, as all of the participants had used smartphones, laptops and / or tablets before they first used their trackers.

Lastly, we defined and named the different themes and developed a thematic map. Perceived benefit was labeled following Yang et al. (2016) and comprises user statements on extrinsic and intrinsic benefits from tracker use. Extrinsic benefits relate to users' functional and utilitarian benefits from use, subsequently referred to with the subthemes performance expectancy and social image. Intrinsic benefits describe an experienced enjoyment for its own sake and are henceforth accounted for with the subtheme hedonic motivation. In this sense, effort expectancy and data as asset are hybrid subthemes, since users perceived them both as a prerequisite for extrinsic and intrinsic benefits. Perceived privacy captures users' attitudes towards PHI disclosure. The notation of the theme was inspired by the study of Dinev et al. (2013). Privacy threats were attributable to the subthemes perceived relativity, perceived severity and perceived control. The theme perceived deficiency was derived from UTAUT 2 and HITAM constructs and accounts for experienced deficiencies of use. Prior studies often used a perceived value construct which explains users' decisions to adopt a technology or not by setting its perceived benefits of use in relation to privacy risks (Yang et al. 2016). We consider such a construct as insufficient for the explanation of users' trade-off decisions, since it does not cover other adverse cost factors, which we consider as part of perceived deficiency.

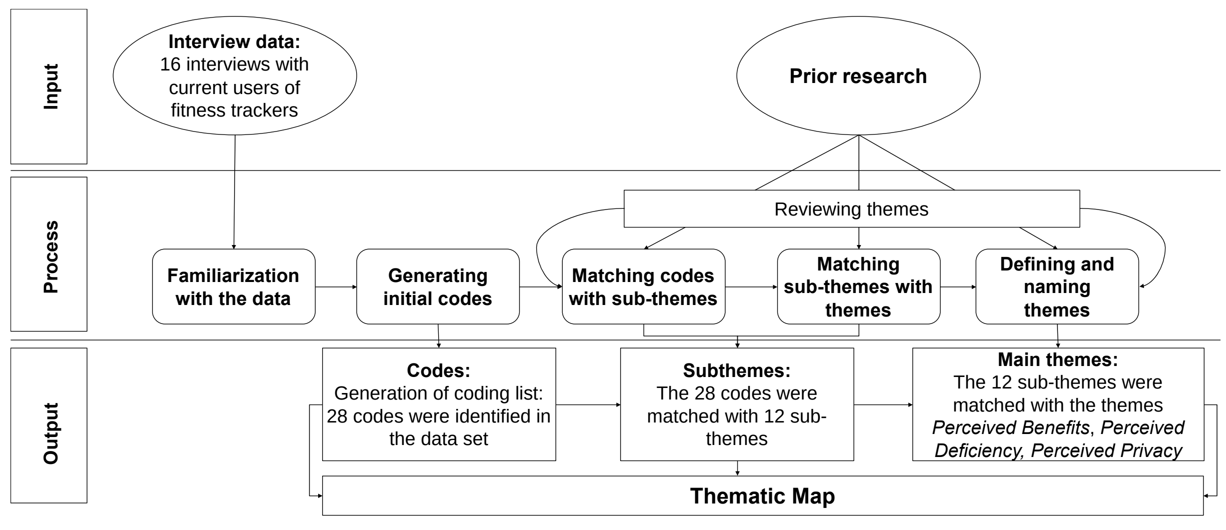

Figure 1 – Iterative Thematic Analysis Approach

Results

Our thematic map builds the basis for the reporting of the results. It is composed of the three themes *perceived benefit*, *perceived privacy*, *perceived deficiency* and their related 11 subthemes (Figure 2). The description of all codes can be obtained from Appendix A1.

Perceived Benefit

Perceived benefit encompasses what users appreciated about their trackers and is labeled in accordance with the study of Yang et al. (2016). We derived *perceived benefit* from user statements related to UTAUT 2 and HITAM and divided it into the subthemes *performance expectancy*, *effort expectancy*, *data as asset*, *social image* and *hedonic motivation*. We will describe each of the subthemes in the following:

Effort expectancy: This subtheme describes the degree to which a participant perceived the use of his tracker as effortless. With one exception, all of the surveyed perceived their fitness trackers as easy to use. When asked for their reasons, one participant stressed the intuitive handling: *"The menu is designed intuitively. I understood all the essential functions on the first day." [P5]* A 41-year-old woman found her tracker easy to use for the automated recognition of activities: *"Regardless of whether I am out walking, jogging or cycling – the tracker automatically recognizes, what I do." [P2]*

Performance expectancy: The subtheme *performance expectancy* describes the extent to which users experienced the interaction with their trackers as functionally beneficial. Following Rooksby et al. (2014), *performance expectancy* captures the different, but partially overlapping motives for tracker use including *directive tracking*, *collecting rewards*, *documentary tracking*, and *diagnostic tracking.* Concerning *directive tracking*, users felt the tracker motivated them to beat their own performance. Other users, such as a 62-year-old woman, derived their motivation from *collecting rewards*: *"When I have achieved all of my daily fitness goals, they light up in green. Additionally, they only praise me: 'Congratulations, you surpassed your fitness goal by 5,000 steps' or 'It's not far anymore, you are close to finishing.' That makes me happy because it confirms my success. It's just like in school when the teacher gives you credit. That's how I have lost 30 pounds since March."* [P4] *Documentary tracking* occurred for users who considered compiled PHI as an end in itself. Two users, who had been diagnosed as obese and thus monitored their weight and calories burned, applied *diagnostic tracking*. In our study, we additionally found support for *social tracking* as a motive for continuous tracker use. Rather than releasing their fitness activities in a social network, many users viewed the "challenge a friend" function of their trackers as motivating for social relatedness: *"I achieve my fitness goals playfully. I regularly use the challenge function of the tracker. For instance, I can invite friends to a challenge called 'Who takes more steps?' If a friend of mine walks 2,000 steps more than me, I am really annoyed and I try to outperform him the next day." [P14]*

Data as asset: This subtheme reflects that many users perceived PHI disclosure as beneficial to them. A 36-year-old man, who used his fitness tracker to fight obesity, perceived his PHI as a means to externally demonstrating his healthy lifestyle to improve patient-doctor relationships. He described the reaction of his physician, when he first showed him his fitness tracker as follows: *"I once came to my doctor's office with my fitness tracker. My doctor asked me for my blood pressure. I then showed him the respective measurements on my tracker. He had a glance at it and complimented me for being so up-to-date." [P7]* Moreover, users valued PHI disclosure as a chance to obtain more accurate recommendations from their fitness trackers. For instance, certain fitness trackers can provide more personalized fitness recommendations if they know more about users' habits or their current fitness levels. Other users considered PHI disclosure as a source of monetary compensation. There is a variety of firms for which PHI is of economic value and some of which let users directly participate by compensating them for voluntary PHI disclosure. For instance, some health insurance companies reward their customers with discounts or vouchers if they use fitness trackers to demonstrate their regular physical activities.

Hedonic motivation: This describes the degree to which users perceived the use of their trackers as enjoyable for their own sake. The majority of users were hedonically motivated. One participant described her impressions of the gamified features of her tracker as follows: *"The badges are really superb. When I covered my first 112 km, I received a penguin badge because that was exactly the distance that penguins cover on the search for food at the South Pole. It's really fun to collect badges since a great deal of effort went into that." [P15]*

Social image: The subtheme *social image* describes the extent to which participants used their trackers to evoke positive reactions from people whose opinions they valued. Interestingly, users did not exclusively want to please people they knew face-to-face. One participant wanted to personify the lifestyle of people she followed on a social network: *"I follow many people on Instagram who display that lifestyle for me. They write about which nutrients one has to pay attention to for a balanced diet. Such role models help me to live healthily. If I want to eat carbohydrates before going to sleep, I think of how they would react and then decide against it." [P6]*

Perceived Deficiency

Perceived deficiency accounts for experienced deficiencies of use and it is subsequently presented by means of its subthemes *limited reliability*, *perceived functional constraints*, and *limited support*.

Perceived functional constraints: Functional constraints hinder users in performing desired activities or tasks. Even uncertainty about whether a product fits users' requirements can lead to users refraining from purchases or choosing other products (Matt and Hess 2016). For fitness trackers, functional constraints appear to be an issue for users who found fault with the perceived complexity of existing functionalities or the perceived lack of other functionalities. All bar three participants voiced such complaints. Not being waterproof was the issue most often complained about: *"The company recommends against using the tracker when swimming because it is only water-repellent and not waterproof." [P9]* Another participant complained about the limited recognition of sport and fitness activities: *"When I bought it, I thought it could recognize my yoga and weight-lifting* *exercises in the fitness center. But it couldn't. That is a shame – especially as weight-lifting consists of such monotonous movements, which I would have thought were easy to detect." [P14]*

Limited support: Research has shown that adequate support is necessary to assist consumers, especially for complex products delivered through electronic channels, albeit there are different options for adequate support, ranging from fully human to technology-generated services or comprehensive technological services (Heinze and Matt 2018). This subtheme describes the degree to which users perceived a lack of technological support with problems experienced with their trackers as well as the lack of social support by others about using their trackers. The former relates to the extent to which users interrupted or limited their use due to comfort issues. One participant had sometimes stopped using the tracker because of skin problems: *"It is too close-fitting for me and the material of the wristband does not suit with my skin. Once, I had to remove it for two weeks because I had a rash on my wrist. Since then, I always use a skin cream in the morning." [P9]* For another user, the design of his tracker constituted an obstacle to comfort: *"Unfortunately, the tracker is very bulky. It does not fit below my shirt, which is why I don't wear it during business appointments at work." [P1]*

Some users complained about the limited customer support they obtained when setting up their trackers. One 33-year-old participant stated: *"In the beginning, I had to find out online how to use the tracker because I really thought it was broken. They had not sent operating instructions. I had to download them on the internet. To download the instructions, I had to have the app installed and an account – but that was exactly what I was having difficulty with in the first place." [P15]*

Limited reliability: This subtheme describes the extent to which users experienced inaccurate data measurements or functional disorders. One 31-year-old man, experienced measurement inaccuracies on his tracker: *"Once, I received a notification that I had reached my 10,000 steps, while I was driving my car – when I certainly wasn't walking." [P16]* Another user reported that data measurements varied with increased performances: *"A few months ago, when I walked up the stairs at home, the tracker displayed that I had gone up six floors. Now it is easier for me to walk up the stairs, my tracker only displays four floors." [P4]*

Perceived Privacy

Aside from the aforementioned general deficiencies associated with UTAUT 2 and HITAM, users' *perceived privacy* constituted a particular factor for the continuous use of fitness trackers. The corresponding theme *perceived privacy* was related to the privacy model HIPC and is examined below, looking at its subthemes *perceived relativity*, *perceived severity* and *perceived control*.

Perceived relativity: This subtheme refers to the observation that users compared their disclosure of PHI to their disclosure behavior in another context and decided to reveal personal information based on the perceived comparative sensitivity of PHI. For instance, when we asked, whether he felt uncomfortable disclosing PHI, one man answered: *"No, I even post my weekly statistics publicly on a fitness website. When I use my Payback Card, Payback knows which products I buy and where I buy them. I find this far more alarming than whether someone knows my fitness data." [P7]* Another participant replied to the same question as follows: *"Actually I don't. I have entered my weight and my height. If I was a short, heavy man – of course the company could imagine how I look. Needless to say, you reveal certain information, but I have a thick skin by now: For Facebook, Google or Whatsapp, I am even more transparent for certain aspects." [P11]*

Perceived severity: This relates to the extent to which users made their information disclosure dependent on its subjective sensitivity or the perceived identity of the data recipient. Many users were reluctant to make their PHI accessible to third parties, but open-minded to its use by employees to improve the tracker: *"I would mind if my data was saved on my health card and physicians and hospitals had access to it. But I don't mind if their software developers use it to improve trackers in future. I would even appreciate that." [P15]* Other users were indifferent towards disclosing their PHI to friends, but reluctant to make it accessible to providers: *"A friend sees when I ate my salad: Who cares? My insurance company figures out my weight: Different story." [P1]*

Perceived control: The subtheme perceived control describes the extent to which users believed they could exercise control over their disclosed PHI. Most users perceived they had limited control over their personal information: For two participants, this was due to a perceived lack of transparency in their interaction with an insurance company. One of them stated: *"If my health insurance offered me a customized fitness program or a better insurance premium, then of course they could access my data. Currently, I do not disclose my data in this respect, because I received contradictory information on how it affects my insurance premium. But, in principle, I am open-minded in this regard." [P7]* One participant felt she had limited control over her PHI when asked to give her consent for the use of her PHI for commercial purposes.

Discussion

Motivated by the increasing popularity of CHWs, while at the same time still lacking knowledge about them, we investigated whether users "accept [the] constant monitoring [of PHI] through sensors because they are persuaded that the benefits outweigh the costs" (Newell and Marabelli 2015, p. 11). Our project sought to provide a comprehensive understanding of the positive and negative factors that govern the continuous use of CHWs. Underlying our approach were UTAUT 2 and HITAM, as well as the HIPC model. We evaluated our 16 semi-structured interviews with a rigorous iterative thematic analysis to empirically understand users' mindsets. Based on this iterative approach that constantly matched our interview codes, subthemes and themes on literature, we used a thematic map to visualize, share and discuss the findings deriving from our qualitative data analysis. The thematic map is built on the three main determinants *perceived benefit*, *perceived deficiency* and *perceived privacy*, including 11 underlying subthemes. By inclusion of the theme *perceived deficiency* in our thematic map, we clarified that perceived costs with fitness trackers are not limited to privacy concerns. Obstacles to their use are also evident in a lack of technical customer support, lack of comfort or in functional constraints, such as the lack of waterproofness. Related factors such as system and service quality have been identified as important antecedents of trust in other contexts (Mou and Cohen 2015). Moreover, our thematic map proposes *perceived relativity* as a new theoretical construct and uncovers five motivational types of tracker use.

Perceived relativity refers to the observation that users compared their attitude towards the disclosure of PHI to their disclosure behavior in other contexts. Many users decided to reveal personal information based on the comparative sensitivity of the health-related information. This means they would not hesitate to publish PHI when they perceived the disclosed PHI as equally or less sensitive to the information they provided to other companies in other contexts. This needs to be addressed in future studies. Our results confirmed the four tracking types (*directive tracking*, *documentary tracking*, *diagnostic tracking*, *collecting rewards*), which Rooksby et al. (2014) had detected in their study. Additionally, we found support for a *social tracking* style. We consider the classification of Rooksby et al. (2014) enriched by *social tracking* as an additional tracking motive as very useful, since it allows for a customization along different usage motives. Labeled differently, many of these tracking motives also occurred in the study of Gimpel et al. (2013), who interviewed 150 members of the quantified self-community to detect their tracking behaviors. Their unveiled tracking motives - self-discipline, self-entertainment and self-healing - are very similar to what Rooksby et al. (2014) and our study referred to with the tracking motives *directive tracking*, *collecting rewards* and *diagnostic tracking* respectively. Their motive self-association resembles what we refer to as *social tracking*. In addition, Gimpel et al. (2013) found support for a self-design motive, which describes that users were motivated by self-optimization and is presumably attributable to the fact that their sample consisted of members from the quantified self-community.

Despite the fact that many users perceived the PHI collection of their fitness trackers as a threat to their privacy, some users also voiced sympathy for PHI disclosure. This contrasts with the majority of privacy research on mobile health technologies where privacy is often exclusively treated as a user-side threat (Miltgen et al. 2013). Our participants value PHI disclosure as an ability to monitor fitness activities or as a source of potential monetary compensation by insurance companies. We accounted for those experienced virtues of PHI collection with the subtheme *data as asset* in our thematic map. Privacy concerns for users in our study were mostly context-related. Users were far more positive towards PHI disclosure for the purpose of product improvement than for transferring PHI to third parties. In accordance with Dinev et al. (2013), we accounted for this observation with the subtheme *perceived severity.* These issues also connected with the previous literature which emphasizes the importance of the completeness of healthcare data for different health institutions (Liu et al. 2017), while, in our case, the increasing extent of the data collection can pose additional risks for users.

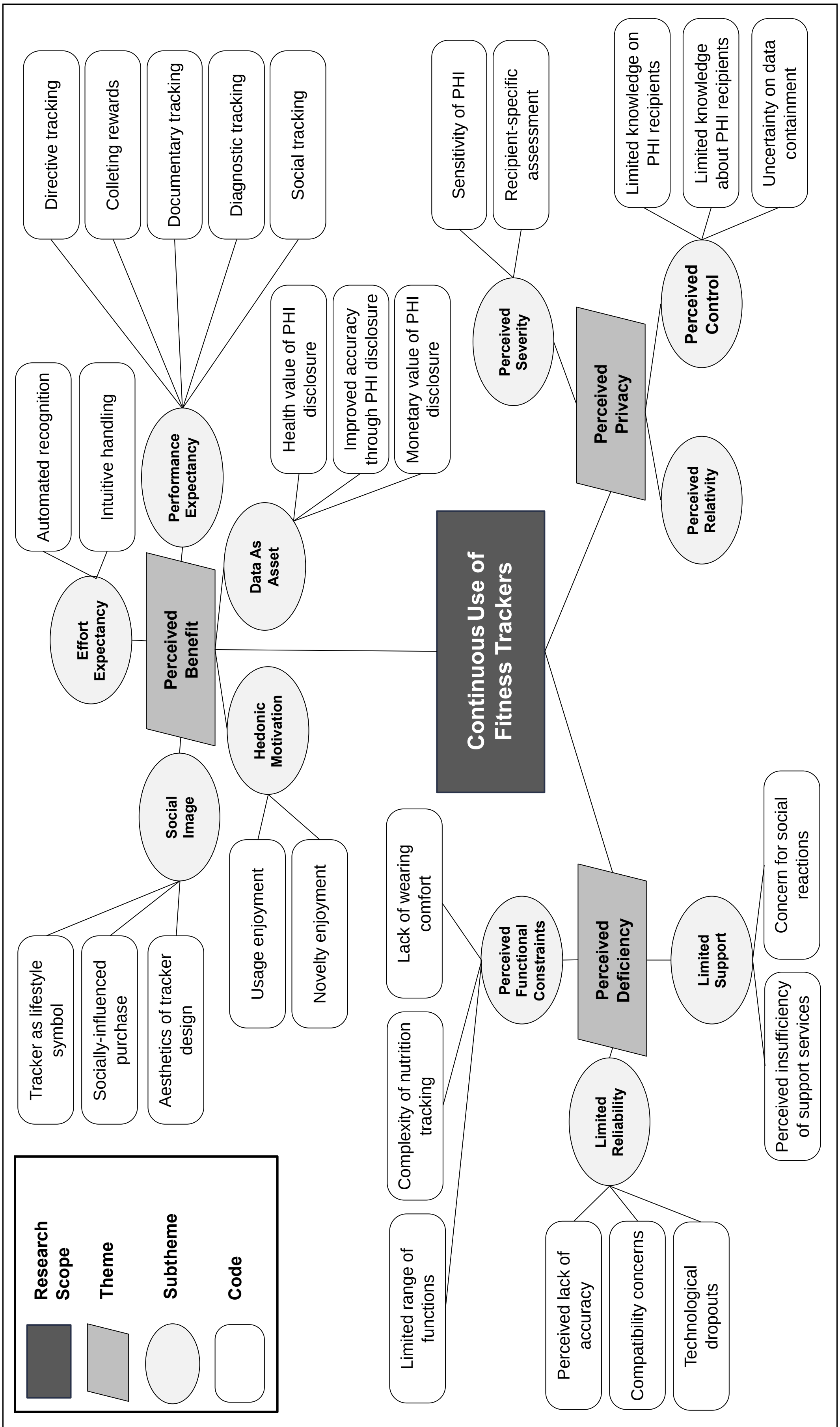

Figure 2 – Thematic Map of Findings

Implications and Limitations

Theoretical Implications

Along with the ongoing digitization of various parts of our corporate and private lives, there are emergent research challenges and opportunities that need to be addressed, and information systems research can play a vital role in shaping the developments already at an early stage (Legner et al. 2017). CHWs are one concrete instance of the "digital self" and they provide new opportunities and control for individuals, but knowledge is still scarce on how individuals encounter the new possibilities that are provided by digital technologies in this particular field. We address the call for more research on the characteristics and classification of CHWs by Alrige and Chatterjee (2015) and develop a comprehensive thematic map of fitness trackers that provides researchers with a comprehensive visualized structure of the determinants that govern users' continuous use of fitness tracker. We therefore extend the previous literature on the usage of CHWs (which has previously focused on individual positive or negative factors) by uncovering the subthemes surrounding the three main themes *perceived benefit*, *perceived deficiency*, and *perceived privacy*. The developed themes and subthemes could support theory-building efforts to uncover the meaningful interplay between fitness trackers and perceived pros and cons in users' minds. This multifaceted picture of users' mental trade-off decision combines the two research streams of which the first investigated motives and the second investigated costs of continuous tracker use. We therefore directly connect to previous research which pointed towards the potential positive and negative aspects of CHW use and which sought to establish a counter-pole perspective (Piwek et al. 2016). At the same time, we also extend the previous literature on continuous use by offering a comprehensive overview of the factors affecting individuals in a specific technology field of growing interest. Future research could use our thematic map, contrast it with thematic maps for other technology fields and use this comparison to obtain further evidence on how technology characteristics and affordances translate into human perceptions and needs.

Privacy and security issues have already been demonstrated to be a major thread for other institutional healthcare contexts (Masrom and Rahimly 2015). We showed that individuals' privacy concerns are also a major hurdle that could prevent continuous use and which therefore need to be considered for CHWs. Our results might serve as a groundwork for a theory of perceived privacy in the context of PHI. For this purpose, we also recommend the further exploration of *perceived relativity* which proposes that users do not merely evaluate PHI disclosure as a decision that is only subject to the current usage scenario, but rather as a decision that compares the benefits and risks of data disclosure in the current case with previously conducted data disclosure agreements on other services.

Practical Implications

The substantial diffusion of CHWs in Asia Pacific and around the globe has shed more light on the potential of CHWs to not only transform individual lives, but also entire industry sectors, into which CHWs can be integrated in both products and services as a source for measuring, analyzing, and sharing personal health information. Owing to the large practical potential, adequate design of CHWs is essential to support this diffusion and exploit its utility for users and suppliers. However, design of consumer information systems has particularities that need to be accounted for (Tuunanen et al. 2010). Both for the development of new CHWs as well as the improvement of existing devices, our thematic map can serve as a comprehensive guideline for developers, based on which they can better review whether their current or newly developed devices cover all of the aspects that are important to consumers. It also highlights potential difficulties for providers as they seek to enter new markets or healthcare systems. They can also segment their product portfolio based on the subthemes and codes that we suggest, based on whether devices score higher or lower for some of them, or whether they have individual strengths that can be associated with the codes. It also serves as a test for ensuring their marketing efforts address those characteristics that appear to matter most to consumers in the sensitive environment in which CHWs operate. Lastly, these pillars of our thematic map are also important for governmental institutions and other health related institutions, who seek to integrate CHWs into existing health ecosystems and make them a fundamental element of the digital transformation in healthcare. For instance, first private health insurance companies in Asia have offered their customers discounts if they use CHWs and share the data with the company. For them, such programs can only be successful if there is no user resistance. By considering our thematic map, they can identify critical fields of action and adapt their communication with customers accordingly.

Our newly developed tracking motive *social tracking* confirms that users are socially motivated by their fitness trackers. Following role models, such as the online health community *Patientslikeme,* activity trackers could detect users' average pulse and compare it to mean values of a user group with roughly the same age, height and weight and suggest the user adjust their pace accordingly (Frost and Massagli 2008). Despite the criticized *limited reliability*, users still regarded trackers as useful for the attainment of self-set fitness goals. Users might have felt compensated for potential measurement errors by an increased motivation or other performance enhancements. This is also relevant for other health communities in Pacific-Asia and around the globe, which could link existing social media functions with other health-related social tracking functions to increase user engagement and retention.

The identification of specific privacy characteristics that consumers perceive as relevant might be of high interest to suppliers, since sensitive consumer data usually has fairly high economic value (Acquisti et al. 2013; Bründl et al. 2016). Our thematic map can help identify the key privacy aspects and, in this way, help develop privacy-friendly and successful devices. Our findings reveal that users do not want their PHI to be used for other purposes than the ones agreed upon between them and the provider. Individuals made their data retention dependent on both the presumed recipients and the perceived sensitivity of PHI. Our thematic map shows that *perceived control* is a substantial factor in users' mindsets. Furthermore, some of our participants demanded that providers protect their PHI irrespectively of costs. This signals that providers need to gain trustworthiness by addressing those privacy concerns through a transparent information policy. Trust is also critical in other online transactions and can substantially impact the diffusion of technologies and the willingness to pay for them (Clemons et al. 2016). Given the sensitivity of PHI, this issue is likely to be of higher relevance than in many other online contacts and should thus be addressed carefully by providers. Consequently, to increase customer satisfaction and market reach, providers need to reveal the identity of third parties accessing the data, the purpose of the data usage and the objectives for which the data is used (Ernst and Ernst 2016). In the course of the General Data Protection Regulation (GDPR), this topic has also received new dynamics through regulation and Asian CHW manufacturers must also take these into account, insofar as their products are offered in the EU.

We also recommend that providers continuously map their expectations on important determinants for continuous usage with those perceived by users to avoid any disappointments. This can help them identify critical shortcomings of the product or also align communication strategies to attenuate those aspects that might be perceived as critical by users but are less critical from a factual point of view.

Limitations

The study has certain limitations, some of which present avenues for future research.

Firstly, the interviews were conducted at a single point in time, thus missing the chance to observe changes to continuous use behavior over time. This is problematic as research has found users to frequently stop using their fitness trackers in the long term (Shih et al. 2015). Future studies should therefore conduct longitudinal investigations into how fitness tracker use changes over time. Secondly, research has shown that that the acceptance of new technologies significantly differs for actual and potential users (Rossiter and Braithwaite 2013). We only interviewed actual users of fitness trackers to identify the determinants of continuous use, but we did not ask potential users about their motives to continuously use fitness trackers after the initial adoption. For the actual users interviewed by us, perceived benefits appear to have outweighed privacy risks and experienced deficiencies – otherwise they would not have decided in favor of using their trackers (Tam et al. 2015). On the other hand, potential users might be deterred from using fitness trackers due to perceived risks, with these effects being so strong that such users do not even consider the potential advantages of fitness trackers – thus leading to a very different thematic map. That is why future studies should analyze potential benefit, deficiency and privacy concerns for the initial adoption and compare those to those of current users to gain more insights whether perceptions might shift in different usage phases. In line with this thought, future research should also place a stronger focus on how users' information processing is conducted (e.g. rather conscious our automatic) in the context of fitness trackers, as has already been done for other contexts (Cheung et al. 2015). Thirdly, the relatively young age of the participants might limit the explanatory power of the age-specific findings on user experiences and privacy concerns. On the other hand, fitness trackers still see stronger diffusion among younger audiences. However, future studies can recruit participants with a broader range of ages to increase the generalizability of the results. Lastly, we cannot fully exclude that observer and social desirability effects might have led to biased statements. For instance, users might have considered their fitness trackers as lifestyle symbols but neglected to say so for reasons of social desirability.

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References

Acquisti, A., John, L. K., and Loewenstein, G. 2013. "What Is Privacy Worth?," *The Journal of Legal Studies* (42:2), pp. 249-274.

Alrige, M., and Chatterjee, S. 2015. "Toward a Taxonomy of Wearable Technologies in Healthcare," *International Conference on Design Science Research in Information Systems*, Dublin, Ireland: Springer, pp. 496-504.

Anderson, K., Burford, O., and Emmerton, L. 2016. "Mobile Health Apps to Facilitate Self-Care: A Qualitative Study of User Experiences," *PLOS One* (11:5), pp. 1-21.

Babar, A., Bunker, D., and Gill, A. Q. 2018. "Investigating the Relationship between Business Analysts' Competency and IS Requirements Elicitation: A Thematic-Analysis Approach," *Communications of the Association for Information Systems* (42:1), pp. 334-362.

Baig, M. M., Gholamhosseini, H., and Connolly, M. J. 2013. "A Comprehensive Survey of Wearable and Wireless ECG Monitoring Systems for Older Adults," *Medical & Biological Engineering & Computing* (51:5), pp. 485-495.

Becker, M., Kolbeck, A., Matt, C., and Hess, T. 2017a. "Understanding the Continuous Use of Fitness Trackers: A Thematic Analysis," *Proceedings of the 21th Pacific Asia Conference on Information Systems (PACIS)*, Langkawi, Malaysia, pp. 1-12.

Becker, M., Matt, C., Widjaja, T., and Hess, T. 2017b. "Understanding Privacy Risk Perceptions of Consumer Health Wearables–an Empirical Taxonomy," *Proceedings of the 38th International Conference on Information Systems (ICIS)*, Seoul, South Korea.

Benbunan-Fich, R. 2017. "Usability of Wearables without Affordances," *Proceedings of the 23rd Americas Conference on Information Systems (AMCIS)*, Boston, USA.

Berghaus, S., and Back, A. 2015. "Requirements Elicitation and Utilization Scenarios for in-Car Use of Wearable Devices," *Proceedings of the 48th Hawaii International Conference on System Sciences (HICSS)*, Hawaii, USA, pp. 1028-1037.

Bloomberg. 2018. "Wearable Tech Seen Offsetting Smartphone Slump in Asia Growth." Retrieved Oct. 23, 2018 from https://www.bloomberg.com/news/articles/2018-05-13/next-era-tech-products-to-drive-reboot-of-asia-s-growth-engine

Braun, V., and Clarke, V. v. 2006. "Using Thematic Analysis in Psychology," *Qualitative Research in Psychology* (3:2), pp. 77-101.

Bründl, S., Matt, C., and Hess, T. 2016. "Daten Als Geschäft - Rollen Und Wertschöpfungsstrukturen Im Deutschen Markt Für Persönliche Daten," *Wirtschaftsinformatik & Management* (8:6), pp. 66-71.

Buchwald, A., Letner, A., Urbach, N., and Entress-Fuersteneck, M. v. 2015. "Towards Explaining the Use of Self-Tracking Devices: Conceptual Development of a Continuance and Discontinuance Model " *Proceedings of the 36th International Conference on Information Systems (ICIS)*, Fort Worth, USA, pp. 1-11.

Canhoto, A. I., and Arp, S. 2017. "Exploring the Factors That Support Adoption and Sustained Use of Health and Fitness Wearables," *Journal of Marketing Management* (33:1-2), pp. 32-60.

Case, M. A., Burwick, H. A., Volpp, K. G., and Patel, M. S. 2015. "Accuracy of Smartphone Applications and Wearable Devices for Tracking Physical Activity Data," *Jama* (313:6), pp. 625-626.

Chen, C.-C., and Shih, H.-S. 2014. "A Study of the Acceptance of Wearable

Technology for Consumers - an Analytical Network Perspective," *International Journal of the Analytic Hierarchy Process* (1:1), pp. 1-5.

Chen, Y., Cheung, C. M., and Tan, C.-W. 2018. "Omnichannel Business Research: Opportunities and Challenges," *Decision Support Systems* (109), pp. 1-4.

Cheng, J. W., and Mitomo, H. J. T. 2017. "The Underlying Factors of the Perceived Usefulness of Using Smart Wearable Devices for Disaster Applications," *Telematics and Informatics* (34:2), pp. 528-539.

Cheung, C. M., Zheng, X., and Lee, M. K. 2015. "How the Conscious and Automatic Information Processing Modes Influence Consumers' Continuance Decision in an E-Commerce Website," *Pacific Asia Journal of the Association for Information Systems* (7:2).

Clemons, E. K., Wilson, J., Matt, C., Hess, T., Ren, F., Jin, F., and Koh, N. S. 2016. "Global Differences in Online Shopping Behavior: Understanding Factors Leading to Trust," *Journal of Management Information Systems* (33:4), pp. 1117-1148.

Coorevits, L., and Coenen, T. 2016. "The Rise and Fall of Wearable Fitness Trackers," in: *77th Annual Meeting of the Academy of Management*. California, USA: pp. 1-24.

Crawford, P., Brown, B., and Majomi, P. 2008. "Education as an Exit Strategy for Community Mental Health Nurses: A Thematic Analysis of Narratives," *Mental Health Review Journal* (13:3), pp. 8-15.

Dinev, T., Xu, H., Smith, J. H., and Hart, P. 2013. "Information Privacy and Correlates: An Empirical Attempt to Bridge and Distinguish Privacy-Related Concepts," *European Journal of Information Systems* (22:1), pp. 295–316.

Ernst, C.-P. H., and Ernst, A. W. 2016. "The Influence of Privacy Risk on Smartwatch Usage," *Proceedings of the 22nd Americas Conference on Information Systems (AMCIS)*, San Diego, USA, pp. 1-10.

Fang, Y.-M., and Chang, C.-C. 2016. "Users' Psychological Perception and Perceived Readability of Wearable Devices for Elderly People," *Journal of Behaviour & Information Technology* (35:3), pp. 225-232.

Frost, J. H., and Massagli, M. P. 2008. "Social Uses of Personal Health Information within Patientslikeme, an Online Patient Community: What Can Happen When Patients Have Access to One Another's Data," *Journal of Medical Internet Research* (10:3), pp. 1-9.

Gimpel, H., Nißen, M., and Görlitz, R. A. 2013. "Quantifying the Quantified Self: A Study on the Motivation of Partients to Track Their Own Health," *Proceedings of the 34th International Conference on Information Systems (ICIS)*, Milan, Italy.

Heinze, J., and Matt, C. 2018. "Reducing the Service Deficit in M-Commerce: How Service-Technology Fit Can Support Digital Sales of Complex Products," *International Journal of Electronic Commerce* (22:3), pp. 386-418.

Holden, R. J., and Karsh, B.-T. 2010. "The Technology Acceptance Model: Its Past and Its Future in Health Care," *Journal of Biomedical Informatics* (43:1), pp. 159-172.

Hong, J.-C., Lin, P.-H., and Hsieh, P.-C. 2017. "The Effect of Consumer Innovativeness on Perceived Value and Continuance Intention to Use Smartwatch," *Computers in Human Behavior* (67:February 2017), pp. 264-272.

Hong, W., and Thong, J. Y. L. 2013. "Internet Privacy Concerns - an Integrated Conceptualization and Four Empirical Studies," *MIS Quarterly* (37:1), pp. 275-298.

IDC. 2017. "Wearables for Reward-Based Health Protection: Manulife Hong

Kong Reference." Retrieved Oct. 27, 2018 from https://www.idc.com/getdoc.jsp?containerId=AP43274417

Ilhan, A., and Henkel, M. 2018. "10,000 Steps a Day for Health? User-Based Evaluation of Wearable Activity Trackers," *Proceedings of the 51st Hawaii International Conference on System Sciences*, Big Island, HI.

Jeong, S. C., Kim, S.-H., Park, J. Y., and Choi, B. 2017. "Domain-Specific Innovativeness and New Product Adoption: A Case of Wearable Devices," *Telematics and Informatics* (34:5), pp. 399-412.

Jiang, L., Jiang, D., and Grover, V. 2017. "The Sphere of Influence of Information Systems Journals: A Longitudinal Study," *Communications of the Association for Information Systems* (41), pp. 150-178.

Jorgensen, R. 2006. "A Phenomenological Study of Fatigue in Patients with Primary Biliary Cirrhosis," *Journal of Advanced Nursing* (55:6), pp. 689-697.

Kari, T., Koivunen, S., Frank, L., Makkonen, M., and Moilanen, P. 2016. "Critical Experiences During the Implementation of a Self-Tracking Technology," *Proceedings of the 20th Pacific Asia Conference on Information Systems (PACIS)*, Chiayi, Taiwan.

Kenny, G., and Connolly, R. 2016. "Drivers of Health Information Privacy Concern: A Comparison Study " *Proceedings of the 22nd Americas Conference on Information Systems (AMCIS)*, California, USA, pp. 1 - 10.

Kijsanayotin, B., Pannarunothai, S., and Speedie, S. M. 2009. "Factors Influencing Health Information Technology Adoption in Thailand's Community Health Centers: Applying the UTAUT Model," *International Journal of Medical Informatics* (78:1), pp. 404-416.

Kim, J., and Park, H.-A. 2012. "Development of a Health Information Technology Acceptance Model Using Consumers' Health Behavior Intention," *Journal of Medical Internet Research* (14:5), pp. 1-14.

Kosmalla, F., Wiehr, F., Daiber, F., Krüger, A., and Löchtefeld, M. 2016. "Climbaware: Investigating Perception and Acceptance of Wearables in Rock Climbing," *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, San Jose, CA, USA: ACM, pp. 1097-1108.

Legner, C., Eymann, T., Hess, T., Matt, C., Böhmann, T., Drews, P., Mädche, A., Urbach, N., and Ahlemann, F. 2017. "Digitalization: Opportunity and Challenge for the Business and Information Systems Engineering Community," *Business & Information Systems Engineering* (59:4), pp. 301-308.

Li, T., and Slee, T. 2014. "The Effects of Information Privacy Concerns on Digitizing Personal Health Records," *Journal Of The Association For Information Science and Technology* (65:8), pp. 1541–1554.

Limayem, M., Hirt, S. G., and Cheung, C. M. 2007. "How Habit Limits the Predictive Power of Intention: The Case of Information Systems Continuance," *MIS Quarterly* (31:4), pp. 705-737.

Lincoln, Y. S., and Guba, E. G. 1985. *Naturalistic Inquiry*. Newbury Park: Sage.

Liu, C., Talaei-Khoei, A., Zowghi, D., and Daniel, J. 2017. "Data Completeness in Healthcare: A Literature Survey," *Pacific Asia Journal of the Association for Information Systems* (9:2), pp. 75-100.

Lunney, A., Cunningham, N. R., and Eastin, M. S. 2016. "Wearable Fitness Technology: A Structural Investigation into Acceptance and Perceived Fitness Outcomes," *Computers in Human Behavior* (65), pp. 114-120.

Lupton, D. 2014. "Self-Tracking Cultures: Towards a Sociology of Personal Informatics," *Proceedings of the 26th Australian Computer-Human Interaction Conference (OZCHI)*, Sydney, Australia, pp. 1-10.

Masrom, M., and Rahimly, A. 2015. "Overview of Data Security Issues in Hospital Information Systems," *Pacific Asia Journal of the Association for Information Systems* (7:4).

Matt, C., and Hess, T. 2016. "Product Fit Uncertainty and Its Effects on Vendor Choice: An Experimental Study," *Electronic Markets* (26:1), pp. 83-93.

McAfee, A., and Brynjolfsson, E. 2012. "Big Data. The Management Revolution," *Harvard Business Review* (90:10), pp. 61-67.

Medgadget. 2018. "The Asia Pacific Wearable Medical Devices Market to Hold a Success with Cagr of 15.94% Till 2023 " Retrieved 25 Oct, 2018 from https://www.medgadget.com/2018/05/the-asia-pacific-wearable-medical-devices-market-to-hold-a-success-with-cagr-of-15-94-till-2023-by-application-fitness-blood-pressure-monitoring-heart-rate-monitoring-weight-monitoring-etc.html

Meng, Y., Choi, H.-K., and Kim, H.-C. 2011. "Exploring the User Requirements for Wearable Healthcare Systems," *Proceedings of the 13th IEEE International Conference on e-Health Networking Applications and Services (Healthcom)*, Columbia MO, USA: IEEE, pp. 74-77.

Mercer, K., Giangregorio, L., Schneider, E., Chilana, P., Li, M., and Grindrod, K. 2016. "Acceptance of Commercially Available Wearable Activity Trackers among Adults Aged over 50 and with Chronic Illness: A Mixed-Methods Evaluation," *Journal of Medical Internet Research* (4:1), pp. 1-17.

Mettler, T., and Wulf, J. forthcoming. "Physiolytics at the Workplace: Affordances and Constraints of Wearables Use from an Employee's Perspective," *Information Systems Journal*).

Miles, M. B., Huberman, A. M., Huberman, M. A., and Huberman, M. 1994. *Qualitative Data Analysis: An Expanded Sourcebook*. Thousand Oaks: Sage.

Miltgen, C. L., Popovič, A., and Oliveira, T. 2013. "Determinants of End-User Acceptance of Biometrics: Integrating the 'Big 3' of Technology Acceptance with Privacy Context," *Decision Support Systems* (56:1), pp. 103-114.

Motti, V. G., and Caine, K. 2015. "Users' Privacy Concerns About Wearables: Impact of Form Factor, Sensors and Type of Data Collected," *Workshop on Wearable Security and Privacy*, Isla Verde, Puerto Rico, pp. 1-15.

Mou, J., and Cohen, J. 2015. "Antecedents of Trust in Electronic-Service Providers: Results from a Meta-Analysis," *Pacific Asia Journal of the Association for Information Systems* (7:1), pp. 1-30.

Nelson, E. C., Verhagen, T., and Noordzij, M. L. 2016. "Health Empowerment through Activity Trackers: An Empirical Smart Wristband Study," *Computers in Human Behavior* (62:1), pp. 364-374.

Newell, S., and Marabelli, M. 2015. "Strategic Opportunities (and Challenges) of Algorithmic Decision-Making: A Call for Action on the Long-Term Societal Effects of 'Datification'," *The Journal of Strategic Information Systems* (24:1), pp. 3-14.

Novak, J. D., and Cañas, A. J. 2006. "The Theory Underlying Concept Maps and How to Construct Them," Florida Institute for Human and Machine Cognition, Florida, pp. 1-31.

Park, S., and Jayaraman, S. 2003. "Enhancing the Quality of Life through Wearable Technology," *IEEE Engineering in Medicine and Biology Magazine* (22:3), pp. 41-48.

Paschou, M., Sakkopoulos, E., Sourla, E., and Tsakalidis, A. 2013. "Health Internet of Things: Metrics and Methods for Efficient Data Transfer," *Simulation Modelling Practice and Theory* (34), pp. 186-199.

Patton, M. Q. 2002. *Qualitative Research and Evaluation Methods*. Thousand Oaks, CA: Sage Publications.

Pfeiffer, J., Entress-Fürsteneck, M. v., Urbach, N., and Buchwald, A. 2016. "Quantify-Me: Consumer Acceptance of Wearable Self-Tracking Devices," *Proceedings of the 24th European Conference on Information Systems (ECIS)*, Istanbul, Turkey, pp. 1-15.

Piwek, L., Ellis, D. A., Andrews, S., and Joinson, A. 2016. "The Rise of Consumer Health Wearables: Promises and Barriers," *PLoS Med* (13:2), p. e1001953.

Prasopoulou, E. 2017. "A Half-Moon on My Skin: A Memoir on Life with an Activity Tracker," *European Journal of Information Systems* (26:3), pp. 287-297.

PwC Health Research Institute. 2014. "Health Wearables: Early Days." Retrieved 04.09.2016 from https://www.pwc.com/us/en/health-industries/top-health-industry-issues/assets/pwc-hri-wearable-devices.pdf

Rooksby, J., Rost, M., Morrison, A., and Chalmers, M. 2014. "Personal Tracking as Lived Informatics," *Proceedings of the 32nd ACM Conference On Human Factors In Computing Systems (CHI)*, Toronto, Canada, pp. 1163–1172.

Rossiter, J. R., and Braithwaite, B. 2013. "C-OAR-SE-Based Single-Item Measures for the Two-Stage Technology Acceptance Model," *Australasian Marketing Journal* (21:1), pp. 30-35.

Sandulescu, V., Andrews, S., Ellis, D., Bellotto, N., and Mozos, O. M. 2015. "Stress Detection Using Wearable Physiological Sensors," in *Artificial Computation in Biology and Medicine. Vol. 9107 of Lecture Notes in Computer Science,* J.M.F. Vicente, J.R.Á. Sánchez, L. Paz, F.J. Toledo-Moreo and H. Adeli (eds.), Elche, Spain: Springer International Publishing, pp. 526-532.

Shih, P. C., Han, K., Poole, E. S., Rosson, M. B., and Carroll, J. M. 2015. "Use and Adoption Challenges of Wearable Activity Trackers," *Proceedings of the iConference*, Newport Beach, CA, USA, pp. 1-12.

Sjöklint, M., Constantiou, I., and Trier, M. 2015. "The Complexities of Self-Tracking - an Inquiry into User Reactions and Goal Attainment," *Proceedings of the 23rd European Conference on Information Systems (ECIS)*, Münster, Germany.

Slade, E. L., Williams, M., and Dwivedi, Y. 2013. "An Extension of the UTAUT 2 in a Healthcare Context," *Proceedings of the UK Academy for Information Systems (UKAIS)*, UK, pp. 1-12.

Soar, J., Tsai, H.-S., Yong, J., and Gururajan, R. 2005. "Mobile Solutions for Aged Care: A Transformational Framework," *Proceedings of the 2nd Australian Aged and Community Care Informatics Conference (ACCIC)*, Hobart, Australia: Health Informatics Society of Australia Ltd.

Tam, J., Choi, B. C., and Jiang, Z. 2015. "The Effect of Online Privacy Information on Privacy Evaluations in Using Mobile Fitness Applications," *Proceedings of the 19th Pacific Asia Conference on Information Systems (PACIS)*, Singapore, pp. 1-12.

Tuunanen, T., Myers, M. D., and Cassab, H. 2010. "A Conceptual Framework for Consumer Information Systems Development," *Pacific Asia Journal of the Association for Information Systems* (2:1), pp. 47-66.

Varshney, U. 2014. "Mobile Health: Four Emerging Themes of Research," *Decision Support Systems* (66:1), pp. 20-35.

Venkatesh, V., Thong, J. Y. L., and Xu, X. 2012. "Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology," *MIS Quarterly* (36:1), pp. 157-178.

Weiser, M., and Brown, J. S. 1997. "The Coming Age of Calm Technology," in *Beyond Calculation,* P.J. Denning and R.M. Metcalfe (eds.), New York: Springer, pp. 75-85.

Whittemore, R., Chase, S. K., and Mandle, C. L. 2001. "Validity in Qualitative Research," *Qualitative health research* (11:4), pp. 522-537.

Wieneke, A., Lehrer, C., Zeder, R., and Jung, R. 2016. "Privacy-Related Decision-Making in the Context of Wearable Use," *Proceedings of the 20th Pacific Asia Conference on Information Systems (PACIS)*, Chiayi, Taiwan.

Yang, H., Yu, J., Zo, H., and Choi, M. 2016. "User Acceptance of Wearable Devices: An Extended Perspective of Perceived Value," *Telematics and Informatics* (33:1), pp. 256–269.

Yin, R. K. 2014. *Case Study Research and Applications: Design and Methods*. Thousand Oaks: Sage.

Zheng, Y.-L., Ding, X.-R., Poon, C. C. Y., Lo, B. P. L., Zhang, H., Zhou, X.-L., Yang, G.-Z., Zhao, N., and Zhang, Y.-T. 2014. "Unobtrusive Sensing and Wearable Devices for Health Informatics," *IEEE Transactions on Biomedical Engineering* (61:5), pp. 1538-1554.

Appendix

Table A1 – Overview of Themes and Code Description			
Theme	**Subtheme**	**Code**	**Description**
Perceived Benefit	Effort Expectancy	Automated recognition	The level of effort it takes to adopt the tracker to a specific activity
		Intuitive handling	The level of difficulty in learning new functions and using the tracker for individual needs
	Performance Expectancy	Directive tracking	Performance of tracking for the purpose of achieving individually set goals
		Social tracking	Performance of tracking for the purpose of competing with friends and comparing with their fitness activities
		Documentary tracking	Performance of tracking for the purpose of documenting users' fitness activities
		Diagnostic tracking	Performance of tracking for the purpose of diagnosing changes to health conditions
		Colleting rewards	Performance related to the possibility of achieving rewards for physical activities
	Data As Asset	Health value of PHI disclosure	Personal profits gained from obtaining more PHI and the dissemination of such data to stakeholders, such as doctors
		Improved accuracy through PHI disclosure	Value of obtaining more accurate information because of PHI disclosure
		Monetary value of PHI disclosure	Direct monetary gains in exchange for disclosing PHI (e.g. receiving payment from health insurance companies)
	Hedonic Motivation	Usage enjoyment	Enjoyment that results from using fitness trackers
		Novelty enjoyment	Enjoyment that results from the novelty of the technology
	Social Image	Tracker as lifestyle symbol	Importance of fitness trackers to symbolize users' desired lifestyle
		Socially-influenced purchase	Degree of social impact on initial purchase decision
		Aesthetics of tracker design	Visual attractiveness of the fitness tracker design
Perceived Deficiency	Perceived Functional Constraints	Limited range of functions	Constraints concerning the potential usage scope
		Complexity of nutrition tracking	Shortcomings and difficulties related to nutrition tracking
		Lack of wearing comfort	Physical discomfort when wearing fitness trackers
	Limited Support	Perceived insufficiency of support services	Dissatisfaction with technology support provided by the vendors of the fitness trackers
		Concern for social reactions	Concerns regarding negative reactions from people that are important to the user
	Limited Reliability	Perceived lack of accuracy	Concerns regarding the accuracy of fitness trackers
		Compatibility concerns	Potential lack of compatibility with other user devices
		Technical dropouts	Frequency and severity of technological malfunctions
Perceived Privacy	Perceived Severity	Sensitivity of PHI	Degree of sensitivity of PHI type
		Recipient-specific assessment	Degree of trustworthiness and potential threat by recipient of PHI
	Perceived Control	Limited knowledge on PHI recipients	Insufficient information on who is receiving PHI
		Limited knowledge about PHI recipients	Insufficient information about PHI receivers, their competencies, and their motivation
		Uncertainty on data containment	Uncertainty about how PHI is stored
	Perceived Relativity	Level of PHI disclosure elsewhere	Extent and sensitivity of the information that users share on other sources

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