QUANTIFY-ME: CONSUMER ACCEPTANCE OF WEARABLE SELF-TRACKING DEVICES

Research

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Abstract

The usage of wearable self-tracking technology has recently emerged as a new big trend in lifestyle and personal optimization in terms of health, fitness and well-being. Currently, only little is known about why people plan or start using such devices. Thus, in our research project, we aim at answering the question of what drives the usage intention of wearable self-tracking technology. Therefore, based on established technology acceptance theories, we deductively develop an acceptance model for wearable self-tracking technologies which sheds light on the pre-adoption criteria of such devices. We validate our proposed model by means of structural equation modeling using empirical data collected in a survey among 206 potential users. Our study identifies perceived usefulness, perceived enjoyment, social influence, trust, personal innovativeness, and perceived support of well-being as the strongest drivers for the intention to use wearable self-tracking technologies. By accounting for the influence of the demographic factors age and gender, we provide a further refined picture.

Keywords: Self-tracking, Quantified-Self, Personal optimization, Wearables, Information systems adoption, Innovation diffusion, Technology acceptance.

1 Introduction

Self-tracking, also referred to as life-logging, the quantified-self, personal analytics, self-quantification and personal informatics, has recently emerged as a new big trend in lifestyle and personal optimization. Self-tracking is the activity by which people voluntarily and autonomously monitor and record specific features of their lives, often using digital technologies (Lupton, 2014a). More specifically, it refers to the practice of gathering data about oneself – often relating to one's bodily functions and everyday habits – on a regular basis and then analyzing the data to produce statistics and other data, such as images and diagrams (Choe et al., 2014; Sjöklint et al., 2015). Technology and devices used for this practice include smartphones, tablet computers, wireless weight scales, blood pressure monitors, and, lately, also so-called wearables. Wearables refer to smartwatches, wristbands, patches, clip-on devices and jewellery or textiles with embedded sensors which measure bodily functions or physical activity (e.g., Nike Fuel, Jawbone or FitBit) (Lupton, 2013a; Swan, 2012b). These devices can be worn 24 hours a day and collect continuously bodymetrics, such as movement, pulse, heart rate, body temperature or calories burned (Lupton, 2013b). This data can be analyzed to enhance the personal health, fitness, or well-being.

It is estimated that the distribution of wearable technology will exceed 126 million units annually by 2019 (IDC, 2015). Despite the fact that the market of quantified-self technology is extremely fast growing, it is still in its infancy. Start-ups and major players in the industry are launching more and more devices and try to capitalize on the practice. For the near future, rapid and vast improvements in terms of quality and capability of sensors built into wearable technology are expected. Market research indicates that more and more people are attracted by the practice of self-tracking, meaning that they are keen to track certain features of their lives, to know more about their bodies, or to live healthier (ABIResearch, 2013). In this early market development phase, in which new players continuously enter the market of wearable technology, it is critical for the producers to identify pre-adoption criteria for such devices in order to attract customers and gain a market advantage. While there is previous research in the field of technology adoption to identify pre-adoption criteria for technology, we posit that current models do not fully reflect the salient characteristics of these self-tracking devices. Hence, with our research, we aim at analyzing which determinants attribute to the intention to use wearable self-tracking devices, which leads to the following research question:

RQ1: What are the determinants of pre-adoption for wearable self-tracking technology?

Furthermore, in line with previous research (e.g., Venkatesh et al., 2003; Venkatesh et al., 2012), we propose that factors, such as age and gender, effect the relationship between the antecedents of pre-adoption and the intention to use wearable self-tracking devices. Thus, besides identifying pre-adoption criteria of wearable self-tracking devices, we further aim at answering the following research question:

RQ2: Which effects do age and gender of a potential user have on the relationship between the determinants of pre-adoption and the intention to use wearable self-tracking devices?

Similar to other technology acceptance studies in the consumer context, we develop an acceptance framework based on the technology acceptance model (TAM) (Davis, 1985; Davis, 1989) and its successors. Although there are reliable TAM adaptions (e.g., Bruner and Kumar, 2005; Kulviwat et al., 2007; Lu et al., 2005; Venkatesh et al., 2012) which explain technology adoption in the consumer context, we argue that these models do not fully account for the specific characteristics of wearable self-tracking devices, which interact with our personal lives in a much deeper way than any other technology. These previous models neglect the need for contextual variables in the field of self-tracking such as the demand for data security, an aesthetic appearance of the device as well as the specific intended purpose for the usage of such devices. To validate our model, we carry out a survey among 206 participants. We apply structural equation modeling using the partial least squares (PLS) approach (Urbach and Ahlemann, 2010).

Our paper is structured as follows. In Section 2, we discuss the relevant theoretical foundations concerning early adoption of wearable self-tracking devices. Based on these foundations, we develop our hypotheses in Section 3. In Section 4, we outline our approach to operationalizing the relevant constructs and collecting empirical data. In Section 5, we report on the measurement model's and structural model's assessment. Subsequently, we discuss our findings in Section 6. Finally, in Section 7, we conclude the paper, highlight the theoretical and practical implications, discuss the limitations, and outline our suggestions for future research.

2 Theoretical Foundations

Our study is built upon established theories to assess individual perceptions about self-tracking technology. In this regard, the technology acceptance model (TAM) as well as the unified theory of acceptance and use of technology (UTAUT) and its extension (UTAUT 2) are of particular relevance for our model (Venkatesh et al., 2012; Venkatesh et al., 2003; Davis, 1985; Davis, 1989). A review of the relevant literature reveals that perceived usefulness (PU), perceived ease of use (PEOU), perceived enjoyment (PE), and social influence (SI) are important and proven determinants of behavioral intention in established technology acceptance models. All four dimensions capture people's perceptions about technology in general, and we assume that they are also relevant for our study with a particular focus on wearable self-tracking technology.

However, we argue that wearable self-tracking devices are different from other consumer technology in that the devices under investigation are deeper rooted into our daily lives and even constitute a part of our identity. With their capability of measuring bodily functions and surroundings with precision, wearable self-tracking devices can function as extensions of our bodily senses. This is why the nature of such devices is much more complex and specific than other consumer electronics. The investigated devices do not simply collect data, but also interact with the user as an extension of the bodily senses – making suggestions regarding better health and lifestyle. In this sense, the character of such devices is not merely *some* human-machine interaction, but it is a *reflexive* one. Sociologists refer to this feature of self-tracking devices as the *qualified-self* (e.g. Davis, 2013), i.e., self-tracking as such is hardly simply about quantified (or quantifiable) information. The practice of collecting data is only one part in the concept of self-tracking. Self-tracking also includes interpretation and assessment of the collected data as well as the reconnection with other forms of data (Lupton, 2014a). In any personal self-quantification project, data and its related subjective interpretations and personal narratives more and more form part of the individual identity. Self-quantifiers use collected data to construct stories that they tell themselves about themselves (Davis, 2013). The mere act of wearing and using a self-tracking device or of positioning oneself as a self-tracker, is already an expression of a certain type of subject: *the entrepreneurial, self-optimizing subject*. Self-tracking devices are not only machines to collect raw data, but also help paying attention to the self, potentially raise self-awareness and may, in this sense, shape to some degree the identity of the user. Wearable self-tracking devices as such are deeply rooted into humanity. They enable us not only to quantify our bodies in certain respects but also interpret and use this information to initiate changes, emotions, and habits (Lupton, 2014a, 2014b).

Previous acceptance models do not fully reflect all pre-adoption criteria relevant in the self-tracking context and important to the understanding of the particular interconnectedness of the individual user and the self-tracking device. Accordingly, we add six variables that we assume to be relevant in the context of wearable self-tracking devices. Three of this six variables are adapted from acceptance models that were used in a different context: Trust was proven to play an important role in the context of online banking and e-commerce (Gefen et al., 2003; Kumar and Sareen, 2011; Suh and Han, 2002; Wang et al., 2003), perceived aesthetics was found to be important in the context of fashion technology adoption (Tzou and Lu, 2009), and personal innovativeness was shown to have an influence in the context of the adoption of wireless internet services via mobile technology (Lu et al., 2005). In our adapted model, trust reflects that self-tracking involves the collection and analysis of highly personal data and therefore requires users to have trust into the self-tracking vendor. Perceived aesthetic refers to self-

tracking devices as a highly personal device that is visibly worn all day long which is why it must conform to the aesthetic understanding of its user. Finally, personal innovativeness refers to the willingness of a potential user to try out new information technology since wearable self-tracking devices are a very new and relatively unknown technology.

In addition, we add three self-developed variables that capture the people's perceptions as to whether wearables support their fitness, health or well-being objectives. The majority of self-quantifiers is tracking physical activity (e.g. exercise, steps walked), body traits (e.g. weight, heart rate), well-being (e.g. sleep cycles and quality), nutrition and medical issues (Appelboom et al., 2014; Gimpel et al., 2013; Rooksby et al., 2014; Swan, 2009, 2012a). The ultimate goal of gathering more knowledge about one's body may comprise weight loss, steps walked, or any other goal related to well-being, health and fitness. In our model, these three determinants are defined as distinct factors and are theorized to have a direct and positive effect on behavioral intention to use a self-tracking device.

3 Conceptual Development

Based on the theoretical foundations, we will now explain the different constructs and propositions to explain the intention to use wearable self-tracking devices.

Perceived Usefulness

In the majority of previous TAM studies, perceived usefulness (PU) was shown to be one of the strongest determinants of technology adoption, user acceptance, and usage behavior (Kulviwat et al., 2007; Taylor and Todd, 1995; Venkatesh et al., 2012). In the case of wearable self-tracking devices, PU is defined as the perceived likelihood that a wearable self-tracking device will support self-tracking users in achieving their goals associated with the usage of such device. We assume that most people have a specific aim in mind when starting to use such devices, such as weight loss, being more active, health tracking, or simply to capture data about habits. Hence, we posit that PU is a relevant determinant in predicting usage intention and hypothesize:

Hypothesis 1: The perceived usefulness of wearable self-tracking devices has a positive effect on intention to use wearable self-tracking devices.

Perceived Ease of Use

In TAM, perceived ease of use (PEOU) is a construct to assess a person's individual believes that using a technology is free of mental effort (Davis, 1985; Lin et al., 2007). PEOU was examined extensively and a significant body of research supports the assumption that the easiness of a system is important for initial user acceptance and sustained usage of information systems (Schepers and Wetzels, 2007; Venkatesh, 2000). Therefore, we hypothesize:

Hypothesis 2: The perceived ease of use of wearable self-tracking devices has a positive effect on intention to use wearable self-tracking devices.

Perceived Enjoyment

Perceived enjoyment (PE), defined as "the fun or pleasure derived from using a technology" (Venkatesh et al., 2012, p. 161), emerged as an important determinant in the use of technology by customers in several studies in the end-user context (Bruner and Kumar, 2005; Kulviwat et al., 2007; Venkatesh et al., 2012). For example, one study investigated consumer acceptance of handheld internet devices and found PE to be a significant determinant (Bruner and Kumar, 2005). As the usage of self-tracking devices includes playful components (e.g. playing around with data and competing with friends or online peers), we include this determinant in our model. Thus, we hypothesize:

Hypothesis 3: The perceived enjoyment of using wearable self-tracking devices has a positive effect on intention to use wearable self-tracking devices.

Social Influence

Social influences are regarded as critical drivers in innovation diffusion (Cooper and Zmud, 1990; Laudon, 1985). We posit that the decision to purchase self-tracking hardware is influenced by social elements, for instance immediate social peers, people's opinions, or superior influences. This assumption is supported by recent technology acceptance studies in organizational settings (Schepers and Wetzels, 2007; Venkatesh, 2000) and in consumer environments (Lu et al., 2005; Venkatesh et al., 2012). Social influence is defined as "the extent to which consumers perceive important others (e.g. close friends and family) believe they should use a particular technology" (Venkatesh et al., 2012, p. 159). This effect is referred to as the *internalization mechanism.* It represents the tendency to interpret human information from important others as evidence about reality (Deutsch and Gerard, 1955; Schepers and Wetzels, 2007). We believe that an individual potential adopter of a wearable self-tracking device is exposed to informal social networks in which everyone is part of his or her own circle of friends, members, and other important connections. This web of relationships affects an individual's opinions, decisions, and behaviors through interactions and communications. Hence, we hypothesize:

Hypothesis 4: The social influence with regard to using wearable self-tracking devices has a positive effect on intention to use wearable self-tracking devices.

Trust

Trust, defined by Colquitt et al. (2007) as "the intention to accept vulnerability to a trustee based on positive expectations of his or her actions" (p. 909) has been shown to be a crucial determinant in technology acceptance, especially in online banking and e-commerce contexts (Gefen et al., 2003; Kumar and Sareen, 2011; Suh and Han, 2002; Wang et al., 2003). The importance of trust in e-commerce seems to be obvious. Consumers interact with business entities, and every transaction entails risk. Especially consumers are often in weaker positions and prone to be vulnerable in different aspects. Trust is an expectation that none of the involved parties will behave opportunistically by taking advantage of a superior position. In the specific case of an online transaction, the consumer expects the vendor to fulfil its commitment despite the consumer's dependence and vulnerability (Gefen et al., 2003). Behaviors deviating from vendor's commitment include unfair pricing, promoting of inaccurate information, or violations of privacy. Trust is especially important in the case of wearable self-tracking devices. In contrast to a single transaction in e-commerce settings, the consumer or self-tracker continuously depends on the vendor of his or her chosen device. The concept of quantified-self entails a continuous collection of data and a subsequent upload and analysis of these data. In the majority of devices, the storage and analysis of data is handled and processed by the vendor and on the vendor's servers. Thus, the supplier of quantified-self hardware is de facto in power and in possession of the users' collected data. The consumer of wearable self-tracking devices is especially vulnerable to violations of privacy and unknown transfer and analysis of his or her data. Hence, we hypothesize:

Hypothesis 5: Trust in wearable self-tracking devices has a positive effect on the intention to use wearable self-tracking devices.

Perceived Aesthetic

Since the 1980's, a growing body of research investigates the role of product design and aesthetics and how design can influence consumer choice (Creusen and Schoormans, 2005; Veryzer, 1993, 1995). It was shown in consumer research that product design is an opportunity for differential advantage in the marketplace (Creusen and Schoormans, 2005). Product design in general triggers both affective and cognitive responses which lead to behavioral responses to the product in terms of accepting or rejecting the product in question (Bloch, 1995). However, only few researchers addressed the role of product design in the adoption process of consumer electronic products (e.g. Hong et al., 2002; Tzou and Lu, 2009). Most research based on TAM does not consider product design as a crucial feature of acceptance determinants. The reason might be that the technology under investigation is often considered on an abstract level, but not in form of distinct hardware. Usually, design features are often covered by PEOU

or are antecedents of PEOU and do not seem to play a major role in the acceptance decision of technology – at least in theory (Hong et al., 2002; Lu et al., 2005). Another reason why aesthetics are most often not explicitly covered in TAM studies is that the influence of product design on consumer evaluation is often complex and influences consumer preferences in a number of ways. Product design refers not only to exterior features (aesthetics), but also to the interior design and functional features of the product (Veryzer, 1995). In this study, perceived aesthetics is defined as the visual appearance or the product form of a self-tracking device, which determines the consumer's impression of the product. This does not cover the functional aspects of design and refers solely to the aesthetic component of product design. Product form creates the initial impression of a self-tracking device and provides a value in itself and can express a product advantage (Bloch, 1995). Similar to its prize, the design of a product creates expectations of the features and attributes of the product (Berkowitz, 1987). We argue that this especially holds true for wearable self-tracking devices which are worn visible day in and day out. Thus, we hypothesize:

Hypothesis 6: The perceived aesthetic of wearable self-tracking devices has a positive effect on intention to use wearable self-tracking devices.

Personal Innovativeness

Drawing upon Rogers' theory of the diffusion of innovations, Agarwal and Prasad (1998) define personal innovativeness (PIIT) as "the willingness of an individual to try out any new information technology" (p.206). Innovativeness influences the intention to use technological products (Agarwal and Prasad, 1998; Lu et al., 2005). Previous research found that consumers high in personal innovativeness tend to look favorably on technology and the use of technology-based products. They enjoy the stimulation of trying new ways to approach old problems (Dabholkar and Bagozzi, 2002; Hirschman, 1980; Lu et al., 2005). Hence we argue, due to the fact that wearable self-tracking devices are a relatively new and still unknown technology, that the personal innovativeness of a potential user is particularly relevant here. We hypothesize:

Hypothesis 7: The personal innovativeness of a potential user has a positive effect on intention to use wearable self-tracking devices.

Perceived Support of Health

Perceived support of health captures the ability of wearable self-tracking devices to keep control over or keep track of health issues. On the one hand, self-tracking devices are able to capture data regarding one's health that can be of value for doctors and physicians. On the other hand, this data might be used to be in control of one's health apart from the doctors analyses and suggestions (Williams, 2014). People are using self-tracking devices if they are interested about their treatment and want to keep track on their own (Appelboom et al., 2014; Gimpel et al., 2013). Thus, we define perceived support of health as the degree to which wearable self-tracking devices are perceived to support the treatment of health related issues. We hypothesize:

Hypothesis 8: The perceived support of health by using wearable self-tracking devices has a positive effect on intention to use wearable self-tracking devices.

Perceived Support of Fitness

While perceived support of health is clearly related to personal health issues, self-tracking devices are also used to keep track of data concerning the personal fitness or well-being (Rooksby et al., 2014). Many self-tracking devices offer particular functions regarding fitness or sports. Almost all devices are capable of tracking steps or activity levels in general, whereas others offer additional possibilities to pair heart rate monitors to track training activities like running or swimming. Additionally, the devices offer a distinct analysis of recorded data on their web platforms and, in most cases, competitions with close social peers or all users in the cloud. Therefore, wearables could be a useful tool to track training progress and offer a way to compete in sporting or fitness activities. Hence, we define perceived support of

fitness as the degree to which wearable self-tracking devices are perceived to support the training progress. We hypothesize:

Hypothesis 9: The perceived support of fitness by using wearable self-tracking devices has a positive effect on intention to use wearable self-tracking devices.

Perceived Support of Well-Being

We define perceived support of well-being as the degree to which wearable self-tracking devices are perceived to support one's general mental and physical constitution. In contrast to perceived support of fitness, this determinant is not about keeping track of a particular sort of training activity or sport but focuses more on general well-being in terms of controlling the general activity level and, for instance, nutrition (Rooksby et al., 2014). Wearable self-tracking devices offer a range of functionalities that may foster well-being in a very general way. Some devices, for instance, are able to do sleep analyses and are capable of informing about the quality of sleep or of offering sleep analyses patterns. Others are capable of reminding the user to be more active from time to time or to sit more straight. These functions are complemented with nutrition tracking abilities which therefore enable analyses about the quality of a diet. Therefore, we hypothesize:

Hypothesis 10: The perceived support of well-being by using wearable self-tracking devices has a positive effect on intention to use wearable self-tracking devices.

Moderating variables

On the basis of the established models UTAUT and UTAUT 2 developed by Venkatesh et al. (2003; 2012), we include the demographic variables age and gender as moderators in our model. Those variables were proven to effect the relationship between the behavioral intention to use a technology and its determinants (Venkatesh et al., 2012; Venkatesh et al., 2003) which is why we argue that these moderators are also relevant in the context of wearable self-tracking devices.

4 Research Method

Quantitative-empirical methods, particularly surveys, are considered suitable research approaches to gain results of high generalizability (e.g. Johnson et al., 2000). Thus, we carried out a quantitative survey to collect empirical data for validating our research model.

4.1 Measurement

To prepare for the research model's empirical validation, we relied on established and proven measurement scales, if available, to enhance validity as suggested by several authors (e.g., DeLone and McLean, 2003). The items for behavioral intention, perceived usefulness, perceived ease of use and perceived enjoyment were adapted from Venkatesh (2003; 2012), Lu et. al (2005) and Schlohmann (2012). The scale for social influence is based on previous works by Venkatesh (2012) and Schlohmann (2012). The scale to measure trust was derived from Gefen et. al (2003) and Wang et. al (2003). The scale for perceived aesthetics was adapted from Tzou and Lu (2009). For measuring personal innovativeness, we adapted a scale based on innovation diffusion research (Lu et al., 2005). Regarding the remaining three determinants perceived support of well-being, perceived support of fitness and perceived support of health, we developed own sets of items based on 5 interviews we conducted with self-trackers and a review of recent literature on the use of self-tracking (Gimpel et al., 2013; Lupton, 2013b, 2014c; Rooksby et al., 2014) because no suitable previous instruments could be identified. All variables were measured on seven-point Likert-type with multiple-item scales. We only used reflective measurement scales. Additionally, we collected demographic information such as age and gender. The resulting questionnaire was reviewed for content validity by two other researchers. Additionally, we carried out a card-sorting procedure similar to the one adopted by Moore and Benbasat (1991) supported by an online tool

(concept codify). The questionnaire was finally pilot tested by seven graduate students and five university staff members through which we found preliminary evidence that the scales we reliable and valid.

4.2 Participants and Data Collection Procedure

Our target population were current *non-users* of wearable self-tracking technology since our primary aim was to cash out decisive factors which are important for people to form a usage (and by that buying) intention for such technologies. We excluded those people already using a self-tracker or that have already used a self-tracking device in the past in the very beginning of the survey. We presented all participants of the study a comprehensive introduction including a definition of wearable self-tracking technology and how it can be used outlining possible benefits. All participants were instructed to base their answers on intuition and prior experience with similar technology. This approach is not unusual and has been applied before (Schlohmann, 2012). All responses were collected using an online survey. The survey was provided in German language only and distributed using the popular online social networks Facebook and Twitter, E-Learning groups of the University of Bayreuth as well as personal contacts. We received a total of 374 responses including those already using a wearable tracking device. After sorting out those, who did not finish the questionnaire or who were already in possession of a self-tracking device, we proceeded with a final sample of 206 responses in the analysis. The average participant is 26.4 years old and earned a university degree. 60% of the respondents are male.

5 Analysis and Results

5.1 Measurement Model

Table 1 presents the measurement model's results, including information about reliability, validity, and factor loadings. The internal consistency reliabilities (composite reliability) of multi-item scales modelled with reflective indicators is 0.89 or greater, suggesting that scales were reliable. In addition, the Cronbach's Alpha values are consistently 0.80 or greater, hence showing a good internal consistency of our scale. The average variance extracted is greater than the critical threshold of 0.50. Hence, we conclude that convergent validity has been established. To check for discriminant validity, we applied the Fornell-Larcker criterion as a conservative measure (Fornell and Larcker, 1981). The square root of each construct's AVE is greater than its highest correlation with any other construct. In addition to the traditional discriminant validity check, we assessed discriminant validity by applying the Heterotrait-monotrait (HTMT) approach (Henseler et al., 2015). All values are below 0.85 which is why we conclude that discriminant validity has been established. The pattern of loadings and cross-loadings supported internal consistency and discriminant validity, with one exception. One trust item had to be dropped due to low outer loading. The outer loadings of all other items exceed the critical threshold of 0.708 and are therefore kept (Hair, JR. et al., 2014).

Latent Variable	CR	AVE	CA
Perceived Usefulness (PU)	0.897	0.688	0.848
Perceived Ease of Use (PEOU)	0.918	0.740	0.883
Perceived Enjoyment (PE)	0.926	0.761	0.893
Trust (T)	0.885	0.659	0.825
Social Influence (SI)	0.864	0.561	0.806
Perceived Aesthetics (PA)	0.859	0.621	0.801
Personal Innovativeness (PIIT)	0.930	0.769	0.901
Perceived Support of Fitness (PSF)	0.901	0.753	0.834
Perceived Support of Well-Being (PWB)	0.918	0.791	0.866
Perceived Support of Health (PSH)	0.913	0.681	0.882
Intention to Use Wearable Self-Tracking Devices (BI)	0.940	0.798	0.915
Notes: CR = Composite Reliability, AVE = Average Variance Extracted, CA: Cronbach's Alpha			

Table 1. Measurement Model's Results

5.2 Structural Model

Due to the explorative nature of our study, we assess the structural model using the PLS approach. In contrast to covariance-based structural equation modeling, the PLS approach has the advantage of more modest distributional assumptions and sample size requirements (Gefen et al 2011). Instead of applying a global goodness of fit criterion, the structural PLS-SEM model is assessed on the basis of heuristic criteria. Bootstrapping is used to derive the key criteria for assessing the structural model. We report the significance of the path coefficients and the level of the R^2 values. To assess the path coefficients, we applied the PLS algorithm with 5,000 iterations and the mean replacement approach for handling missing values. To check for significance, we applied the bootstrapping routine. Figure 1 presents the path coefficients, significance levels, and R^2 value for the complete model without moderating variable effects.

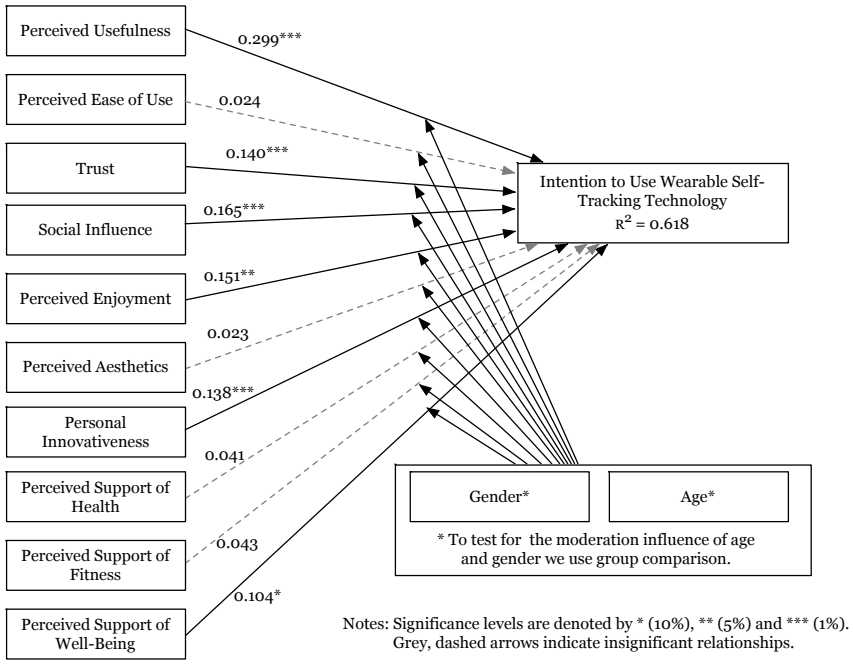

Figure 1. Assessment of the structural model

Relating to our direct effects we proposed in H1 to H10, six hypothesis could be confirmed. We find support for perceived usefulness, perceived enjoyment, social influence, trust, personal innovativeness and perceived support of well-being to be significant determinants of the behavioral intention to use a wearable self-tracking device. The R^2 of the dependent variable is at 0.618.

After segmenting the sample by gender, we gain a group of 120 male and 76 female participants. Ten respondents did not indicate their gender and were thus excluded from this analysis. For the male group, we find support for perceived usefulness, perceived ease of use, perceived enjoyment, social influence, trust and personal innovativeness to be significant determinants of the behavioral intention to use a wearable self-tracking device. In contrast, in the female group, we find support for the determinants perceived enjoyment, social influence, perceived aesthetics, personal innovativeness, perceived support of health and perceived support of fitness. The R^2 increases from 0.618 for the complete sample to 0.676 for the male group and 0.654 in the female group. The complete results are shown in Table 2.

		Complete	**Gender Male**	**Gender Female**
Number of observations		206	120	76
Path coefficients	PU -> BI	0.299***	0.410***	0.100
	PEOU -> BI	0.024	0.132**	-0.012
	PE -> BI	0.151**	0.190**	0.194*
	SI -> BI	0.165***	0.167***	0.163**
	T -> BI	0.140***	0.183***	0.085
	PA -> BI	0.023	0.039	0.142*
	PIIT -> BI	0.138***	0.120**	0.146**
	PSH -> BI	0.041	-0.029	0.148*
	PSF -> BI	0.043	-0.038	0.228**
	PWB -> BI	0.104*	0.024	0.112
R^2	BI	0.618	0.676	0.654
*Notes: Significance levels are denoted by * (10%), ** (5%) and *** (1%).*				

Table 2. Results for moderating effect of gender using group comparison

For the segmentation by age, we decided to divide the complete sample into two groups. The split is conducted at the median which is at age 25. For participants younger than 25, we find support for perceived usefulness, trust, personal innovativeness and perceived support of well-being to be significant determinants of the behavioral intention to use a wearable self-tracking device, while for participants older than 25 the determinants perceived usefulness, perceived enjoyment, social influence, perceived aesthetics and personal innovativeness become significant. The R^2 increases from 0.618 for the complete sample to 0.628 for participants younger than 25 and 0.644 for participants older than 25. The complete results are shown in Table 3.

		Complete	Age < 25	Age > 25
Number of observations		206	87	117
Path coefficients	PU -> BI	0.299***	0.234**	0.329***
	PEOU -> BI	0.024	-0.009	0.028
	PE -> BI	0.151**	0.060	0.186**
	SI -> BI	0.165***	0.103	0.212***
	T -> BI	0.140***	0.162**	0.087
	PA -> BI	0.023	-0.135	0.100*
	PIIT -> BI	0.138***	0.112*	0.112**
	PSH -> BI	0.041	-0.011	0.069
	PSF -> BI	0.043	0.129	0.008
	PWB -> BI	0.104*	0.244**	0.023
R^2	BI	0.618	0.628	0.644
Notes: Significance levels are denoted by * (10%), ** (5%) and *** (1%).				

Table 3. Results for moderating effect of gender using group comparison

6 Discussion

Our analysis reveals a direct and positive effect between perceived usefulness, perceived enjoyment, social influence, trust, personal innovativeness, perceived support of well-being and the behavioral intention to use wearable self-tracking devices. While established predictors from acceptance models such as TAM and UTAUT (2) are confirmed, the results also show that due to the collection and analysis of personal data, the trust into the vendor plays an important role in the pre-adoption phase in the context of self-tracking devices. Also the personal innovativeness of a potential user is of importance since wearable self-tracking devices are a new and relatively unknown technology. In contrast, with perceived support of well-being, only one of the three very specific determinants (health, fitness and well-being) is a relevant determinant for the intention to use self-tracking devices – at least at the aggregated level. An explanation might be that wearable self-tracking devices are seen more as a toy to give some new and interesting insights into one's daily behavior and less as serious health or fitness devices since there is a professional market for such kind of devices as well. Further, we could not find support for the influence of perceived ease of use and perceived aesthetics in the complete sample. The results for perceived ease of use are rather surprising, since this construct is highly established in acceptance theory. A potential explanation might be that the survey group cannot yet evaluate the importance of the ease of use for wearable self-tracking devices due to the novelty of the technology and the inexperience of the potential users. Concerning the influencing effect of perceived aesthetics, we did not find support in the complete sample. It seems that perceived aesthetics is only relevant in certain user groups which we will discuss subsequently.

When we divided our sample by gender, we only find perceived enjoyment, social influence and personal innovativeness to be significant determinants of the behavioral intention to use a wearable self-tracking device in both groups. Further, male participants seem to emphasize more on the general usefulness of the device and technical aspects since the influences of perceived usefulness, perceived ease of use and trust are significant in this group. In contrast, the female participants seem to be more goal-orientated in terms of the support for their health and fitness activities and appreciate an appealing visual appearance of the self-tracking device as the effects perceived support of health, perceived support of

fitness and perceived aesthetics are significant here. Hence, we conclude that wearable self-tracking devices should be designed and promoted differently for males and females or, if the device is developed for both genders, emphasize on different features of the product. A good example might be the Apple Watch for which technical aspects (e.g., usability and connection features) are promoted just as much as the aesthetic appearance (e.g., adaptability of the screen design and wristbands) and its dedicated self-tracking capabilities (e.g., heart rate monitoring).

Concerning our group analysis with the factor age, we get surprisingly different results in both groups. For the group aged under 25, perceived usefulness, trust, personal innovativeness and perceived support of well-being are still significant determinants of the behavioral intention to use a wearable self-tracking device, while the influence of perceived enjoyment and social influence become insignificant. In contrast, the group aged over 25 emphasizes on the perceived enjoyment, social influence and perceived aesthetics, while the influence of trust and perceived support of well-being is insignificant in this group. We conclude that the group aged under 25 sees wearable self-tracking devices more as a serious tool while the group aged over 25 sees them more like a toy and fashionable device. Hence, it seems reasonable that vendors of wearable self-tracking devices should emphasize on distinct device features for user of different age. Younger user groups can be reached with sophisticated self-tracking and technical features, while the aesthetic appearance can be rather disregarded. In contrast, for older user groups, it is not necessary to enhance the self-tracking or technical features but the aesthetic appearance of the product which should ultimately contribute to the enjoyment of the product. The Apple Watch may serve once again as a good example. Assuming that the group aged over 25 is also more solvent, all models are shipped with the same software and technical features, while a product and price differentiation is achieved by the possibility to adapt the external appearance and quality of the product.

7 Summary and Conclusion

The purpose of this study was to investigate the usage intention of wearable self-tracking devices and evaluate the impact of the demographic factors age and gender. To identify the pre-adoption criteria particularly relevant for a self-tracking device in the digital health context, we developed an adapted acceptance model based on the prominent technology acceptance model (Davis et al., 1989; Davis, 1985) and its successors (Bruner and Kumar, 2005; Kulviwat et al., 2007; Lu et al., 2005; Venkatesh et al., 2012). Our findings confirm the need for an adapted acceptance model in the context of wearable self-tracking devices since we found support for the influence of trust, perceived aesthetics, personal innovativeness, perceived support of health, perceived support of fitness and perceived support of well-being.

Our research project was a first attempt to gain knowledge about pre-adoption criteria of wearable self-tracking devices. The present study has some limitations, most prominently a potential sampling bias and the relatively small sample size. Concerning the sampling bias, the sample of respondents might not be representative for the entire population of potential users of wearable self-tracking devices, since the survey reached mainly university students and university employees and was only available in German language. Furthermore, because of the chosen sampling approach, we were not able to assess potential non-response bias, since we have no detailed information on the group of people that received our questionnaire. It is also worthy of note that this study is entirely based on expected assessments of wearable self-tracking devices. None of our participants has used a wearable self-tracker before taking part in our study. Despite these limitations, we believe that our exploratory empirical study is a valuable step in structuring the usage intention for wearable self-tracking devices.

Last but not least, further research should be carried out for a better understanding of the facets and effects of variables in our study. Further it is of interest if and how the relevant determinants change after the initial adoption of a wearable self-tracking device (Buchwald et al., 2015). Finally, we suggest a more comprehensive analysis concerning the segmentation of potential users (e.g., using the FIMIX

method). While we found interesting results by segmenting for age and gender, we assume further influencing factors here. For the practice, our results can be useful to guide future product development and sharpen marketing activities for specific customer segments since we showed that the determinants for the behavioral intention to use wearable self-tracking devices differ for different user groups.

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