ELSA NIEPPOLA

CONTINUANCE BEHAVIOR OF SMART WEARABLE DEVICES

By Finnish university students

Master’s thesis
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ABSTRACT

Elsa Nieppola: Continuance Behavior of Smart Wearable Devices
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Smart wearable devices (SWDs), like smart watches and smart rings, are well accepted and used among the general public. Although the attributes that contribute to SWD adoption are comprehensively researched, there is still a gap in knowledge, what factors promote continuous SWD usage.

This research uses the unified model of IT continuance to study continuance behavior of SWDs by Finnish university students. The study was conducted via questionnaire, which was distributed to Finnish university students who are users of SWDs. In total, 100 usable responses were collected, and the results were analyzed using PLS-SEM method in SmartPLS4 to find the linkages between different continuous use contributors.

The study found that disconfirmation, satisfaction, continuance intention, and habit promote continuous SWD usage. Perceived usefulness and subjective norm were not found to have a significant contribution towards continuous use. Age, gender, student status, educational level, and gross income did not alter users' continuance behavior.

For future research, it is suggested to study how culture and geographical location affect the significance of certain contributors. A study done by using a more comprehensive continuance behavior model and greater sample size is also recommended for results with higher overall validity.

Keywords: SWD, Smart Wearable Devices, Continuous use, smart Watch, Smart Ring

TIIVISTELMÄ

Elsa Nieppola: Puettavien älylaitteiden jatkuva käyttö
Diplomityö
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Tuotantotalouden diplomi-insinööri
Syyskuu 2023

Puettavat älylaitteet, kuten älykellot ja -sormukset, ovat saavuttaneet suurta suosiota kuluttajien keskuudessa. Vaikka puettavien älylaitteiden käyttöönottoa ja siihen vaikuttavia tekijöitä on tutkittu kattavasti, on edelleen epäselvää, mitkä tekijät edistävät puettavien älylaitteiden jatkuvaa käyttöä.

Tämä tutkimus käyttää pohjanaan yhtenäistä IT:n jatkuvan käytön mallia tutkiakseen puettavien älylaitteiden jatkuvaa käyttöä suomalaisten opiskelijoiden keskuudessa. Tutkimus toteutettiin kyselytutkimuksena, joka jaettiin suomalaisille opiskelijoille, joilla on puettava älylaite käytössään. Kyselyyn tuli yhteensä sata (100) käyttökelpoista vastausta, joita analysoitiin PLS-SEM-metodia hyödyntäen, jonka avulla löydettiin linkkejä tutkittavien tekijöiden ja jatkuvan käytön väliltä.

Tutkimuksessa huomattiin, että epävahvistus, tyytyväisyys, aikomus jatkuvaan käyttöön sekä tapa/tottumus edistävät puettavien älylaitteiden käyttöä. Koetun hyödyn sekä subjektiivisen normin ei huomattu vaikuttavan merkittävästi jatkuvaan käyttöön. Ikä, sukupuoli, opiskelijastatus, koulutustaso sekä bruttotulot eivät aiheuttaneet muutoksia jatkuvan käytön kannalta.

Tulevien tutkimusten suositellaan keskittyvän, kuinka kulttuuri ja maantieteellinen sijainti vaikuttavat tiettyjen jatkuvaa käyttöä edistävien tekijöiden merkittävyyteen. Tutkijoita kehotetaan myös kattavampaan jatkuvan käytön teoriamalliin sekä suurempaan otantaan korkeamman validiteetin saavuttamiseksi.

Avainsanat: Puettavat älylaitteet, jatkuva käyttö, älykello, älysormus

Tämän julkaisun alkuperäisyys on tarkastettu Turnitin OriginalityCheck –ohjelmalla.

PREFACE

This thesis was made for Center for Innovation and Technology Research, Tampere University and was funded by Industrial Research Fund at Tampere University of Technology. The research area was originally based on the combination of the author’s two different degree programmes: Industrial Engineering and Management at Tampere University, and Biochemistry at University of Turku. Since the beginning, the area of interest and the study subject has shifted and changed multiple times finally fixating on SWD continuance behavior in March 2022.

The process of writing this thesis has been long and rocky 1,5 years including a lot of frustration, confusion, and exhaustion. The process started in late 2021 when the author was actively pursuing two degrees, and when one was finally out of the picture, came a full-time job. Finally, after a lot of encouragement from friends, family, colleagues, and directors, and many questions and a few phone calls later the thesis finally started to progress during the spring of 2023, reaching it finished state after summer 2023.

Lastly, I would like to thank my amazing directors, who were quick to answer my questions and kick me out of despair in times when needed, my friends and family, who listened to my continuous complaining and encouraged me to keep on writing, and my psychiatrist for prescribing me medication for my depression and apathy. A special acknowledgement to the album folklore by Taylor Swift, which helped me to get to a concentrated state time after time.

Espoo, 4.9.2023

TABLE OF CONTENT

PICTURE CATALOG

TABLE CATALOG

ABBREVIATIONS AND SYMBOLS

AVE	*Average Variance Extracted*
f^2	*Effect Size*
ECM	*Expectation-Confirmation Model*
ECT	*Expectation-Confirmation Theory*
HTMT	*Heterotrait-Monotrait*
IS	*Information System*
IT	*Information Technology*
KAP	*Knowledge, Attitude, Practice Model*
KAPB	*Knowledge, Attitude, Practice, Belief Model*
PLS-SEM	*Partial Least Squares Structural Model*
R^2	*Coefficient of Determination*
STDEV	*Standard Deviation*
SWD	*Smart Wearable Device*
TAM	*Technology Acceptance model*
TPB	*Theory of Planned Behavior*
TRA	*Theory of Reasoned Action*
UTAUT	*Unified Theory of Acceptance and Use of Technology*
UTAUT2	*Unified Theory of Acceptance and Use of Technology 2*
VIF	*Variance Inflation Factor*

1. INTRODUCTION

This chapter gives a general introduction to this research. It presents how this research connects to the real world and why this is an important field to study. Later on, the real research question and the context of this research will be introduced. Lastly it goes through the structure of this report to give the reader an understanding of the scope of this study.

1.1 Background

Fitness and wellness have been in people's minds for ages, but its popularity does not seem to decline anytime soon. According to Callaghan et al. (2021), 79% of people consider their wellness to be important and 42% consider it to be their top priority. At the global level, wellness industry is estimated to be over 1,5 trillion American dollars with annual growth of 5% to 10%. Consumers' view of wellness consists of six dimensions: health, fitness, nutrition, appearance, sleep, and mindfulness. (Callaghan et al. 2021) Out of these six categories health, fitness and sleep can be measured with personal-health trackers.

Smart wearable devices (SWDs) are one of the most popular categories of personal-health trackers, since they are widely accessible to consumers without any medical prescription. They are either attached to the user as an accessory or embedded in their clothes, and they actively collect data of the user during their every-day life. SWDs seamlessly transport the data into selected apps on the user's smart phone, which then analyze and display the data in a user-friendly manner giving information about the user's health, fitness, and sleep behavior.

Smartwatches and other smart wearable devices have gained a lot of popularity after Apple Inc. launched their first Apple Watch in April 2015. In Q4 of 2021 alone, 40 million smart watches were sold while Apple Inc. obtaining over 30% market share (Wooden 2022). Nine out of ten smart phone vendors have already entered the SWD market or are about to launch their first product (Gartner 2014; see Yang et al. 2016).

1.2 Objective of the Research

It is well known and researched, what makes consumers to adopt SWDs to their lives: useful functions, reliable and accurate data, aesthetic appeal, social influence, and personal motivations (Kim & Shin, 2015; Gao et al. 2015; Yang et al. 2016; Canhoto & Arp, 2017; Talukder et al. 2019; Dehghani & Kim, 2019; Cheung et al. 2019; Park 2020; Peng et al. 2021). It is also important to understand, what factors contribute to the continuous use of the SWDs. That helps the SWD industry to stay prominent by maintaining the role that the SWDs have in consumers' lives. Many researchers study continuance behavior from the expectation-confirmation theory's (ECT) perspective lacking the inclusion of emotional bond and habit towards SWD usage. Thus, there is still an opportunity to study continuance behavior by applying Unified Model of IT Continuance by Bhattacherjee & Lin (2015). This research tries to fill that gap by examining this theory's in SWD context and better understand the continuous use from new perspectives. The research question for this study is:

"What factors contribute to continuous SWD usage by Finnish university students"

First this research studies literature of technology acceptance models of IT and then does the same for SWDs. Then the theoretical background for IT continuance is explored, after which this research inspects the current studies conducted about SWD continuance behavior. After setting the theoretical premises this study builds on, the unified model of IT continuance will be tested in practice by exploring the connections between user behavior, continuous use intention, habit, satisfaction, disconfirmation, perceived usefulness, and subjective norm. The empirical study is done through an online survey distributed to university students in Finland.

The first chapter of this paper sets the background for this research and presents the research objective. The second chapter goes through the theoretical background and premises that are relevant to first, build the research questionnaire, and then to understand the results. The third chapter introduces the research methodology to help the reader to understand, how this study was conducted. The fourth chapter presents the results of the research, and the fifth chapter discusses about the implications of these findings and the possible limitations and suggestions for future research.

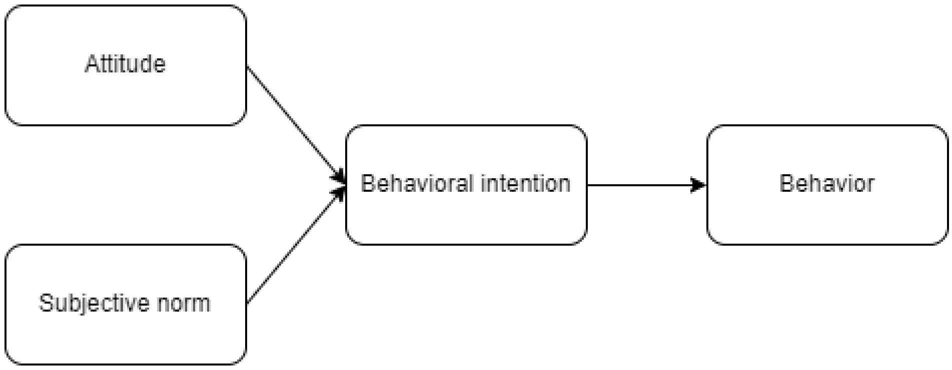
2. THEORY BACKGROUND

This chapter goes through the theoretical framework that this research builds onto. To understand, what makes people continue using their SWDs, it is important to understand what drives them to adopt SWDs in the first place. Thus, this chapter will first go through a few popular Technology Acceptance Models (TAMs) then diving into the theory behind continuance intention and behavior. Technology acceptance models depict the factors that influence people to adopt certain technology. Continuance intention and behavior, on the other hand, explains what makes people continue using their acquired technology. These theories will also be applied to SWDs' context considering their unique features regarding adoption and continuous use intention.

2.1 Technology Acceptance Models

In this section, the theory behind technology acceptance is presented. First it goes through general technology acceptance models that apply to IT-systems in both organizational and consumer context. After that the theory is applied to SWDs' context by also utilizing literature considering SWDs' specific attributes. The models and findings will be presented in a chronological order giving a better understanding how the theories have developed.

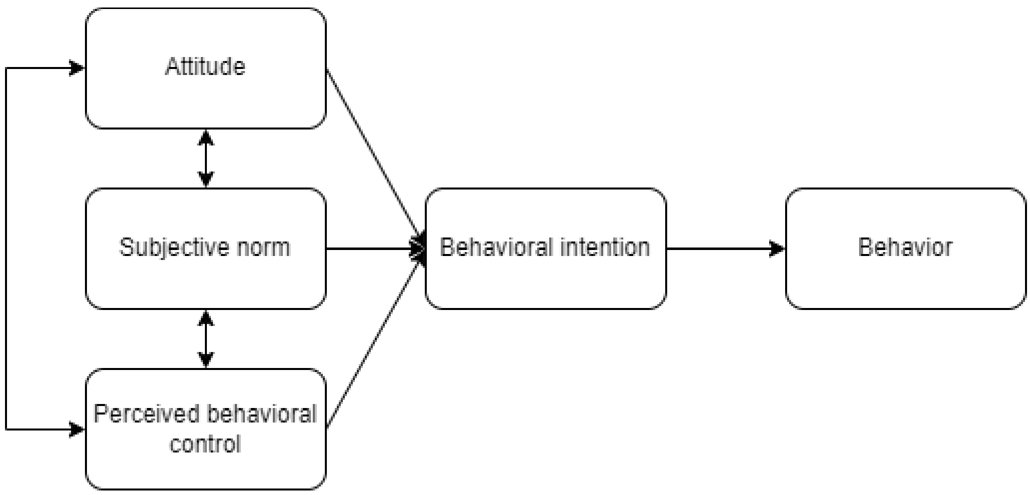
Most of the technology acceptance literature base their premises on Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB), which is an extended version of TRA (Amin et al. 2021). TRA has four key constructs: attitude, subjective norm, behavioral intention, and behavior (picture 1) (Fishbein & Ajzen, 1980; see Becker & Gibson, 1998). Attitudes refer to the person's overall reaction about a specific behavior performance (Alagoz & Hekimoglu, 2012; see Amin et al. 2021). Subjective norm is defined as the person's perception of what people that are close to them think of the technology and its use (Venkatesh & Davis, 2000).



Picture 1 *Theory of reasoned action (TRA) (Fishbein & Ajzen, 1980).*

TRA concludes that both attitudes and subjective norm influence behavioral intention, which is directly correlated with behavior. The theory proposes that most human behavior is guided by a person's intention to take a particular action and the person's ability to decide about it. However, this perspective remains quite basic and narrow ignoring the person's perception of the effort and put into the behavioral action and its difficulty level. Thus, Ajzen updated it into TPB in 1985 to improve its predictive power of actual behavior instead of behavioral intention.

Ajzen (1985) brings perceived behavioral control as a new construct to TRA and names the new framework TPB (picture 2). Perceived behavioral control means how easy or difficult a person perceives a particular behavior performance (Ajzen & Fishbein, 1980; see Amin et al. 2021).

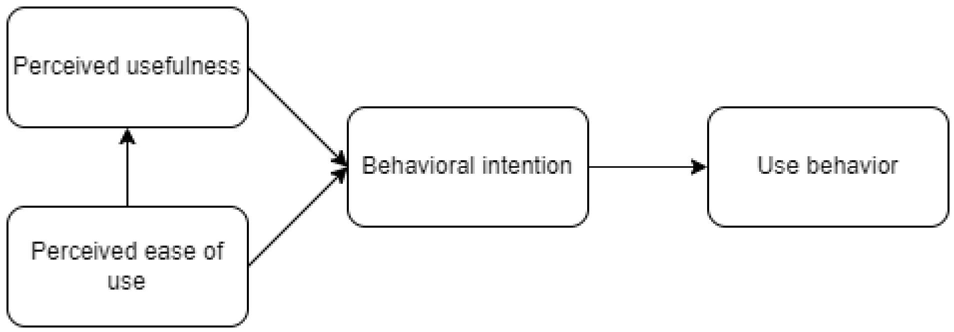


Picture 2 *Theory of planned behavior (TPB) (Ajzen 1985).*

The TPB demonstrates that attitudes, subjective norm, and behavioral control affect the behavioral intention. These attributes also influence each other respectively instead of being independent factors. The final improvement is that behavioral control directly affects one's actual behavior. This theory alone is not enough to explain why people end up acquiring SWDs because it does not consider what affects the attitudes and perceived behavioral control. Thus, the technology acceptance models need to be studied.

2.1.1 Technology Acceptance of IT-Systems

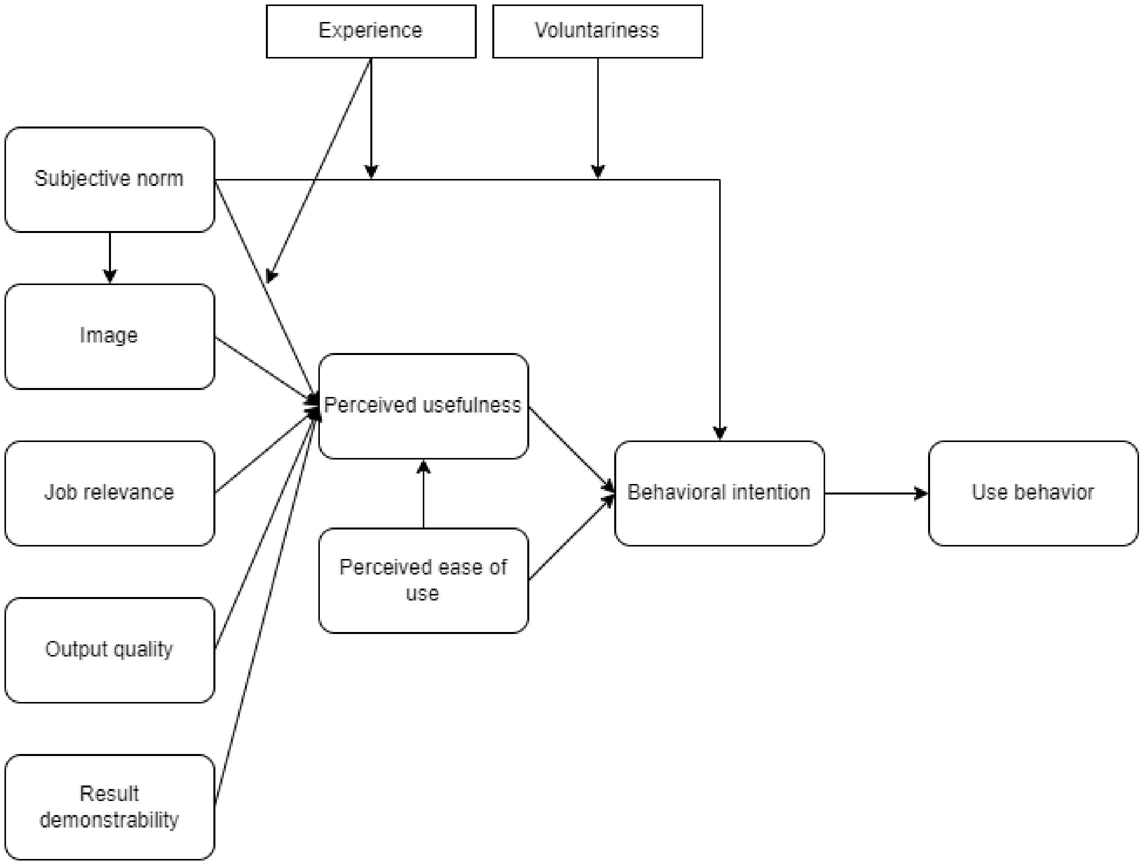
The first widely accepted technology acceptance model was presented by Davis (1989), and it is referred to as TAM (picture 3). It has two constructs that have a direct effect on user's behavioral intention: perceived usefulness and perceived ease of use. By perceived usefulness, this article means how useful the user experiences the new technology in performing certain tasks. Perceived ease of use, on the other hand, is defined to mean how free of effort said technology is for the user. (Davis, 1989)



Picture 3 *Technology acceptance model (TAM) (Davis 1989).*

In TAM, a person's intention to use new technology is increased by its perceived usefulness and perceived ease of use. The perceived ease of use does not only raise the probabilities for actual adoption, but it also increases the perceived usefulness, thus having more impact on the final behavioral intention. Behavioral intention, on the other hand, has a direct impact on final use behavior. (Davis 1989) This theory has since been proven by Venkatesh and Speier (1999) to compare favorably with TRA and TPB, which has made it popular basis for future studies and technology acceptance theories.

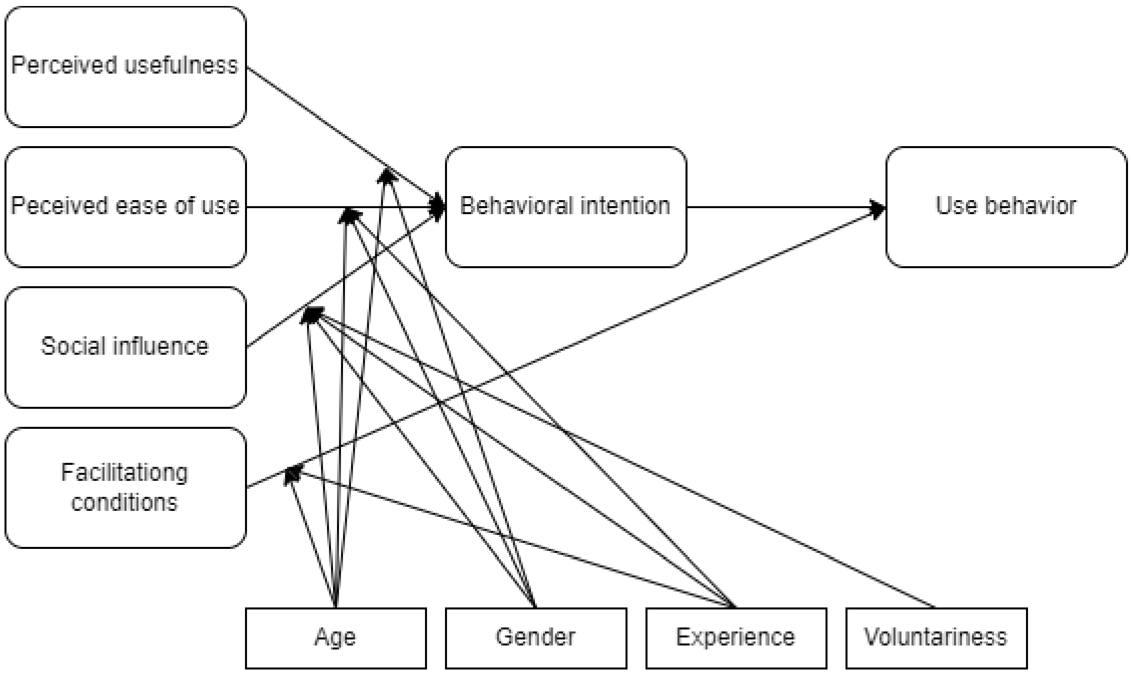
Since the first introduction of TAM, it has been updated by Venkatesh and Davis (2000) with a TAM2 that focuses on technology acceptance in organizational context (picture 4). Venkatesh and Davis's (2000) present seven new determinants (result demonstrability, output quality, job relevance, image, subjective norm, experience, and voluntariness) that affect the user's intention to use directly or indirectly. Result demonstrability means how tangible the innovation's results are for the user. Output quality measures how well the technology performs its tasks. Job relevance is defined as the degree to which the technology is applicable to the user's needs. Image is related to how the user is perceived by its social contacts before and after the use of a new technology. Experience in this context means the user's experience with the new technology. Voluntariness measures the extent to which the user thinks the new technology's usage is non-mandatory. (Venkatesh & Davis, 2000)



***Picture 4** Technology acceptance model 2 (TAM2) (Venkatesh & Davis, 2000).*

TAM2 demonstrates how result demonstrability, job relevance, and image influence positively technology's perceived usefulness. Output quality does not have an increasing effect on perceived usefulness directly, but it increases job relevance. The framework also proposes that subjective norm directly increases the image, but person's experience has an attenuating effect on the subjective norm's increasing effect on perceived usefulness. Lastly, subjective norm has a positive effect on intention to use but it is attenuated by experience and voluntariness. (Venkatesh & Davis, 2000)

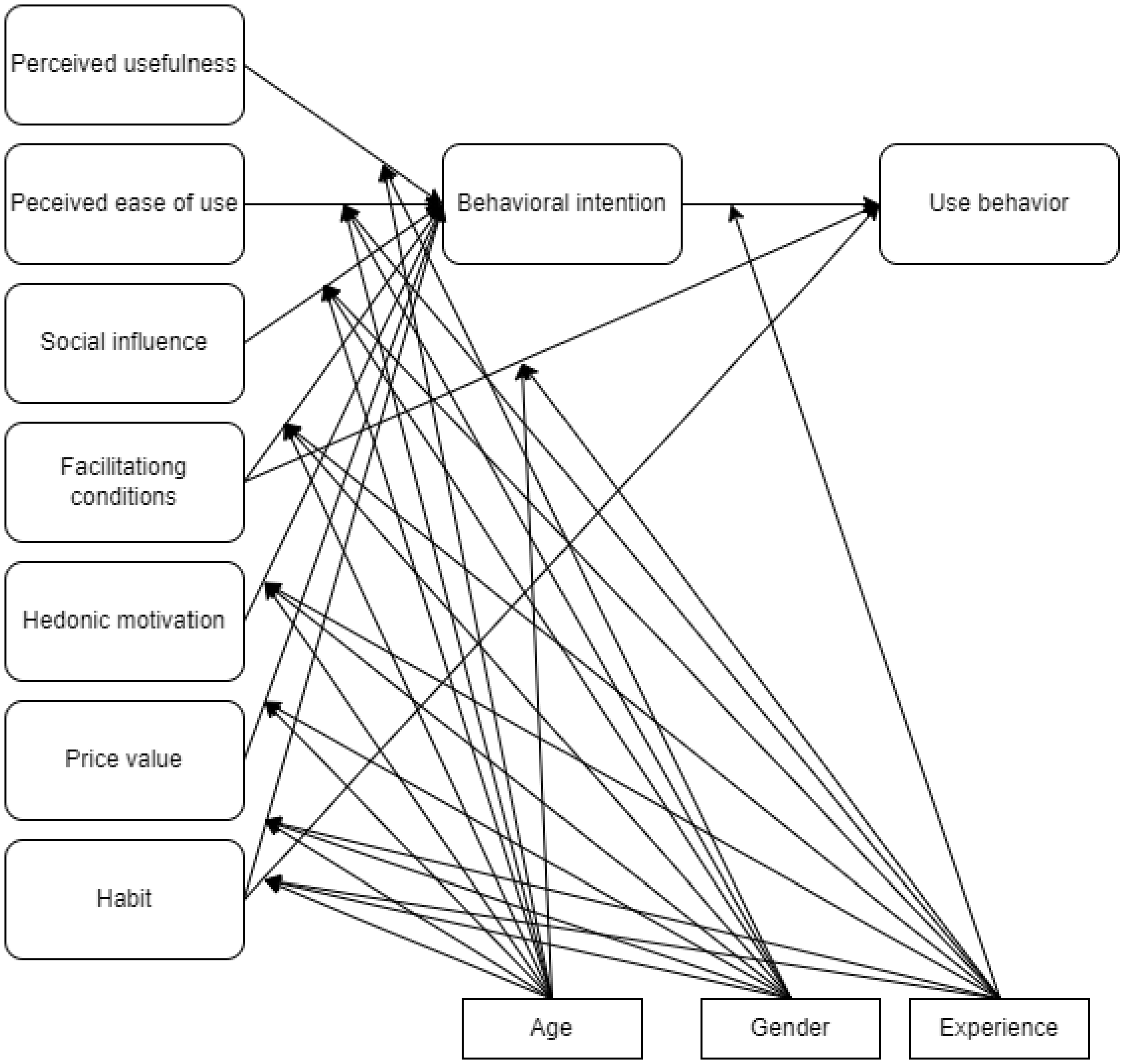
Unified theory of acceptance and use of technology (UTAUT) was developed in 2003 by Venkatesh et al. to form a comprehensive theory of technology acceptance combining prior technology acceptance research (picture 5). It is developed primarily for organizational context and builds on four key factors that affect behavioral intention and use behavior: performance expectancy, effort expectancy, social influence, and facilitating conditions. Venkatesh et al. (2003) define performance expectancy as the degree to which the technology is beneficial to the user in performing specific tasks. For more unified form, performance expectancy will be referred to as perceived usefulness due to their similar definitions. Venkatesh et al. (2003) describe effort expectancy similarly to perceived ease of use, which is why the name will be changed to make the models more comparable. Social influence is the extent to which the user perceives important people in their life think they should use the technology and facilitating conditions means the perceived resources and support that are available for the technology acceptance (Venkatesh et al. 2003).



Picture 5 *Unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al. 2003).*

UTAUT suggests that perceived usefulness, perceived ease of use, and social influence impact the behavioral intention to use new technology while behavioral intention and facilitating conditions affect actual technology use. The theory also identifies individual differences such as age, gender, experience, and voluntariness that moderate the effect of these relationships. Young people, males, experienced users, and those with higher voluntariness being more open for new technology adoption and usage than others. More so, perceived usefulness's effect on behavioral intention is moderated by age and gender, perceived ease of use's impact is moderated by age, gender, and experience while social influence's effect is moderated by age, gender, experience, and voluntariness. Facilitating conditions' impact on use behavior is moderated by age and experience. (Venkatesh et al. 2003)

Currently, an updated version of UTAUT has been introduced by Venkatesh et al. (2012) with the name of UTAUT2 that modifies the original theory to focus on consumer usage (picture 6). This relatively new, updated theory has been highly cited and well embraced by many researchers interested in technology acceptance in consumer context. Its main improvement to the previous model is to add hedonic motivation, price value and user habit to the equation while dropping out voluntariness, since consumer adoption is always voluntary. Hedonic motivation means the pleasure or fun that the user experiences while using the technology. Price value is defined as the tradeoff between perceived benefits and monetary costs of using the technology. Habit is the extent to which certain behaviors are automatic to the person due to learning. (Venkatesh et al. 2012)



Picture 6 *Unified theory of acceptance and use of technology 2 (UTAUT2) (Venkatesh et al. 2012).*

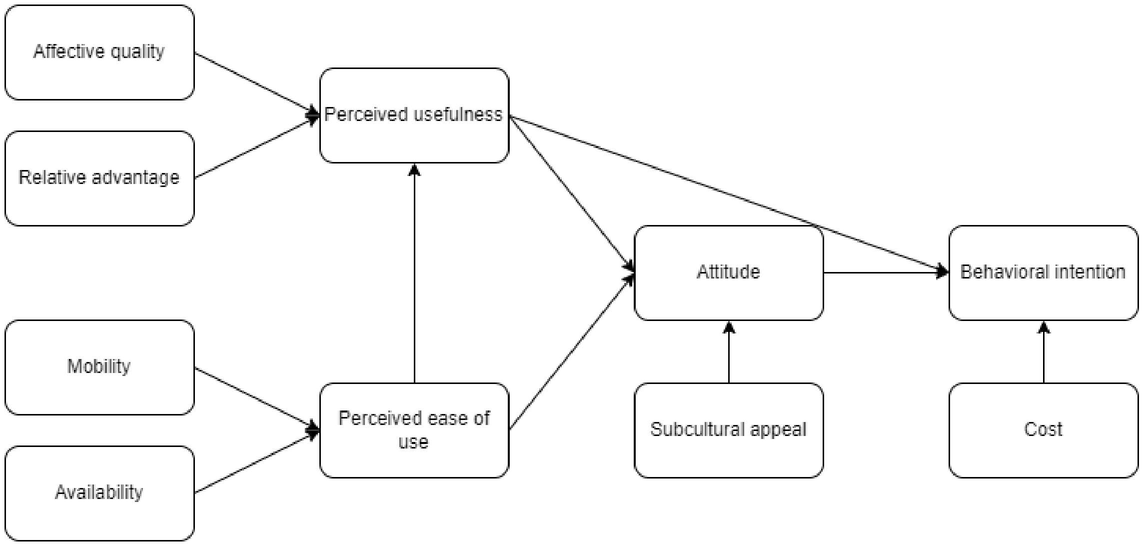
UTAUT2 points out that facilitating condition’s affect not only final use behavior but also intention to adopt, which is moderated by age, gender and experience. The same can be noted about habit with the exception that the relationship between habit and use behavior is also moderated by gender. Hedonic motivation and price value affect only intention to adopt, and both relationships are moderated by age and gender while hedonic motivation's impact is also moderated by experience. The final change is that the relationship between behavioral intention and use behavior is moderated by experience. (Venkatesh et al. 2012)

In conclusion, TAM is a good basis for technology acceptance theories, but it falls short on considering all the factors affecting technology adoption. TAM2 and UTAUT extend the TAM by considering new, more precise attributes, but their weakness is, that they do not apply directly to consumer context since they were invented for organizational technology adoption behavior. UTAUT2 is the most comprehensive technology acceptance model to date in a consumer context, but since it has been developed for general IT adoption, it does not consider the unique features of different technological inventions that influence the acceptance. Thus, it needs to be investigated, what are all the attributes leading to SWD adoption specifically.

2.1.2 Technology Acceptance of SWDs

A lot of the literature regarding SWD adoption include same determinants as presented in technology acceptance models, such as intention to adopt, perceived usefulness, perceived ease of use, social influence, hedonic motivation, and price value. In addition to these, many of the studies the effects of design, data privacy, and the user's attitude towards the technology on the intention behavior.

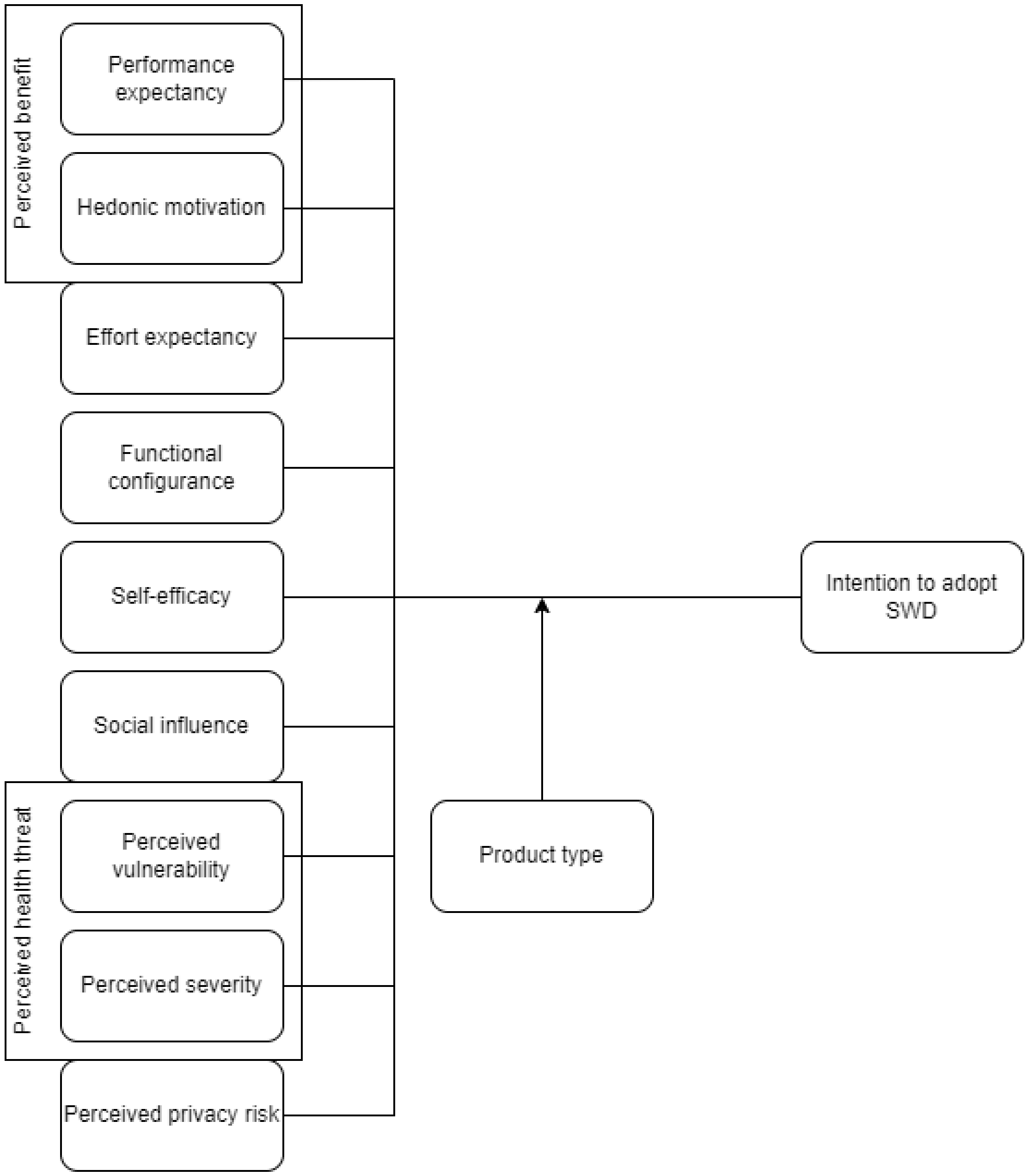
Kim and Shin (2015) studied the psychological determinants of smart watch adoption. They based their research on TAM and integrated their findings to the original technology acceptance model creating an extended TAM for smart watch adoption (picture 7). Their model considers the effects that perceived usefulness, affective quality, relative advantage, perceived ease of use, mobility, availability, attitude, subcultural appeal, behavioral intention, and cost have on smart watch adoption. Affective quality is described to be the degree to which the consumer believes that the technology can change their core affect and is a part of hedonic components. Relative advantage means the advantage the user gets from the technology opposed to using an alternative product. Mobility stands for the ability to use the device anywhere and availability measures the degree to which the user believes the device to give them real-time connection to information. Subcultural appeal is related to the user's sense of fashion and uniqueness when using the smart watch; the aesthetical purposes opposed to smart watches technological characteristics. (Kim & Shin, 2015)



***Picture 7** Psychological determinants of smart watch adoption using TAM (Kim & Shin, 2015).*

The study found that consumer's intention to adopt SWD is affected by the cost of the SWD, attitude towards the SWD and its perceived usefulness. The attitude is affected by the perceived usefulness, perceived ease of use, and subcultural appeal. The perceived usefulness is influenced by affective quality, relative advantage, and perceived ease of use. Perceived ease of use, on the other hand, is impacted by the SWD's mobility and availability. (Kim & Shin, 2015)

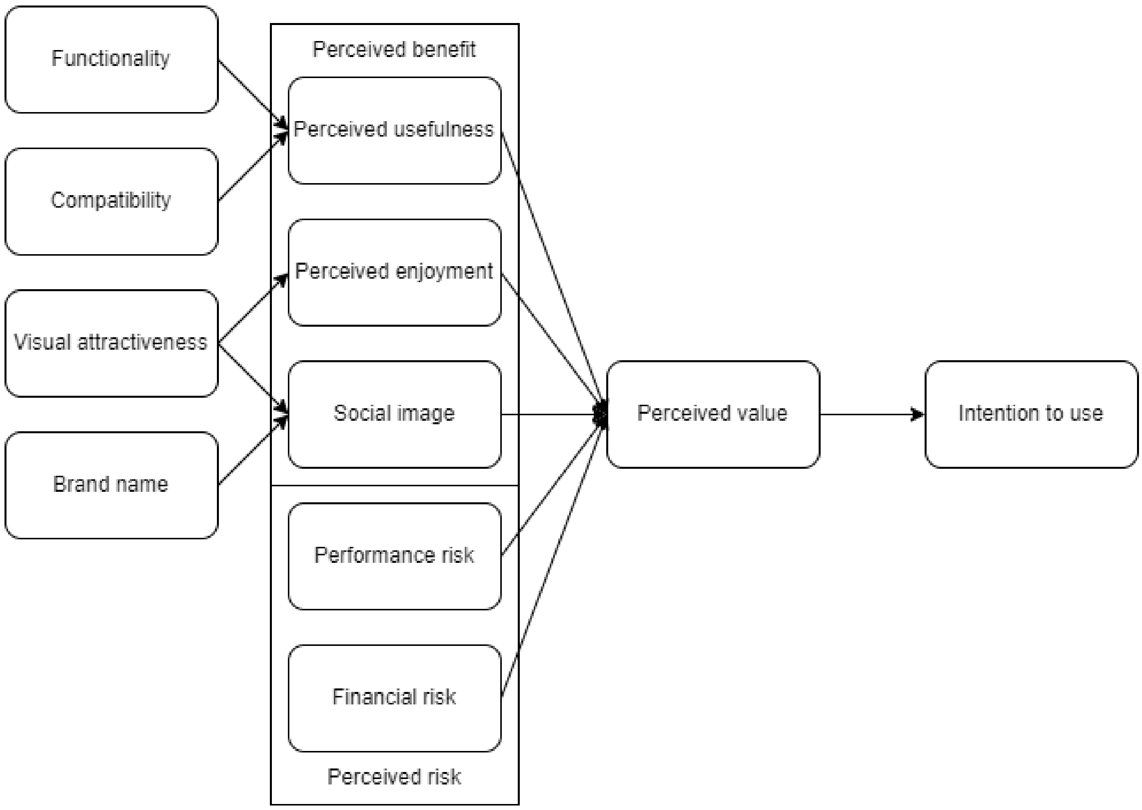
When Kim and Shin (2015) based their research on TAM, Gao et al. (2015) used UTAUT2 as their basis for theoretical background and they consider the factors from technology, health, and privacy perspectives. They study hedonic motivation, functional congruence, social influence, perceived privacy risk and perceived vulnerability as the factors for SWD adoption (picture 8). In their report functional congruence is described as the perceived suitability of the product to fulfill its functional and basic product-related needs. Because its similar description to perceived usefulness, the name will be changed to make the model more comparable to other models presenting similar ideas. Privacy risk represents the potential misuse of personal health information. (Gao et al. 2015) Li et al. (2015) state that privacy risk consists of health information sensitivity (what information the user is not willing to share), user's personal innovativeness (how open to new technologies the user is), legislative protection coming from the user's living area's government, and perceived prestige (similar to social influence). Finally, perceived vulnerability measures how likely the user perceives themselves to be experiencing health threat (Gao et al. 2015).



Picture 8 *Technology, health, and privacy as determinants for SWD adoption utilizing UTAUT2 (Gao et al. 2015).*

Gao et al. (2015) fount in their study, that fitness device users cared about the hedonic motivation, perceived usefulness, social influence, perceived privacy risk, and perceived vulnerability. Only perceived privacy risk had a moderating effect on the adoption. Li et al. (2016) stated that a user is more likely to adopt a healthcare wearable device if its perceived usefulness is greater than the privacy risk. A study done by Canhoto and Arp (2017) found that the interviewees were not willing to share their health data with their employers nor insurance companies and thus considered that as a barrier for adoption.

Yang et al. (2016) studied the perceived value of wearable devices in potential and current SWD users. They suggested that perceived value, the difference between benefits and sacrifices, is an antecedent of adoption intention, and it is influenced by perceived benefit and perceived risk (picture 9). Perceived benefit consists of perceived usefulness, perceived enjoyment, and social image. Perceived usefulness in this study includes the SWD's technical functionality, and its compatibility. Compatibility is defined as the degree to which the device complies with other products and user's needs and lifestyle (Yang et al. 2016; Peng et al. 2021). Perceived enjoyment and social image are influenced by the visual attractiveness of the product and brand name impacts the social image. Perceived risk includes performance risk and financial risk. Performance risk describes the potential loss faced when the product fails to meet consumers expectations, and financial risk portrays the monetary costs of the product before and after the purchase. (Yang et al. 2016)



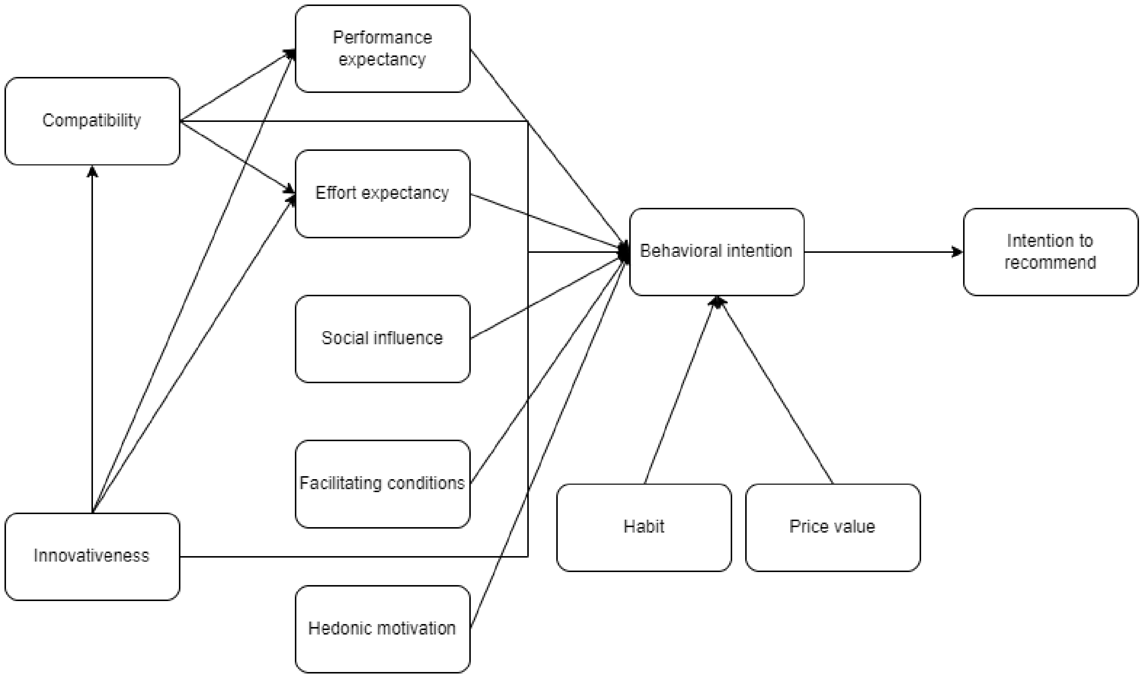
Picture 9 *Perceived value and intention to use (Yang at al. 2016).*

The theory shows that the perceived value has a strong correlation with the intention to use. Perceived value is heavily increased by the perceived benefit and moderated by the perceived risk factors. (Yang et al. 2016) However, this theory does not investigate the privacy risk's impact on perceived value, which has been proven to decrease the intention to adopt (Gao et al. 2015; Li et al. 2016; Canhoto & Arp 2017).

In 2017 Canhoto and Arp made qualitative research studying the factors influencing SWD adoption. Most of the current users said that they have a specific goal that SWD helps them to achieve, which impacted their adoption decision. Thus, they looked for a particular functionality (step counting, pulse measuring, etc.) that the SWD provided. Because these are the technical aspects that the user seeks SWD to fulfill, they can be considered under the perceived usefulness. The interviewees were also individuals that considered themselves to be interested in technology in general, thus reinforcing the theory that personal innovativeness has a positive influence in SWD adoption. The study also found that ease of accessing data, aesthetics of the SWD, price, social influence and data privacy have an impact on SWD adoption (Canhoto & Arp, 2017). These factors were also found by Kim and Shin (2015) if we consider the ease of accessing data to reflect the mobility and availability, and aesthetics to be included in subcultural appeal.

Hsiao and Chen (2018) argue that attitude has the most significant direct effect on the intention to adopt and the design (part of subcultural appeal) has the greatest impact on that attitude. In contrary to many other studies, they found that social value (part of sub-cultural appeal) and performance expectancy did not affect consumers' intention to adopt.

Talukder et al. (2019) studied the key facilitators and inhibitors of SWD adoption using UTAUT2 and diffusion of innovation as their theoretical background. They investigate the effects of performance expectancy, effort expectancy, social influence, habit, compatibility, personal innovativeness, facilitating conditions, hedonic motivation, and price value (picture 10).



***Picture 10** Facilitators and inhibitors for SWD adoption using UTAUT2 (Talukder et al. 2019).*

The study found that performance expectancy, effort expectancy, social influence, habit, compatibility, and personal innovativeness had the most significant effects on SWD adoption. Facilitating conditions, hedonic motivation, and price value have also positive influence on behavioral intention. (Talukder et al. 2019) These findings are consistent with previous studies on SWD adoption.

Papa et al. (2020) introduced the idea of smart healthcare devices' intrusiveness's and comfort's effects on adoption intention. They argue that if the user perceives the device to be intrusive or uncomfortable to wear, they are less likely to adopt the product. Because these attributes can be considered inhibiting the user's physical enjoyment, these can be considered factors of hedonic motivation.

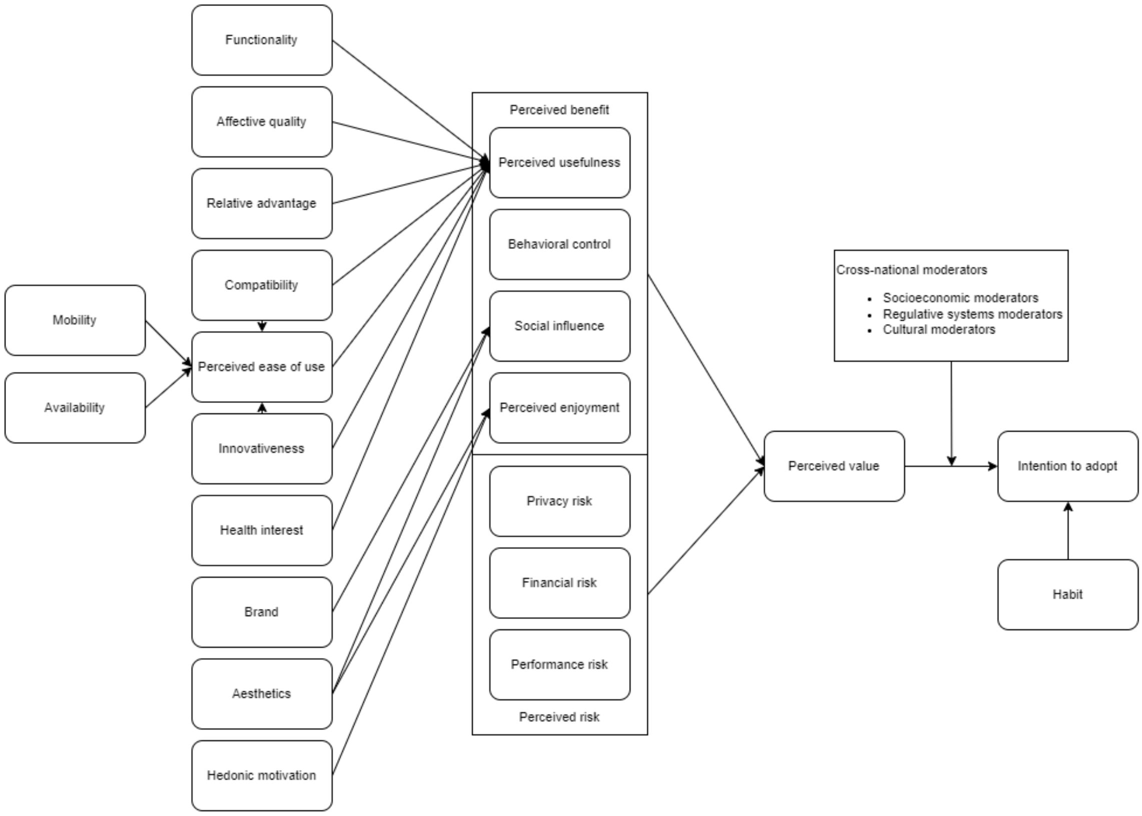
Dehghani & Kim (2019) pointed in their research that design aesthetics are most important factors for behavioral intention to adopt and continue usage. Especially screen size and the device's uniqueness have a positive effect on current users' use behavior and potential users' purchase intention. They also found that females value aesthetics more than males. Design aesthetics and uniqueness are already mentioned in Kim and Shin's (2015) research under subcultural appeal, so this study can be considered as a reinforcement for their theory.

Cheung et al. studied in 2019 the adoption of wearable healthcare technology and pointed out that health belief, health information accuracy, and privacy protection affect perceived usefulness. Health belief depicts the consumer's personal belief in the effectiveness of the device in improving their health, and it stems from user's concern for their health; perceived vulnerability introduced by Gao et al. (2015). Health information accuracy describes how reliable and credible the information provided by the device is. The study also captures the effects of reference group influence (or social influence) and user's personal innovativeness. (Cheung et al. 2019)

In 2021 Peng et al. made a cross-national meta-analysis on wearable health trackers. They found that the intention to adopt is influenced by consumer characteristics, technological characteristics, and cross-national moderators. Consumer characteristics include behavioral control, innovativeness, social influence, and health interest. Technological characteristics consist of the device's usefulness, ease of use, compatibility, enjoyment, and privacy risk. The cross-national moderators consider the socioeconomic moderators (e.g., GDP growth), regulative systems moderators (e.g., control of corruption), and cultural moderators (e.g., power distance, masculinity, individualism).

Huarng et al. (2022) investigated the key factors influencing intention to use healthcare wearable devices. In their study, monetary costs, data privacy, and perceived ease of use affected both perceived usefulness and intention to adopt. Perceived usefulness influenced directly intention to adopt.

Drawing conclusions from all these theories, picture 11 depicts all the factors affecting SDW adoption. It takes into account the consumer characteristics, technological characteristics, and cross-national moderators drawn from the analysis done by Peng et al. (2021) but it also shows the interdependencies and internal factors of each determinant.



***Picture 11** Determinants and cross-national moderators for SWD adoption based on research from years 2015-2021.*

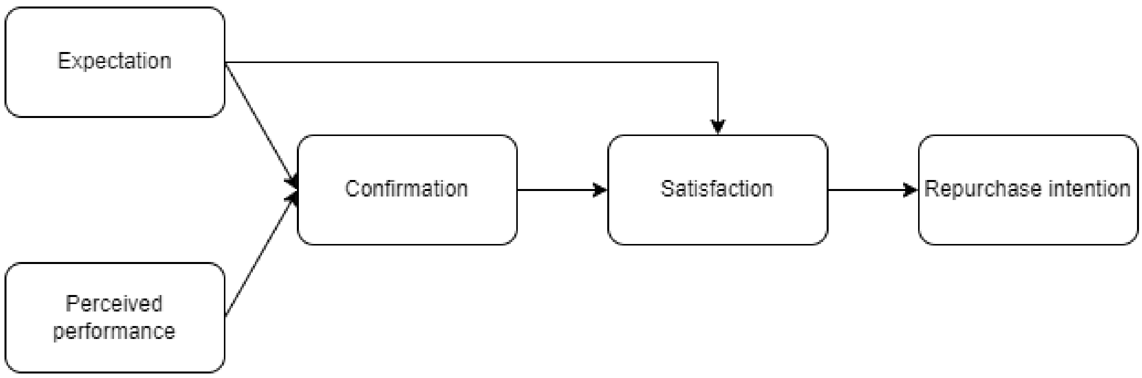
In picture 11 can be seen, that all the intention to adopt is relational to perceived value but moderated by cross-national moderators. This is, because the consumer characteristics and technological characteristics in Peng's et al. (2021) study can be divided into perceived benefit and perceived risk, which form the perceived value by Yang et al. (2016). Also, many of the individual determinant from the studies were placed under umbrella terms found in other studies based on their descriptions, so that all the mentioned factors could be included.

2.2 Continuance Intention and Behavior

This chapter introduces the theory behind continuance intention and behavior. Like in the previous chapter, first, the continuance intention for IT-systems is presented in a chronological order, after which relevant articles and theory frameworks concerning SWDs specifically are introduced. The theoretical models and research findings will be presented in a chronological order giving a better understanding of the theory development over time.

After adopting new technology comes the question, what contributes to its continuous use. Canhoto and Arp (2017) suggest that the factors supporting the adoption differ from those that contribute to continuous use. Bhattacherjee (2001) argues that continuation is intentional and planned behavior, but Bhattacherjee and Lin (2015) note that some studies indicate continuation behavior to be habitual rather than purposeful to some degree. They also found a theory that suggests continuance behavior to be also based on emotional or affective reactions, such as satisfaction. Thus, it can be said that continuance behavior is not only affected by continuance intention but also habit and emotions.

Expectation-Confirmation Theory (ECT) (picture 12) is widely used theory framework in studies researching consumer satisfaction, post-purchase behavior, and service marketing in general, and it has been proven to be applicable in various contexts. It suggests that a consumer's intention to repurchase or continue using a service is based on their satisfaction with prior use of said product or service. (Bhattacherjee, 2001)



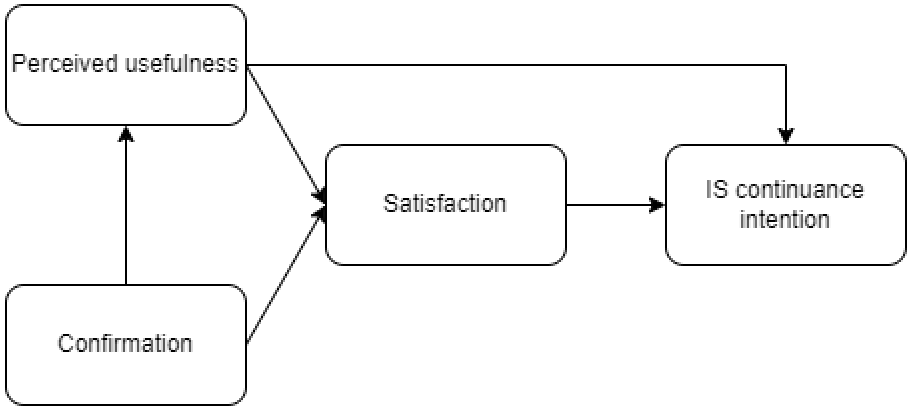
***Picture 12** Expectation-confirmation theory (ECT) (Bhattacherjee, 2001).*

The first step in ECT is consumer's expectations of a product or service prior to use, which is followed by the acceptance of said offering. After a period of initial usage, they form a perception about its performance, which is then compared to their original expectations, after which they determine the extent to which their expectation is confirmed (confirmation). The satisfaction is based on the confirmation level and the original expectation. In the final step, a satisfied customer forms a repurchase intention and dissatisfied customer discontinues the usage. (Bhattacherjee, 2001)

2.2.1 Continuance Intention for IT-Systems

The ECT has been critiqued by its ignorance of potential changes in consumer's expectations following their consumption of the product or service. There have also been differences in conceptualization of satisfaction and expectations, which result in varying results in studies using ECT (Bhattacherjee, 2001). Thus, Bhattacherjee (2001) presents

A Post-Acceptance Model of IS Continuance (later named expectation-confirmation model; ECM) (picture 13) that is derived from ECT and has four variables: perceived usefulness, confirmation, satisfaction, and Information System (IS) continuance intention. Confirmation is determined by how the user perceives the technology performs in comparison to their performance expectancy and can change according to the use experience. Satisfaction means the emotive state that results from users' disconfirmation of expectations pre-usage. (Bhattacherjee, 2001)

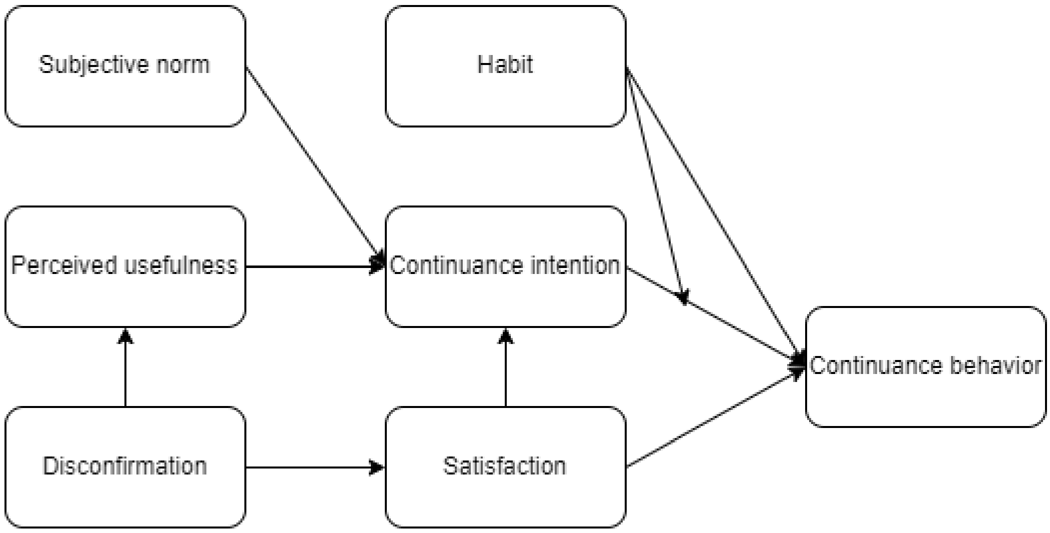


Picture 13 *Expectation-confirmation model (ECM) (Bhattacherjee, 2001).*

A Post-Acceptance Model of IS Continuance states that continuous use is determined by the satisfaction of information systems (IS) usage and perceived usefulness of sustained use. The confirmation of prior IS usage and perceived usefulness influence user satisfaction and perceived usefulness is determined by user's confirmation level. (Bhattacherjee, 2001)

While ECM is builds on the premises of TPB, other researchers argue that it is emotions and habit that play a significant role in users' continuance behavior. Thus, there was a need for a study covering all these theories together and their effects on continuous IT usage. Poole and Van de Ven (1989, p. 563) state that leveraging theoretical tensions between different perspectives can result in significantly improved theory.

In 2015 Bhattacherjee and Lin presented a Unified Model of Information Technology Continuance (UMITC) (picture 14) to combine different existing theories regarding IT continuance behavior. Their theory is heavily based on Bhattacherjee's ECM published in 2001, but they also consider the possible effects of habit, experience, and emotions. They suggest that three alternative influences, that are interdependent, complementary, and have cross-over effects, shape user's continuance behavior: reasoned action, experiential response and emotions, and habitual response. Reasoned action results from and is consistent with users' conscious intentions and it is based on reasoned and planned action. It includes subjective norm and perceived usefulness as determinants. Experiential response and emotions are shaped by users' satisfaction with the IT usage. Satisfaction is a unique determinant for continuance behavior due to its irrelevance to technology acceptance given the lack of experience before IT adoption. Experiential response and emotions also take into account the disconfirmation: the difference between pre-usage expectations and performance. Disconfirmation can be positive if performance exceeds expectations, or it can be negative if performance falls short of said expectations. Habitual response means that a lot of continued IT use is habitual, which is defined as an originally intentional learned action sequence, which can be repeated as it was learned without conscious intention. Habitual response is triggered by environmental cues in a stable context. (Bhattacherjee & Lin, 2015)



Picture 14 *Unified Model of Information Technology Continuance (UMITC) (Bhattacherjee & Lin, 2015).*

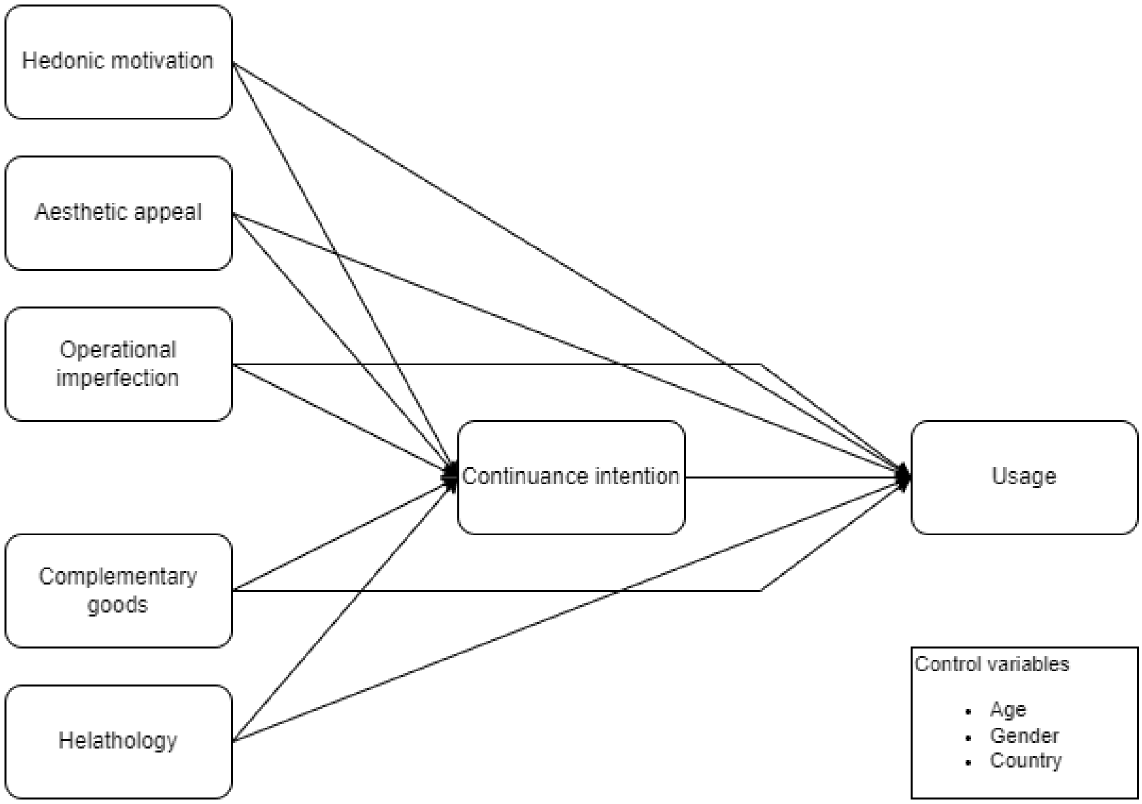
Reasoned action hypothesizes that users' continuance behavior is increased by their intention to continue IT usage. The continuance intention, on the other hand, is positively impacted by the users' perceived usefulness of continued IT usage, and their subjective norm toward continued IT usage. Experiential response and emotions theorize that users' continuance intention and continuance behavior are positively influenced by their satisfaction with prior IT usage. Their satisfaction with prior IT usage, in turn, is increased by the positive disconfirmation of their expectations from prior IT usage. Also, users' perceived usefulness is positively impacted by their positive disconfirmation of expectations. Habitual response states that users' continuance behavior is positively correlated with their habit regarding IT usage. It also explains that the relationship between continuance intention and continuance behavior is negatively influenced by the users' habits regarding IT usage. (Bhattacherjee & Lin, 2015)

2.2.2 Continuance Intention for SWDs

Lazar et al. (2015) studied the factors contributing to continuous SWD usage and abandonment. They found that continuous usage is positively influenced by users' developed routines (or habit), perceived usefulness, satisfied curiosity, and hopes for potential benefit. The participants were more likely to abandon the device if it did not fit the users' perception of themselves, the data provided by the device was not perceived useful, or the device maintenance became unmanageable. (Lazar et al. 2015)

Canhoto and Arp (2017) interviewed current SWD users and found that users, who achieved their set goal with the SWD, were more likely to abandon the device. Thus, continuous use can be supported by on-going health and/or fitness goals. The respondents also pointed out that the device portability and data availability were important for the users resulting in continuous usage. These attributes include battery life, size, working in different conditions, and data transportability to other devices. Also, the aesthetics and comfort were perceived as essential for sustained use. Some users liked the applications that worked with the SWD. Enjoyment, including contributors such as supportive messages, new features, games, and badges, was also mentioned as a factor supporting continuous use. They also mentioned the community of users and ability to share workouts and achievements to be important for some users. All these factors supporting sustained use differ from person to person depending on their attitudes towards health and fitness. Finally, it should be noted, that even though the user sustained SWD usage, the user may change from device to another SWD over time.

In 2018 Dehghani et al. made a theoretical model to research continuous use of smart watches. Their model takes into account the hedonic motivation, aesthetic appeal, operational imperfection, complementary goods, healthology, and continuance intention (picture 15). Their control variables were age, gender, and country the user lived in. Healthology depicts the interaction of health issues, informatics, and technology aiming to satisfy user's healthcare needs. Operational imperfection includes the technical issues occurring in smart watches (e.g., failure to detect movement) as well as impracticalities (e.g., device is too big to be portable). (Dehghani et al. 2018)



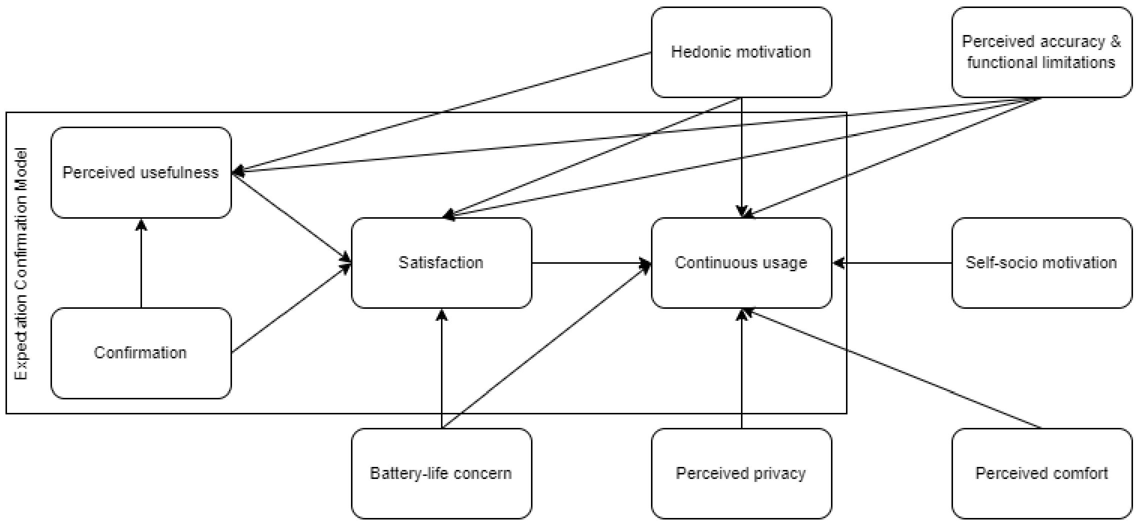
***Picture 15** Determinants affecting smart watch usage found by Dehghani et al. 2018).*

The study shows that aesthetics positively influenced both continuance intention and usage, when hedonic motivation only increased the continuance intention. Complementary goods and healthology increased the usage but not continuance intention. Operational imperfection had a negative impact on continuance intention. (Dehghani et al. 2018) From Lazar's et al. (2015) research, this study addresses the user's habit, and hopes for potential health benefits (under healthology). From Canhoto and Arp's (2017) study, this research also captures the importance of aesthetics, enjoyment (part of hedonic motivation), and complementary goods. However, this model failed to address the perceived usefulness (Lazar et al. 2015), curiosity satisfaction (Lazar et al. 2015), health-goals (Canhoto & Arp, 2017), comfort (Canhoto & Arp, 2017), battery-life concern (Canhoto and Arp, 2017), and social aspect (Canhoto & Arp, 2017).

The factors resulting in long-term SWD use was researched by Shin et al. (2019). They stated that previous studies have investigated the continuous use only during the novelty period (up to 3 months). In their study, during the novelty period, the user can be only curious about the data about their activity patterns, the device's functionalities and new technologies in general, and still continue using the SWD. When the novelty effect wears off, the interest towards knowing repetitive patterns of behavior and the functionalities fade. Also, the user's situation can change (e.g., less time to exercise and thus no need to track activity), which may result in abandonment of SWD. The research found that the long-term usage is supported by the user’s personal motivation, like existing medical conditions and existing motivation to be physically active, the social motivation, like feeling included (relatedness) and competing with others, and gaming motivation, like established goals, rewards or badges when achieving goals (recognition), feedback from the devices on set goals. (Shin et al. 2019)

Dehghani & Kim (2019) studied the effects of design on SWD use continuance. They discovered that the users value uniqueness, aesthetic appeal and sufficient screen size and those impact the users’ continuous use intention and behavior. Since this study focuses only on design attributes, it does not itself explain users’ continuance behavior.

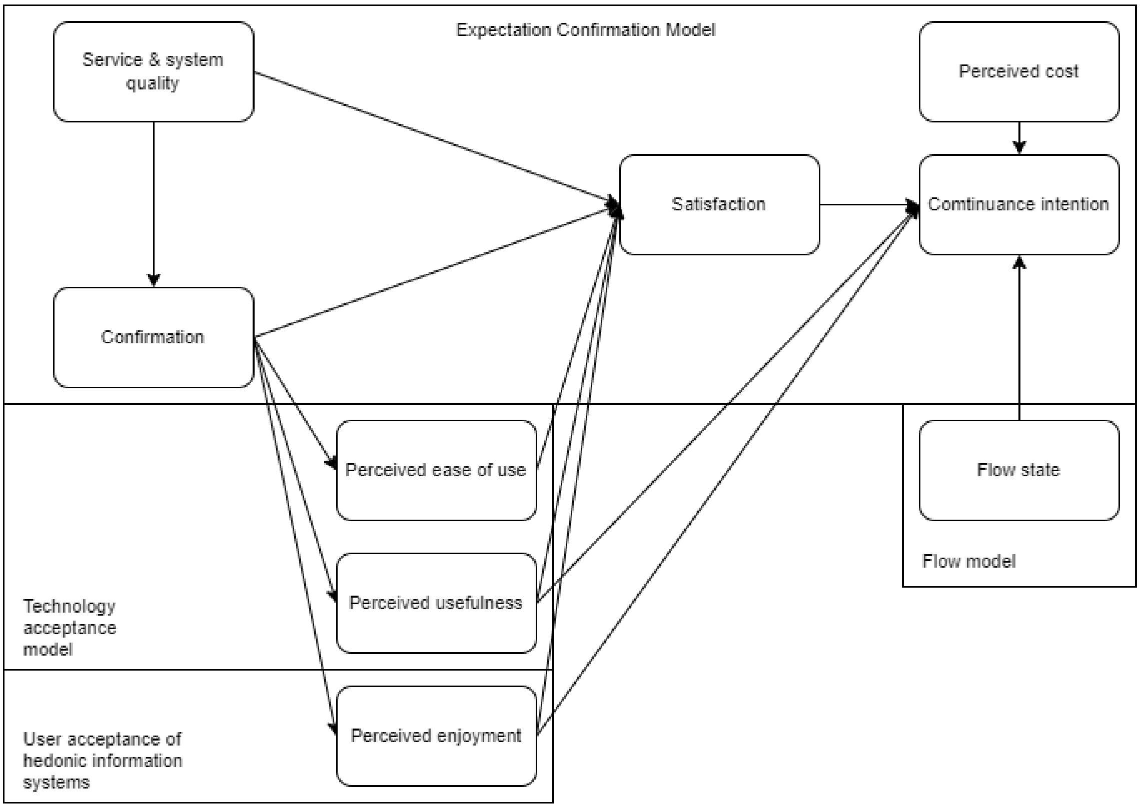
Pal et al. (2020) used the ECM (Bhattacherjee, 2001) as the basis for their research. They extended it by including six additional attributes: hedonic motivation, perceived accuracy, functional limitations, self-socio motivation, perceived comfort (including aesthetic appeal), perceived privacy, and battery life (picture 16). Perceived accuracy measures, how accurate the user thinks the data provided by the device is (e.g., does the device’s step count reflect the user’s perceived step count). Functional limitations, on the other hand, mean the constraints that the device has for its usage, e.g., device not being waterproof and thus used while swimming, and device not being compatible with other goods. (Pal et al. 2020) These can be viewed similarly to operational imperfections presented in Canhoto and Arp’s (2017) study. Pal et al. (2020) describe self-socio motivation being a combination of user’s self-motivation (motivation to do something due to inherent satisfaction) and subjective norm.



Picture 16 *Continuous SWD usage based on ECM (Pal et al. 2020).*

Pal et al. (2020) found, that perceived usefulness, hedonic motivation, perceived comfort and self-socio motivation had a positive influence on continuous usage. Perceived privacy risk, battery-life concern, perceived accuracy (or inaccuracy), and functional limitations had a negative effect on use continuance. Functional limitations being particularly important predictor (Pal et al. 2020). This study did not count in the effects of healthology from Dehghani's et al. (2018) study, but it can be perceived as an integrated part of users' expectations, since users adopting the device for health purposes expect it to fulfill their needs. Same applies to Canhoto and Arp's (2020) health-goal attribute.

In 2020 Park studied SWD users' continuance intention using ECM, TAM, user acceptance of hedonic information systems, and flow models as theoretical frameworks. The model includes service and system quality, confirmation, satisfaction, perceived cost, perceived ease of use, perceived usefulness, perceived enjoyment, flow state, and continuous intention to use (picture 17). Service and system quality is defined as "the extent of users' feeling on the performance of a system in their usage" (DeLone & McLean, 1992; Park, 2013). Perceived costs include the initial purchase costs as well as usage and maintenance costs related to the SWD. The flow state refers to the immersed feeling the user experiences while using the SWD. (Park, 2020)



Picture 17 *ECM, TAM, user acceptance of hedonic information systems, and flow model affecting continuance intention (Park 2020).*

The study found four positive (satisfaction, perceived usefulness, perceived enjoyment, and flow state) and one negative factors (perceived cost), which play notable roles in users' continuance intention. However, the negative effect of costs was marginal in users' that already have the device, which can be explained by the fact that the initial purchase cost does not affect current users, since they already have the device. Service and system quality pose an increasing role for confirmation and satisfaction. Confirmation increases perceived ease of use, perceived usefulness, and perceived enjoyment. Perceived ease of use, perceived usefulness, and perceived enjoyment, on the other hand, have a positive influence on users' satisfaction level. The relationship between confirmation and satisfaction was slightly negative and thus insignificant. (Park 2020) The study is the most comprehensive thus far, but it fails to address the sociological factors influencing continuance intention and behavior.

Bölen (2020) investigated smart watch users' continuance intention. He used an extended model of ECM adding individual mobility, perceived aesthetics, and habit to the equation to assess the continuous SWD usage (picture 18).

Picture 18 *Extended ECM affecting continuance intention of SWDs (Bölen, 2020).*

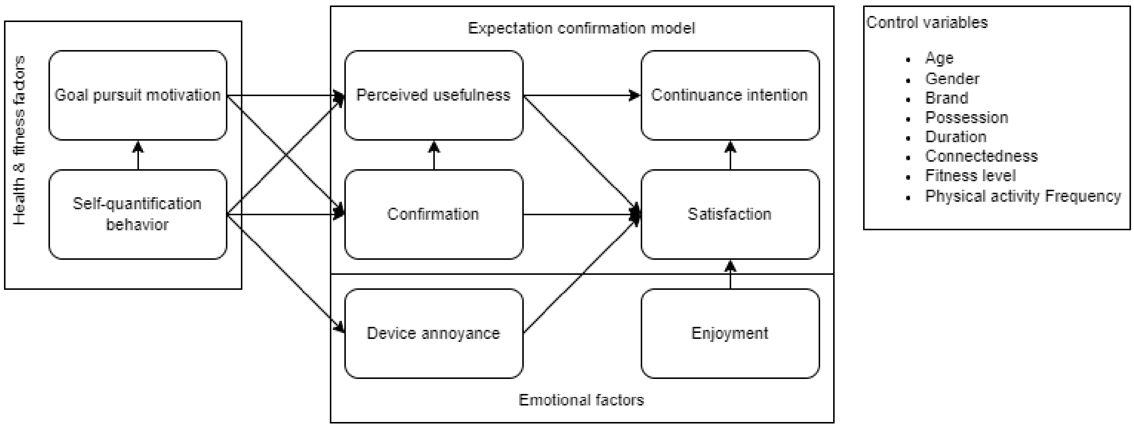
The study shows that individual mobility has a positive effect on perceived usefulness and continuance intention. Perceived aesthetics increase the user's satisfaction and continuance intention, and habit influences the continuance intention. (Bölen, 2020) On contrary to previous studies, Bölen (2020) deemed perceived usefulness' effect on continuance intention as non-significant, but it still poses a role influencing satisfaction. Like the research conducted by Park (2020), this study fails to consider different social factors and norms when assessing the continuance intention.

Lee and Lee (2020) made an empirical study examining the effect of internal and external factors on continuance behavior (picture 19). The internal factors are based on Humphis and Ling' (2000) KAP model, used to evaluate the knowledge, attitudes, and practices of the general public regarding their health behavior, which was then enriched by Health Belief Model (HBM) to include health belief to the model making it the KAPB model. Knowledge is defined as the understanding, acquisition, management and use of knowledge and technology. Attitude consists of cognitive, emotional, sensory, and behavioral tendencies. Practice means the appliance of knowledge and rules to result in a final action. Health belief represents the user's perceived usefulness of the device in health care setting. This was the first study to assess the relationship between attitudes and continuance behavior using KAPB model. However, the practice factor was dropped, since in order to continue the usage of the device, it must be actively used in practice. The external factors were extracted from TPB and UTAUT2, that include technological factors and social factors. The social factors define the level of technology and characteristics associated with the device. Social factors are the beliefs of others' opinions of the product and its efficacy. (Lee & Lee, 2020)

Picture 19 *Internal and external factors for continuous SWD usage (Lee & Lee, 2020).*

The study demonstrates that the internal and external factors promote actual use behavior. It also shows that the use behavior increases users' health improvement expectancy, which is defined as the degree to which the user believes the device has worked. Health improvement expectancy consecutively, increases the continuous use intention. The final point made by the study was, that these relationships are stronger among health care professionals compared to general public. This research includes many of the factors previous studies deemed as important for continuance behavior. However, its relationships remain one-sided and straight-forward without considering possible cross-effects and internal relationships between its factors leaving the model to be naïve. In addition, it did not consider the possible effects of habit.

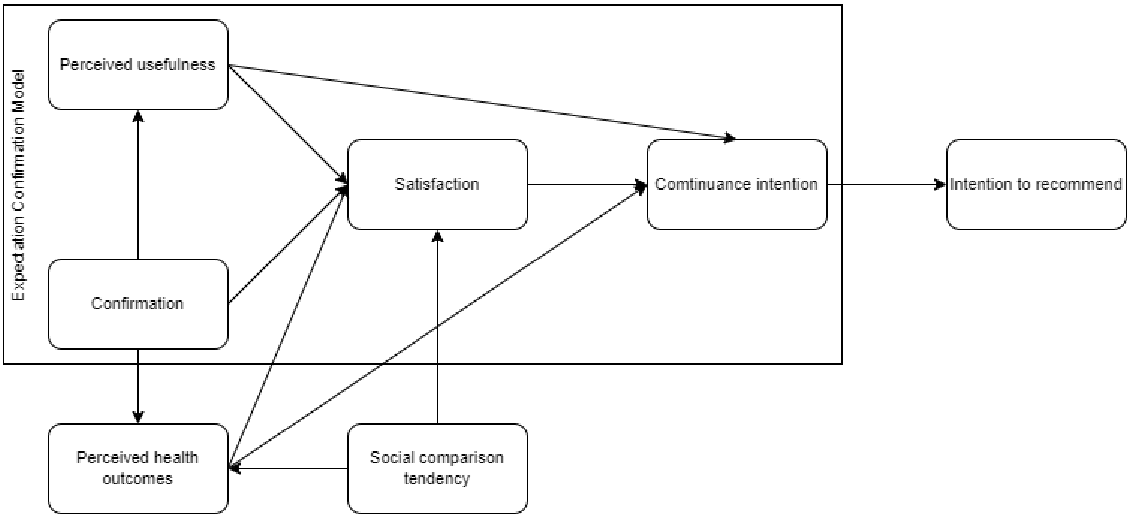
Siepmann and Kowalczuk (2021) researched the continuance intention from extended ECM's perspective, adding health and fitness, and emotional factors to the model (picture 20). Health and fitness factors include goal pursuit motivation and self-quantification. Goal pursuit motivation is defined as the degree to which the user engages in a certain behavior to reach their goals. Self-quantification depicts the process of collecting and reflecting on personal data by using the SWD. Emotional factors consist of device annoyance and enjoyment. Device annoyance is the unpleasant reaction to subjective overexposure to the device (e.g., notifications). (Siepmann & Kowalczuk, 2021)



Picture 20 *ECM, emotional factors, and health and fitness factors influencing continuance intention of SWDs (Siepmann & Kowalczuk, 2021).*

Siepmann and Kowalczuk's (2021) research found multiple cross-relations between its model's factors. Self-quantification has a positive effect on goal pursuit motivation, perceived usefulness, and confirmation. It was also perceived to decrease device annoyance. Goal pursuit increased both perceived usefulness and confirmation. Satisfaction was decreased by device annoyance but increased by enjoyment. The effects inside ECM remained as in Bhattacherjee's (2001) original study. (Siepmann & Kowalczuk, 2021) Like Park's (2020) and Bölen's (2020) studies, this study did not examine the social factors influencing continuance behavior, but it highlighted the importance of health and fitness factors, which were not specifically examined by Park (2020) or Bölen (2020). It also ignores the importance of habit or flow state.

Gupta et al. (2021) used ECM as their base theory for investigating continuance intention and combined it with social comparison theory and introduced perceived health outcomes as a new determinant (picture 21). Social comparison theory examines the influence of social comparison tendencies on certain topic. It assumes that people have tendency to compare themselves to others. Social comparison tendency is defined as the degree to which person thinks about other people in relation to oneself. (Gupta et al. 2021)



Picture 21 *ECM, social comparison theory and perceived health outcomes impacting continuance intention (Gupta et al. 2021).*

The research demonstrates that social comparison tendencies increase user satisfaction and perceived health outcomes. Perceived health outcomes is also influenced positively by confirmation, and it promotes both user satisfaction and continuance intention. The results are controlled by age, gender, and device type variables. The ECM section proves to remain as in Bhattacherjee's (2001) version. It also points out that post-adoption perceived usefulness does not guarantee continuance intention if perceived health outcomes are not achieved. (Gupta et al. 2021) Although this model considers the health perspective and social influences, it fails to assess the effect of habit.

In conclusion, the ECM was widely used framework to examine users' continuance intention. It was extended by the researchers with various new elements relating to SWDs, but none of the studies considered the effects of ECM, social factors, and habit together, which were noted to be important for IT continuance by Bhattacherjee and Lin (2015). Thus, the users' SWD continuance intention and behavior should be assessed using this Unified Model of IT Continuance to capture the effects of reasoned action, experiential response, and habitual response.

The effect of design and appeal was noted by Canhoto and Arp (2017), Dehghani et al. (2018), Dehghani and Kim (2019), Pal et al. (2020), and Bölen (2020). However, since the aesthetics also influence greatly the adoption of SWD (Kim & Shin, 2015; Canhoto & Arp, 2017; Hsiao & Chen, 2018; Dehghani & Kim, 2019) it can be assumed that the user is already pleased with the aesthetics of their acquired SWD and thus, the aesthetics can be ignored as its own factor when researching the factors influencing continuous SWD usage. The user's opinion on the aesthetical appeal can change, but it can be ingrained in the user's satisfaction and confirmation factors. If the user was satisfied with the aesthetics before but is not now, their new expectations of the appeal is negatively disconfirmed and their satisfaction with the device is lower.

2.3 UMITC and SWDs

As noted earlier, there has not been research done on SWD continuance by using UMITC. This research is trying to fill this gap in the literature. To understand the UMITC in SWD context, this section will present the seven determinants of the model and go through the used survey questions to explain how this study is conducted and why.

Each determinant is assessed using several different questions that may seem similar at first but have different undertones. This gives the researcher a more comprehensive picture of the determinant regarding one user. Also, more questions per determinant inhibit the effect of occasional clicking errors and thus the results can be viewed as more reliable.

2.3.1 Continuance behavior

Continuance behavior means the degree to which the user continues using their SWD in practice based on past approval decision (Tran, 2021; Amin et al. 2021). It is important to measure the continuance behavior to detect if the different UMITC determinants translate into actual continuous usage.

Tran (2021) measured the continuance behavior of mobile food delivery apps with questions CB1, CB2, CB3, and CB4 (appendix A). CB1, "if I have the chance, I will use my wearable device", measures the users' willingness to use their SWD when having the possibility to do so. The question is not definitive, since it is not expected that the users use their SWD during e.g., formal events or medical procedures.

Question CB2, "I will always try to use my wearable device in my daily life", maps the users' readiness to use their SWD. It depicts if the users are actively trying to integrate the SWD in their daily life (Tran, 2021). While CB1 measures the usage behavior in known possible circumstances, CB2 measures if the users' try to use the SWD outside of these situations.

CB3, "I maintain to utilize my wearable device on a regular basis", assesses if the users' will maintain their SWD usage as it is (Tran 2021). It rules out the possibility that the users' situation change, thus leading to limited SWD usage. For example, if the responder uses SWD to train for a marathon, they are more likely to reduce their SWD usage after the marathon is completed and thereby their answer to this question may differ from someone who uses SWD for other purposes even though their answers to CB1 and CB2 were the same.

The last question regarding continuance behavior, CB4 "in the future, I will use my wearable device", measures the users' active intention to use the SWD down the line without taking a stand on how often the SWD is used (Tran, 2021). For instance, the user training for marathon may disagree with CB3, since they are reducing their SWD usage, but still intend to use the SWD on some occasions without being so strict about it. Thus, they may agree with CB4 and therefore evince continuous use behavior.

2.3.2 Continuance intention

Continuance intention portrays the degree to which the users think that they will perform a certain activity. According to TRA, the behavioral intention promotes actual behavior (Fishbein & Ajzen, 1975). Thus, the stronger the intention, the more likely the user is to continue their SWD usage. Studies done by Dehghani et al. (2018), and Pal et al. (2020) have already proved the correlation between these determinants in SWD context, which this study tries to confirm by using UMITC. To assess the behavioral intention, users were asked questions CI1 (Bhattacherjee, 2008; 2015; Siepmann & Kowalczuk, 2021), CI2 (Siepmann & Kowalczuk, 2021), and CI3 (Bhattacherjee, 2008; 2015; Siepmann & Kowalczuk, 2021).

CI1, "I intend to continue using my wearable device rather than discontinue its use", measures the users' notion to continue SWD usage compared to device abandonment. It depicts the user's mental state that they want to continue using their SWD. (Bhattacherjee, 2008; 2015; Siepmann & Kowalczuk, 2021)

Question CI2, "I predict I would continue using my wearable device", evaluates how probable the user thinks it is that they continue using their SWD (Siepmann & Kowalczuk, 2021). Its main difference to CI1 is, that CI1 measures the users' willingness to continue

SWD usage as CI2 measures the likelihood of that occurring in practice, since sometimes people's intentions and actions may contradict. This gives us a better picture of not only the users' intentions but their predictions of how strong their intentions are.

The users' systematic and deliberate intention of SWD continuation is assessed with CI3, "I plan to continue using my wearable device" (Bhattacherjee, 2008; 2015; Siepmann & Kowalczuk, 2021). It measures the users' conscious choice to continue SWD usage as CI1 measures the users' state of will and CI2 measures their prediction of their actual behavior.

2.3.3 Subjective norm

Subjective norm refers to the user's perception, of what people that are close to them think of the technology and its use, and its influence on the user's behavior (Venkatesh & Davis, 2000; Pal et al. 2020). Thus, the social influences recognized in some studies can be also included under social norm. Social norm is assessed in this study to know the effect social influences have on users' continuance behavior. TRA recognized the effect of subjective norm on behavioral intention (Fishbein & Ajzen, 1975) and many other studies have recognized its effect on SWD adoption and continuous use (Venkatesh & Davis 2000; Venkatesh et al. 2003; Gao et al. 2015; Yang et al. 2016; Canhoto & Arp 2017; Talukder et al. 2019; Shin et al. 2019; Cheung et al. 2019; Pal et al. 2020; Lee & Lee 2020; Peng et al. 2021). Subjective norm was examined by asking the respondents questions SN1, SN2, and SN3 (adapted from Bhattacherjee, 2008; 2015).

SN1, "People who influence my behavior (e.g., family, friends, colleagues) think that I should use my wearable device", measures the impact influential people have on the user's continuance behavior (Bhattacherjee, 2008; 2015). More so, it assesses, do the influential people think the user should use their SWD and how it affects the continuance intention.

Question SN2, "People who are important to me (e.g., family, friends, colleagues) think that I should use my wearable device", is similar to SN1, but instead of measuring influential people's impact, it concentrates on those people's opinions that are close to the responder (Bhattacherjee, 2008; 2015). This is assessed, since sometimes generally influential people do not affect one's behavior but e.g., close family members do. Thus, asking both these questions, we can capture all social influences impacting behavioral intention.

SN3, “People who influence my behavior (e.g., family, friends, colleagues) would welcome my use of my wearable device in my life” assesses again the influential people’s impact on continuance intention, but this time it examines the user’s perception of if those influential people would recommend the SWD pre-purchase (Bhattacherjee 2008; 2015). It is differentiated from SN1, since sometimes people think one should continue their behavior as is (SN1) but would not have encouraged the behavior before (SN3). Thus, we also assess how the responders’ perceptions of the influential people’s recommendation probability impact the responders’ continuance intention.

2.3.4 Perceived usefulness

Perceived usefulness depicts the extent to which the user finds the SWD to enhance their performance (Davis, 1989). It is recognized to increase intention to adopt both general IT systems and SWDs as per TAM (Davis, 1989; Kim & Shin, 2015; Gao et al. 2015; Yang et al. 2016; Canhoto & Arp, 2017; Cheung et al. 2019; Peng et al. 2021; Huarng et al. 2022). Bhattacherjee and Lin (2015) argue that perceived usefulness directly increases intention to continue IT usage. This argument has been proved to hold true in SWD context as well by Pal et al. (2020), Park (2020), Siepmann and Kowalczuk (2021), and Gupta et al. (2021). Park (2020), Siepmann and Kowalczuk (2021), and Gupta et al. (2021) argue that perceived usefulness does not only increase continuance intention but also user satisfaction, which has a positive influence on continuance intention. Bölen (2020), on the other hand, found that perceived usefulness does not directly increase continuance intention of SWDs. This study tries to untangle these contradictions between previous studies and find if there is a correlation between perceived usefulness and continuance intention. This study does not, however, examine the relationship between perceived usefulness and satisfaction as per Bhattacherjee and Lin’s (2015) model.

The survey questions used to measure perceived usefulness were copied from studies made by Bhattacherjee and Lin (2015), Siepmann and Kowalczuk (2021), and Davis (1989). PU1, “Using my wearable device improves my performance”, measures the user’s perception of improved performance resulted from SWD usage. It examines the results the user perceives to achieve by using SWD.

PU2, “Using my wearable device increases my productivity”, also measures the results yielded from SWD usage, but it measures a different kind of result. Improved performance and improved productivity can be achieved without one another, which is why they both need to be assessed to measure the overall achieved results perceived by the user.

Question PU3, “I find my wearable device to be useful”, maps if the user perceives the SWD to be beneficial. It is different from PU1 and PU2 since it does not measure the outcome of SWD usage but if it is overall useful for the user. Sometimes even without any visible results. For example, some smart watch users may use their smart watch to get text notifications and thus perceive it to be useful without improving productivity or performance. With these questions, we can depict the consciously perceived benefits (PU3) and sometimes subconsciously perceived benefits (PU1, PU2) the user experiences while using their SWD.

2.3.5 Satisfaction

Satisfaction describes the level of gratification gained from prior SWD usage (Bhattacherjee 2001; Guinea & Markus, 2009). Pal et al. (2020), Bölen (2020), Park (2020), Siepmann and Kowalczuk (2021), and Gupta et al. (2021) have found that satisfaction has a notable positive impact on continuance intention of SWDs. It is argued that satisfaction influences also the continuance behavior directly without intention’s mediating effect (Guinea & Markus 2009). To assess the effects satisfaction has on continuance intention and continuance behavior, the level of satisfaction is measured with questions SA1, SA2, and SA3 taken from studies made by Hsiao et al. (2016) and Bölen (2020).

SA1, “I am satisfied with the experience of using my wearable device”, evaluates the user’s level of satisfaction with their experience with using SWD. This can be considered the most straight forward way to measure satisfaction since it asks about the satisfaction that the user is conscious of.

Question SA2, “My decision to use my wearable device was a wise one”, measures the less conscious satisfaction level the user has of the SWD. The responder can be slightly unsatisfied with their SWD experience thus far but still remain optimistic for the future or consider some SWD attributes to be satisfactory making the usage decision to be perceived as wise. Thus, this question in addition to SA1 makes the satisfaction assessment more comprehensive.

SA3, “I think I made the correct decision in using my wearable device”, is similar to SA2 but with slightly different wording, which makes the responder to consider the question from different perspective. Thus, this question combination gives a boarder picture of the user's overall satisfaction level on conscious and subconscious level.

2.3.6 Disconfirmation

Disconfirmation is the difference between pre-usage expectations and performance (Bhattacherjee & Lin, 2015). It can be positive if performance exceeds user's expectations, or it can be negative if performance falls short of said expectations. In ECM the same concept is depicted by 'confirmation'. While disconfirmation represents the differences between expectations and reality, confirmation describes how close the reality matches user's expectations. In this study, disconfirmation is used as a term for user experience that exceeds their expectations and includes all types of expectations related to SWD use including aesthetics, hedonic motivation, healthology, and functional expectations, which affect either confirmation directly or same determinants as confirmation (Pal et al. 2020; Bölen, 2020; Park, 2020; Siepmann & Kowalczuk, 2021)

Bhattacherjee and Lin (2015) found in their study that disconfirmation has a positive impact in perceived usefulness and satisfaction. This theory is proved to hold true also in SWD context (Pal et al. 2020; Park, 2020; Bölen, 2020; Gupta et al. 2021; Siepmann & Kowalczuk, 2021). Gupta et al. (2021) theorizes confirmation to increase also perceived health outcomes, which is not included in this study. Similarly, referring to Park's (2020) study, confirmation affects perceived ease of use and perceived enjoyment, which are not studied in this research due to their absence in UMITC.

Disconfirmation is measured with questions DI1 (Bhattacherjee, 2001; Siepmann & Kowalczuk, 2021), DI2 (Bhattacherjee, 2001; Siepmann & Kowalczuk, 2021), DI3 (Bhattacherjee, 2001; Siepmann & Kowalczuk, 2021), and DI4 (Hsiao et al. 2016; Bölen, 2020). DI1, "My experience with using my wearable device was better than what I expected", assesses directly user's perception of the positive difference between their expectations and user experience.

DI2, "The functions provided by my wearable device were better than what I expected", tries to find out more specifically, what contributed to the exceeded expectations. It assesses the user's perception of the functions provided by the SWD in relation to their presumption.

Question DI3, "Overall, most of my expectations from using my wearable device were confirmed", measures the user's confirmation level. The user's expectations may not have been exceeded, but they may still have been confirmed. This question tries to separate those users from the user's, whose expectations were not met by the SWD.

DI4, "My wearable device can meet demands in excess of my required functions", examines the level of expectation exceeding. If the user had low expectations, they may have been met but not in excess to the user's needs. This question tries to map those users, whose SWD can fulfill also upcoming functional needs.

2.3.7 Habit

Habit is defined as the automatic actions a person performs due to learning. (Venkatesh et al. 2012). Bhattacherjee and Lin (2015) argue that habit inhibits the influence continuance intention has to continuance behavior, but it has a direct positive effect on continuance behavior. The theory indicates that if the user has already formed a habit of using certain IT, they are more likely to continue the usage without the conscious intention to do so. (Bhattacherjee & Lin, 2015) Bölen's (2020) and Park's (2020) studies show that habit impacts positively continuance intention saying that as the user becomes more used to using a technology, the intention to continue using it increases. These two perspectives prove that habit has an overall positive effect on continuance but have different points of view on how the habit affects the conscious intention. Because Bölen's (2020) and Park's (2020) studies did not include continuance behavior as a determinant, thus ignoring habit's possibly different impacts on continuance intention and continuance behavior, the model done by Bhattacherjee and Lin (2015) can be viewed as more comprehensive.

This study examines the users' habit and its influence on continuance intention and continuance behavior with questions HA1 (Bhattacherjee & Lin, 2015), HA2 (Bhattacherjee & Lin, 2015), HA3 (Bhattacherjee, 2008; Bhattacherjee & Lin 2015; Siepmann & Kowalczuk, 2021), and HA4 (Siepmann & Kowalczuk, 2021). HA1, "Using my wearable device has become automatic to me", asks the user if they have to put in a conscious effort to use their SWD. It tries to find out how automatic the SWD usage has become to the user.

HA2, "Using my wearable device comes naturally to me", measures the extent to which the user thinks using SWD has become a part of them. It has a similar connotation to HA1 but due to different wording it gives a more comprehensive picture of the user's effort towards using SWD.

HA1 and HA2 measure the habit as per the definition of a habit, but the user may still not consider the usage as a habit themselves. Thus, question HA3, “The use of my wearable device has become a habit for me”, assesses the user’s own perception if the SWD usage is a habit of them.

HA4, “Using my wearable device belongs to my daily routine”, measures the strength of the habit. It targets to find out how frequent the SWD usage is and thus, how strongly the SWD usage is ingrained within the user’s life.

3. METHODOLOGY

This chapter goes through all the essential elements regarding this research's methodology. It defines the research question, research design, including the context of the research, data gathering methods, and the research process.

Saunders at al. (2016) argue, that to fully understand a research, it is crucial to understand its research philosophy and the approach to theory development behind said study. This research builds on critical relativism, which, according to Saunders et al. (2016, p. 136) assumes reality to be layered consisting of the empirical, the actual, and the real realities. It has objective structures and causal mechanisms take place. According to critical relativism, acceptable knowledge is considered historically situated and transient. Historical causal explanations contribute to socially constructed facts. In this research philosophy, the researcher acknowledges bias by world views, cultural experience and upbringing, and tries to minimize their effect on the results. Researcher itself remains unbiased. (Saunders et al., 2016 p. 136)

This research bases its theory development in deduction. Saunders et al (2016, p. 145) say, that deductive interference assumes conclusions to be true, when the premises are true. The conclusions are generalizable from the general to the specific and the data is collected evaluate propositions or hypotheses related to an existing theory, which is then either falsified or verified (Saunders et al., 2016 p. 145). This research builds its theoretical framework and then tests its accuracy via survey.

3.1 Research Design

This research aims to find out the correlations between different SWD usage determinants, users' continuance intention, and their continuance behavior. The research is conducted to university students in Finland. Thus, the research question for this study is:

"What factors contribute to continuous SWD usage by Finnish university students"

Because the purpose of this research is to find causal relationships in users' SWD continuance behavior, it can be viewed as an explanatory study. The used research strategy is thus survey, which answers to the questions 'what', 'who', and 'how much'. Or in this research's context: 'what contributes to continuance behavior', 'in which demographic', and 'how strong is the relationship'. To answer these questions in the most efficient and objective way, this research is conducted by using quantitative analysis as a methodological choice. The survey's responds are turned into numbers and analyzed by using statistical methods. No qualitative interpretation took place in the data gathering nor the analyzing.

The time horizon used for this study is considered cross-sectional, because the phenomenon is studied at a particular timeframe. Thus, the results are prone to change in the future when the technology and surrounding environment change, which is also align with critical relativism's epistemology.

3.2 Data Gathering and Analysis

The data gathering in this research can be divided into two sections: literature review and empirical study. The literature review was conducted to form the theory framework for this research and the empirical study was conducted to test said framework in real-life context to understand actual behavioral patterns.

3.2.1 Literature Review

The literature review was made using peer-reviewed, high-quality articles from trusted journals found on Web of Science. The sources were found by first searching for relevant articles and then reviewing their source material; search terms included "wearable device" "smart wearable device", "healthcare wearable device", "health wearables", "fitness wearables", "wearable health tracker". After reviewing the source materials in many different articles, the most cited articles researching the subject were found. These formed the core of the theoretical background.

The theory framework was formed from research about technology adoption and continuance intention alongside with literature about SWD adoption and continuance intention. These previous studies were published primarily in information technology and management sciences journals and thus the main focus of this literature review is within technology context. Some of the articles and theories also utilize psychology and human behavior research to better understand the psychological aspect of the subject, but it was not specifically investigated for this research.

3.2.2 Empirical Study

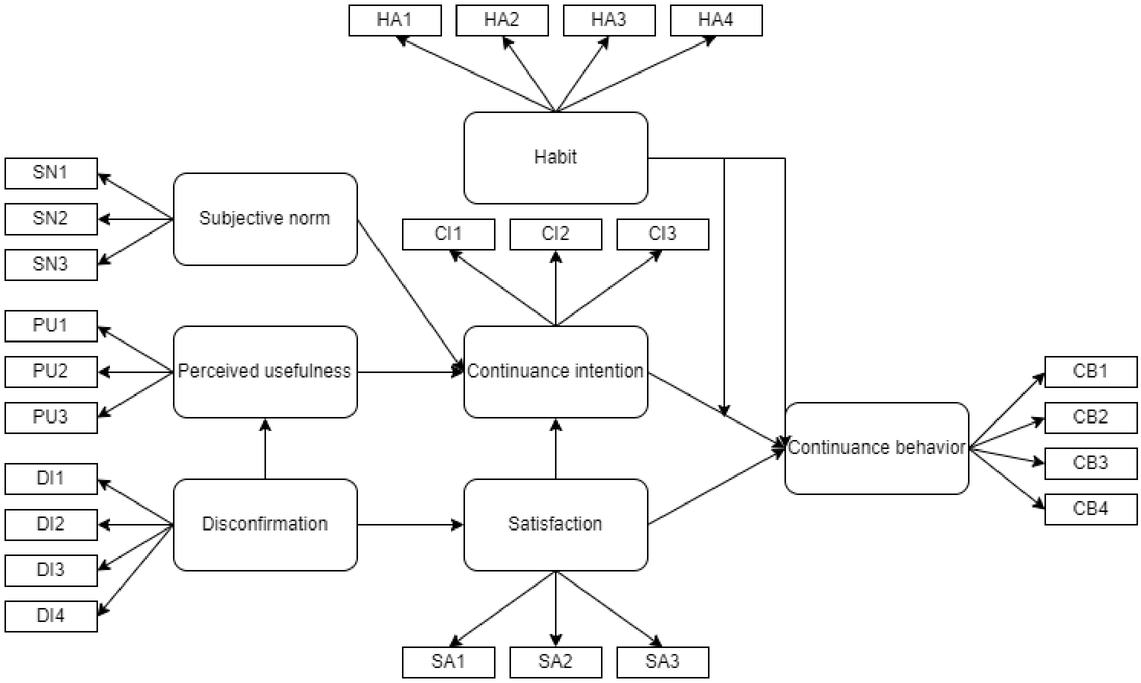
The survey bases on Bhattacherjee and Lin's (2015) Unified Model of IT Continuance. Thus, the survey was divided into seven sections in following order: continuance behavior, continuance intention, subjective norm, perceived usefulness, satisfaction, disconfirmation, and habit. The demographical data, gender, age, student status, education level, and income, were collected and their effect on continuance behavior was reported separately.

The survey questions were replicated from other research studying continuance behavior for smartwatches, IS, food delivery applications, and mobile social apps using a five-point-scale (1 strongly disagree – 5 strongly agree). This was done to better the validity and reliability of this research because the use of certain questions can be explained by other studies. The questionnaire and its source material can be seen in attachment A.

The survey was distributed to university students in Finland. It turned out to be challenging to identify enough respondents, since they had to be current SWD users. Eventually enough responds were gathered to conduct the research in full and draw conclusions.

Bhattacherjee and Lin's (2015) research uses structural equation model (SEM) but since this study's sample size is 100, the partial least squares structural model (PLS-SEM) is used instead. PLS-SEM works better for smaller sample sizes than SEM and it causal-predictive approach, which emphasizes prediction in statistical model estimations that are designed to provide causal explanations. Hair et al. (2019) propose that PLS-SEM should be used when a theoretical framework is tested from a prediction perspective, the structural model is complex, the research objective is to better understand increasing complexity, and when the sample size is small. Barclay et al. (1995) state that PLS model should be at least ten times the largest number of inner model paths directed at a particular construct in the inner model, which is fulfilled in this case.

To use PLS-SEM, the used structural model should be specified and then the outer and inner models should be evaluated. PLS-SEM requires that the structural model has no circular relationships within the model. (Hair et al. 2014) The model used in this study is in picture 22, which shows the outer and inner models, and their paths. The inner model in this research is UMITC and outer model is formed by the survey questions (2.3 UMITC and SWDs; appendix A).



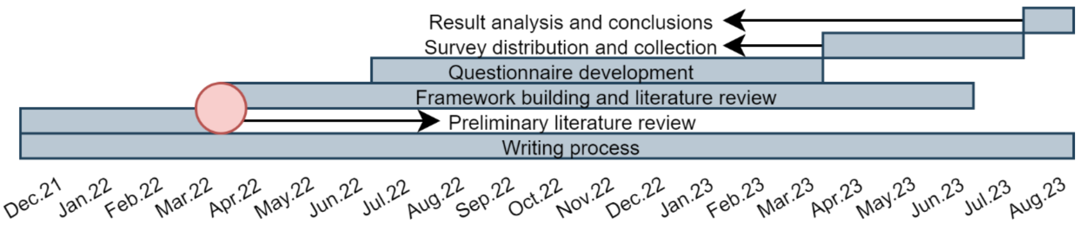
Picture 22 *The structural model for PLS-SEM. Survey questions (small rectangles) form the outer model and UMITC (round rectangles) form the inner model.*

The survey questions are reflective to their latent constructs as per Coltman's et al. (2008) criteria. In their review it is stated that the items are reflective if the latent construct exists independently, changes in the construct causes variation in the items, the items are manifested by the construct, have high positive intercorrelations and have similar sign and significance of relationships with the antecedents as the construct, and the error term in the items is identifiable. In this model subjective norm, disconfirmation, and habit are exogenous, and continuance behavior, continuance intention, perceived usefulness, and satisfaction are endogenous constructs. The relationships between outer and inner models are direct as well as continuance intention's effect on continuance behavior. Habit and satisfaction have both direct and indirect effect on continuance behavior. Habit act as a moderator for the relationship between continuance intention and continuance behavior, and satisfaction is mediated by continuance intention. Subjective norm, perceived usefulness, and disconfirmation have direct effects only on other latent constructs and thus, affect continuance behavior indirectly.

All the direct and indirect effects on the structural model are calculated with PLS-SEM. This study is conducted by using SmartPSL4 (Ringle et al. 2022) to compute the validity and reliability of the model, as well as the path coefficients, mean values, standard deviation (STDEV), T-values, and p-values.

3.3 Research Process

The research process started in late 2021 when the research area was decided. The process is described below and picture 23 shows the timeline of the research. The writing of this report started at a very early stage and went on the whole process gradually progressing.



***Picture 23** Research process timeline. Red dot marking the time of deciding research question.*

From the picture 23 can be seen, that the actual research process started after deciding the research area, when an extensive, although surface-level, literature review took place to map existing knowledge regarding SWD adoption and continuance intention. It went on a few months in early 2022. After the literature review the final research question was elected based on, what could contribute to existing literature. This point in time is shown as a circle in picture 23.

Based on the research question, the actual theoretical framework was built. After building the theory framework, the questionnaire was created. Because it was formed to test the existing research and thus the questions were collected from the articles that were read during literature review, the questionnaire-forming overlaps the literature review.

After building the questionnaire, it was translated to Finnish, and it went through a test round to get feedback on the questions. Some minor changes were made and then the questionnaire was distributed, and answers collected.

When enough responses were gotten after 4 months, the results were analyzed, and the final conclusions were drawn. Afterwards, the report was finalized and final touches on grammar and changes to the structure were made.

4. RESULTS

In this chapter the results of the empirical study are presented and analyzed. First the demographic characteristics are shown, after which the initial and trimmed PLS-SEM models are analyzed for their validity and reliability. Lastly, the final results of the different constructs' effects on continuance behavior are presented.

The survey got the total of 104 responses but since four of them were incomplete, they were eliminated. Thus, the used sample size (N) for data analysis was 100.

4.1 Demographic Characteristics

The demographical characteristics of the respondents can be seen in table 1. Those answer options, that got no answers, were left out from the table. All the answer options from the survey in their original form can be seen in appendix A.

Table 1 *The demographical data from 100 respondents.*

Question	Options	n	Percentage (%)
Gender	Male	40	40 %
	Female	58	58 %
	Prefer not to say	2	2 %
Age group	18-25	49	49 %
	26-35	49	49 %
	36-45	1	1 %
	46-55	1	1 %
Status	Full-time student	46	46 %
	Part-time student	2	2 %
	Student with a job	48	48 %
	Taking a leave of absence	3	3 %
	Other	1	1 %
Highest education	Primary education	1	1 %
	Student/high school	33	33 %
	College	12	12 %
	University	48	48 %
	Postgraduate education	6	6 %
Gross income	Don't want/can't say	17	17 %
	Under 9 999 €	32	32 %
	10 000 € - 19 999 €	21	21 %
	20 000 € - 39 999 €	18	18 %
	40 000 € - 69 999 €	9	9 %
	70 000 € - 99 999 €	1	1 %
	100 000 € - 150 000 €	2	2 %
	N	100	100 %

Table 1 shows that most of the respondents were women, under 35, and currently studying with a gross income is under 40 000 €. The maximum income rose over 100 000 €, but no more than 150 000 €. The education level varies from primary education to postgraduate with university being the most common completed education level. Two did not want to disclose their gender and the oldest respondent was under 55-years-old.

4.2 Initial PLS-SEM Model

Before measuring the relationships between variables, it is important to assess the reflective measurement model, after which the structural model should be assessed. First, the item reliability was measured by calculating the outer loadings for the items. Item reliability depicts how consistently certain item measures the construct associated with it. Inter-item reliability, on the other hand, refers to the extent of consistency between a group of items measuring the same construct. In this study there were no item reliability issues since all the items exceeded the threshold of 0,708 set by Hair et al. (2019), which means that the construct explains over 50 per cent of the item's variance making the items relevant to that construct.

Second, an internal consistency assessment was conducted by calculating the Cronbach's α, composite reliability ρ_c, and composite reliability ρ_a. While item reliability measures the individual items' reliability, internal consistency measures the construct reliability. It specifies the degree to which the items measuring certain construct are associated with each other, depicting various aspects of that construct. Good internal consistency reliability means that the measurement of the construct is reliable. Hair et al. (2019) state that the values should fall between 0,70 and 0,90 and values over 0,95 are problematic since they can signify the item to be redundant thereby reducing construct validity. They also state, that if the values are significantly greater than 0,70, a bootstrap technique should be applied. Since the values significantly exceeded the threshold of 0,70, the bootstrap was used, and no issues were found.

Third, the convergent validity, signifying the extent to which the construct explains the variance of its items, was assessed by using average variance extracted (AVE) for all the items. The model fulfilled the criteria by being over 0,50, which was set as a threshold value by Hair et al. (2019).

Lastly, the discriminant validity, extent to which the constructs are empirically distinct from each other, was measured. Henseler at al. (2015) propose, that if all the indicator loadings are close to each other, heterotrait-monotrait (HTMT) should be used. They also suggest the threshold value of 0,90 for structural models, that have conceptually similar constructs (in this study continuance intention, continuance behavior, and habit). There were no issues found regarding the discriminant validity.

Since there reflective measurement model proved to be valid and reliable, the structural model was then assessed. Before assessing the structural relationships, collinearity was examined to ensure that there is no collinearity to bias the regression results. This is measured with variance inflation factor (VIF), which should fall under the threshold of 5 (Mason & Perreault, 1991; Becker et al. 2015). The VIF values for CI3, HA1, SN1, and SN2 rose above 5, which means that there are collinearity issues within the model. Since continuance intention is the main indicator for continuance behavior, and the VIF value for CI3 was only slightly above 5, it was kept within the model. HA1 and SN2 with the highest VIF values for their constructs were eliminated from the model, after which there were no longer collinearity issues, and the analysis could be completed with the trimmed model.

4.3 Trimmed PLS-SEM Model

The used PSL-SEM model was modified by eliminating HA1 and SN2 from the outer model to abrogate the collinearity issue. The same validity and reliability tests are done to the trimmed model as for the initial model, after which the structural model is assessed. Lastly, the path coefficients are calculated and examined for their significance.

4.3.1 Validity and Reliability of the Outer Model

The same validity and reliability tests were done to the trimmed model' reflective measurement model than to the initial PLS-SEM model that was derived from theory. The results of loadings, Cronbach's α, composite reliability ρ_c composite reliability ρ_a, and AVE, and their reference values are listed on table 2. The results of HTMT are in table 3.

***Table 2** The validity and reliability of the reflective measurement model measured with loadings, Cronbach's α, composite reliability ρ_c composite reliability ρ_a, and AVE*

Latent variable	Item	Loadings	C.B. Alpha	C.R. (rho_a)	C.R. (rho_c)	AVE
Reference value		**>0,708**	**0,70 – 0,90 (<95)**			**>0,50**
Continuance behavior	**CB1**	0,907	0,924	0,926	0,946	0,815
	CB2	0,900				
	CB3	0,922				
	CB4	0,882				
Continuance intention	**CI1**	0,933	0,938	0,938	0,960	0,890
	CI2	0,942				
	CI3	0,954				
Disconfirmation	**DI1**	0,842	0,789	0,817	0,864	0,616
	DI2	0,838				
	DI3	0,823				
	DI4	0,613				
Habit	**HA2**	0,886	0,895	0,896	0,935	0,827
	HA3	0,921				
	HA4	0,922				
Perceived usefulness	**PU1**	0,830	0,794	0,819	0,877	0,704
	PU2	0,826				
	PU3	0,860				
Satisfaction	**SA1**	0,848	0,880	0,880	0,926	0,807
	SA2	0,912				
	SA3	0,932				
Subjective norm	**SN1**	0,772	0,730	1,143	0,864	0,762
	SN3	0,964				

***Table 3** The results of heterotrait-monotrait (HTMT) for discriminant validity.*

	Continuance Behavior	**Continuance Intention**	**Disconfirmation**	**Habit**	**Perceived Usefulness**	**Satisfaction**	**Subjective Norm**
Continuance Behavior							
Continuance Intention	0,848						
Disconfirmation	0,609	0,691					
Habit	0,923	0,798	0,665				
Perceived Usefulness	0,572	0,630	0,743	0,585			
Satisfaction	0,702	0,816	0,867	0,711	0,710		
Subjective Norm	0,335	0,323	0,686	0,426	0,607	0,505	

Since the average of the tree internal consistency values for each construct fell under the criteria, they were considered as acceptable. The bootstrap technique was also applied with 97,5 per cent confidence interval. Since there were no issues regarding the validity and reliability of the reflective measurement model, the model was tested for any collinearity issues.

The collinearity of the trimmed model was assessed by using the VIF. After removing HA1 and SN2 from the initial model, there were no significant collinearity issues. Only CI3 was reported to have VIF above 5, but since it exceeded the limit only by 2,1% and was part of the main promoter for continuance behavior, it was kept within the model. All the VIF-values are listed in table 4.

Table 4 *The results of collinearity test.*

Latent variable	Item	VIF
Reference value		<5
Continuance behavior	CB1	3,488
	CB2	3,834
	CB3	2,731
	CB4	3,562
Continuance intention	CI1	4,438
	CI2	5,105
	CI3	1,914
Disconfirmation	DI1	2,011
	DI2	1,685
	DI3	1,247
	DI4	2,267
Habit	HA2	3,149
	HA3	3,167
	HA4	1,804
Perceived usefulness	PU1	1,762
	PU2	1,547
	PU3	1,871
Satisfaction	SA1	3,355
	SA2	3,834
	SA3	1,492
Subjective norm	SN1	1,492
	SN3	3,318

Since the VIF-values were considered acceptable for the model, implying no collinearity problems, the structural model assessment could be conducted. The assessment was made using the R^2-value and f^2-value

4.3.2 Structural Model Assessment

According to Hair at al. (2014) the model's quality lies on its ability to predict the endogenous constructs. R^2, the coefficient of determination, measures how much the exogenous constructs combined explain variance in their endogenous construct and thus, is an indicator of the model's predictive power. R^2-value varies between 0 and 1 with higher value meaning higher prediction accuracy. (Hair at al. 2019) R^2 increases each time a new, even slightly correlated, exogenous construct is added, which is why an adjusted R^2 is used to eliminate said effect. It penalizes increased model complexity by decreasing R^2 when a new construct is added. R^2-values of 0,25; 0,50; and 0,75 represent weak, moderate, and substantial levels of prediction accuracy. (Hair et al. 2014) The normal and adjusted R^2-values for each endogenous construct are listed in table 5.

Cohen's f^2 notes the change in endogenous constructs' R^2 when a specific construct is eliminated. Thus, it measures how much each exogenous construct affect certain endogenous constructs. f^2 is calculated only for paths present in the inner model 0,02; 0,15; and 0,35 representing small, medium, and large effects. (Hair at al. 2014) The effect size of each path is listed in table 5.

Table 5 *The predictive power and effective sizes for each endogenous construct.*

	R-square		**f-square**						
Reference values	**0,25 – 0,50 – 0,75**		**0,02 – 0,15 – 0,35**						
Endogenous construct	**normal**	**adjusted**	**Continuance Behavior**	**Continuance Intention**	**Disconfirmation**	**Habit**	**Perceived Usefulness**	**Satisfaction**	**Subjective Norm**
Continuance Behavior	0,774	0,767		0,216		0,624		0,000	
Continuance Intention	0,679	0,666				0,325	0,029	0,282	0,023
Perceived Usefulness	0,361	0,355			0,565				
Satisfaction	0,533	0,528			1,142				

The R^2-values show that the model has high predictive power for continuance behavior. The lower R^2-value for perceived usefulness is acceptable, since it is only partially affected by disconfirmation as per Bhattacherjee and Lin (2015), but not fully explained by it. The f^2-values prove that most exogenous constructs have medium to large effect on the endogenous constructs. Satisfaction has no effect on continuance behavior, and perceived usefulness and subjective norm have only small effect on continuance intention.

4.3.3 Path Coefficients

Path coefficients represent the type and strength of the hypothesized relationships between constructs. They range from –1 to +1 with –1 indicating strong negative relationship and +1 indicating strong positive relationship. The significance of the path coefficient is calculated by using bootstrapping, which calculates the path coefficient of the original sample (O), representing the calculated relationship between constructs based on the used sample (survey responses), sample mean (M), standard deviation (STDEV), T-statistics ($|O/STDEV|$), and p-values for each path. (Hair et al. 2014; Hair et al. 2019) The results are visible in table 6.

Table 6 *The results of the significance measures.*

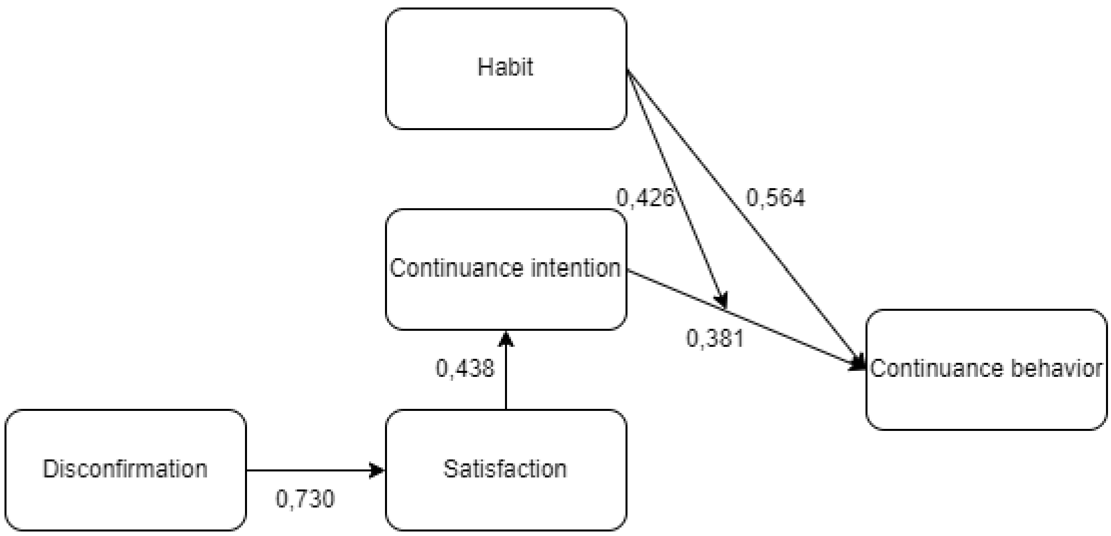
	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Continuance Intention -> Continuance Behavior	0,381	0,384	0,090	4,227	0,000
Disconfirmation -> Perceived Usefulness	0,601	0,610	0,071	8,414	0,000
Disconfirmation -> Satisfaction	0,730	0,730	0,046	16,021	0,000
Habit -> Continuance Behavior	0,564	0,561	0,082	6,887	0,000
Habit -> Continuance Intention	0,426	0,427	0,073	5,839	0,000
Perceived Usefulness -> Continuance Intention	0,128	0,129	0,087	1,472	0,141
Satisfaction -> Continuance Behavior	-0,004	-0,003	0,090	0,042	0,967
Satisfaction -> Continuance Intention	0,438	0,439	0,092	4,778	0,000
Subjective Norm -> Continuance Intention	-0,100	-0,098	0,078	1,289	0,197

The results from bootstrapping show that five out of nine hypotheses were confirmed (table 7). The paths from perceived usefulness and subjective norm to continuance intention, and from satisfaction to continuance behavior are considered non-significant according to their p-values. Habit's effect on the relationship between continuance intention and continuance behavior is significant, but positive instead of negative.

***Table 7** The results compared to hypotheses. "+" meaning positive relationship, "–" meaning negative relationship, 0 meaning non-significant relationship.*

	Hypothesis	Result
Continuance Intention -> Continuance Behavior	+	+
Disconfirmation -> Perceived Usefulness	+	+
Disconfirmation -> Satisfaction	+	+
Habit -> Continuance Behavior	+	+
Habit -> Continuance Intention	-	+
Perceived Usefulness -> Continuance Intention	+	0
Satisfaction -> Continuance Behavior	+	0
Satisfaction -> Continuance Intention	+	+
Subjective Norm -> Continuance Intention	+	0

Because the paths to continuance intention are the only paths yielded from perceived usefulness and subjective norm, this would ultimately imply that they do not promote continuance behavior and are thus redundant constructs. When perceived usefulness is removed from the model, the relationship between disconfirmation and perceived usefulness is also removed. The trimmed model showing only the significant constructs and paths is presented in picture 24.



***Picture 24** The trimmed model showing only significant constructs and paths.*

At the end of the result analysis, the analysis was run with the demographic variables to see if they have any effect on continuance behavior. None of the demographic variables made a notable difference in continuance behavior, thus they were not included in the analysis.

5. CONCLUSIONS

This chapter goes through the final conclusions for the study. First the theoretical and practical implications of the study are presented, after which the research limitations and suggestions for future research are proposed.

5.1 Theoretical Contribution

This study fulfilled 5/9 of the hypotheses from the original UMITC. It was found that subjective norm and perceived usefulness do not contribute to continuance behavior, satisfaction affects continuance behavior only through continuance intention, and habit reinforces the relationship between continuance intention and continuance behavior.

The results differ from those in the UMITC as well as other studies researching continuance intention/behavior of SWDs. Subjective norm was found to be notable continuance intention/behavior contributor by three previous studies (Shin et al. 2019; Pal et al. 2020; Lee & Lee, 2020). Since the previous studies were conducted in different countries, Shin et al. (2019) in southeast USA, Pal et al. (2020) in Asian counties, and Lee and Lee (2020) supposedly in Korea, it is possible that the differences are be due to cultural differences or geographical location.

Perceived usefulness was found to contribute to continuance intention or behavior in previous studies done by Pal et al. (2020), Park (2020), Siepmann and Kowalczuk (2021), and Gupta et al. (2021). However, Bölen (2020) found that perceived usefulness does not increase continuance intention of SWDs, which this study supports. Thus, it is increasingly unclear if perceived usefulness does affect continuance behavior in SWD context.

In contrary to UMITC, Bölen (2020) and Park (2020) argued that habit has a positive effect on continuance intention. This study reinforces that idea. Thus, it may be possible that habit's influence on continuance intention is positive in SWD context opposed to IT context.

This study did not find that the collected demographical data would affect users' continuance behavior. Since it has not been studied how gender, age, student status, education level, or gross income affect SWD continuance behavior, this study is the first one to suggest that they are non-significant in this context. However, there was a difference found between this study's and a few other studies' results regarding subjective norm, which implies that the culture and/or geographical location could affect continuance behavior in SWD context.

5.2 Practical Implications

Based on the results stating that the drivers for continuance behavior are habit, continuance intention, satisfaction, and disconfirmation, SWD manufacturers could focus their attention on these attributes. Continuance intention and satisfaction are the user's subjective states of mind, which can be difficult to influence, but habit and disconfirmation are somewhat affectable.

Since disconfirmation relies on the user's exceeded expectations, the SWD brands should pay attention to the quality of their products. The users can get a picture of the SWD's functionalities through marketing and word-of-mouth, which sets the baseline for their expectations. These expectations can be exceeded only when the functionalities work better than expected, which leaves no room for errors or poor designed features. Another way to exceed expectations is to provide functions that the user is not initially aware of. However, there is a risk that the lack of information impacts negatively the purchase intention altogether or that the user goes with a competing brand.

The users' habit formation can be reinforced by adding features that rewards the user of daily usage. For example, daily goals, progress reports, and fitness challenges with trackable features can inspire the user to wear the SWD more consistently. When the usage becomes a habit, the user is more likely to continue SWD usage in the future and eventually update it by buying the latest model.

5.3 Research Limitations

There are some issues regarding this research's validity and reliability. The validity and reliability are not to be confused with the validity and reliability tests done to the PLS-SEM model, which tested the analysis's validity and reliability opposed to the entire research layout's validity and reliability.

Since this research was done by using the UMITC model, it ignored some other studies' findings on the continuance intention and behavior of SWDs. The relationship between perceived usefulness and satisfaction was not examined albeit they were found to be linked by Park (2020), Siepmann and Kowalczuk (2021), and Gupta et al. (2021). If this relationship would have been found significant, it would have made perceived usefulness an important construct again. In addition, this study did not consider the importance of hedonic motivation, which Dehghani et al. (2018), Pal et al. (2020), Park (2020), and Siepmann and Kowalczuk (2021) found significant for continuance intention.

The research's reliability might have been compromised by both the participant and the researcher. First, the participant error, which occurs when the respondent does not fully understand the question or the context resulting in inaccurate responses. Second, the participant bias, taking place when the respondent feels like the researcher wants certain answers or wants to lie to themselves that having an SWD is a good choice. By using a pre-constructed theoretical model, many of the researcher errors and biases were dodged. However, since the questionnaire was not translated by a professional interpreter, some of the questions' nuances may have been lost when translated into Finnish. Thus, the quality of the Finnish version's responses could be compromised due to the researcher's translation.

Furthermore, as the survey was limited to a geographical region (Finland) and demographic group (students, mostly young participants), the results cannot be generalized across contexts. Lastly, it is important to note that since technology evolves with rapid pace, the SWDs can develop with it. When new functions and replacement products emerge, the factors contributing to continuous SWD usage may also change to match the evolving environment.

5.4 Suggestions for Future Research

As noted earlier, four of the hypotheses were not confirmed. It is not certain, whether it was due to the differences between study subjects (IT continuance vs. SWD continuance), the differences between demographical data, or the small sample size. Thus, further research needs to be done to find out where these differences in results emerge from.

Another study needs to be done to find the source for differences in results between different studies examining continuance behavior of SWDs. Especially the varying importance of perceived usefulness needs further investigation. It is also recommended, that the future study would include all the determinants, which were considered important by other studies, to make fully comprehensive model for SWD continuance behavior.

The last suggestion for future research is the effects of demographical data. In this study, the demographical data did not affect the results regarding continuance behavior, which may imply that the sample was too homogenous for them to matter, or that the collected demographic features do not affect the continuance behavior of SWDs. However, by comparing this study to other studies, it was found that cultural or geographical differences might contribute to different results regarding at least subjective norm.

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ATTACHMENT A: QUESTIONNAIRE

Determinant	Question	Scale	Source
Continuance behavior	I have the chance, I will use my wearable device	Strongly disagree – disagree – neutral – agree – strongly agree	Tran, 2021
	I will always try to use my wearable device in my daily life		Amin et al., 2021; Tran, 2021
	I maintain to utilize my wearable device on a regular basis		Tran, 2021
	in the future, I will use mu wearable device		Tran, 2021
Perceived usefulness	Using the wearable device improves my performance		Bhattacherjee, 2008; Bhattacherjee & Lin 2015; Siepmann & Kowalczuk, 2021
	Using the device increases my productivity		Siepmann & Kowalczuk, 2021
	I find the wearable device to be useful		Bhattacherjee, 2008; Bhattacherjee & Lin 2015; Siepmann & Kowalczuk, 2021
Continuance intention	I intend to continue using my wearable device rather than discontinue using it		Adapted from Bhattacherjee, 2008; Bhattacherjee & Lin 2015
	I predict I would continue using my wearable device		Adapted from Bhattacherjee, 2008; Bhattacherjee & Lin 2015
	I plan to continue using my wearable device		Adapted from Bhattacherjee, 2008; Bhattacherjee & Lin 2015
Disconfirmation	My experience with using the wearable device was better than what I expected		Bhattacherjee and Lin 2015; Siepmann & Kowalczuk, 2021; Davis, 1989
	The functions provided by the wearable device were confirmed		Bhattacherjee and Lin 2015; Siepmann & Kowalczuk, 2021
	Overall, most of my expectations from using the wearable device were confirmed		Bhattacherjee and Lin 2015; Siepmann & Kowalczuk, 2021
	My wearable device can meet demands in excess of my required functions		Bölen, 2020; Hsiao et al., 2016
Satisfaction	I am satisfied with the experience of using my wearable device		Bölen, 2020; Hsiao et al., 2016
	My decision to use my wearable device was a wise one		Bölen, 2020; Hsiao et al., 2016
	I think I made the correct decision in using my wearable device		Bhattacherjee, 2001; Siepmann & Kowalczuk, 2021

Subjective norm	People who influence my behavior (e.g., family, friends, colleagues) think that I should use my wearable device		Bhattacherjee, 2001; Siepmann & Kowalczuk, 2021
	People who are important to me (e.g., family, friends, colleagues) think that I should use my wearable device		Bhattacherjee, 2001; Siepmann & Kowalczuk, 2021
	People who influence my behavior (e.g., family, friends, colleagues) would welcome my use of the wearable device in my life		Bölen, 2020
Habit	Using my wearable device had become automatic to me		Bhattacherjee, 2015
	Using my wearable device comes naturally to me		Bhattacherjee, 2015
	The use of my wearable device has become a habit for me		Bhattacherjee, 2008; 2015; Siepmann & Kowalczuk, 2021
	Using my wearable device belongs to my daily routine		Siepmann & Kowalczuk, 2021
Demographics	Gender	woman – man – non-binary – prefer not to say	Tran, 2021
	Age group	18-25; 26-35; 36-45; 46-55; 56-65; over 65	Amin et al., 2021; Tran, 2021
	What best describes your current status	Full-time student – part-time student – student with a job – taking a leave of absence from my studies – other	Tran, 2021
	What is your highest level of education completed	primary education – vocational education – student/high school – college – university – postgraduate education	Tran, 2021
	What is your total gross income (before taxes) (€)	Under 9 999; 10 000-19 999; 20 000.39 999; 40 000-69 999; 70 000-99 999; 100 000-150 000; More than 150 000; I don't want / can't say	Bhattacherjee, 2008; 2015; Siepmann & Kowalczuk, 2021