“Smartwatches as Smart Shopping Devices: Enhanced Information Retrieval in an Omni-channel Environment”

Master Thesis

Teun Koldeweij

University of Twente

Supervisors: DR. IR. A.A.M. Spil & IR. B. Kijl

Abstract— **Information retrieval by smartwatches is a feature that can be used to make better buying decisions in an omni-channel environment, and can turn a smartwatch in a smart shopping device. In order to employ smartwatches in this way, actual use of smartwatches, a fitting retail environment and the right communicated information are factors that should be aligned. This research explored literature regarding omni-channel retailing, buying behavior and shopping technology to find if smartwatches can enhance consumer information retrieval in a buying situation in a physical store. Opportunities for smartwatch shopping were found in each of these factors. A UTAUT based questionnaire is used to find enabling factors from consumers. To boost the use of smartwatches, Performance Expectancy, Social Influence, Facilitating Conditions and Attitude should be addressed to increased use and the Behavioral Intention. Anxiety should be avoided to prevent a negative effect on Behavioral Intention. This research presents possible alterations in both the retail environment, thoughts and ideas of the consumer and the actual smartwatch technology to facilitate information retrieval via smartwatches in a shopping environment. This enables the smartwatch to become a smart shopping device.**

***Index Terms*— Smartwatch, Omni-channel, UTAUT, Information Retrieval, Smart Shopping**

I. Introduction

Smartwatches are an emerging wrist-worn product group that is championed as an extension, or replacement of a smartphone, with the proposition of offering a more direct interaction with the user. Information and communication technologies (ICT’s), such as smartphones, proved to have a large impact on everyday life, health and education (Luxton et al. (2011); Merchant (2012)), by providing easier access to information (White (2010); Choudrie (2014)) through the use of applications (apps). The Smartwatch has potential to follow the footsteps of its smartphone predecessor. The smartwatch market is expected to grow substantially with an annualized rate of 18% in the next few years, after a sluggish start caused by the lack of device-specific apps and distinct smartwatch capabilities (Beaver, 2016). Current Smartwatch producers such as Apple, Samsung or Fitbit put a great focus on health and fitness related smartwatch capabilities which already results in a large appeal to the major part of the health and fitness segment (Spil, Sunyaev, Thiebes, & van Baalen, 2017). This shows that the right apps and functions can make a smartwatch a useful tool.

Because of the rising smartwatch demand, smartwatches become more relevant to research. The Marketing Science Institute (2016) urges smartwatch related research to be applied to the marketing field. This paper researches the marketing related subject of smartwatch (smart) shopping, how people come to better purchases, and gives implications to turn a smartwatch in a smart shopping tool. This research presents enabling factors for smartwatch shopping, combining consumer input, smartwatch capabilities and the physical and online shopping environment. This paper gives answer to the following research question: “Can smartwatches enhance consumer information retrieval in a buying situation in a physical store?” This paper will conclude in possibilities for shop and smartwatch design that will enable the customer to make better buying decisions using the information delivered by the smartwatch. Or, to use the smartwatch as a smart shopping device to come to better purchases through better information supply. This paper also proposes interesting research opportunities through new findings.

II. Method

A. Literature

The base of this research lies in an extensive literature research (SCOPUS) that tries to mirrors the up to date situation in both smartwatches and retailing. The literature focuses on smartwatch applied shopping and changes in the retail environment. This requires the research to contain up to date literature and prefers the latest released papers as smartwatches deal with rapid innovation. Where necessary however, older literature is used to explain long standing concepts or rules that still apply to current situations, for example in buying theory and the UTAUT questionnaire. The literature regarding buying is grounded in the theory that describes three different purchasing phases, in this research taken from Frambach & Krishnan (2007).Following the buying stages, the buying uncertainty theory, originally described by Bauer (1960) and

taken from the paper of Sheth and Venkatesan (1968) is used to describe the driver between consumer choices and decision influencers. Social influence was found to be a great influencer on aforementioned consumer buying. The choice was made to further elaborate on this topic as research to buying uncertainty led to the influence of the social environment.

Smartphone shopping research is used as foundation to further built on the possible applications of smartwatch shopping. Decision support systems literature shows the application of technology to support consumer choices with the elaboration of appliances from Paradowski & Kruger (2013) that shows a smartphone can be a shopping assistant.

Literature regarding omni-channel retailing is mostly new literature with no further framework. The newly designed framework for omni-channel integration by Saghiri (2017) however is used in the implications. Literature for omni-channel retailing was mainly found by search for "Retailing" and "Technology" which led to articles regarding omni-channel retailing. During this literature search, information about online-retailing is excluded as only examples from physical stores were deemed relevant.

Literature concerning gestural input and vibration recognition is excluded from this research. Although several researched succeeded in testing smartwatches to recognize hand movements and product vibrations, these functions are not yet commercialized and mainly exist in experiments and pilot studies. (Radhakrishnan, et al., 2016); (Matthies, Bieber, & Kaulbars, 2016). These functions are deemed to need more testing to become feasible smartwatch features.

B. Questionnaire

The questionnaire will be administered using the UTAUT model. Venkatesh et al. (2003) summarized large bodies of technology acceptance research and proposed the unified theory of acceptance and use of technology model (UTAUT). This model bundles the best components of several technology acceptance models to create an improved explanatory model of technology acceptance. This questionnaire will include the UTAUT items: Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Behavioral Intention, Attitude, Self-Efficacy and Anxiety. The questionnaire will also contain items regarding demographics and a comparison between everyday use of smartwatches versus use while shopping to reveal initial differences between use. There is also an option for respondents to give their own personal opinion about improvements in smartwatches. The questionnaire will be designed to put respondents in an imaginary shopping situation. This type of questionnaire is found in the research of Zagel et al. (2017). An example of such a question is: "You are in a shoe store and stand in front of the sneakers, how likely is it that you want to see user reviews about the products?" Users can rate their agreeability on the UTAUT items on a 7-point Likert scale. To make the questionnaire more "realistic", an image of a store shelf with products is shown in the introduction of the questionnaire. This ensures a good internal validity. These results can then be converted to median scores to measure the overall score of agreement to perform a certain smartwatch related task. The outcomes of the questionnaire will be analyzed using SPSS in both descriptive statistics and regression analyses. The administered questionnaire is found in Appendix A.

1) Respondents

The target group for this questionnaire will be the customer that is familiar with new technology and is willing to understand and use this technology. As described by Ryan and Jones (2009), the customer 2.0. These are customers that are actively using several technological tools to connect with the world. Heinemann (2014) sees customers under the age of 30 as this specific customer 2.0 group this research targets. In line with former retail research, students are taken as our target group (Donovan & Rossiter, 1982); (Tai-Kuei & Guey-Sen, 2007). Taking a minimum of 100 responding students will result in reliable conclusions.

III. LITERATURE

A. The new retail environment

The world of retailing has taken a huge change in the last decade since the introduction of new mobile channels and social media. Where retailing was all about multi-channeling in the last decade, a movement called Omni-retailing can now be observed (Verhoef, Kannan, & Inman, 2015). "A well-integrated multi-channel format enables consumers to examine goods at one channel, buy them at another channel, and finally pick them up at a third channel" (Berman & Thelen, 2004). A multi-channel format is concerned with issues such as: integrated promotions between channels, consistent product information across channels and an integrated information system that shares customer and product information between the channels (Berman & Thelen, 2004).

Omni-channel shopping differ from the multi-channel approach by using different channels simultaneously. This use of different channels "blurs" the difference between the research stage and purchase stage (Shi, 2016). Omni-channel retailing is concerned with the way shoppers are influenced and how they move through these multiple channels in their shopping behavior (Verhoef, Kannan, & Inman, 2015). Frazer and Stiehler (2014) state that in an omni-channel approach, various channels needs to be combined in order to serve the customer in this environment.

Where a multi-channel strategy was mainly driven by the ongoing growth of the online channel, much used new channels as the mobile channel and social channel are now driving this omni-channel change (Rigby, 2011). "The increased deployment of new technologies such as smart mobile devices and social networks and the growing importance of in-store technological solutions create new opportunities and challenges for retailers. As the line between online and physical channels is blurred, a new approach to channel integration is emerging, the omni-channel, which aims to deliver a seamless customer experience regardless of the channel" (Piotrowicz & Cuthbertson, Introduction to the Special Issue Information Technology in Retail: Toward Omnichannel Retailing, 2014). Flavian et al. (2016) expected the influence of online information on offline purchases to be especially significant due to the development on mobile technologies. Omni-channel retailing however, does require the necessary preparation and changes in a company. "Omni-channel systems may need various enablers, including broadband Internet accessibility,

well-located and well-designed distribution centers, efficient and extensive logistics network, cross-channel integration, customer analytics, omni-channel visibility to customers, and product digitization" (Saghiri, Wilding, Mena, & Bourlakis, 2017).

B. Shopping applied technology

There are multiple ways technology can be applied to shopping. Introduced as Decision support systems (DDS), these mobile tools can process the user's request for specific product attributes, reviews and reputation (Kowatsch, Maass, & Fleish, 2011) (Kawamura, Nagano, Inaba, & Mizoguchi, 2008). Paradowski et al. (2013) describe the use of smartphones as a shopping assistant with seven smartphone features/apps that can influence the shopping process. Consumers can manage their potential purchases with a) shopping list management prior to visiting a store. While shopping, consumers can check their potential purchases with b) shopping basket management, they can retrieve information with c) product information procurement and they can plan their route with d) the orientation function. At the counter consumers can make use of e) payment software and additionally f) coupon redemption and g) customer loyalty reward options.

As mentioned, this study focuses on information retrieval, related to "product information procurement". When in a physical store environment, the customer has various possibilities to retrieve information about specific products using mobile features on a smart device. The ways customers can retrieve data are through the use of RFID/NFC tags, scanning barcodes, QR codes or image recognition. For smartwatches, only RFID and NFC are able functions where most new smartwatches have one of these connectivity features. Scanning objects however, becomes hard because a camera is a rare function in smartwatches (Bol.com, sd), (Iphonefaq, sd), (Pocket-Lint, sd).

1) RFID

Radio Frequency Identification (RFID) is a versatile wireless technology. It makes use of radio waves to track and identify objects. Evolved from the barcode system, RFID is the more digitized concept for the modern world. RFID has a fairly long range of a few meters and can identify different products with a vicinity of just a few centimeters (IMPINJ, sd). Paradowski et al. (2013) suggest that every product can be tagged with a RFID tag in the near future, which makes this a technology that can be used in a lot of shopping tasks. RFID technology can be used to recognize nearby products and display product information and promotion retrieved from a wireless backend system (Roussos, 2006).

2) NFC

Near Field Communication (NFC) is a technology that evolved from RFID and is being used in a lot of new services such as Apple Pay and Google Wallet. NFC is a functionality that enables users to transfer data between NFC tags by holding these tags a few centimeters from each other (TechRadar, sd). "Near Field Communication (NFC) is a standards-based short-range wireless connectivity technology that makes life easier and more convenient for consumers around the world by making it simpler to make transactions, exchange digital content, and connect electronic devices with a touch" (NFC Forum, 2016). An NFC reader allows precise detection of tagged objects. This opens up a lot of new opportunities in shopping scenarios, especially for product identification (Paradowski & Kruger, 2013). NFC can just as RFID, be used to check product information on the Point of Sale (Karpischek, Michahelles, Resatsch, & Fleisch, 2009), making this an ideal shopping feature.

C. Buying behavior

Buying behavior involves several stages and placing this behavior in the context of smartwatch shopping can help to understand the use of smartwatches in a buying situation.

Sharma (2014) defines buying behavior as follows**: "**Buying Behavior is the decision processes and acts of people involved in buying and using products". A broader definition is given by Inamdar (2016): "Consumer buying behavior is the sum total of a consumer's attitudes, preferences, intentions, decisions regarding the consumer's behavior in the marketplace when purchasing a product or service. The study of consumer behavior draws upon social science disciplines of anthropology, psychology, sociology, and economics."Frambach and Krishnan (2007) describe three different stages in buying behavior: pre-purchase, purchase and post-purchase. Neslin, et al. (2006) noted that these different stages of the decision process require different types of information to serve the customer at best. Customers in the pre-purchase stage for example, require mostly product information. Saghiri et al. (2017) stress the need to find the specific buying phase to design the omni-channel environment around it. In the case of this research, it would be the most product information demanding pre-purchase phase.

Sheth and Venkatesan (1968) state that consumers are in a certain state of uncertainty when they get involved in the buying (decision) process. A positive relation was found between the amount of information searched, and the decrease of buying uncertainty (Urbany, Dickson, & Wilkie, 1989). Consumers that were unsure about what product to choose tended to look for more information, to decrease their uncertainty. Sheth and Venkatesan (1968) distinguish three different kind of ways to reduce uncertainty, information seeking in an informal space (such as friends and family), pre-purchase deliberation (structuring information among brands) and reliance on brand image. Also, in the consumer service industry, brand image is an important factor to limit the risk that is perceived when choosing between alternatives (Mitchell & M., 1993).

D. Social Influence on buying behavior

The informal space of a consumer (friends and family) is of influence on what buying decisions a consumer makes. Different studies support the claim of social influence (Social Influence) on the buying behavior of the consumer (Bearden & Etzel, 1982); (Burnkrant & Cousineau, 1975); (Bearden, Netemeyer, & Teel, 1989). Consumers can be influenced by

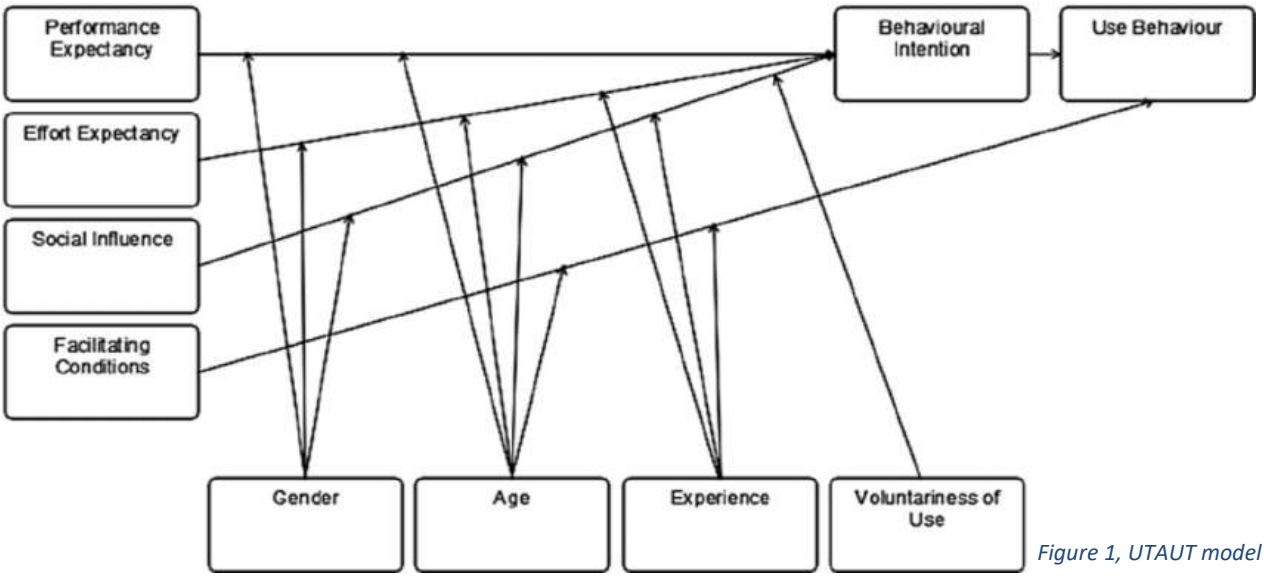


Figure 1, UTAUT model

their social environment and this can change the buying decision regarding different products and brands.

1) Social Media

In a study conducted by Forbes (2013), it was discovered that social media has an influence on the buying behavior of consumers. A recommendation of a product by someone using social media can influence the buying behavior. Forbes (2013) also notes that there is a shift from the more traditional marketing to the quicker social media. This also reflects in the use of online brand communities. Consumers react more to Facebook brand community content than they do to (corporate) marketer generated information in terms of purchasing behavior (Goh, Heng, & Lin, 2013). Consumers can be tempted to a more active purchasing behavior when they are supported by actual user generated information while using social media.

2) Advertisement

Brands are a way to communicate a certain product image to the consumers, brand perceivement is subject to social influence. "Advertising is a form of communication intended to convince an audience to purchase or take some action upon products, information or services etc." (Kumar & Venkateswara, 2013). Advertisement can therefore be seen a way of information exchange to the customer and can influence the decision process. Malik et al. (2013) state that if people are aware of a certain brand and if they have a good brand perception, the brand might be favored in a buying situation. According to the study of Malik (2013) brand advertisement is a big marketing weapon to attract customers and also to stay in the customers mind. In accordance to previous sources, this study suggest that brand image and advertising play a crucial role in peoples buying behavior.

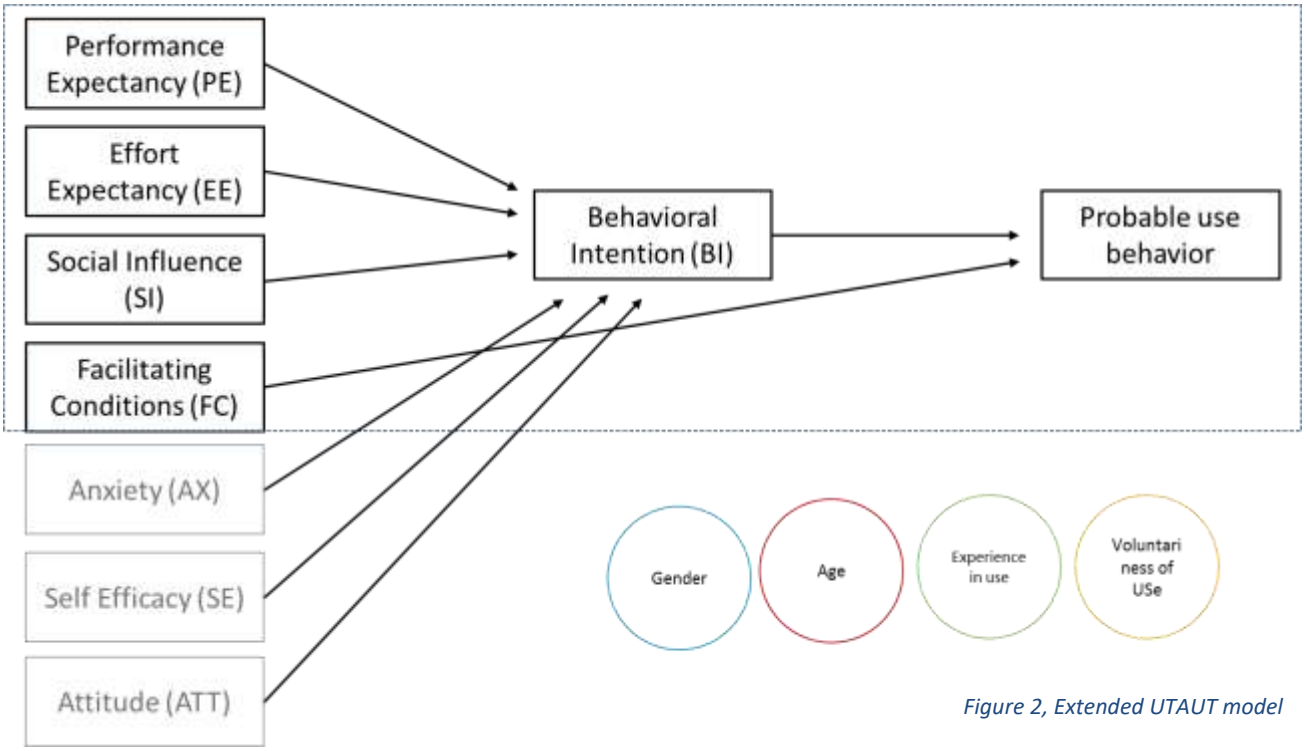


Figure 2, Extended UTAUT model

3) Electronic Word of Mouth

The electronic word of mouth is an increasingly important source for consumers to find information prior to their purchases. Electronic word on mouth is one of the most effective factors influencing brand image and purchasing intentions of consumers (Jalivand & Samiei, 2012). Consumers can openly share their product experiences for other consumers to read on all kinds of internet platforms. Consumers are interested in both reading and writing positive and negative comments about their experiences with products and services, as stated by Jalivand and Samiei (2012). Electronic word on mouth can occur, for example, on social media and can improve the brand image of a product of service. Consumers can read reviews to determine whether a product is recommended and should be bought or not.

IV. Research model (UTAUT)

The UTAUT model displayed in figure 1 tries to explain the use behavior of a technology by several independent variables. The exogenous variables Performance Expectancy, Effort Expectancy and Social Influence are expected to have a direct effect on Behavioral Intention and an indirect effect on Use Behavior through Behavioral Intention. Facilitating Conditions is assumed to have a direct effect on Use Behavior. Gender, Age, Experience and Voluntariness of Use are the expected moderator variables. Venkatesh et al. (2003) propose Self Efficacy, Attitude and Anxiety as constructs to be included in the UTAUT model, but they are not deemed to have a significant effect on Behavioral Intention. All independent variables are included in the survey as ordinal Likert scales (1-7) and the Voluntariness of Use is measured by an ordinal scale with three categories (Probable Use: Always, Sometimes, Never).

A. Extended UTAUT model

The new UTAUT model, based on Venkatesh et al. (2003) Is pictured in figure 2. The original UTAUT is tested with the original constructs (Performance Expectancy, Effort Expectancy, Social Influence and). Anxiety, Attitude and Self Efficacy are tested in a separate model, but are not expected to show a significant relation to Behavioral intention. Anxiety and Self-Efficacy showed to only influence Behavioral Intention through the mediation of variables related to Effort Expectancy. Attitude on the other hand, only showed significant effect on behavioral intention when amongst other variables, Effort Expectancy was omitted from the UTAUT model. When tested, these variables indeed showed to have no significant relation to Behavioral Intention as they were "captured" by Effort Expectancy (Venkatesh, Morris, Davis, & Davis, 2003).

V. Results

Prior to the analysis of the results, it should be noted that the administered questionnaire included two open questions. Respondents could give their opinion on how they think a smartwatch could be helpful in a buying situation, and what would have them use a smartwatch more. The results were very different and there was not a distinct pattern in the answers.

A. Descriptive statistics

The total amount of responses is 155. After filtering the data, only valid responses with no missing answers are left. Unfinished surveys and responses that exceeded the age limit are not included. This leaves a valid response of N=107.
The distribution of male and female respondents was N=61 and N=46. The respondents are mostly aged between 18-21 years old and 22-26 years old with the largest group having a background of higher education. With the exception of one, all the respondents knew about wireless services, this gives reason to believe that the items regarding connectivity were interpretable. Smartwatch use was not common among the respondents, even though the group of respondents was chosen exactly for an increased change of familiarity. The most used search tool was the use of a search engine that can be used on a variety of devices. The most important product information is

Figure 3, Smartwatch use in everyday life

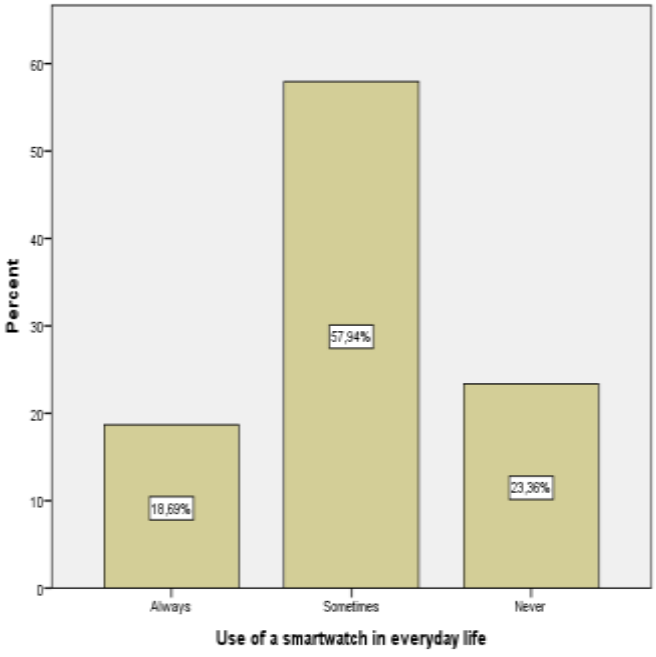
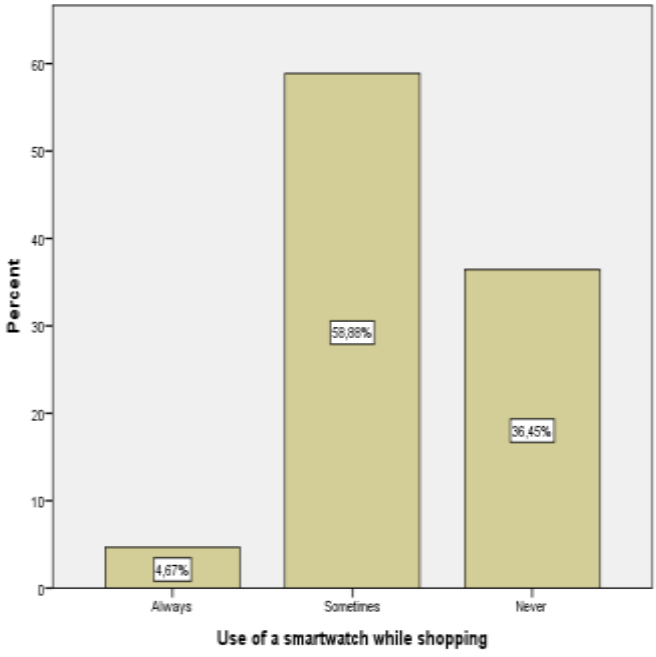


Figure 4, Smartwatch use while shopping



product price, followed by product reviews. Used materials in products and product endorsement were deemed to be the least important. The tables with the descriptive statistics are found in Appendix B.

The two graphs in figure 3 and 4 display the expected use of a smartwatch in two different situations. From the descriptive analysis, it immediately shows differences in the percentage of use in an everyday life situation and a shopping situation. People are more confident with smartwatch use in everyday life, this may suggest that people see more use to this. There is also a larger group of people that will say no to smartwatch use while shopping versus the use in everyday life. The size of the group that will sometimes use a smartwatch is about equal among both situations. This may indicate that consumers are unsure of the application of smartwatches in both everyday life and shopping.

B. Correlations

A correlation matrix shows the initial relations between variables, and provides an easy and clear overview. The UTAUT data first is checked for normality to determine the type of correlation matrix. A Shapiro-Wilk test proved our data to not be normally distributed (Sig<0,05) and therefore, a Spearman correlation matrix is used for non-parametric tests. The full correlation matrix is found in Appendix C.

The highest significant correlation to the dependent variable Behavioral Intention is reported in Attitude (,664**), followed by Performance Expectancy (,565**), Social Influence (,452**), Self Efficacy (0,309**) and Effort Expectancy (,201*).This immediately suggests a strong influence of Attitude on Behavioral Intention at first glance. A further high inter-item correlation (>0,7) is only found between Performance Expectancy and Attitude (,737**). The correlations of Anxiety are mostly negative, in line with this scale being the only "negatively" formulated series of items. Because there are no further high inter-item correlation, the items are expected to measure different constructs. The rest of the correlations between items can either be qualified as low (0,3 to 0 ,5) and moderate (0,5 to 0,7) correlations. This indicates that our items are somewhat related, this justifies the use of the chosen items in out UTAUT model.

C. Regressions

The regressions are used to check for significant coefficients of the exogenous variables to Behavioral intention and Use Behavior. Because our dependent variables can be classified as ordinal variables, an ordinal regression (dependent variable= ordinal, independent variable= scale) is used to determine the coefficients. The interaction function within the ordinal regressions is used to determine interaction effects. The original UTAUT model is to be kept unchanged. Together with the regression, a model fitness test and a goodness of fit test is used to test whether the test fits the data. A significant value for the model fitness test (Sig<0,05) and a non-significant value for the goodness of fit test (Sig>0,05) is reported, which both indicate that the right test is used. Tables with the ordinal regression outcomes are found in Appendix D.

The "full" invalidated model as suggested by Venkatesh et al. (2003), including Anxiety, Attitude) and Self Efficacy, is tested and correlations from these variables to Behavioral Intention are noted. The testing of the "original" model will consist of Performance Expectancy, Effort Expectancy and Social Influence to Behavioral Intention , and the link between Facilitating Conditions and Use Behavior .

The full model with all added variables reveals one significant coefficient at a 0,05 alpha level. Attitude (Sig < 0,05) is the only significant determinant variable in the full model. Anxiety almost exceeds the alpha threshold 0,5 and would be significant at the second level significance of 0,1. This model shows that there are no significant coefficients of the assumed significant variables Performance Expectancy, Effort Expectancy and Social Influence, this is at odds with the model presumptions. Facilitating Conditions is not assumed to have a link with Behavioral Intention as is confirmed by this model When the validated UTAUT is tested and the amount of variables are reduced to only Performance Expectancy, Effort Expectancy and Social Influence and, Significant coefficients of Performance Expectancy and Social Influence become apparent (Sig<0,05). Effort Expectancy is showing a slight negative estimate (-,073) and is of no significant value. The coefficient, 927 of Facilitating Conditions to Use Behavior is significant (Sig<0,05) and completes the analysis of the exogenous variables, at this point without an analysis of moderator variables. Behavioral Intention does not show a significant effect on Use Behavior,

The exogenous variables are tested for interaction effects with the respondent's gender, age experience and voluntariness of use. For age, interaction effects are found for Performance Expectancy and Social Influence (Sig<0,05). Performance Expectancy shows interaction effects with age categories 18-21 and 22-26 years old, where Social Influence only shows an interaction effect with the 22-26 year olds. For gender, again only Performance Expectancy and Social Influence show interaction effects (Sig<0,05) where both male and female interaction effects show significant results. Experience of use shows interaction effects (Sig<0,05) with Performance Expectancy and Social influence, both from the groups that never used a smartwatch or recently used a smartwatch. Finally, Voluntariness of Use also shows interaction effects, on Performance expectancy where the intention to sometimes or never use a smartwatch while shopping interacted. Social influence interacted with the intention to never use a smartwatch while shopping.

As the full model was examined, the estimates of Performance Expectancy, Effort Expectancy and Social Influence were non-significant. Attitude however, showed a positive significant estimate at 0,05 alpha level. Anxiety on the other hand showed a negative estimate significant at a 0,1 alpha level. In the full model, these variables have a larger effect on Behavioral Intention than Performance Expectancy, Effort Expectancy and Social Influence, as opposite to the expectation of Vekantesh et al. (2003). Moderator, or interaction, effects are noted for Performance Expectancy and Social Influence. It should be mentioned that the noted interaction effects are true for the most represented categories

(referring to the descriptive statistics where, for example, age category 26-30 is heavily under represented and the category of non-experienced users is overrepresented), which might be because of their larger numbers, as there are no interaction effects for the smaller categories. Finally, significant results are found for Performance Expectancy and Social influence on Behavioral Intention, and for Facilitating Conditions on Use Behavior

VI. UTAUT MODEL WITH ESTIMATES

From the ordinal regression, the new UTAUT model in figure 5 is constructed with the estimates found in the ordinal regressions. Performance Expectancy, Effort Expectancy, Social Influence and Facilitating Conditions are taken as the primary model, with the additions of Anxiety, Self-Efficacy and Attitude. The rectangular box around the upper part of this figure 11 indicates the separate testing of these variables. The non-validated factors Anxiety, Self-Efficacy, Attitude displayed in a light grey box are added to test the effects with these variables included. Moderator effects are display with the colored arrows.

VII. CONCLUSIONS

This research attempted to understand the use of smartwatches for an information retrieval task in a shopping environment. This study investigated the new Omni-channel retail environment, consumer buying behavior, possible functions of smartwatch technology and lastly, includes a UTAUT survey to reveal enabling factors for smartwatch use.

The results of the UTAUT model show that Performance Expectancy and Social Influence had a significant positive effect on Behavioral Intention. Facilitating conditions has a significant positive effect on Use Behavior. This study does however fail to find a significant effect of Behavioral Intention on Use Behavior. The addition of Attitude and Anxiety however showed a positive effect of Attitude, and a negative effect of Anxiety on Behavioral Intention. To increase the intentional use of smartphones, Performance Expectancy, Social Influence and Attitude are factors to be addressed. Anxiety would lower the degree on intentional use. Facilitating condition can be linked to the actual use behavior.

The use of smartwatches in a retail environment is partly determined by the way the retailer chooses to organize the distribution channels and information systems. Omni-channel retailing offers a change for smartwatch applications because of the characteristics of switching between online and offline channels and the fast use of connectivity like NFC to retrieve information. It is for the retailer to create the setting for Omni-channel retailing and improve the customers experience in the purchasing process. In line with the UTAUT survey, facilitating conditions, albeit related to the shopping environment, is a determinant factor for smartwatch shopping.

In comparison with other portable technologies like smartphone, smartwatches are limited in their connectivity options, and the only possible connectivity options are RFID and NFC as there is no camera present for scanning objects or codes. NFC is however not the most popular way to connect with the retailer's information, simply using an internet browser to look up information is the most sought out way. The measured effect of Performance Expectancy on Behavioral Intention can therefore not be fully accounted for by wireless technology, as it is also the function of web browsing that is perceived as being performance enhancing.

To reduce uncertainty and increase the likeliness to purchase a product, smartwatches need to be able to communicate information coming from social media, commercials and electronic word on mouth. Social Influence plays a role in the use of smartwatches, so does it in purchasing other products. From the descriptive statistics, price and product reviews are

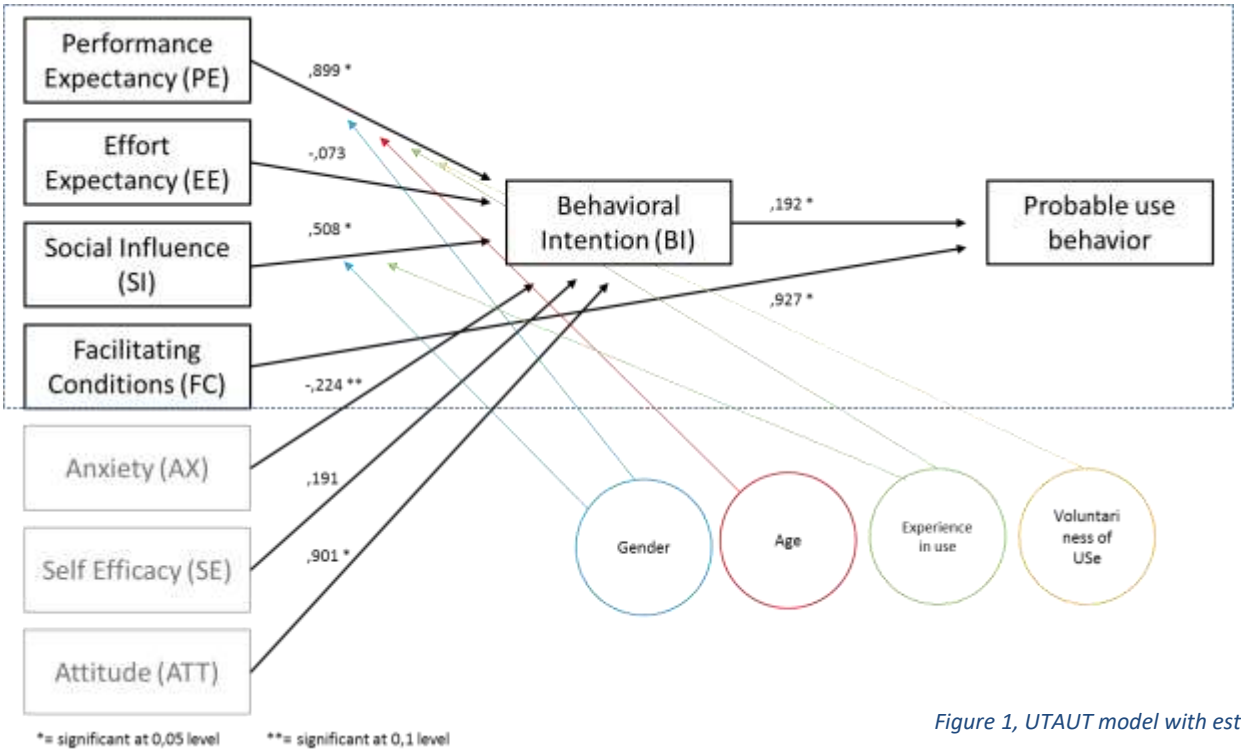


Figure 1, UTAUT model with estimates

the most important product details. These types of information in addition to the social information sources need to be communicated to the user to reduce buying uncertainty.

To summarize, the UTAUT factors Performance Expectancy, Social Influence, Facilitating Conditions and Attitude need to be favorable to increase the Behavioral Intention and Use of smartwatches. Anxiety should be low. Retailers then need to apply an Omni-channel approach and use connectivity options as NFC and RFID to communicate messages to the smartwatch user that are relevant to the product to reduce buying uncertainty. This will lead to better buying decisions through the use of a smartwatch.

VIII. Implications

What are the actions that need to be taken to make smartwatch shopping useful after the information this research provided?

For the alteration of the retail stores, Saghiri et al. (2017) propose a three-dimensional framework for omni-channel retailing that is able to structure such an environment. This framework builds on the customer decision stage, which underlines the importance of the prior buying behavior research, the types of channels and an interdependently connected entity to the customers. The retailer should according to the findings in this paper, focus on the pre-purchase stage and provide relevant information across the online and offline channels, which on their turn, should provide a seamless experience between those channels. This can be done by employing mobile touchpoints (NFC tags) to supply product information to a smartwatch. The retailer should also align the product information between the online and offline channels. This way, the retailer creates facilitating conditions for shopping with a smartwatch. As for the user, the facilitating conditions are limited to smartwatch knowledge and financial resources and can be connected to the later mentioned anxiety and the consumer's personal situation.

The smartwatch should have the ability to display social media opinions, advertisement and electronic word of mouth. App developers should create applications for smartwatches that enable these functions. In this way, the smartwatch can expose the user to their social environment and influence buying behavior. As for initial smartwatch use, the consumer is opinionated by their social environment whether to use a smartwatch at all. Getting a positive smartwatch image, for example by using marketing, can create an overall positive attitude towards smartwatches and increases use.

Smartwatches should possess the right technology and applications. Smartwatches without a NFC functionality are limited in their shopping applications. The performance expectancy of the consumer is related to the quality of information and the ease of the information retrieval, as found in the questionnaire. This can be achieved by designing good apps and by the retailer to provide the most relevant information in the omni-channel network, in this research the price and product reviews. The relative advantage (Rogers, 1995) of these functions should be significant in order to attract consumers to go shopping using a smartwatch.

Individuals can sometimes perceive a lack of ability which can lead to anxiety when using computer systems (Bandura, 1986). This can possibly be countered by encouraging playful behavior in the use of a computer system (Webster, Heian, & Michelman, 1990). It can be assumed that playful behavior also encourages users to overcome anxiety on smartwatch use. Flatla et al. (2011) used gamification to make a task like screen calibration more playful and fun. In the health and fitness industry, consumers already show to have a positive attitude towards gamified fitness and health apps, reflecting in a combined majority of consumers that already uses these apps, or is willing to do so in the short-term (Spil, Sunyaev, Thiebes, & van Baalen, 2017). Gamified smartwatch shopping apps could be a solution to overcome Anxiety.

The utilization of PC use is influenced by the individual's feelings, or attitude towards using it (Triandis, 1980). Two ways to influence attitude are proposed by Fishbein and Azjen (1975): active participation and persuasive communication. Active participation can be achieved by the retailer, for example, when smartwatches are presented in a store for trail use. Persuasive communication refers to the active communication of the advantages of smartwatch shopping, for example by marketing campaigns and commercials.

IX. Limitations/ Future Research

The skewed distribution of respondents regarding age and education led to moderator effects that were only significant for these larger groups. Our sample consisted of mainly highly educated respondents between the age of 18 and 26. A more evenly distributed outcome would perhaps also reveal a moderator effect in the other groups. In this study, it was not possible to validate results on anxiety and attitude, although these seem to have a great effect on the use of smartwatches. Future research should focus on these two factors to determine smartwatch by using a validated model.

This study was conducted using literature research and questionnaire methods and outcomes are not yet physically tested in an experimental form. The major part of the respondents were non-experienced users and their answers are based on probable actions. An actual experiment could reveal how users would react in a certain situation while using a smartwatch, making them an actual user.

As for the omni-channel environment, the concept and literature regarding an omni-channel are novel. Despite this, different implication are given to fit a smartwatch in an omni-channel environment. This research does however lack a fully supported insertion of smartwatch use in an omni-channel framework. New research can build on the mentioned framework of Saghiri et al. (2017) to fully structure a business fit for omni-channel retailing.

The application of gamification in shopping is an interesting research topic as this already shows positive effects for health and fitness applications and can potentially reduce any anxiety that a user might experience in smartwatch use.

Finally, the use of gestural recognition and vibration based product recognition might prove interesting research opportunities in the future. The choice was made to not include these features in this research. The fact that NFC is not yet the most sought out information retrieval technology can justify the exclusion of these even newer and mostly unknown features.

X. LITERATURE USED

Bandura, A. (1986). Social Foundations of Thought and Action.

Bauer, R. (1960). Consumer Behavior as Risk Taking. *Dynamic Marketing for a Changing World, Proceedings of the 43rd. Conference of the American Marketing Association*, 389-398.

Bearden, W. O., & Etzel, M. J. (1982). Reference Group Influence on Product and Brand Purchase Decisions. *Journal of Consumer Research, 9*(2), 183-194. doi:https://doi.org/10.1086/208911

Bearden, W. O., Netemeyer, R. G., & Teel, J. E. (1989). Measurement of Consumer Susceptibility to Interpersonal Influence. *Journal of Consumer Research, 15*(4), 473-481. doi:https://doi.org/10.1086/209186

Berman, B., & Thelen, S. (2004). A guide to developing and managing a well-integrated multi-channel retail strategy. *International Journal of Retail & Distribution Management, 32*(3), 147-156. doi:http://dx.doi.org/10.1108/09590550410524939

Bol.com. (n.d.). *Samsung Gear S3 Frontier - Donker Grijs*. Retrieved from Bol.com: https://www.bol.com/nl/p/samsung-gear-s3-frontier-donker-grijs/9200000064831762/?suggestionType=browse#product_specifications

Burnkrant, R. E., & Cousineau. (1975). Informational and Normative Social Influence in Buyer Behavior. *Journal of Consumer Research, 2*(3), 206-215. doi:https://doi.org/10.1086/208633

Donovan, R., & Rossiter, J. R. (1982). Store atmosphere: An environmental psychology approach. *Journal of Retailing, 58*(1), 34-55. Retrieved from https://www.researchgate.net/publication/248766608_Store_atmosphere_An_environmental_psychology_approach

Fishbein, M., & Azjen, I. (1975). Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research.

Flatla, D. R., Gutwin, C., Nacke, L. E., Bateman, S., & Mandryk, R. L. (2011). Calibration Games: Making Calibration Tasks Enjoyable by Adding Motivating Game Elements. *Proceedings of the 24th annual ACM symposium on User interface software and technology*, 403-412. doi:10.1145/2047196.2047248.

Flavian, C., Gurrea, R., & Orus, C. (2016). The Impact of Recommendations on the Cross-Channel Shopping Behavior. *Rediscovering the Essentiality of Marketing*, 295-301. doi:10.1007/978-3-319-29877-1_60

Frambach, R. T., & Krishnan, T. (2007). The Impact of Consumer Internet Experience on Channel Preference and Usage Intentions Across the Different Stages of the Buying Process. *Journal of Interactive Marketing, 21*(2), 26-41. doi:10.1002/dir.20079

Frazer, M., & Stiehler, B. E. (2014). OMNICHANNEL RETAILING: THE MERGING OF THE ONLINE AND OFF-LINE ENVIRONMENT. *Global Conference On Business and Finance Proceedings, 9*(1), 655-657. doi:http://search.proquest.com/openview/1bf146b83e17434145da811757b5e756/1?pq-origsite=gscholar

G., H. (2014). *Always-on im Handel. Die soziale, lokale und mobile Zukunft.* Wiesbaden: Gabler. Retrieved from http://www.springer.com/us/book/9783658039684

Goh, K.-Y., Heng, C.-S., & Lin, Z. (2013). Social Media Brand Community and Consumer Behavior: Quantifying the Relative Impact of User- and Marketer-Generated Content. *Information Systems Research, 24*(1), 88-107. doi:http://dx.doi.org/10.1287/isre.1120.0469

IMPINJ. (n.d.). *Wat is RFID?* Retrieved from IMPINJ: http://www.impinj.com/resources/about-rfid/

Inamdar, M. A. (2016). Online marketing: Buying Behaviors of Customers in Miraj City. *International Journal of Multifaceted and Multilingual Studies, 3*(4), 15. doi:2350-0476

Iphonefaq. (n.d.). *Does Apple Watch have NFC?* Retrieved from Iphonefaq: http://www.iphonefaq.org/archives/974380

Jalivand, M. R., & Samiei, N. (2012). The effect of electronic word of mouth on brand image and purchase intention: An empirical study in the automobile industry in Iran. *Marketing Intelligence & Planning, 30*(4), 460-476. doi:http://dx.doi.org/10.1108/02634501211231946

Karpischek, S., Michahelles, F., Resatsch, F., & Fleisch, E. (2009). Mobile Sales Assistant - An NFC-Based Product Information System for Retailers. *Near Field Communication, 2009*. doi:10.1109/NFC.2009.18

Kawamura, T., Nagano, S., Inaba, M., & Mizoguchi, Y. (2008). WOM Scouter: mobile service for reputation extraction from weblogs. *International Journal of Metadata, Semantics and Ontologies, 3*(2), 132-141. doi:http://dx.doi.org/10.1504/IJMSO.2008.021891

Kowatsch, T., Maass, W., & Fleish, E. (2011). The role of product reviews on mobile devices for in-store purchases: consumers usage intentions, costs and store preferences. *Int. J. Internet Marketing and Advertising, 6*(3), 226-244. doi:10.1504/IJIMA.2011.038237

Kumar, D. P., & Venkateswara, R. K. (2013). The role of Advertising in Consumer Decision Making. *Journal of Business and Managment, 14*(4), 37-45. doi:2319-7668

Malik, M. E., Ghafoor, M. M., Ali, Q., Hunbal, H., Noman, M., & Ahmad, B. (2013). Impact of Brand Image and Advertisement on Consumer Buying Behavior. *World Applied Sciences Journal, 23*(1), 117-122. doi:10.5829/idosi.wasj.2013.23.01.824

Marketing Science Institute. (2016). *RESEARCH PRIORITIES 2O16–2O18.* Cambrigde. Retrieved from www.msi.org

Matthies, D. J., Bieber, G., & Kaulbars, U. (2016). AGIS: Automated Tool Detection & Hand-Arm Vibration Estimation using an unmodified Smartwatch. *roceedings of the 3rd International Workshop on Sensor-based Activity Recognition and Interaction*. doi:10.1145/2948963.2948971

Mitchell, V., & M., G. (1993). Risk Perception and Reduction in the Purchase of Consumer Services. *The Service Industries Journal, 13*(4), 179-200. doi:http://dx.doi.org/10.1080/02642069300000068

Neslin, S. A., Grewal, D., Leghorn, R., Shankar, V., Teerling, M. L., S., J., . . . Verhoef, P. C. (2006). Challenges and Oppurtunities in Multichannel Customer Management. *Journal of Service Research, 9*(2), 95-112. doi:10.1177/1094670506293559

NFC Forum. (2016). *What is NFC?* Retrieved from NFC Forum: http://nfc-forum.org/what-is-nfc/

P., F. L., & Vespoli, E. M. (2013). Does Social Media Influence Consumer Buying Behvior? An Investigation Of

Recommendations And Purchases. *Journal of Business & Economics Research, 11*(2), 107-112.
Paradowski, D., & Kruger, A. (2013). Modularization of Mobile Shopping Assistance. *Near Field Communication (NFC)*. doi:10.1109/NFC.2013.6482444
Piotrowicz, W., & Cuthbertson, R. (2014). Introduction to the Special Issue Information Technology in Retail: Toward Omnichannel Retailing. *International Journal of Electronic Commerce, 18*(4). Retrieved from http://www.tandfonline.com/doi/abs/10.2753/JEC1086-4415180400
Pocket-Lint. (n.d.). *Best smartwatches to look forward to in 2017*. Retrieved from Pocket-Lint: http://www.pocket-lint.com/news/132033-best-smartwatches-to-look-forward-to-in-2017
Radhakrishnan, M., Eswaran, S., Sen, S., Subbaraju, V., Misra, A., & Balan, R. K. (2016). Demo: Smartwatch based Shopping Gesture Recognition. *Research Collection School of Information Systems*. Retrieved from http://ink.library.smu.edu.sg/cgi/viewcontent.cgi?article=4590&context=sis_research
Rigby, D. (2011). The future of shopping. *Harvard Business Review, 89*. Retrieved from https://www.researchgate.net/publication/265118174_The_Future_of_Shopping
Rogers, E. M. (1995). Diffusions of innovations. doi:ISBN 0-02-874074-2
Roussos, G. (2006). Enabling RFID in retail. *Computer, 39*(3), 25-30. doi:10.1109/MC.2006.88
Ryan, D., & Jones, C. (2009). *Understanding Digital Marketing, Marketing strategies for engaging the digital generation.* London: Kogan Page. Retrieved from http://ewing.ir/download/Understanding-Digital-Marketing.pdf
Saghiri, S., Wilding, R., Mena, C., & Bourlakis, M. (2017). Toward a three-dimensional framework for omni-channel. *Journal of Business Research, 77*, 53-67. doi:https://doi.org/10.1016/j.jbusres.2017.03.025
Sharma, M. K. (2014). The Impact on Consumer Buying Behaviour: Cognitive Dissonance. *Global Journal of Finance and Manangement, 6*(9), 833-840. doi:ISSN 0975-6477
Sheth, J. N., & Venkatesan, M. (1968). Risk-Reduction Processes in Repetitive Consumer Behavior. *Journal of Marketing Research, 5*(3), 307-310. doi:10.2307/3150350
Shi, F. (2016). Omni-Channel Retailing: Knowledge, Challenges and Opportunities For Future Research. *AMS 19th World Marketing Congress*. Retrieved from https://www.researchgate.net/publication/295671991_Omni-Channel_Retailing_Knowledge_Challenges_and_Opportunities_For_Future_Research
Spil, T., Sunyaev, A., Thiebes, S., & van Baalen, R. (2017). The Adoption of Wearables for a Healthy Lifestyle: Can Gamification Help? *Conference: Hawaiian International Conference on Information Systems*. doi:10.24251/HICSS.2017.437
Tai-Kuei, Y., & Guey-Sen, W. (2007). Determinants of Internet Shopping Behavior: An Application of Reasoned Behaviour Theory. *International Journal of Management, 24*(4), 744-762,823. Retrieved from http://search.proquest.com/openview/50ea549cb89c59d4e4dbafb0f8da7851/1?pq-origsite=gscholar&cbl=5703
TechRadar. (n.d.). *What is NFC? Everything you need to know*. Retrieved from TechRadar: http://www.techradar.com/news/phone-and-communications/what-is-nfc-and-why-is-it-in-your-phone-948410
Triandis, H. (1980). Beliefs, Attitudes, and Values. 195-259.
Urbany, J. E., Dickson, P. R., & Wilkie, W. L. (1989). Buyer Uncertainty and Information Search. *Journal of Consumer Research*, 208-2015. doi:http://dx.doi.org/10.1086/209209
Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly, 27*(3), 425-478. Retrieved from http://www.jstor.org/stable/30036540?seq=1#page_scan_tab_contents
Verhoef, P. C., Kannan, P., & Inman, J. (2015). From Multi-Channel Retailing to Omni-Channel Retailing, Introduction to the Special Issue on Multi-Channel Retailing. *Journal of Retaling, 91*(2), 174-481. doi:http://dx.doi.org/10.1016/j.jretai.2015.02.005
Webster, J., Heian, J., & Michelman, J. (1990). Mitigating the Effects of Computer Anxiety. *Proceedings of the Elev-enth International Conference on Information Systems*, 171-182.
Zagel, C., Niels, A., & Bodendorf, F. (2017). Using Smartphones for Information Retrieval in Omnichannel Scenarios—Assessing the Effectiveness of Technological Triggers. *Advances in The Human Side of Service Engineering*, 151-159. doi:10.1007/978-3-319-41947-3_15

XI. Appendix

A. Questionnaire

Questionnaire
Are you experienced in using a smartwatch?
Are you familiar with wireless services (wireless payment, OV chip)
Assume that you want more product information about the sneaker you are interested in. How would you use a smartwatch to get to know more about the product?
Would you use a smartwatch to get to know more about the product?
What kind of product information would be most relevant to you?
* I would find a smartwatch useful while shopping
* Using a smartwatch enables me to retrieve product information more quickly
* Using a smartwatch increases the quality of product information received
* If I use a smartwatch, it will lead to better purchases
* My interaction with a smartwatch would be clear and understandable
* It would be easy for me to become skillful at using the smartwatch
* I would find a smartwatch easy to use
* Learning to operate a smartwatch would be easy for me
* Using a smartwatch while shopping is a good idea
* A smartwatch makes shopping more interesting

* Working with a smartwatch is fun
* I (would) like working with a smartwatch
* People who influence my behavior think that I should use a smartwatch
* People who are important to me think that I should use a smartwatch
* I have the resources necessary to use a smartwatch
* I have the knowledge necessary to use a smartwatch
* I could complete an information retrieval task with a smartwatch
* If there was no one around to tell me what to do as I go
* If I could call someone for help if I got stuck
* I feel at unease using a smartwatch
* A smartwatch is somewhat intimidating to me
* I intend to use a smartwatch in a buying situation in the next months
Do you (or would you), use your smartphone in everyday life?
Would you use a smartwatch while shopping?
In what way do you think a smartphone can be helpful in a buying situation?
What would make you use a smartwatch more?
Gender
Age
Education
* = UTAUT questionnaire item

B. Descriptive Statistics

Gender	Frequency	Percent
Male	61	57,0
Female	46	43,0
Total	107	100,0
Age	Frequency	Percent
18-21 years old	43	40,2
22-26 years old	59	55,1
26-30 years old	5	4,7
Total	107	100,0
Highest Education	Frequency	Percent
Middle Education (Dutch MBO)	17	15,9
Higher education (Dutch HBO)	62	57,9
University undergraduate	12	11,2
University postgraduate	15	14,0
Other	1	,9
Total	107	100,0
Knowledge about wireless technology	Frequency	Percent
Yes	106	99,1
No	1	,9
Total	107	100,0
Smartwatch use	Frequency	Percent
Yes, last use was less than 6 months ago	9	8,4
Yes, last use was less than 12 months ago	5	4,7
Yes, last use was more than 12 months ago	5	4,7
No	88	82,2
Total	107	100,0
Search tool use	Frequency	Percent
Use of a search engine	54	47,8
Visit the website of the retailer	10	8,8
Scan the NFC or RFID tagged product	30	26,5
I would not know what to do	13	11,5
Total	107	94,7
Important product information	Frequency	Percent
Price	58	51,3
Availability	6	5,3
Used materials or technologies	1	,9
Product reviews and ratings	24	21,2
Comparing information (with similar products)	13	11,5
Sustainability	3	2,7
Association with celebrities (endorsement)	2	1,8
Total	107	94,7

C. Correlation Matrix

Correlations

	Performance_Expectancy	Effort_Expectancy	Social_Influence	Facilitating_Conditions	Anxiety	Self_Efficacy	Attitude	Hedonic	Behavioral_Intention
Performance_Expectancy	1,000	,383	,444	,089	-,012	,354	,737	-,484	,565
	.	,000	,000	,363	,900	,000	,000	,000	,000
	107	107	107	107	107	107	107	107	107
Effort_Expectancy	,383	1,000	,176	,421	-,312	,101	,273	-,198	,201
	,000	.	,069	,000	,001	,299	,004	,041	,038
	107	107	107	107	107	107	107	107	107
Social_Influence	,444	,176	1,000	-,024	-,288	,227	,564	-,272	,452
	,000	,069	.	,805	,003	,019	,000	,005	,000
	107	107	107	107	107	107	107	107	107
Facilitating_Conditions	,089	,421	-,024	1,000	-,223	,010	,063	,015	,048
	,363	,000	,805	.	,021	,921	,517	,882	,624
	107	107	107	107	107	107	107	107	107
Anxiety	-,012	-,312	-,288	-,223	1,000	,059	-,153	,213	-,081
	,900	,001	,003	,021	.	,549	,114	,027	,408
	107	107	107	107	107	107	107	107	107
Self_Efficacy	,354	,101	,227	,010	,059	1,000	,357	-,230	,309
	,000	,299	,019	,921	,549	.	,000	,017	,001
	107	107	107	107	107	107	107	107	107
Attitude	,737	,273	,564	,063	-,153	,357	1,000	-,548	,664
	,000	,004	,000	,517	,114	,000	.	,000	,000
	107	107	107	107	107	107	107	107	107
Behavioral_Intention	,565	,201	,452	,048	-,081	,309	,664	-,383	1,000
	,000	,038	,000	,624	,408	,001	,000	,000	.
	107	107	107	107	107	107	107	107	107

D. Ordinal Regressions

1) Full model to Behavioral Intention

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Location	Performance_Expectancy	,340	,237	2,067	1	,150	-,124	,804
	Effort_Expectancy	-,080	,212	,145	1	,704	-,495	,334
	Social_Influence	,270	,204	1,743	1	,187	-,131	,670
	Anxiety	-,178	,108	2,727	1	,099	-,390	,033
	Attitude	,963	,242	15,804	1	,000	,488	1,438
	Self_Efficacy	,200	,184	1,184	1	,276	-,160	,561

Link function: Logit.

2) Validated model to Behavioral Intention

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Location	Performance_Expectancy	,899	,186	23,297	1	,000	,534	1,263
	Effort_Expectancy	-,073	,201	,130	1	,719	-,467	,322
	Social_Influence	,508	,196	6,745	1	,009	,125	,892

Link function: Logit.

3) Facilitating Conditions to Use Behavior

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Location	Facilitating_Conditions	,927	,366	6,420	1	,011	,210	1,644

Link function: Logit.

4) Behavioral Intention to Use Behavior

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Location	Behavioral_Intention1	,192	,143	1,815	1	,178	-,088	,472

Link function: Logit.