**Smart Retail – An Exploratory Analysis of the Impact of Virtual Mirrors within the Concept of Digital Retail Stores**

Masters Thesis


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## List of Abbreviations

| | |
|---|---|
| AR | Augmented Reality |
| ATU | Attitude Toward Using |
| AVE | Average Variance Extracted |
| CFA | Confirmatory Factor Analysis |
| CFI | Comparative Fit Index |
| df | Degrees of Freedom |
| DV | Dependent Variable |
| IDT | Innovation Diffusion Theory |
| IU | Intention to Use |
| IV | Independent Variable |
| PE | Perceived Enjoyment |
| PEOU | Perceived Ease of Use |
| PN | Perceived Newness |
| PU | Perceived Usefulness |
| RMSEA | Root Mean Square Error of Approximation |
| SEM | Structural Equation Modeling |
| TAM | Technology Acceptance Model |
| TI | Technology Innovativeness |

| | |
|---|---|
| TRA | Theory of Reasoned Action |
| VIF | Variance Inflation Factor |

# Abstract

In an increasingly competitive retail environment, brick-and-mortar retailers are in search for innovative ways to provide customers with unique and high-quality experiences. Technologies such as virtual mirrors enable retailers to improve in-store customer satisfaction and push cross-channel sales. However, academic research on virtual mirrors is still in its infancy. This paper reports a scenario-based laboratory experiment (N=37) for understanding the benefits and risks of the technology and for examining potential drivers for the intention to use virtual mirrors. Based on prior findings of technology acceptance research, an exploratory model of antecedents to virtual mirror adoption is developed. The results of the structural equation modeling show that perceived enjoyment and perceived usefulness are the strongest predictors of consumers' adoption intentions. Moreover, the findings reveal that the product is evaluated as very new and that this perceived newness negatively affects the relation between perceived ease of use and usage intention. The results provide new theoretical backgrounds for studying virtual mirrors. Scholars and marketers can build upon the findings and use them to design implementation and advertising strategies.

Keywords: *Digital stores, augmented reality, virtual mirror, TAM, technology adoption*

# 1. Introduction

Brick-and-mortar retailers are progressively put under pressure by the intense growth development of online retailing. In 2014, brick-and-mortar retailing achieved just about 1% sales growth. Online retailers yet managed to increase their sales by 12% (Bovensiepen, Rumpff, and Bender 2015, p. 7) not least because they successfully implemented omni-channel solutions. New technologies and the diverse portfolio of digital offers significantly change consumers' shopping behaviors: Consumers wish for a convenient and unique shopping experience that implicates an attractive product portfolio as well as individual solutions and services. However, physical store environments often do not meet these requirements. According to a study conducted by the consulting firm Capgemini (Jacobs et al. 2017), nearly half of the participants perceived a store visit as a chore that had to be done. Long queues at the checkout, difficulties to compare and locate products, and the lack of in-store assistance were found to be the main reasons for frustration. Many store retailers have realized that they need to keep up and optimize their store formats. Innovative technologies, the digitalization of operations, and the right people capabilities are key success factors for the digital store transformation (Jacobs et al. 2017, pp. 2-7). The winners of the future will invest in their innovation management and ensure that innovative solutions support each step of the customer's shopping journey.

Academics and practitioners have long acknowledged the importance of innovation for long-term growth of businesses and competitive advantage (Ireland and Webb 2007, p. 50). Brick-and-mortar retailers are already experimenting with mobile apps, location trackers, and augmented reality (AR) programs. Nevertheless, the underlying customers' innovation adoption decisions depend on various drivers, such as product newness and perceived technology advantages (Rauschnabel and Ro 2016, p. 137). It has been shown that consumers are more risk-averse toward very innovative products as the nature of these products is too

unique and complex compared to products that are less inventive. Potential benefits of really-new products are often not understood and thus, not appreciated by customers (Hoeffler 2003, p. 418). Pursuant to the definition of really-new products by Urban, Weinberg, and Hauser (1996, p. 47), virtual mirrors can be perceived as one of these revolutionary products. Using AR, the technique allows customers to virtually wear products and therefore, it transforms the way products are being tried on. To date, relatively little research has investigated the mechanism that drives the perception and acceptance of virtual mirrors among users and the influence of virtual mirrors on the success of the digital retail transformation.

This thesis aims to explore the impact of virtual mirrors within the concept of digital fashion stores by analyzing their general acceptance as well as context-specific product and individual factors, such as perceived newness (PN) and technology innovativeness (TI). For this purpose, the study empirically tests how virtual mirrors affect the in-store shopping experience. The objective is to answer the following research questions: (1) Is there an interest in using virtual mirrors in physical store environments? (2) What are the adoption drivers and barriers of virtual mirrors from the perspective of potential users? In order to answer these questions, this thesis proceeds as follows: First, a theoretical background on digitalization in retail and virtual mirrors is given, thereby defining the terms, discussing the relevance, and describing best practices. The next section resumes recent research findings on AR technologies. The main part outlines the experimental study: hypotheses are developed, the methodology of the experiment is explained, and the results of the study are presented. Lastly, this paper examines the theoretical contribution of the findings, points out managerial implications and limitations, and proposes directions for future research.

## 2. Theoretical Background

In the following chapter, the term digitalization is defined and linked to the retail sector. Furthermore, reasons for the rise of digital technologies in retail are described. The section

also provides a brief overview on the most recent digital devices used in (fashion) retail and outlines best practices– with a special focus on virtual mirrors.

### *2.1 Definition of Digitalization*

*Digitalization* is defined as the "[i]ntegration of digital technologies into everyday life by the digitization of everything that can be digitized" (BusinessDictionary 2017) and as "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities" (Gartner 2017). Thus, the notion of digitalization implies the enablement of new forms of value creation as well as the shift from analogue to digital (Amit and Zott 2001, p. 504; Hagberg, Sundstrom, and Egels-Zandén 2016, p. 696). As the role of brick-and-mortar stores is changing, digital technological solutions become more relevant for the retail sector (Piotrowicz and Cuthbertson 2014, p. 5). In this case, the implementation of digital technologies in retailing can entail a renewal of existing activities, processes, and products (e.g. introduction of mobile payment types), but may also lead to the emergence of new goods and services (e.g. digital in-store assistance) (Hagberg, Sundstrom, and Egels-Zandén 2016, p. 696). The digital transformation in retail is not a new phenomenon and has been progressing for decades (e.g. Alba et al. 1997; Sorescu et al. 2011). However, recently, the significance of the transformation has become more and more visible to retailers and consumers (Hagberg, Sundstrom, and Egels-Zandén 2016, p. 695).

### *2.2 Relevance of Digitalization in Retail*

The need for digital in-store technologies originated in the early nineties when the first e-commerce companies emerged. Information asymmetries declined through the increased usage of the Internet and through the rise of social media platforms and price comparison websites. Moreover, the low costs and easy access to technologies led to and still result in a greater demand for expertise, content, and personalized solutions (Parise, Guinan, and Kafka

2016, pp. 411-412). Thus, physical store retailers face challenges, such as meeting diverse customer requirements, redesigning supply chains, and connecting multiple distribution channels. These challenges call for a solution: Smart Retail – a reinvention of the traditional store concept by combining the physical, digital, and virtual world (Licoppe 2013, p. 124). There are many different technologies that have the potential to connect offline and online retailing. The three most recent in-store technology streams are (1) interactive touch screen displays/in-store totems (e.g. virtual mirrors), (2) systems for mobile (e.g. mobile apps) and (3) hybrid systems (e.g. Beacons) (Pantano and Viassone 2014, p. 44).

Touch screen devices such as self-service kiosks are increasingly implemented in physical stores to push in-store service quality (Piotrowicz and Cuthbertson 2014, p. 6). Customers can thereby interact with computer terminals to browse the product catalogue or to search for relevant product information without the need of staff assistance. Furthermore, brick-and-mortar retailers progressively introduce mobile shopping apps (Kang, Mun, and Johnson 2015, p. 211; Shankar et al. 2011, p. 32) that connect, when in-store, to location transmitters called Beacon sensors. Those sensors emit radio signals to the operating systems of Android and iOS, allowing to trigger programmed actions, such as in-store navigation and the transmission of personalized promotion codes (Gast 2014, pp. 13-15; Newman 2014, pp. 222-225). More and more mobile shopping apps also incorporate AR features. For instance, Sephora's Virtual Artist app enables customers to virtually try on different make-up looks (Sephora 2018). This 3D image processing technique, called virtual mirror, is a sub-category of AR. In general, AR programs account for the expansion of the real world by integrating virtual (e.g. text, graphics, audio) with real-world objects. AR devices (e.g. Google glasses) supplement rather than replace reality (Azuma 1997, pp. 355-356).

These exemplary digital technologies facilitate every stage of the in-store customer shopping journey: recognition, search, consideration, choice, and payment (Lemon and

Verhoef 2016, p. 74), meaning that they inspire customers to browse for new arrivals, navigate shoppers through the store, boost a customer's product choice through personalized recommendations and promotional codes and ensure an easy and fast check-out procedure. Therefore, digital in-store technologies provide customers with an experience[1] that is even greater and more diverse than the online or multi-channel approach. This so-called concept of omni-channel retailing (e.g. Verhoef, Kannan, and Inman 2015) allows consumers to seamlessly switch between (online and offline) channels. A study conducted by Sopadjieva, Dholakia, and Benjamin (2017) reveals that 73% of the participants (N=46,000) already use more than one channel during their shopping journey. In addition, these multi-channel customers spend 4% more on every shopping occasion and revisit stores more often than single-channel customers. Embracing an in-store omni-channel strategy can thus be the key to regain sales strength.

### *2.3 The Rise of a Digital In-Store Technology Called Virtual Mirror*

There is no academic definition for the term *virtual mirror* (also known as *smart mirror, digital mirror,* or *virtual fitting system*). One may define it as an interactive device that reflects a person's own image on a real mirror while adding virtual objects, such as desired apparel or accessories, to the live video feed through a monitor that is incorporated in the mirror (see Figure 1). Hence, a user can try on individual garments or entire outfits without going to the dressing room (Parise, Guinan, and Kafka 2016, p. 417; Sato, Kitahara, and Ohta 2009, p. 482). Using monitor-based configurations, video cameras capture real time pictures and movements of the user. A user's viewing position is calculated by utilizing a view marker and video cameras. After the selection of the desired product(s) using gestures or a touch-based interface, the so-called scene generator creates computer graphic models of the

[1] Customer experience relates to internal (e.g. cognitions, feelings) and behavioral reactions to any type of direct or indirect interaction with an organization/store (Meyer and Schwager 2007, p. 117).

consumer's articles. Thereafter, the two coordinate systems of the real and virtual world are processed and integrated (Azuma 1997, pp. 355-363; Sato, Kitahara, and Ohta 2009, pp. 482-487). A software such as *Microsoft Kinect SDK* (Fitnect 2018) is able to provide this assistance. By tracking the accurate body shape and movements of the user in real-time, the consumer seems to wear the virtual objects. Algorithms and models have been developed to extract precise measurements from a human's body, however, for reasons of technical complexity, the topic of automatic modeling of body clothing is not further discussed in this thesis (see Apeagyei 2010; Magnenat-Thalmann, Seo, and Cordier 2004 for more details).

- INSERT FIGURE 1 ABOUT HERE -

The 360-degree fitting solution is an important feature of the virtual mirror, but the device has more to offer. The mirror is able to provide personalized outfit recommendations and fashion advice if the user is logged into his/her account (Bovensiepen, Rumpff, and Bender 2015, p. 14). Another option is to see videos of the product or check its availability (different colors and sizes) in the store and online. Users can also share a picture of their virtual outfit on social media platforms to ask friends and family for their opinion (Parise, Guinan, and Kafka 2016, p. 417). Moreover, the technology can provide consumers with product-specific details, such as brand, color, size and information about the materials and the production process. Besides, virtual mirrors enable consumers to ask store assistants to either bring selected items to the dressing room or checkout area. Another feature allows consumers to purchase products by placing an order online or by paying the respective item on the spot (e.g. by using their mobile device via QR Codes) (Fretwell 2011, pp. 3-5). In conclusion, virtual mirrors are powerful tools that can provide consumers with a completely different in-store shopping experience and with a new type of communication. Yet, little research has been conducted to empirically prove the benefits and acceptance of virtual mirrors.

Cisco, a global technology provider, developed its virtual mirror solution *StyleMe*$^{TM}$

(see Figure 2) based on customer testing and reviews. Two target groups were found to show the highest interest for this technology: women above the age of 50 and women in their 20s. Whereas the older generation appreciated the easy way of selecting and trying on clothes (e.g. expert advice, outfit creations), the younger participants liked the social and entertaining features (e.g. image sharing, fashion videos) (Fretwell 2011, pp. 5-6). It is believed that such entertaining shopping experiences lead to higher customer satisfaction and hence, more store revisits (Pantano and Servidio 2012, p. 283). Besides, Fretwell (2011, p. 2) states that virtual mirrors have the potential to boost (cross-channel) sales by offering the entire online and in-store inventory and by quickly creating personalized outfits. However, brick-and-mortar retailers may be faced with privacy and performance concerns. Studies on AR highlight that participants have issues with trusting the technology to be of excellent quality. Several components need to work together seamlessly to perfectly blur the real world with the virtual one. Otherwise, users might be dissatisfied with the virtual fitting performance, as outfits do not match their body shape or movement (Olsson et al. 2012, p. 42).

- INSERT FIGURE 2 ABOUT HERE -

By analyzing the recent developments of digital store concepts, it becomes clear that in-store technologies can facilitate product information search and provide customized solutions and services, thereby reducing costs, saving time as well as increasing the entertainment value (Pantano and Viassone 2014, p. 44). Yet, the acceptance and diffusion of such technologies is complex and depends on many factors. The following section shows recent findings on store digitalization and AR programs in the (fashion) retail industry to further explore this complexity.

## 3. Recent Literature Findings on Augmented Reality Technologies

The literature review was performed using a combination of keywords, including *retail, digital, technologies, augmented reality, virtual mirrors, magical mirrors, smart mirrors,*

*virtual fitting*, and *self-service* on Google Scholar, followed by more specific searches after having read various journal articles. Relatively little research has been conducted in the field of virtual mirrors, hence, there is a lack of articles from highly ranked journals. Thus, relevant academic literature of topics surrounding virtual mirrors are explained in this section as well.

As mentioned before, brick-and-mortar retailers have difficulties to introduce online shopping features, such as product information search, price comparison, and social media sharing, into the in-store shopping experience (Blázquez 2014, p. 97). A study conducted by Blázquez (2014) compared utilitarian and hedonic shopping values in physical and online environments, thereby measuring the shopping experience perception and shopping motivation of 439 participants. 38.1% of the online survey respondents stated that they look for product information (especially men) and 23.1% for inspiration in social networks (especially women) prior to the store visit. Moreover, results reveal that hedonic elements are more important for in-store than for online shopping experiences ($mean_{store}$=3.02; $mean_{online}$=2.91). Consequently, physical store retailers are challenged to provide consumers with more pleasing and experiential properties while still ensuring functional benefits. Mathwick, Malhotra, and Rigdon (2002, p. 57) suggest that each channel in a brick-and-mortar environment must be tailored to specific shopper tasks.

For instance, Spreer and Kallweit (2014) conducted a study to analyze the acceptance of AR and the potential that AR provides in improving the assessment of information at the point of sale. The researchers measured perceived usefulness (PU), perceived ease of use (PEOU), and perceived enjoyment (PE) of the AR application to gain insights into what drives acceptance. The study took place in a bookstore with a specifically designed AR app that delivered features, such as animated book covers or interviews with the authors. Using a sample of 97 participants, the researchers asked them to search for product information by using either the app (treatment group) or other information sources (control group). The

participants who utilized the app evaluated the information significantly better and were more satisfied ($mean_{treatment}$=2.89; $mean_{control}$=2.47 out of 5). In addition, the output of the multiple regression analysis reveals that only PU and PE significantly influence the intention to reuse the technology ($p<0.01$). Thus, the acceptance of AR technologies at the point of sale depends on the technology's concrete benefit of usage and its entertaining elements.

Rauschnabel and Ro (2016) also examined the technology acceptance of AR smart glasses. With new communication and information technologies continuously being developed, a new stream of wearable technology devices has arisen to improve how companies interact with consumers. Smart glasses such as Google glasses fall under the category of "wearable devices that meld both real and virtual information in the consumer's view field" (Rauschnabel and Ro 2016, p. 124). The study aimed to analyze the impact of various drivers, such as social norms, functional benefits, and gender, on technology's adoption intentions. 201 participants were provided with a brief description of smart glasses and were asked to fill out a survey measuring relevant constructs. The research shows that the following three antecedents are particularly important in predicting adoption intentions: functional benefits (ß=0.33), attitude toward the manufacturer brand (ß=0.15), and the consumer's TI (ß=0.28). Furthermore, results reveal that male respondents perceive higher functional benefits in using smart glasses than female participants ($mean_{male}$=3.04; $mean_{female}$=2.56 out of 7). The researchers ascribe this output to the higher degree of prior knowledge about Google glasses presented by male participants ($mean_{male}$=5.26; $mean_{female}$=4.05 out of 7). Thus, the study supports the above-mentioned importance of functional benefits of AR technologies.

In addition, Olsson et al. (2012) studied users' expectations and acceptances of mobile AR technologies by comparing five scenarios. One of the scenarios incorporated the idea of a virtual mirror being located in a clothing store and connected to data glasses. The 260

participants were provided with the information that users are able to virtually try on styles and appearances, including clothes, hairstyles, make-up, and accessories. Results demonstrate that the majority of the participants perceived the device as not useful, yet entertaining. 12% of the participants appreciated the try-on outfit feature. Some participants (19%) raised the doubt that the technology might not perform satisfyingly: “I would use this as a first step in order to cut down all the candidates that wouldn’t fit/look good. Then, I would try on the final candidates ‘manually’, in the traditional way. I’d assume that I have to doublecheck the fit anyway – I wouldn’t trust the virtual service all the way” (Olsson et al. 2012, p. 38). In sum, the research provides first insights into the perceived value and risks of virtual mirrors but missed to measure any quantitative data on technology acceptance. Besides, the virtual mirror scenario was only described with words, not visual elements, which potentially lowers the response quality (e.g. Deutskens et al. 2004, p. 21).

Another study conducted by Begole et al. (2009) investigated the impact of responsive mirrors on a customer’s shopping experience, buying intention, and privacy concern. A responsive mirror is a video technology used for clothes fitting scenarios. Users see themselves in conventional mirrors, yet have the option to compare their current worn apparel with the previous one on a display situated next to the mirror. Hence, customers are able to see their chosen outfits in parallel rather than in sequence. Another display provides shoppers with images of other people also wearing the garment, thereby including a social context (Zhang et al. 2008, pp. 60-61). Participants (N=12) were asked to try on six shirts and to state their preferences regarding the conditions. Results reveal that seeing images from previous outfits improves the shopping experience to a higher degree as does the presentation of other people wearing the product ($mean_{previous}$=3.0; $mean_{others}$=2.5 out of 5). Therefore, the research provides evidence that consumers value the possibility to digitally compare outfits without the need to try them on.

Overall, there is a relatively limited amount of research within the context of virtual mirrors and AR technologies. Many researchers provide first insights into how powerful such technologies are in revolutionizing physical store concepts. However, limitations, such as the lack of retail field experiments and sample size impede concrete interpretations.

# 4. Virtual Mirrors in Retail Stores – An Empirical Research Study

Many research studies have focused on analyzing the effectiveness and attractiveness of technologies by using specific innovation diffusion or technology adoption models. To the best of the author's knowledge, there is yet no study on technology acceptance in the context of virtual mirrors. This section illustrates the development of an exploratory model covering potential adoption drivers and barriers of virtual mirrors and the outcomes resulting from testing the approach through an experiment.

## *4.1 Conceptual Framework and Hypothesis Development*

Understanding a consumer's technology acceptance is important for the successful implementation of a new technology in the market and for a positive return on investment for retailers (Pantano and Viassone 2014, p. 46). The Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975), the Technology Acceptance Model (TAM) by Davis (1989), and the Innovation Diffusion Theory (IDT) by Rogers (2003) are among the most widely supported theories to measure user acceptance and innovation adoption (e.g. Adams, Nelson, and Todd 1992; Chen, Gillenson, and Sherrell 2002; Dabholkar and Bagozzi 2002; Kallweit, Spreer, and Toporowski 2014). The TRA highlights the strong and positive relationship between attitudes and intentions. The theory has been proven to successfully predict and explain behavioral intentions in various research domains and settings (Bagozzi 1981, pp. 624-625; Sheppard, Hartwick, and Warshaw 1988, p. 338). Davis (1993, p. 476) based his TAM on the research findings of the TRA and adopted it to predict usage intentions for

technologies. The TAM illustrates the relationship between the utilitarian motives of an IT system, the attitude toward using (ATU) the technology, and the intention to use it (IU). The beliefs about the system are thereby constructed by PU and PEOU. The relevant constructs are defined as follows:

- **Perceived Usefulness** is initially referred to as a person's tendency "to use or not use an application to the extent they believe it will help them perform […] better" (Davis 1989, p. 320). In this study, PU is seen as improving the efficiency in shopping or information seeking.
- **Perceived Ease of Use** is defined as "the degree to which a person believes that using a particular system would be free of physical and mental effort" (Davis 1993, p. 477).
- **Attitude Toward Using the Technology** refers to "the degree of evaluative affect that an individual associates with using the target system" (Davis 1993, p. 476).
- **Intention to Use** relates to "indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behaviour [in question]" (Ajzen 1991, p. 181). With regards to this research, IU is viewed within the context of technology usage behavior.

General tendencies emerged from past research, indicating that PU and PEOU are positively related to adoption intentions and that ATU mediates the relationship between those antecedents and IU (Davis, Bagozzi, and Warshaw 1992, p. 1124; Rauschnabel and Ro 2016, p. 137). Numerous studies have successfully proven the general applicability of TAM to study the acceptance of AR technologies (e.g. Haugstvedt and Krogstie 2012; Rauschnabel and Ro 2016; Spreer and Kallweit 2014). However, many researchers (e.g. Chen, Gillenson, and Sherrell 2002; Davis, Bagozzi, and Warshaw 1992) did not approve of PU and PEOU being the only independent variables (IV) for adoption intentions. One of the key modifications of TAM was the inclusion of intrinsic motives such as PE. PE is thereby defined as "the extent to which the activity of using the [technology] is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated" (Davis, Bagozzi, and

Warshaw 1992, p. 1113). As fashion retailing is classified as a high hedonic product category (Crowley, Spangenberg, and Hughes 1992, p. 246), incorporating entertaining and experiential properties in the conceptual framework seems crucial. Ha and Stoel (2009, p. 570) as well as Pantano and Servidio (2012, p. 284) provide evidence that enjoyment has a high relevance for the adoption intention in retail environments and hence, should be perceived as a third IV. Formally, the following is predicted:

> *H1: A consumer's attitude toward using virtual mirrors has a significant positive effect on his/her intention to use the technology.*
> *H2a: Perceived usefulness has a significant positive effect on attitude toward using virtual mirrors.*
> *H2b: Perceived ease of use has a significant positive effect on attitude toward using virtual mirrors.*
> *H2c: Perceived enjoyment has a significant positive effect on attitude toward using virtual mirrors.*

Many research studies also analyzed the impact of socio-demographic and personality traits on IU. For socio-demographic characteristics, such as age, gender, level of education, and income, no significant effects on IU were generally found (Arts, Frambach, and Bijmolt 2011, p. 142; Meuter et al. 2003, p. 904; Steenkamp and Gielens 2003, p. 380). Moreover, it is assumed that today's consumers have access to and develop some level of familiarity with technologies regardless of age, gender, education, and income, supporting the point of view that socio-demographic factors are not crucially important for the understanding of adoption intentions (Dabhalkar and Bagozzi 2002, p. 186). With regards to consumer traits, technology orientation, social anxiety, and self-efficacy are often studied to influence the effects on ATU (e.g. Arts, Frambach, and Bijmolt 2011, p. 142; Dabholkar and Bagozzi 2002, pp. 187-190; Meuter et al. 2003, p. 904). Rauschnabel and Ro (2016, p. 137) point out that for research studies focusing on AR, the inclusion of the variable 'personal TI' is of central relevance. TI can be referred to as the "degree to which an individual is receptive to new ideas and makes

innovation decisions independently of the communicated experience of others" (Midgley and Dowling 1978, p. 236). Therefore, a person high in technology novelty seeking has a deep intrinsic motivation to use devices such as virtual mirrors and they often want to try them for reasons of entertainment (Dabholkar and Bagozzi 2002, p. 188; Midgley and Dowling 1978, p. 236). Olsson et al. (2012, p. 36) as well as Rauschnabel and Ro (2016, p. 137) provide evidence that participants who are more technologically oriented show higher intentions of using the respective technology. Furthermore, findings by Dabholkar and Bagozzi (2002, pp. 193-195) as well as Venkatesh and Bala (2008, p. 290) reveal that TI positively moderates the effect of PEOU and PE on ATU. Hence, the following hypotheses are put forth:

> *H3: A consumer's socio-demographic traits (especially age and gender) do not have a significant effect on his/her intention to use virtual mirrors.*
>
> *H4a: A consumer's technology innovativeness has a significant positive effect on his/her intention to use virtual mirrors.*
>
> *H4b: A consumer's technology innovativeness positively moderates the effect of perceived ease of use on the attitude toward using virtual mirrors.*
>
> *H4c: A consumer's technology innovativeness positively moderates the effect of perceived enjoyment on the attitude toward using virtual mirrors.*

Another well-researched theory is the IDT by Rogers (2003). In contrast to TAM, the IDT examines adoption drivers as well as the innovation decision process itself. The approach is based on five attributes: relative advantage, compatibility, complexity, trialability, visibility, and observability. However, research findings by Tornatzky and Klein (1982, pp. 34-39) illustrate that only relative advantage, compatibility, and complexity significantly relate to innovation adoption and that out of the three remaining attributes only complexity provides a consistent relationship across various innovation types. Thus, only complexity is evaluated for inclusion in the present conceptual framework. Complexity is defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" (Rogers and Shoemaker 1971, p. 154). Previous research shows that the meaning of complexity and PEOU

are very similar (Davis 1989, p. 322), yet, complexity additionally incorporates the level of product newness in its overall construct impact. Rogers states in his definition of complexity that "new ideas [which] are simpler to understand are adopted more rapidly than innovations that require the adopter to develop new skills and understandings" (2003, p. 16). Morwitz, Steckel, and Gupta (2007, pp. 359-360) confirm that the adoption process also depends on the PN of a technology. Innovations can be perceived either as really-new or incremental. Whereas the latter only improves or adjusts established technologies, really-new innovations revolutionize product categories. Pursuant to the definition of really-new products by Urban, Weinberg and Hauser (1996, p. 47), virtual mirrors fall into this category. Research conducted by Hoeffler (2003, p. 418) further reveals that consumers often perceive really-new innovations as too complex to operate resulting in a low level of PEOU. Hence:

> *H5a: The perceived newness of the technology has a significant positive effect on the intention to use virtual mirrors.*
>
> *H5b: The perceived newness of the technology negatively moderates the effect of perceived ease of use on the attitude toward using virtual mirrors.*

In addition, the study controls for product category liking. The chosen product category 'sunglasses' should not have a significant impact on the relations between the antecedents of adoption and the dependent variable (DV). The literature review (see Section 3.) verifies that the TAM approach is generally applicable across product categories. Thus, it is proposed that:

> *H6: The degree of affection for sunglasses does not have a significant effect on the intention to use virtual mirrors.*

Conclusively, the proposed exploratory model of this research (see Figure 3 for a graphic illustration) adopts the most important TAM factors and adds context-specific components for virtual mirrors. This is in line with earlier research where the basic TAM was also extended with findings from other theories such as the IDT (e.g. Chen, Gillenson, and Sherrell 2002).

- INSERT FIGURE 3 ABOUT HERE -

### *4.2 Methodology*

To empirically test the impact of virtual mirrors in the context of digital retail stores, a program was needed that captures a participant's interaction with the technology. An online virtual fitting solution from a well-known e-commerce website serving this purpose was found by scanning the World Wide Web and was incorporated into the experimental design (see Appendix A for an exemplary image of the program). The study was conducted using the context of fashion retail, more precisely the product category of sunglasses. This section illustrates the study design, construct measurements and data collection.

- INSERT TABLE 1 ABOUT HERE –

*4.2.1 Procedure.* To assess contextual relevance, logical consistencies, and ease of understanding for the experimental survey, a pretest was conducted. Hereinafter, the structure of the pretest is briefly presented and key changes to the survey of the main experiment are demonstrated. The pretest data was collected using an online survey. The sample consisted of 39 participants. Table 1 provides details on the pretest sample. The online survey was composed of five parts: (1) questions about the participant's background, (2) questions about the participant's shopping behavior and in-store technology preferences, (3) a short description of a virtual mirror scenario, (4) questions about the product category (sunglasses) and the perceived need of touch, and (5) questions about virtual mirror features, benefits, and risks.

Regarding part (2), the statements were adapted from earlier research focusing on in-store shopping experience drivers (Burke 2002, pp. 415-416) and on recent in-store technologies (e.g. Parise, Guinan, and Kafka 2016, p. 417). With regards to the qualitative pretest results, the wording and the number of items for the in-store shopping experience had to be revised and more detailed measurements for the construct 'TI' were implemented in the

subsequent main experiment. Part (3) outlined an exemplary scenario of the in-store usage of virtual mirrors:

> Imagine now that you are currently looking for new sunglasses for your upcoming holidays. You are entering your favorite store but cannot find any suitable sunglasses. Now imagine that you go to a mirror that is prominently placed in the store. The mirror sees and greets you and asks how it can help you. From a variety of features (call for assistance, look at new arrivals, search for categories etc.), you select the step-by-step product search process. By pressing the respective buttons, you let the mirror know that you are searching for (male/female) summer clothes and accessories (occasion) and that you like bright colors (preferences). Subsequently, the mirror uses its camera to capture your body format and projects suitable products offered in-store and/or online right on you. Finally, let us pretend that you like the sunglasses that you wore virtually. Imagine now that the item can either be brought to you immediately by a store assistant or delivered directly to your home.

Part (4) controlled for the liking of the product category and examined the perceived ownership. The author's initial interest for the ownership construct originated from previous research conducted by Brasel and Gips (2014, p. 229) who claim that touchscreen interfaces lead to stronger levels of ownership compared to simple screen and mouse devices. Thus, the inclusion of a touchscreen interface in virtual mirrors potentially lowers the need for touch for products with high haptic importance to a certain extent. Yet, the statements 'I feel a very high degree of personal ownership of the sunglasses', 'I feel like I already own these sunglasses', and 'I feel like these are already my sunglasses' (Peck and Shu 2009, p. 437) were regarded as too challenging to be evaluated based on such an abstract and textual scenario. Therefore, the construct was excluded from the main experiment. The last part of the survey included questions about the PN on a seven-point semantical differential as well as 12 statements about PU, perceived risk (trust), and PE of the virtual mirror measured on a seven-point Likert scale (1=I do not agree at all; 7=I completely agree). The items for the three constructs were either based on research findings of Chiu et al. (2009, p. 773), Ha and Stoel

(2009, p. 568), and Van der Heijden, Verhagen, and Creemers (2003, pp. 45-48) or developed by the author.

Testing the internal reliability of the pretest scale items, however, shows that not all constructs yield a good level of reliability. The analysis reveals that the Cronbach's alphas for PU ($\alpha$=0.901) and PE ($\alpha$=0.715) are above, yet for perceived risk ($\alpha$=0.164) below the reference value of 0.7 (Nunnally 1978, p. 245). Subsequently, a more sorrow literature review was required, focusing on finding more suitable constructs to measure consumer technology acceptance. The following section illustrates the final structure of the survey for the main experiment and provides details on the construct metrics of the conceptual framework.

*4.2.2 Survey structure and construct measurement.* For the main experiment, all construct measurements were adapted from existing literature. In some cases, the wording of the items had to be changed slightly to suit the current research context. The first section of the survey included questions concerning the demographic background (gender, age, education, profession, income). Next, the shopping behavior of the participant was analyzed with respect to shopping platform preferences (online vs. in-store), possible reasoning behind online shopping preferences, the in-store shopping frequency, and the relevance of certain drivers for the in-store shopping experience. In general, the objective is to gain greater insights on whether certain drivers leading to online shopping preferences can be also experienced through the usage of virtual mirrors. The stated items for online shopping activities (e.g. product selection, convenience, product search process) and in-store shopping features (e.g. service, price, social interaction) were adapted from Burke (2002, pp. 415-416), Childers et al. (2001, pp. 515-517) as well as Erdem, Ben Oumlil, and Tuncalp (1999, p. 142) and measured on a seven-point Likert scale (1=not at all important; 7=extremely important).

Furthermore, the five response options for the shopping frequency (e.g. 'several times each week', 'about once each week') were based on metrics used by Davis (1993, p. 480).

Part three of the questionnaire addressed the participant's knowledge about and desire for existing in-store technologies and his/her general TI. The list of recent in-store technologies (QR Codes, mobile apps, beacons, virtual mirrors, interactive displays) was developed by screening various academic literature on digitalization of retail stores (e.g. Parise, Guinan, and Kafka 2016, p. 417) and newspaper articles (Bovensiepen, Rumpff, and Bender 2015, pp. 10-17; Hagberg, Sundstrom, and Egels-Zandén 2016, pp. 695-700). The measures for TI were based on Dabholkar and Bagozzi (2002, p. 199), Olsson et al. (2012, p. 35), and on Steenkamp and Gielens (2003, p. 382) and assessed through eight items (see Table 2) using a seven-point Likert scale (1=I completely disagree; 7=I completely agree). After answering questions about their demographics, shopping behavior, and technology orientation, participants were given a similar scenario as the one from the pretest. However, during the main experiment participants received a time frame of two minutes to personally experience the potential of virtual mirrors by using the virtual fitting software (see Appendix B).

> […] Subsequently, the mirror uses its camera to capture your body format and projects suitable products offered in-store and/or online right on you. **Please raise your hand once you are finished reading this section. The test administrator will open a new window on the PC.** […] Imagine now that the item can either be brought to you immediately by a store assistant or delivered directly to your home.

Part six controlled for the participant's affection for and usage frequency of sunglasses. Subsequently, participants were asked to rate the virtual mirror in terms of (1) features, (2) PN, (3) PU, (4) PEOU, (5) PE, (6) ATU, and (7) IU. In accordance with Fretwell (2011, pp. 3-7), a catalogue of potential drivers for virtual mirror usage was established and the importance of each feature was measured on a seven-point Likert scale (1=not at all important; 7=extremely important). Based on Herzenstein, Posavac, and Brakus (2007, p. 255), PN was assessed using a seven-point semantic differential scale for three items: 'not at all new – extremely new', 'not a novel product – extremely novel product', 'not at all

innovative – very innovative'. The measures for PU were adapted from Chen, Gillenson, and Sherrell (2002, p. 713), Dabholkar (1994, p. 107), and Davis (1989, p. 340) and consisted of six items. PEOU was evaluated through five items (Davis 1989, p. 340) and PE through four items (Dabholkar 1994, p. 107) (see Table 2). All three constructs were presented on a seven-point Likert scale (1=I completely disagree; 7=I completely agree). ATU was determined using a seven-point semantic-differential scale with the endpoints 'good-bad', 'pleasant-unpleasant', 'harmful-beneficial', and 'favorable-unfavorable' (Ajzen and Fishbein 1980, p. 21; Dabholkar 1994, p. 107). Based on Fishbein and Ajzen (1975, p. 108), Sheppard, Hartwick, and Warshaw (1988, p. 329), and Dabholkar (1994, p. 107), IU was examined on a seven-point semantic-differential scale with the endpoints: 'likely-unlikely' and 'possible-impossible'. Furthermore, the order of the items within questions was randomized to prevent sequence effects.

- INSERT TABLE 2 ABOUT HERE -

The successive analysis of the internal reliability of the scale items reveals that all but one construct is above the reference value of 0.7 (Nunnally 1978, p. 245). For PEOU, the Cronbach's alpha is slightly lower ($\alpha$=0.680). Consequently, two items had to be dropped due to low loadings. In addition, three items loading on TI were eliminated from further analysis to generate a higher Cronbach's alpha ($\alpha_{,old,}$=0.769; $\alpha_{,new,}$=0.844). Table 2 presents the results of the remaining items. It should be mentioned that high values for Cronbach's alpha only demonstrate good internal consistency of the items in the scale. A confirmatory factor analysis (CFA) was conducted in Section 4.3.2 to evaluate the general reliability and validity of the overall model.

*4.2.3 Data collection.* To investigate the acceptance and effects of the virtual mirror application, 40 participants were recruited in a German town through social media and word-

of-mouth channels to participate in the experiment. However, two participants were excluded since they inconsistently responded to control questions and another subject proved to be a multivariate outlier (see Section 4.3.1). Coffee and sweets were offered as incentives for participation. In order to gather widely unbiased pre-market observations, Germany as a technologically and economically well-developed country was chosen, as there exists basically no virtual mirror market penetration yet. In addition, the data collection was conducted in a well-controlled environment mainly at the author's own premises but also via Skype (see Appendix B). Unlike many of the aforementioned studies (e.g. Olsson et al. 2012) that had difficulties displaying the full potential of new technologies by only using words, this study enabled participants to experience the application in person. The demographic description of the final sample (N=37) is provided in Table 3.

- INSERT TABLE 3 ABOUT HERE -

The final sample is comprised of slightly more males (56.8%) than females (43.2%). The largest group of respondents is between the ages of 22 and 26 (62.2%), yet, the sample ranges from 23 to 59 years of age. Regarding the educational level, 94.6% of the participants have a Bachelor's or more advanced university degree. The income distribution ranges from no personal income (5.4%) to €2,000 or more (16.2%), whereat the most common selected income bracket is between €500 - €1,000 (43.2%). The majority of participants (73.0%) are university students, followed by 24.3% of employed participants. 70.3% of the participants prefer to purchase fashion items in a physical environment and not online. Nevertheless, 78.4% of the subjects do not shop for fashion products more than once per month, expressing a rather limited shopping desire or budget. With respect to the liking of sunglasses, the output reveals a moderate affection for the product category among participants ($mean_{Liking}$=5.68 out of 7). Besides, 18.9% (includes scores above 5.5) of the subjects rate themselves as having a high level of technology orientation ($mean_{TI}$=4.26).

To give an indication of the representativeness of the sample, comparisons with nationwide consumers were drawn. According to Statista (2018), the majority of shoppers in Germany are female (62%). However, the sample consists of more male than female participants, which could lead to an unbalance in terms of gender. Moreover, the large number of students represents only one segment within the culture of interest and a generational demographic cohort named generation Y (Solomon 2018, pp. 498-499). Yet, according to Von Hippel, Ogawa, and de Jong (2011), consumer innovators are often characterized as being male, highly educated, and technically trained. Consequently, they can understand the principles of virtual mirrors to a greater degree and therefore, provide more interesting insights toward the early adoption of this new technology.

### *4.3 Empirical Analysis and Results*

In order to test the hypotheses, a CFA and path analyses through multiple regression and structural equation modeling (SEM) were employed using SPSS and SPSS AMOS. A multiple regression analysis was thereby chosen as appropriate method of analysis due to its high frequency of application in similar TAM research studies (e.g. Davis, Bagozzi, and Warshaw 1992; Rauschnabel and Ro 2016, Spreer and Kallweit 2014). Yet, as will be seen below (see Section 4.3.4), an additional finding of a mediating effect resulted in a model modification and thus, relations had to be reassessed through SEM. In contrast to other multivariate techniques, SEM provides researchers with the ability to simultaneously test a series of dependence relations (Hair et al. 2010, p. 630).

*4.3.1 Multivariate assumptions.* Data screening was carried out to examine multivariate assumptions (i.e. normality, homoscedasticity, linearity, and multicollinearity). Generally, different methods can be used to test for normality violations. A common technique is to evaluate the skewness and the kurtosis values of each variable/item.

Researchers declare different acceptable ranges for skewness and kurtosis. Based on reports by Garson (2012, pp. 18-19), the results were checked to be within the satisfactory range of ±2 for skewness and ±3 for kurtosis. All but one of the initial items meet the requirements (skewness: -1.632-737; kurtosis: -1.062-1.599). The item PEOU1 ($kurtosis_{PEOU1(old)}$=3.338; $kurtosis_{PEOU1(new)}$=-0.702) as well as the variable age were transformed in SPSS (*IDF.Normal*) in order to fit the normal distribution (Hair et al. 2010, p. 78). Potential multivariate outliers were inspected through squared Mahalanobis distance ($D^2$) values (Garson 2012, pp. 31-32) in the SPSS AMOS CFA output. Two subjects yield values ($p_1$=0.023; $p_2$=0.042) below the suggested statistical significance level of $p \geq 0.05$ (respectively $p \geq 0.001$) (Byrne 2001, pp. 51-52). However, only the most extreme outlier was excluded from the sample to limit the bias which dropping outliers can have on the researcher's results (Garson 2012, p. 30). The final normality analysis of the revised measurement model (see Section 4.3.2) in SPSS AMOS supports the hypothesis of moderate normality as Mardia's coefficient of multivariate normality (multivariate kurtosis critical ratio value=1.197) is below the acceptable threshold of 1.96 (Mardia 1970, p. 528).

Furthermore, homoscedasticity was tested visually and statistically. The visual inspection of the scatterplots of residuals (Garson 2012, p. 39) reveals a rather patternless cloud of dots contributing to the assumption of homoscedasticity. The subsequent *White's* test (Garson 2012, p. 41) confirms the absence of heteroscedasticity within the revised measurement model. With the p-value being equal to 0.39, the null hypothesis of homoscedasticity cannot be rejected. Moreover, linearity was checked by reviewing the scatterplots for the selected variables. As per the author's visual inspection, no violation of linearity can be reported, as most data points are in straight lines around the diagonal axes and no curves can be identified (Hair et al. 2010, p. 39). With regards to multicollinearity, an examination of the correlation matrix for the IVs was performed. The highest correlation

coefficient (r=0.782) is between PE and PU. Thus, no correlation is higher than the proposed threshold of 0.85 (Kline 2005, p. 56). Additionally, the tolerance values for all constructs as well as the variance inflation factors (VIF) were calculated to assess multicollinearity issues. According to Kline (2005, p. 57), VIF values less than 10.0 and tolerance values greater than 0.10 indicate absence of multicollinearity. In the current study, tolerance values spread between 0.229 and 0.856 and the VIF values range from 1.168 to 4.372. Therefore, no signs of violation can be found.

*4.3.2 Confirmatory factor analysis.* The validity and reliability of the explorative model were evaluated using the CFA function in SPSS AMOS. In accordance with Anderson and Gerbing (1988, p. 414) and Garson (2012, p. 16), CFA has proven to sufficiently predict a satisfactory model fit for the collected data. The initial framework (see Table 2) consists of seven latent constructs with each construct being built on several items ($N_{items}$=29). The output of the first CFA (see Table 4) does not yield tolerable goodness-of-fit indices ($\chi$2/df=1.944, CFI=.706, RMSEA=.162)[2]. Adjustments had to be made to ensure a better fit of the model. As suggested by Hair et al. (2010, pp. 725-727), standardized factor loadings, residuals, and modification indices were screened to spot problematic items. Following this procedure and considering theoretical implications and relevance, the construct ATU and nine additional items were removed to increase model fit. The results of the revised CFA model (see Table 4) present acceptable goodness-of-fit measures ($\chi$2/df=1.248, CFI=.952, RMSEA=.083). The selection of the stated goodness-of-fit measures and cut-off values are in accordance with Herrmann, Homburg, and Klarmann (2008, p. 288).

- INSERT TABLE 4 ABOUT HERE -

[2]df=degrees of freedom; CFI=Comparative Fit Index; RMSEA=Root Mean Square Error of Approximation.

The adequacy of the measurement model was further addressed by means of the criteria of reliability, convergent validity, and discriminant validity. In addition to the Cronbach's alpha analysis, reliability was evaluated using construct reliability values. In contrast to the coefficient alphas, construct reliability values are commonly applied in combination with SEM and are less likely to underestimate internal consistency (Hair et al. 2010, p. 709). Table 5 demonstrates that all values are greater than the proposed threshold of 0.7 for construct reliability (Hair et al. 2010, p. 710). The construct PEOU has the lowest value (CR=0.864).

Moreover, convergent validity was verified by checking two criteria suggested by Hair et al. (2010, p. 709): (1) standardized factor loadings should be above 0.7 and (2) the average variance extracted (AVE) of each construct should exceed 0.5. Table 5 and Appendix C provide evidence that all of the 16 remaining items exhibit loadings higher than 0.7 on their respective construct. The AVE values are spread between 0.703 (TI) and 0.859 (IU). Thus, both conditions for convergent validity are fulfilled (see Table 5). Discriminant validity was assessed by inspecting whether the square root of AVE values of each construct is greater than the squared inter-construct correlations related to the respective construct (Fornell and Larcker 1981, p. 46). All constructs provide a satisfactory level of discriminant validity, illustrating that the constructs are truly distinct from one another.

- INSERT TABLE 5 ABOUT HERE –

*4.3.3 Descriptive statistics.* The participants show a moderate interest for in-store technologies ($mean_{tech\_importance}$=3.68 out of 7), yet 64.9% state that they would be more satisfied if innovative technologies were to be provided in physical stores. Especially the implementation of virtual mirrors (54.1%), customized mobile shopping apps (40.5%), and interactive displays (37.8%) are of interest for the subjects. Therefore, a significant number of participants would like to use virtual mirrors in the future. Examining the relevance of

potential features of the virtual mirror reveals a very positive attitude toward functional traits, such as 'Accurate body sizing' (mean=6.03), 'Display of product information' (mean=5.73), and 'Display of the online and in-store product portfolio' (mean=5.32 out of 7). Relating this to the output of why people prefer to shop online, one may argue that virtual mirrors potentially offer a similar convenience and product variety, which people are seeking in their online shopping activities ($mean_{online\_convenience}$=4.84 and $mean_{online\_variety}$=4.84 out of 7). The findings are in line with qualitative feedback from the open question, stating that the use of virtual mirrors would first of all "[s]ave time [and secondly, enable shoppers] to view [the] whole product range without all products being in stock at the physical store" (male, 24-years old). Another subject (female, 25-years old) mentions that virtual mirrors would "make the buying decision easier because [one] can compare the items directly". However, gimmicks, such as 'Photo-taking and sharing via social media' (mean=2.38) or the 'Display of latest fashion videos' (mean=3.38 out of 7) are perceived as rather unnecessary. The descriptive statistics of the studied constructs[3] also provide insights on how participants value utilitarian and hedonic aspects of the technology. The mean scores of the measured constructs are spread between 3.07 ($mean_{PEOU}$) and 5.61 ($mean_{IU}$), demonstrating an overall positive reaction toward virtual mirrors.

One further interesting finding is that participants see higher hedonic than functional benefits in the technology ($mean_{PE}$=5.37 vs. $mean_{PU}$=5.04 and $mean_{PEOU}$=3.07). Moreover, male subjects seem to be slightly more technology-oriented than female subjects ($mean_{male}$=4.41 vs. $mean_{female}$=4.06), which might explain the higher mean of PEOU for male compared to female participants ($mean_{male}$=3.14 vs. $mean_{female}$=2.97). In addition, female participants show marginally higher means of PE ($mean_{female}$=5.81 vs. $mean_{male}$=5.03) and IU ($mean_{female}$=5.91 vs. $mean_{male}$=5.38). Regarding the subgroup of 'age', older participants react

[3]Even though ATU was not included in the final measurement model, the analysis reveals an overall positive tendency for the attitude toward using virtual mirrors (mean=5.29; standard deviation=1.26).

less favorably toward the usefulness of virtual mirrors than the younger subjects ($mean_{older}$=4.57 vs. $mean_{younger}$=5.32). Furthermore, when analyzing the means of the TI-subsample, technology innovative participants evaluate virtual mirrors slightly more positive in terms of PU and PEOU as compared to less technology-oriented respondents (PU: $mean_{high}$=5.29 vs. $mean_{low}$=4.69; PEOU: $mean_{high}$=3.25 vs. $mean_{low}$=2.79). Table 6 exhibits the means of all the constructs for the total sample (N=37) as well as for selected subsamples.

- INSERT TABLE 6 ABOUT HERE -

Overall, the analysis of the descriptive statistics reveals that shoppers are generally interested in such an in-store technology and that they favor the adoption of virtual mirrors in physical shopping environments. Yet, the results of the descriptive analysis of the subgroups should be carefully interpreted, as the output of the independent-samples t-tests in SPSS shows no significant differences in scores (Pallant 2001, p. 181). Therefore, the stated findings should merely represent tendencies with respect to the adoption of virtual mirrors.

*4.3.4 Results from the multiple regression analysis.* The procedure for hierarchical multiple regression was applied to analyze the strength of the various drivers on consumers' adoption intentions. One may note that H1 cannot be tested as the construct ATU was removed from the measurement model due to poor fit. Subsequently, the hypotheses H2a, H2b, H2c, H4b, H4c, and H5b were evaluated in the context of IU rather than ATU. Previous studies confirm the existence of a significant direct effect of the investigated antecedents on IU (Davis, Bagozzi, and Warshaw 1989, p. 997; Haugstvedt and Krogstie 2012, p. 251; Hu et al. 1999, p. 105; Mun and Hwang 2003, p. 442; Spreer and Kallweit 2014, p. 23). Thus, the exclusion of ATU has no critical impact on the overall measurement model. Accordingly, the hierarchical regression model assessed the relationship between all IVs (PU, PEOU, PE, TI, PN) on IU while controlling for possible effects of age, gender, and affection for sunglasses.

Gender, age, and the liking of sunglasses were entered in step one as control variables. The second block of IVs consisted of the investigated drivers of IU. The results (see Table 7) show that PE is the only significant antecedent of IU (ß=0.444; p=0.038). Concerning the effect of the control variables, the R-squared value of 0.053 indicates that age, gender, and the affection for sunglasses only account for 5.3% of the variance in the outcome. The predictor variables explain an additional 64.0% (R square change value) of the variance providing a significant contribution (Sig. F Change = 0.000) to the model. The R-squared of 69.2% (60.1% adjusted) for the complete model demonstrates a satisfactory amount of explained variance. Taking everything into account, hypotheses H2c ($ß_{PE}$=0.444; p=0.038), H3 ($ß_{Gender}$=0.015; p=0.906; $ß_{Age}$=0.124; p=0.293), and H6 ($ß_{Sunglasses\text{-}Liking}$=-0.105; p=0.459) can be supported and hypotheses H2a ($ß_{PU}$=0.282; p=0.217), H2b ($ß_{PEOU}$=0.083; p=0.539), H4a ($ß_{TI}$=0.138; p=0.426) and H5a ($ß_{PN}$=0.219; p=0.139) are to be rejected.

- INSERT TABLE 7 ABOUT HERE -

In the next step, potential interaction effects were tested. To avoid multicollinearity issues with the interaction term, variables were centered ex ante (Aiken and West 1993, pp. 32-36). Consistent with H4b, the inclusion of the interaction term into the model reveals a significant effect between PEOU and TI ($p_{PEOUxTI}$=0.045). The visual inspection of the interaction graph certifies that PEOU has a stronger effect on IU for innovative consumers than for less technology-oriented shoppers (see Figure 4). However, no support for H4c can be detected as the results illustrate no significant moderation effects between PE and TI ($p_{PExTI}$=0.264). Furthermore, the interaction effect between PEOU and PN was checked and a significant effect is found both statistically ($p_{PEOUxPN}$=0.021) and visually (see Figure 4). Thus, H5b is confirmed: PEOU has a stronger effect on IU when the PN is low. The results of the regression analysis are presented in Table 7.

- INSERT FIGURE 4 ABOUT HERE -

After the initial analysis, additional analyses were conducted to test for indirect effects that were not previously suspected. Based on the procedure by Rauschnabel and Ro (2016, pp. 136-138), three regression models were taken into account: the first regression model includes the initial structure (IV: PU, PEOU, PE, TI, PN, age, gender, sunglasses-liking; DV: IU), the second regression model assesses the relation between all predictors as IVs and PE as DV, and the third regression model replaces PE by IU as DV (PE was excluded as IV).

Multicollinearity was ruled out prior to the interpretation of the regression results. The highest VIF-value across the three models is 4.372 and hence, below the critical value of 10.0 (Kline 2005, p. 57). Regression model two shows significant relations between PU and PE ($ß_{PU}$=0.847; p=0.000). The R-squared of 72.6% (65.7% adjusted) implies an acceptable amount of explained variance. In model three, the same significant effect is identified ($ß_{PU}$=0.658; p=0.000; R-squared=0.638; R-squared adjusted=54.8%). For the initial model, only PE is determined to be a significant predictor of IU (see above-mentioned multiple regression results). PU becomes insignificant when controlling for PE. This indicates that PU achieves its effects on IU through PE. Using Hayes' PROCESS SPSS macro (2013, pp. 98-113), the mediating effect was checked on a 95% bias corrected confidence interval and with 5,000 bootstrap samples. The expected significant indirect effect of PU on IU through PE is found ($ß_{indirect}$=0.3627 for p<0.05 with BootLLCI=-0.0070 and BootULCI=.07227 $\neq$ 0).

*4.3.5 Results from the structural equation modeling.* The modified version of the measurement model (including PE as a mediator) was examined through SEM under the maximum likelihood method in SPSS AMOS. As mentioned above, SEM is particularly used when a conceptual framework consists of more than one DV for which direct and indirect links need to be measured (Hair et al. 2010, p. 630). The goodness-of-fit indices for the revised structural model meet the required cut-off values (Herrmann, Homburg, and Klarmann 2008, p. 288): $\chi$2/df=1.358, CFI=.946, RMSEA=.1.

- INSERT FIGURE 5 ABOUT HERE –

The results of the revised model show that PE still significantly predicts IU ($ß_{PE}$=0.341, p=0.009), yet a significant effect of PU on IU ($ß_{PU}$=0.330, p=0.023) is identified. Despite the direct effects, the expected significant indirect effect of PU on IU is confirmed ($ß_{PU\text{-}indirect}$=0.782, p<0.001). Moreover, the hypothesis (H5b) stating that PN negatively moderates the relation between PEOU and IU is partially supported ($ß_{PEOUxPN}$=-0.199, p=0.061), but the moderating effect of TI (H4b) is nonexistent ($ß_{PEOUxTI}$=0.144, p=0.204) in the revised version. Together, the predictors explain 76% of the variance in IU. The respective paths and standardized coefficients ß are summarized in Figure 5. Table 8 presents the results of the initial and modified conceptual framework for the adoption of virtual mirrors in terms of the tested hypotheses.

- INSERT TABLE 8 ABOUT HERE –

### *4.4 Discussion of the Results*

The analysis reveals that consumers' adoption intentions of virtual mirrors in the physical shopping environment are mainly driven firstly, by the degree of enjoyment using the technology and secondly, by functional benefits. These results only partly conform to theoretical expectations. Many research studies state that consumers appreciate technologies with hedonic elements (Bruner and Kumar 2005, p. 556; Pantano and Servidio 2012, p. 284; Watchravesringkan, Nelson Hodges, and Kim 2010, p. 275), but that PU is normally a stronger predictor of IU than PE (Davis, Bagozzi, and Warshaw 1992, p. 1123; Kallweit, Spreer, and Toporowski 2014, p. 274), implying that consumers are more likely to adopt technologies when the devices enhance their lifestyle in some way. An explanation for this strong impact of PE may be that the buying process in in-store fashion retailing is rather experiential than goal-oriented and hence, shoppers look for emotionally enriching shopping

activities (Crowley, Spangenberg, and Hughes 1992, p. 246). Exemplary research by Spreer and Kallweit (2014, p. 23) verifies that participants primarily rely on PE when deciding whether to adopt AR technologies. Another interesting finding is that PE significantly mediates the relationship between PU and IU, indicating that users who perceive the functional benefits of the technology as favorable are more likely to experience fun. This is in line with past research confirming the significant indirect relationship between PU and IU through hedonic attitudes (Watchravesringkan, Nelson Hodges, and Kim 2010, p. 275).

Against expectations, the third major antecedent, PEOU, does not significantly influence IU. As PN is linked to PEOU and as the mean score for PN is relatively high, one may assume that the virtual mirror is perceived as too new to accurately evaluate its operationality. The limited interaction with and the short description of the virtual mirror probably conveys the impression that the technology is difficult to comprehend. Therefore, low adoption intentions by PEOU may result from both the missing motivation to understand the novel product as well as possible imagination difficulties with respect to product usage (Zhao, Hoeffler, and Dahl 2012, pp. 83-84). Although the present study cannot find a significant effect between PEOU and IU, evidence for the prominence of PU to PEOU is identified. Results, thus, support previous research (Davis 1989, p. 333; Keil, Beranek, and Konsynski 1995, p. 89) proposing that users are willing to cope with operative issues if the technology provides the needed functionality. Exemplary research conducted by Spreer and Kallweit (2014, p. 23) highlight similar findings: The relation between PEOU and IU is insignificant and PEOU is the weakest predictor of adoption intentions.

Furthermore, none of the investigated personal characteristics (age, gender, TI) illustrates a significant impact on IU. For socio-demographic characteristics, such as the consumer's age and gender, no significant relations are expected (Arts, Frambach, and Bijmolt 2011, p. 142; Steenkamp and Gielens 2003, p. 380). Yet, TI is predicted to strongly

influence IU as well as the effects of PEOU on IU (Dabholkar and Bagozzi 2002, pp. 193-195; Olsson et al. 2012, p. 36; Rauschnabel and Ro 2016, p. 137). Citrin et al. (2000, p. 298), Goldsmith and Hofacker (1991, pp. 212-216), and Hirunyawipada and Paswan (2006, p. 193) explain that the issue may result from the application of the general innovativeness scale not being adapted to domain-specific characteristics (e.g. 'I am usually reluctant to try new products and technologies' vs. 'I am usually reluctant to try new fashion products and in-store technologies'). Users are possibly technology-oriented but simultaneously no heavy shoppers and hence, do not see how the technology fits to their lifestyle. Nevertheless, the results confirm the tendency of technology-oriented consumers being more likely to adopt virtual mirrors than respondents with lower TI.

In sum, the high mean score of IU points at the fact that shoppers seem to enjoy the idea of using a virtual mirror for garment fitting and that they would adopt the technology in physical shopping environments.

# 5. Conclusion

## *5.1 Theoretical Contributions*

Research on consumers' attitudes and acceptance behaviors for in-store technologies disagrees on how individuals actually make decisions to adopt or reject new technical devices. A considerable amount of studies challenged the classic assumption that shoppers only look for technologies that facilitate their lives in a functional way. Critical studies (Bruner and Kumar 2005, p. 556; Olsson et al. 2012, p. 36; Pantano and Servidio 2012, p. 284; Rauschnabel and Ro 2016, p. 137; Watchravesringkan, Nelson Hodges, and Kim 2010, p. 275) postulate that humans also favor entertaining features of technologies and that certain consumer characteristics (e.g. TI, prior technology knowledge, social norms) impact the overall acceptance decision. Yet, little research has been conducted to understand consumer usage and perceptions of digital in-store technologies, particularly virtual mirrors, even

though the interest in AR applications in the retailing industry is constantly increasing (Tirico 2017). The current study closes this deficiency in research by empirically testing an extended TAM framework for virtual mirrors. Despite the commonly studied antecedents of adoption intentions (PE, PEOU, PU), two variables are added to the model: PN and a consumer's TI. Overall, the study confirms the robustness of TAM in the context of in-store fashion retailing. Consistent with previous research (Chen, Gillenson, and Sherrell 2002, p. 714; Davis, Bagozzi, and Warshaw 1992, p. 1124; Rauschnabel and Ro 2016, p. 138; Spreer and Kallweit 2014, p. 23; Watchravesringkan, Nelson Hodges, and Kim 2010, p. 275), PE as well as PU are proven to significantly predict technology acceptance behavior. In particular, the findings highlight that adoption decisions regarding virtual mirrors mainly involve hedonic technology aspects. Entertaining features seem to attract the consumer's interest in the technology. Nevertheless, functional benefits (e.g. higher convenience level, time saving) turn out to be another integral component in the adoption intention process.

In addition, the study partially sustains the assumption that the consumer's degree of TI influences the acceptance behavior (Dabholkar and Bagozzi 2002, pp. 193-195; Olsson et al. 2012, p. 36; Rauschnabel and Ro 2016, p. 137). By tendency, innovative participants demonstrate higher adoption intentions. However, this interpretation should be treated with caution, as no significant group differences are identified in terms of TI. Another interesting aspect is found with respect to PN. PN negatively moderates the effect of PEOU on IU, indicating that the product is so new that subjects find it difficult to accurately evaluate whether the technology is easy to operate or not. Examining the current stage of the product lifecycle of virtual mirrors, one may state that the technology is a really-new innovation. Prior research did not put a lot of emphasis on this construct within the technology acceptance framework; PN was rather studied in different contexts and areas (e.g. Hoeffler 2003, p. 418; Urban, Weinberg, and Hauser 1996, p. 47). In summary, not all postulated relations are

significant, but interesting tendencies are detected. Thus, the study contributes to the existing literature by providing first insights into the underlying mechanisms explaining consumers' adoption intentions toward virtual mirrors on which future research can build upon.

### *5.2 Managerial Implications*

The findings have some important implications to managers and developers of virtual mirrors in brick-and-mortar shopping environments. Organizations can use the framework to diagnose the attitude and degree of acceptance for AR technologies such as virtual mirrors and to subsequently develop implementation and positioning strategies. Key success factors are entertaining features and a satisfactory level of usability, as they are found to strongly predict consumers' adoption intentions. Yet, the fun of using virtual mirrors should not come at the expense of the technology being useful. The qualitative feedback of the participants reveals practicality concerns: "The satisfaction with the usage of the mirror depends very much on the quality of the image provided in combination with a very good fit of the tried outfits/glasses. A virtual mirror which only works more or less would be just a 'fun' experience but not useful for 'serious' shopping" (male, 25-years old). Given the findings of the current study, product designers and retailers need to ensure that the technology provides both adequate hedonic and utilitarian features. As mentioned above, the display of product information and an accurate 360° body fitting are perceived as extremely important compared to gimmicks, such as social media content sharing and the display of fashion shows.

Besides, the number of relevant features needs to be limited. According to Thompson, Hamilton, and Rust (2005, p. 431), incorporating too many features in a technology may lead to consumers being confused and overwhelmed. This can result in a lack of understanding the operationality of the product, as seen in the recent study. Therefore, complexity needs to be reduced and retailers must guide and assist consumers on how to use the technology (Wood and Moreau 2006, p. 55). For example, IKEA recently introduced an AR app that allows

consumers to virtually place products from the IKEA catalogue into their homes (Lehnert 2017). They familiarized and educated shoppers about the app through a simple product demonstration video on their website, making it easy for potential customers to understand the technology advantages. Subsequently, retailers should illustrate that virtual mirrors can help to facilitate a customer's shopping journey, as the technology will allow him/her, for instance, to conveniently access the entire product portfolio (online and offline) as well as provide support to efficiently choose the right product and outfit. A potential communication strategy for virtual mirrors could embody a cooperation with fashion bloggers that report to their followers on their experience using virtual mirrors via Instagram or Snapchat. Nowadays, they are perceived as the opinion leaders in the field of fashion and thus, are of great interest for fashion retailers (Rocamora 2011, p. 409).

In addition, brick-and-mortar retailers should not just reduce product complexity, but also adapt the virtual mirror according to their target groups' needs. Retailers should focus on consumers who are most likely early adopters, as they play an important role in the lifecycle of the product (Goldsmith and Reinecke Flynn 1992, p. 42). For example, the company Cisco introduced and tested their own virtual mirror application and identified two target groups: women above the age of 50 appreciated the practicality of the virtual mirrors, whereas women in their 20s enjoyed the fun features (Fretwell 2011, pp. 5-6). Therefore, managers who wish to use virtual mirrors to provide unique shopping experiences must gain a thorough understanding of the antecedents that predict their customers' adoption intentions (e.g. virtual mirrors in exclusive men's clothing stores). Pantano and Servidio (2012, p. 283) state that such superior experiences result in increased customer satisfaction and store revisits.

Furthermore, implementing virtual mirrors would decrease consumers' waiting times for staff members and simultaneously increase (cross-channel) sales (Fretwell 2011, p. 2; Kallweit, Spreer, and Toporowski 2014, p. 274). Yet, as with any other innovation, retailers

must evaluate whether the delivered value is sufficient to offset the monetary investments (Burke 2002, p. 431; Pantano, Iazzolino, and Migliano 2013, p. 226). Accordingly, retailers should validate and modify their digital in-store technology concepts through market research techniques (surveys, field experiments). For instance, Ralph Lauren limited their launch of the interactive mirror to its New York flagship store (Nazario 2015) and Topshop introduced the virtual mirror only in its flagship store in Moscow (Sterling 2011) to better understand how their customers would react to the new technology before making extensive investments. Despite the perceived uncertainty regarding the return on investment, retailers should embrace the underlying power of digital in-store technologies and effectively use virtual mirrors to differentiate themselves from their competitors (Kleinschmidt and Cooper 1991, p. 250).

### *5.3 Limitations and Directions for Future Research*

As with any research effort, there are certain limitations that need to be examined. First of all, an issue results from the experimental design. The data was collected through a scenario-based laboratory experiment and thus, provides limited external validity. Replicating the study in a field setting in a real fashion store may generate more applicable and deeper insights regarding the consumer's behavior toward virtual mirrors in a public environment (Levitt and List 2007, p. 170; Rese, Schreiber, and Baier 2014, p. 875; Roe and Just 2009, pp. 1267-1270). A multimodal research design coupling both laboratory and field experiment settings would lead to more valuable findings due to the decreased tradeoff between the pursuit of internal and external validity (Roe and Just 2009, p. 1270). Moreover, the study only assesses one product category, thereby confining the generalizability of the findings. Future research should test the proposed model with more than just one virtual product (e.g. sunglasses, makeup, sweaters) to minimize potential positive/negative demand effects for a specific product category and to confirm the findings across product categories (Batra and Ahtola 1991, p. 160; Crowley, Spangenberg, and Hughes 1992, p. 241).

Another major limitation of the study derives from the sample size and composition. First, the sample size for the main experiment (N=37) is too small to fully measure the direct and indirect effects of all the suggested constructs. Accordingly, certain findings lack a sufficient level of significance. In order to increase statistical power, future research should apply the rule that 15-20 observations are needed for every investigated construct (Hair et al. 2010, p. 175). However, this number of participants was out of scope for this research study. Second, the participants conducted the experiment voluntarily and hence, self-selection bias cannot be excluded (Bradley 1999, p. 388). Besides, the sample is not fully representative as it consists of a high number of students, resulting in limited socio-demographic variance and generalizability (Peterson 2001, p. 458; Roe and Just 2009, p. 1269). Yet, the generation Y is technology- and fashion-savvy and has a great spending power and, thus, is of particular interest for fashion retailers (Solomon 2018, pp. 498-499). Nevertheless, as seen from findings by Fretwell (2011, pp. 5-6), older consumers are also perceived as potential adopters. Therefore, future research should replicate the study with a more representative sample to deepen the understanding of the underlying motivation and behavior to use virtual mirrors.

Moreover, the analysis reveals that the composition and the number of constructs need refinements. On the one hand, the innovativeness scale is kept too general to accurately measure the consumer's TI in the fashion context. Domain-specific scales for innovativeness should be used in future research to correctly examine the relations of TI within the proposed model (Goldsmith and Reinecke Flynn 1992, p. 46). On the other hand, Venkatraman (1991, p. 63) suggests dividing consumers into sensory and cognitive innovators to investigate utilitarian and affective motives. Alternatively, the recommended antecedent 'compatibility' could be introduced to the model to cover the lifestyle fit of the participant (Chen, Gillenson, and Sherrell 2002, p. 714). Another potential adjustment relates to PN. This study was employed in Germany where virtual mirrors are rather unknown. As a result, the technology

is comprehended of being very new across the participants. Further research should be conducted in countries with a higher coverage of virtual mirrors in physical stores, such as the UK or US, to evaluate through control groups whether prior knowledge or experience with virtual mirrors would significantly impact the findings (Moore and McElroy 2012, pp. 271-272; Rauschnabel and Ro 2016, p. 137). Furthermore, future research needs to explore the role of ATU on IU, as the construct could not be analyzed in this study due to poor model fit indices. Watchravesringkan, Nelson Hodges, and Kim (2010, p. 268) took an interesting path by further separating ATU into hedonic and utilitarian attitudes. This may reveal new findings regarding the differences in technology acceptance for distinct consumer types.

In addition to the suggested construct refinements, future research could study the impact of other consumer traits (e.g. self-efficacy, need for interaction) (Lee and Yang 2013, p. 55) as well as the influence of situational factors (e.g. social anxiety, perceived waiting times) (Dabholkar and Bagozzi 2002, p. 186; Venkatesh and Davis 2000, p. 197) on IU.

### *5.4 General Conclusion*

The aim of this thesis was to investigate the impact of virtual mirrors in physical store environments. An overall acceptance toward using virtual mirrors is found among consumers. Important adoption drivers, such as perceived usefulness and perceived enjoyment, are identified. To be precise, virtual mirrors seem to have the potential to improve the customer shopping journey, as they provide consumers with unique and experiential shopping features. Yet, one may note that virtual mirrors are still in an early product lifecycle stage and thus, not easy to evaluate by users. Perceived complexity may be a challenging adoption barrier that needs to be assessed in future research. In sum, the present study offers meaningful answers to the research questions and provides first insights into the underlying mechanisms of measuring technology acceptance of virtual mirrors.

# Tables

**Table 1:** Pretest Sample Composition

| | | Frequency | |
|---|---|---|---|
| | | *n* | *%* |
| Gender | Female | 22 | 56.4 |
| | Male | 17 | 43.6 |
| Age | <22 | 1 | 2.6 |
| | 22–26 | 23 | 59.0 |
| | 27–31 | 12 | 30.8 |
| | >32 | 3 | 7.7 |
| Income | I do not have a personal income | 7 | 17.9 |
| | Below 500 EUR | 3 | 7.7 |
| | 500–1,000 EUR | 8 | 20.5 |
| | 1,001–1,500 EUR | 4 | 10.3 |
| | 1,501–2,000 EUR | 4 | 10.3 |
| | Above 2,000 EUR | 13 | 33.3 |
| Education | No Degree | 0 | 0.0 |
| | High School Degree | 0 | 0.0 |
| | A-Levels | 2 | 5.1 |
| | Completed vocational training | 1 | 2.6 |
| | Bachelor’s Degree | 19 | 48.7 |
| | Master’s Degree | 14 | 35.9 |
| | Diploma, state examination | 3 | 7.7 |
| | PhD | 0 | 0.0 |
| | Other | 0 | 0.0 |
| Profession | Pupil/in school | 0 | 0.0 |
| | Training/apprenticeship | 0 | 0.0 |
| | University student | 20 | 51.3 |
| | Employee | 18 | 46.2 |
| | Civil servant | 0 | 0.0 |
| | Self-employed | 1 | 2.6 |
| | Unemployed/seeking employment | 0 | 0.0 |
| | Other | 0 | 0.0 |

**Table 2:** Overview of the Used Measurements for Consumer Technology Acceptance

| Construct | Item | Response Format | α | Source |
|---|---|---|---|---|
| Perceived Usefulness | PU1: Using virtual mirrors would improve my performance in shopping or information seeking (e.g. save time or money).<br>PU2: Using virtual mirrors would increase my productivity in shopping or information seeking (e.g. make purchase decisions or find product information within the shortest time frame).<br>PU3: Using virtual mirrors would enhance my effectiveness in shopping or information seeking (e.g. get the best deal or find the most information about product).<br>PU4: Using virtual mirrors would make it easier for me to shop or find information.<br>PU5: I find virtual mirrors very useful in my shopping or information seeking.<br>PU6: I am unsure if the virtual mirror would perform satisfactorily. | 7-point Likert | 0.930 | Adapted from Chen, Gillenson and Sherrell (2002, p. 713); Dabholkar (1994, p. 107); Davis (1989, p. 340) |
| Perceived Ease of Use | PEOU1: Learning to operate virtual mirrors would be easy for me.<br>PEOU2: I believe that the technology would be difficult to use.*<br>PEOU3: My interaction with the virtual mirror would be clear and understandable.*<br>PEOU4: I would find virtual mirrors to be flexible to interact with.<br>PEOU5: It would be easy for me to become skillful at using virtual mirrors. | 7-point Likert | 0.708 | Adapted from Davis (1989, p. 340) |
| Perceived Enjoyment | PE1: Using a virtual mirror will not be interesting.<br>PE2: Using a virtual mirror will be entertaining.<br>PE3: Using a virtual mirror will not be fun.<br>PE4: Using a virtual mirror will be enjoyable. | 7-point Likert | 0.889 | Dabholkar (1994, p. 107) |
| Attitude toward Using | ATU1: Good – Bad<br>ATU2: Pleasant – Unpleasant<br>ATU3: Harmful – Beneficial<br>ATU4: Favorable – Unfavorable | 7-point semantic differential | 0.954 | Ajzen and Fishbein (1980, p. 21); Dabholkar (1994, p. 107) |

| | | | | |
|---|---|---|---|---|
| Intention to Use | IU1: Likely – Unlikely<br>IU2: Possible – Impossible | 7-point semantic differential | 0.907 | Dabholkar (1994, p. 107); Fishbein and Ajzen (1975, p. 108); Sheppard, Hartwick and Warshaw (1988, p. 329) |
| Technology Innovativeness | TI1: I think that technology is necessary in my everyday life.<br>TI2: In general, I am among the first to buy new products and technologies when they appear on the market.<br>TI3: I help my friends and relatives using technical devices.<br>TI4: I like to share information about myself in the web, for example in Facebook or Instagram.*<br>TI5: Spreading and abusing of my personal data in the web worries me.*<br>TI6: I am very cautious in trying new and different products and technologies.<br>TI7: I would rather wait for others to try new products and technologies before buying them myself.<br>TI8: I am usually reluctant to try new products and technologies.<br>TI9: When things get boring I like to find some new and unfamiliar experience.*<br>TI10: I like to experience novelty and change in my daily routine. | 7-point Likert | 0.844 | Dabholkar and Bagozzi (2002, p. 199); Olsson et al. (2012, p. 35); Steenkamp and Gielens (2003, p. 382) |
| Perceived Newness | PN1: Not at all new – Extremely new<br>PN2: Not a novel product – Extremely novel product<br>PN3: Not at all innovative – Extremely innovative | 7-point semantic differential | 0.882 | Adapted from Herzenstein, Posavac and Brakus (2007, p. 255) |

*Note: *****Items were removed according to the analysis of Cronbach's alpha.*

**Table 3:** Main Experiment Sample Composition

| | | Frequency | |
|---|---|---|---|
| | | *n* | *%* |
| Gender | Female | 16 | 43.2 |
| | Male | 21 | 56.8 |
| Age | <22 | 0 | 0.0 |
| | 22–26 | 23 | 62.2 |
| | 27–31 | 12 | 32.4 |
| | >32 | 2 | 5.4 |
| Income | I do not have a personal income | 2 | 5.4 |
| | Below 500 EUR | 4 | 10.8 |
| | 500–1,000 EUR | 16 | 43.2 |
| | 1,001–1,500 EUR | 8 | 21.6 |
| | 1,501–2,000 EUR | 1 | 2.7 |
| | Above 2,000 EUR | 6 | 16.2 |
| Education | No Degree | 0 | 0.0 |
| | High School Degree | 0 | 0.0 |
| | A-Levels | 1 | 2.7 |
| | Completed vocational training | 0 | 0.0 |
| | Bachelor's Degree | 27 | 73.0 |
| | Master's Degree | 6 | 16.2 |
| | Diploma, state examination | 2 | 5.4 |
| | PhD | 0 | 0.0 |
| | Other | 1 | 2.7 |
| Profession | Pupil/in school | 0 | 0.0 |
| | Training/apprenticeship | 0 | 0.0 |
| | University student | 27 | 73.0 |
| | Employee | 9 | 24.3 |
| | Civil servant | 0 | 0.0 |
| | Self-employed | 1 | 2.7 |
| | Unemployed/seeking employment | 0 | 0.0 |
| | Other | 0 | 0.0 |

**Table 4:** Goodness-of-fit Indices for the Initial and Revised Measurement Model

| **Fit Indices** | **Threshold Value** | **Initial Model Value (29 items)** | **Revised Model Value (16 items)** |
|---|---|---|---|
| $\chi 2$ | | 692.099 | 111.099 |
| df | | 356 | 89 |
| $\chi 2$/df | ≤3 | 1.944 ✓ | 1.248 ✓ |
| p (probability level) | >0.000 | 0.000 × | 0.056 ✓ |
| CFI | ≥0.9 | 0.706 × | 0.952 ✓ |
| RMSEA | ≤0.10 | 0.162 × | 0.083 ✓ |

*Note: 13 items were removed from the initial model.*

Source: Herrmann, Homburg, and Klarmann (2008, p. 288)

**Table 5:** Measurement Model Reliability and Validity

| Measurement Items and Constructs | CFA Standardized Factor Loadings | Construct Reliability[a] | AVE[b] | Cronbach's Alpha |
|---|---|---|---|---|
| Perceived Usefulness | | 0.931 | 0.818 | 0.931 |
| PU1 | 0.908 | | | |
| PU3 | 0.922 | | | |
| PU4 | 0.883 | | | |
| Perceived Ease of Use | | 0.864 | 0.761 | 0.875 |
| PEOU1* | 0.853 | | | |
| PEOU5 | 0.891 | | | |
| Perceived Enjoyment | | 0.892 | 0.733 | 0.889 |
| PE1 | 0.850 | | | |
| PE3 | 0.869 | | | |
| PE4 | 0.849 | | | |
| Intention to Use | | 0.924 | 0.859 | 0.907 |
| IU1 | 0.978 | | | |
| IU2 | 0.873 | | | |
| Technology Innovativeness | | 0.876 | 0.703 | 0.868 |
| TI2 | 0.927 | | | |
| TI3 | 0.733 | | | |
| TI7 | 0.844 | | | |
| Perceived Newness | | 0.905 | 0.761 | 0.894 |
| PN1 | 0.949 | | | |
| PN2 | 0.875 | | | |
| PN3 | 0.785 | | | |

*Note:*Item had to be normalized.*

[a] *Composite reliability = (Σ standardized factor loadings)²/((Σ standardized factor loadings)² +Σ measurement error)*

[b] *Average Variance Extracted = Σ(standardized factor loadings²)/$N_{\text{items loading on respective construct}}$*

**Table 6:** Descriptive Statistics (Overall Sample and Subgroups)

| | **Overall Sample** | | **Group Comparisons** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Gender | | | Age | | | TI | | |
| Variable | *Mean* | *SD* | *F* | *M* | *p* | *≤26* | *>26* | *p* | *low* | *high* | *p* |
| PU | 5.04 | 1.27 | 5.29 | 4.84 | 0.292 | 5.32 | 4.57 | 0.083 | 4.69 | 5.29 | 0.182 |
| PEOU | 3.07 | 0.74 | 2.97 | 3.14 | 0.485 | 3.06 | 3.08 | 0.950 | 2.79 | 3.25 | 0.083 |
| PE | 5.37 | 1.23 | 5.81 | 5.03 | 0.055 | 5.45 | 5.24 | 0.620 | 5.35 | 5.40 | 0.920 |
| PN | 5.44 | 1.07 | 5.67 | 5.27 | 0.268 | 5.65 | 5.10 | 0.125 | 5.35 | 5.51 | 0.681 |
| TI | 4.26 | 1.25 | 4.06 | 4.41 | 0.408 | 4.35 | 4.12 | 0.598 | N/A | N/A | N/A |
| IU | 5.61 | 1.31 | 5.91 | 5.38 | 0.231 | 5.77 | 5.36 | 0.370 | 5.26 | 5.77 | 0.304 |
| Sunglasses -Liking | 5.68 | 1.44 | 5.88 | 5.52 | 0.469 | 5.65 | 5.71 | 0.900 | 4.94 | 6.47 | 0.001 |
| Age | 27.59 | 7.56 | N/A | N/A | N/A | N/A | N/A | N/A | 29.35 | 26.00 | 0.249 |
| Gender | 1.57 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 1.53 | 1.60 | 0.699 |

*Note. Age and TI were grouped based on calculated cut-off points (Percentiles 50). The grouped TI outcome was based on only N=32 (not N=37) due to calculation restrictions in SPSS. p-values were based on independent-samples t-tests (with the level of significance set at 0.05).*

*F: female; M: male; SD: standard deviation; N/A: not applicable.*

**Table 7:** Summary of the Findings for the Initial Model and Mediator Model

| | ***Initial Model (DV: IU)*** | *Model 2 (DV: PE)* | *Model 3 (DV: IU)* |
|---|---|---|---|
| **Independent Variables:** | | | |
| PU | 0.282 | 0.847*** | 0.658*** |
| PEOU | 0.083 | 0.197 | 0.170 |
| PE | 0.444* | --- | --- |
| PN | 0.219 | -0.064 | 0.190 |
| TI | 0.138 | -0.261T | 0.022 |
| **Control Variables:** | | | |
| Sunglasses-Liking | -0.105 | -0.085 | -0.143 |
| Age | 0.124 | 0.049 | 0.146 |
| Gender (1=female) | 0.015 | -0.166 | -0.059 |
| $R^2$ | 0.692 | 0.726 | 0.638 |
| Adjusted $R^2$ | 0.601 | 0.657 | 0.548 |
| Change in $R^2$ (control variables) | 0.640 | 0.589 | 0.586 |

*Note. ***p<.001; **p<0.01; *p<.05; T p<.10.*
*All F-tests were significant on a p<.001-level.*
*Multiple regression method was applied.*
Source: Adapted from Rauschnabel and Ro (2016, pp. 136-138)

**Table 8:** Summary of the Results for the Hypothesis Testing

| | | ***Initial Model[a]*** | | | ***Modified Model[b]*** | | |
|---|---|---|---|---|---|---|---|
| Nr. | *Hypothesized Direction* | *ß* | *p* | *Supported* | *ß* | *p* | *Supported* |
| H1 | ATU→IU | N/A | N/A | N/A | N/A | N/A | N/A |
| H2a | PU→IU | 0.282 | 0.217 | No | 0.330 | 0.023 | Yes |
| H2b | PEOU→IU | 0.083 | 0.539 | No | 0.163 | 0.112 | No |
| H2c | PE→IU | 0.444 | 0.038 | Yes | 0.341 | 0.009 | Yes |
| H3 | Gender→IU | 0.015 | 0.906 | Yes | 0.008 | 0.926 | Yes |
| H3 | Age→IU | 0.124 | 0.293 | Yes | 0.133 | 0.152 | Yes |
| H4a | TI→IU | 0.138 | 0.426 | No | 0.160 | 0.190 | No |
| H4b | PEOUxTI→IU | (pos.) | 0.045 | Yes | 0.144 | 0.204 | No |
| H4c | PExTI→IU | --- | 0.264 | No | N/A | N/A | N/A |
| H5a | PN→IU | 0.219 | 0.139 | No | 0.164 | 0.132 | No |
| H5b | PEOUxPN→IU | (neg.) | 0.021 | Yes | -0.199 | 0.061 | Yes |
| H6 | Sunglasses-Liking→IU | -0.105 | 0.459 | Yes | -0.057 | 0.599 | Yes |

*Note. Level of significance set at 0.1.*

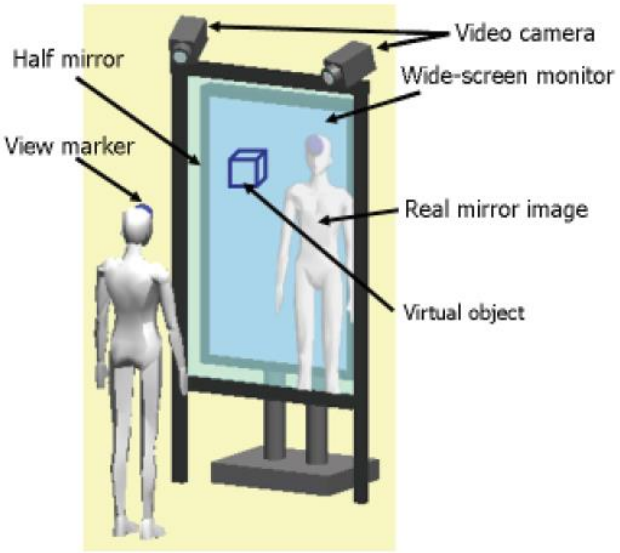
*[a]Multiple regression method was applied.*

*[b]Structural equation modeling was applied where PE functioned as a mediator variable.*

*ß: standardized coefficient.*

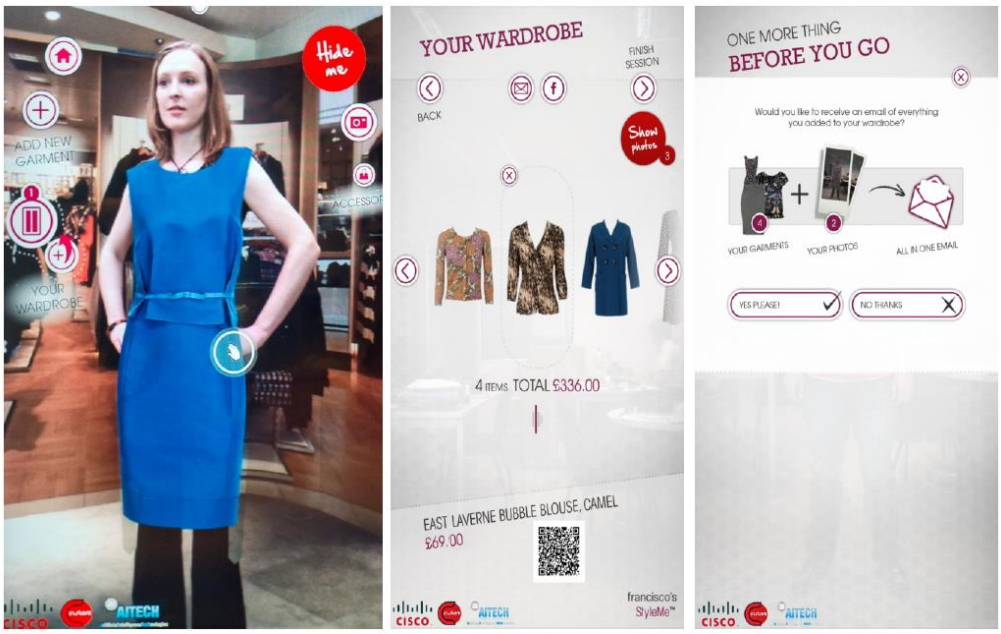
## Figures

**Figure 1:** Overview of a Virtual Mirror System



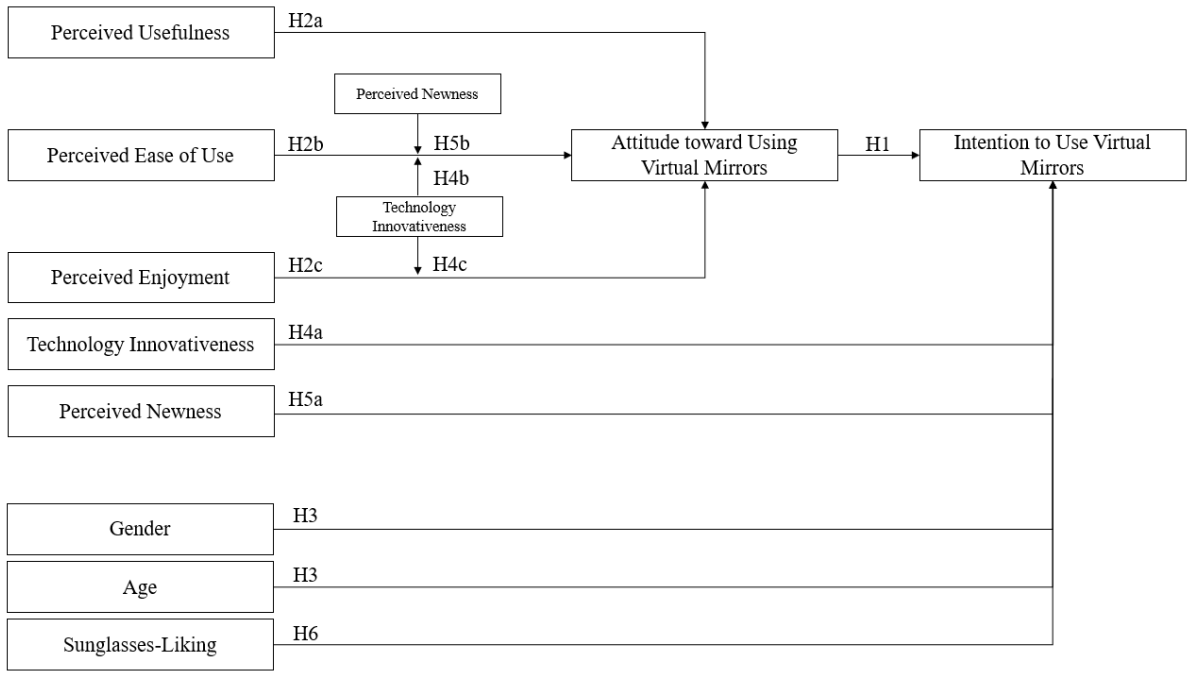

Source: Sato, Kitahara, and Ohta (2009, p. 483)

**Figure 2:** Cisco's StyleMe™ Mirror



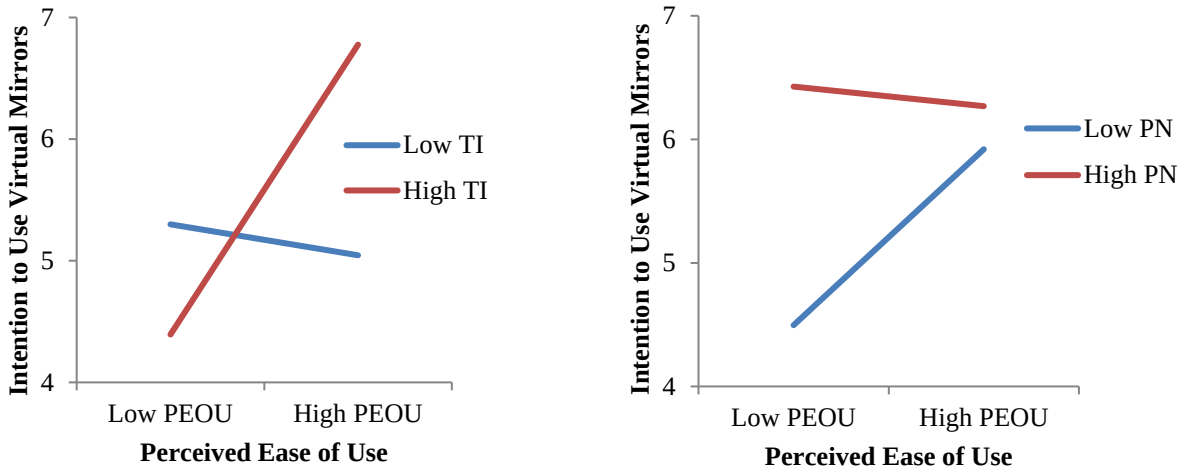

Source: Fretwell (2011, p. 4)

**Figure 3:** Proposed Research Model for Consumer Acceptance of Virtual Mirrors




Source: Author's own work (2018)

**Figure 4:** Moderating Effects of TI and PN on the Relation between PEOU and IU

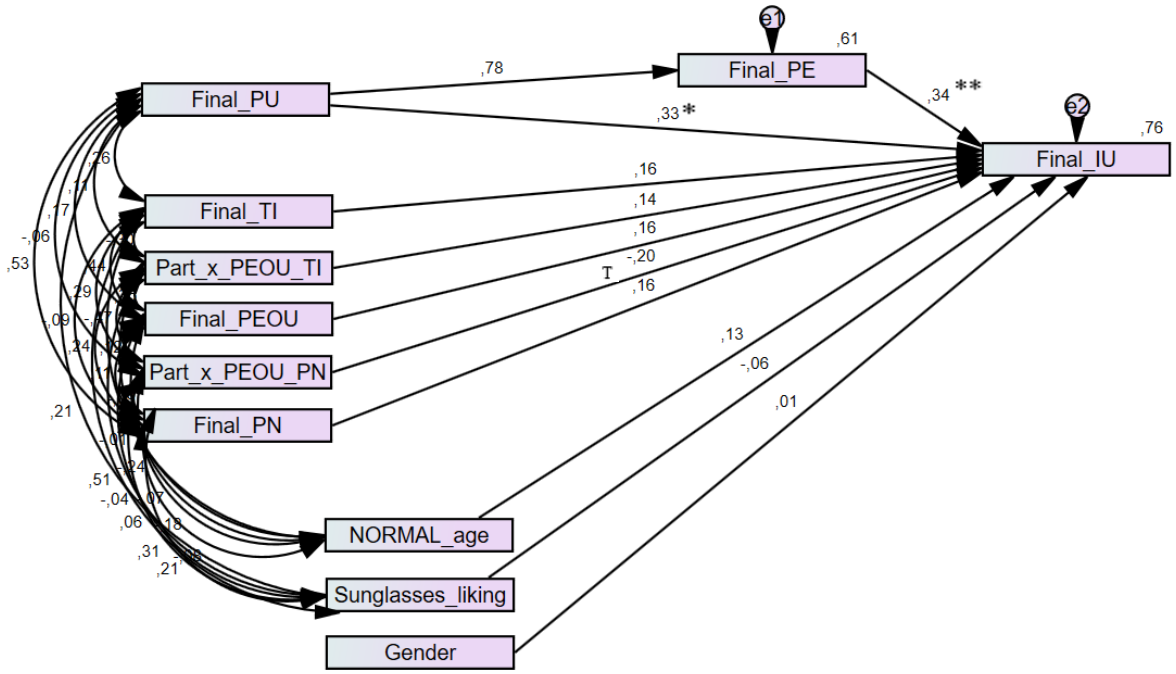



Moderator (1): Technology Innovativeness

Moderator (2): Perceived Newness

*Notes: Interaction diagram was conducted using Hayes' PROCESS Macro.*
Source: Adapted from Hayes (2013, pp. 231-233)

**Figure 5:** Summary of the Findings for the Modified Measurement Model (SEM)

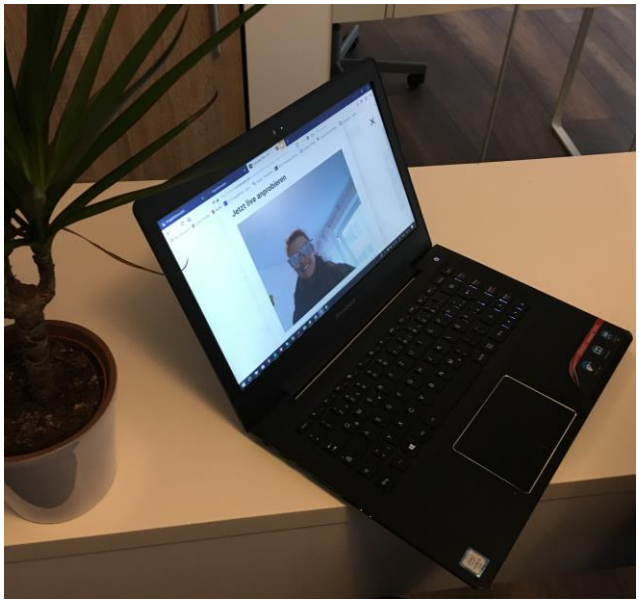


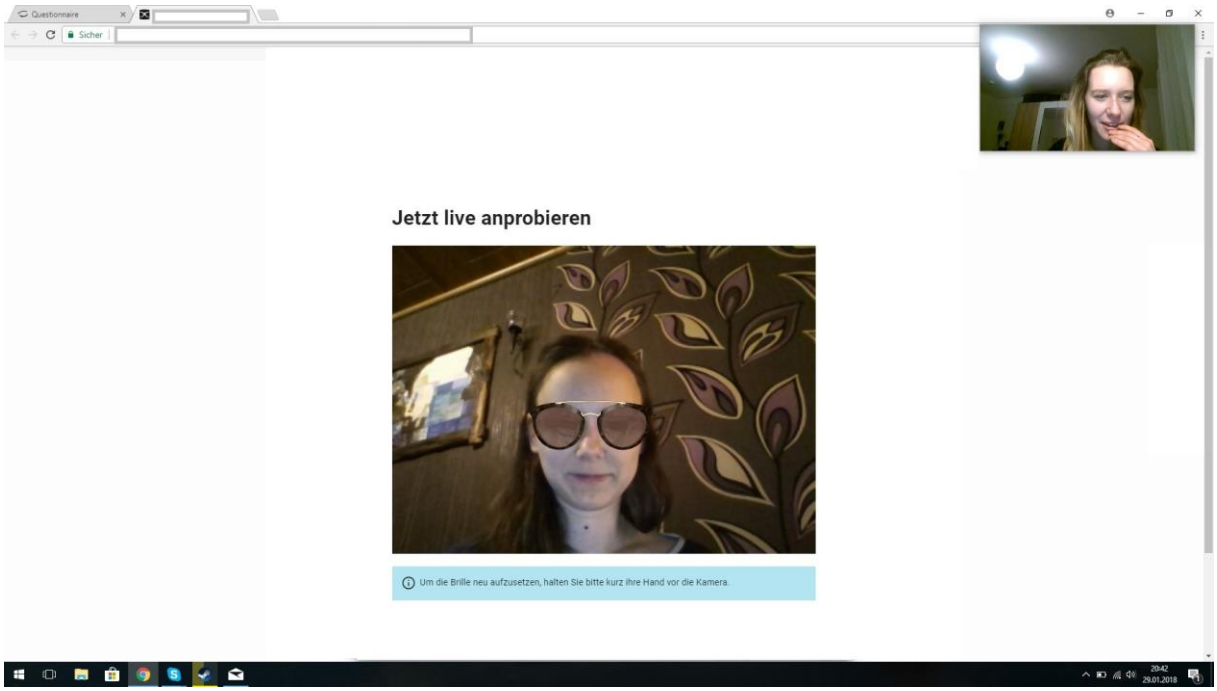

*Notes: Graph conducted using SPSS AMOS.*
****p<.001; **p<0.01; *p<.05; T p<.10.*

# Appendices:

**Appendix A:** Exemplary Image of the Virtual Fitting Software

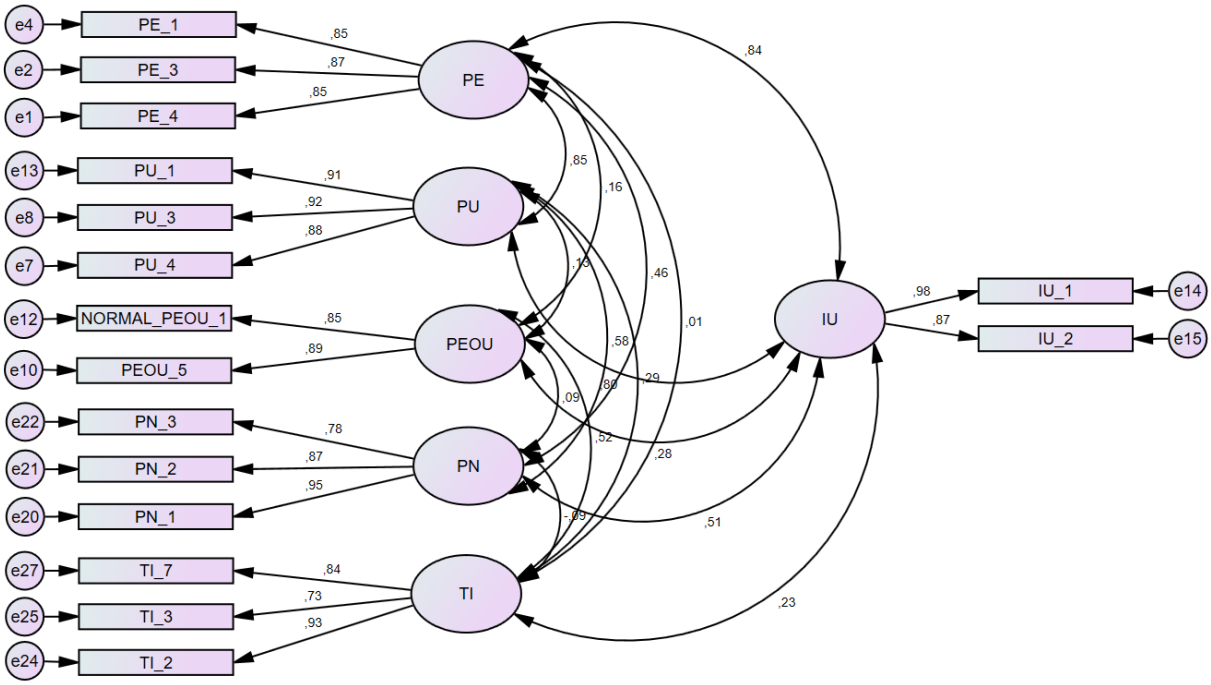
**Appendix B:** Experimental Setting






*Note: Experiment was conducted at author's own premises or via Skype.*
Source: Author's own work (2018)

**Appendix C:** Summary of the Findings of the CFA




*Note: Age, Gender, and Sunglasses-Liking had to be excluded from the CFA as SPSS AMOS can only measure constructs that consist of at least 2 items.*

## Appendix D: Literature Review Table

| Author (Year) [Journal] | Topic | Research Focus | Theoretical Background | Sample | Method/Analysis | Main Finding(s) |
|---|---|---|---|---|---|---|
| Adams, Nelson, and Todd (1992) *[MIS Quarterly]* | Technology Acceptance Model | A replication of previous TAM work on PU, PEOU, and usage | Technology acceptance model | Study I: N=118<br><br>Study II: N=73 | SEM:<br>DV: IU<br>IV: PEOU, PU | PU was the key determinant of usage. For PEOU a significant effect on usage could be found in Study I but not in Study II. The measures for the respective constructs are to be adapted to the context of the research. |
| Ajzen (1991) *[Organizational Behavior and Human Decision Processes]* | Theory of Planned Behavior | Review of the theory of planned behavior | Theory of planned behavior | - | Rescaling of expectancy and value measures from established research findings (analysis of correlations) | Attitudes toward the behavior, subjective norms associated with the behavior and perceived control over the behavior showed high consistency in predicting behavioral intentions. |
| Alba et al. (1997) *[Journal of Marketing]* | Online Shopping | Consumer, retailer, and manufacturer incentives to participate in interactive home shopping | | - | Theoretical | Retailers who had a strong national reputation for high-quality, unique products but only operate stores in certain regions benefited the most from implementing interactive home shopping. Such retailers could use the market-expanding feature of interactive home shopping to create an international presence without investing further in store locations. |
| Amit and Zott (2001) *[Strategic Management Journal]* | E-Business Models | Foundations of value creation in e-business | Value chain analysis, Schumpeterian innovation, RBV, strategic network theory | - | Theoretical | There were four main drivers that addressed the value creation potential of e-businesses: efficiency, complementarities, lock-in, and novelty. |
| Anderson and Gerbing (1988) *[Psychological Bulletin]* | Structural Equation Modeling | Guidance on the use of structural equation modeling in practice for theory testing | - | - | Testing a two-step approach for structural models by conducting sequential chi-squared difference tests | The previous one-step approach focused on analyzing the final measurement model without examining respective sub-models and thus, suffered from interpretational confounding. In the two-step approach, researchers first checked for an acceptable goodness of fit for the structural model. The chi-square should not be significant. In a next step, estimates for additional structural (sub-) models were assessed allowing for specification guidance. |

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| Apeagyei (2010) *[International Journal of Digital Content Technology and its Applications]* | Body Scanning Technologies | Application of body scanning technologies in clothing industry | - | N=191 | Analysis of female body measurements (e.g. waist measure) via Excel and SPSS | Body scanning technologies are able to capture and analyze body size and shape. 3D body scanning is expected to reduce return rates and to shift the focus from mass production to mass customization. |
| Arts, Frambach, and Bijmolt (2011) *[International Journal of Research in Marketing]* | Consumer Innovation Adoption | Meta-analysis on the drivers of intention and behavior | Construal level theory, innovation diffusion theory, technology acceptance model | N=77 | Multivariate regression models analyzing the relationships between the adoption antecedents and intention and behavior<br><br>DV I: Adoption intention<br>DV II: Adoption behavior<br>IV: Relative advantage, compatibility, complexity, trialability, observability, uncertainty, age, education, income, product involvement, innovativeness, opinion leadership, information seeking, media proneness | Participants were more likely to adopt innovations if those had a high level of complexity yet involved a low level of uncertainty. In addition, consumers' psychographic traits were more influential than the demographic characteristics. |
| Azuma (1997) *[Presence: Teleoperators and Virtual Environments]* | Augmented Reality | Application areas for AR technology | - | - | Theoretical | AR receives much attention and is prominently used in academic and industrial research laboratories. The major issue is the generation of virtual objects that are very similar to the real ones. |
| Bagozzi (1981) *[Journal of Personality and Social Psychology]* | Attitude-Behavior Relation | Test of attitude-intention-behavior relations using causal modeling methodology | Expectancy-value model, Triandis' model | N=157 | SEM in LISREL:<br>DV I: Behavioral intentions<br>DV II: Behavior (Time 1 and Time 2)<br>IV: Expectancy-value and semantic differential attitude<br>IV (Model I): Attitude<br>IV (Model II): Attitude, past behavior | Attitudes indirectly influenced behavior through their impact on intentions. The IV also partly influenced the actual behavior. Moreover, past behavior has shown to potentially reduce the effect of intentions on behavior. |
| Batra and Ahtola (1991) *[Marketing Letters]* | Hedonic and Utilitarian Attitude | Measuring the hedonic and utilitarian sources of consumer attitudes | Adequacy-importance model | Study I: N=59<br><br>Study II: N=108<br><br>Study III: N=93 | Exploratory common factor analysis for respective semantic differentials:<br>Study I: 16 items<br>Study II: 9 items<br>Study III: 23 items<br><br>Study II: Correlations analysis<br><br>Study III: Model estimation via LISREL | Study I and II revealed a two-factor model: (1) 'hedonic' (e.g. pleasant-unpleasant, nice-awful) and (2) utilitarian (e.g. beneficial-harmful, useful-useless). Moreover, in study II, the hedonic attitude scale correlated more strongly compared to the utilitarian with the sensory attribute adequacy scale and vice versa with the instrumental attribute adequacy scale. The third study showed that the type of behavior (intrinsic vs. extrinsic) influenced the respective strengths of the two factors (e.g. beneficial behavior led to higher salience of utilitarian attitudes). |

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| Begole et al. (2009) *[International Conference on Human-Computer Interaction]* | Clothes Fitting Room Technologies | Challenges of interaction design for clothes technologies | - | N=12 | ANOVA I:<br>DV: Perceived appeal and purchase intentions<br>IV: Display condition (Three different conditions: (1) Mirror alone, (2) Mirror with display showing previous outfit(s), (3) Mirror with display showing other people wearing the same outfit/product)<br><br>ANOVA II:<br>DV: Perceived privacy concern<br>IV: Social group (family, friends, co-workers, strangers) | Seeing images from previous outfits improved the shopping experience to a higher degree as did the presentation of other people wearing the product. Moreover, the study revealed that consumers have privacy concerns that retailers need to be aware of when implementing a technology that takes (public) pictures. |
| Blázquez (2014) *[International Journal of Electronic Commerce]* | Digitalization of Retailing | Understanding of multichannel fashion-shopping experiences | Framework of hedonic and utilitarian shopping values | N=439 | Paired-sample dependent t–tests (comparing the two shopping channels: Online and offline)<br><br>ANOVA I: Testing the impact of the level of Internet experience (DV: Hedonic and utilitarian values; IV: Experience level)<br><br>ANOVA II: Testing motivation differences (DV: Hedonic and utilitarian motivators; IV: Experience level) | In a general brick-and-mortar shopping context, utilitarian values showed greater significant effects than hedonic values. However, in a fashion retail context, retailers should emphasize on making the shopping environment more pleasant as multichannel consumers value hedonic elements in the fashion shopping experience. Also, channels should not be separated but rather connected to each other to enable a seamless shopping journey. |
| Bradley (1999) *[Journal of the Market Research Society]* | Sampling for Internet Surveys | Examination of respondent selection for research studies | - | - | Theoretical | There is no single sampling method for Internet surveys. Depending on the given task, the sampling approach needs to be modified. 'Saturation Surveying' is increasingly used by researches. |
| Brasel and Gips (2014) *[Journal of Consumer Psychology]* | Perceived Ownership and Endowment | Impact of various touch interfaces on psychological ownership and endowment | Endowment effect | Study I: N=56<br><br>Study II: N=63 | MANOVA (DV: Product, willingness to accept, psychological ownership; IV: Interface touch)<br><br>Study I: 3x2 design (touch interface: mouse, touchpad, touchscreen; product haptic importance: sweatshirt, city tour)<br>Study II: 2x2 design (interface touch: tablet, laptop computer; interface ownership: owned, not-owned) | In contrast to traditional computers, touchscreen interfaces led to higher levels of endowment. Psychological ownership thereby acted as a mediator. In addition, the touch-ownership relation increased for products high in haptic value. |
| Bruner and Kumar (2005) *[Journal of Business Research]* | Consumer Technology Acceptance | Explaining consumer acceptance of handheld Internet devices | Technology acceptance model | N=212 | Structural model/ path analysis:<br>DV I: Attitude toward the act<br>DV II: Behavioral intentions<br>IV: Usefulness, ease of use, fun | Consumer adoption intentions for Internet devices are mainly driven by hedonic aspects. With an increased ease of use, technologies can be perceived as even more fun to use. Moreover, usefulness had no direct effect on behavioral intentions. |

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| Burke (2002) *[Journal of the Academy of Marketing Science]* | Digitalization of Retailing | Customer interface technology in the physical and virtual world | - | N= 2,120 | Discriminant analysis of product differences on the importance of shopping attributes | Consumers are looking for greater service, a quicker shopping process, and the availability of product information within their shopping experience. New technologies need to be included into the shopping journey to provide each customer segment with unique features at the right decision process stage. |
| Chen, Gillenson, and Sherrell (2002) *[Information & Management]* | Technology Acceptance Model | Analysis to explain consumers' use of virtual stores and its antecedents | Technology acceptance model, innovation diffusion theory | N=253 | SEM:<br>DV I: ATU<br>DV II: Behavioral IU<br>DV III: Actual use<br>IV: Compatibility, PU, PEOU | Compatibility, PU, and PEOU were predictors of consumer attitude toward using virtual stores. Furthermore, compatibility and PEOU affected PU. |
| Childers et al. (2001) *[Journal of Retailing]* | Technology Acceptance Model | Hedonic and utilitarian motivations for online retail shopping behavior | Technology acceptance model | Study I: N=274<br><br>Study II: N=266 | SEM:<br>DV: Attitude (Study I: Hedonic attitude; Study 2: Utilitarian attitude)<br>IV: PU, PEOU, PE, convenience, navigation, sub-personal examination | PU and PEOU strongly predicted the attitude toward interactive shopping, yet PE was a more consistent determinant of technology adoption than were the other two. Thus, hedonic aspects played a significant role for new media devices. |
| Chiu et al. (2009) *[Online Information Review]* | Technology Acceptance Model | Determinants of customer repurchase intention in online shopping | Technology acceptance model | N=360 | SEM:<br>DV: Repurchase intentions<br>IV: PEOU, PU, trust, PE, fulfilment, privacy, system availability, responsiveness, contact | The extension of the initial TAM (PEOU and PU) by PE and trust proved to be important in the context of online shopping. All four determinants were significant positive predictors of customers repurchase intentions. Retailers must balance between providing utilitarian and hedonic value to customers. |
| Citrin et al. (2000) *[Industrial Management & Data Systems]* | Adoption of Internet Shopping | The role of consumer innovativeness within the adoption process of Internet shopping | - | N=403 | Multiple regression analysis:<br>DV: Internet shopping<br>IV: Internet usage<br>Moderator: Innovativeness (open-processing vs. domain-specific) | The level of internet usage positively affected the adoption intentions for Internet shopping. Furthermore, domain-specific innovativeness but not open-processing innovativeness has been proven to positively moderate the effect of Internet usage on the Internet shopping intentions. Thus, it is important to understand domain-specific innovativeness levels in order to accurately predict adoption intentions. |
| Crowley, Spangenberg, and Hughes (1992) *[Marketing Letters]* | Hedonic and Utilitarian Consumer Attitudes | Measuring the hedonic and utilitarian dimensions of attitudes toward product categories | - | N=151 | Exploratory factor analysis for 8 items across 24 product categories | Hedonic and utilitarian dimensions are not generalizable across product categories. The factor analysis revealed mixed results to the respective product categories (suggested 2-factor vs. 3-factor model). Research needs to redefine/replace certain items to effectively measure the two dimensions. |

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| Dabholkar (1994) *[Journal of Consumer Research]* | Choice Within the Attitudinal Framework | Analyzing models of mental comparison processes | Attitudinal theory, theory of reasoned action | Pretest: N=141<br><br>Main: N=305 | Exploratory factor analysis for 14 items (in pretest)<br><br>Multiple regression analysis and comparative analysis of four selected choice models:<br>DV I: Intention<br>DV II: Attitude<br>IV: PEOU, fun, performance<br>Models: Belief comparison, expectancy comparison, attitude comparison, intention comparison | The factor analysis found a three-factor model consisting of PEOU, fun, and performance as IVs. The expectancy model showed the highest fit with the data. Choice was made prior to the attitude evaluation. The incorporation of choice between alternatives within the framework has been shown to be of high importance, as it can impact the engagement behavior. |
| Dabholkar and Bagozzi (2002) *[Journal of the Academy of Marketing Science]* | Technology-based Self-service | Moderating effects of consumer traits and situational factors for technology-based self-services | Attitudinal model, technology acceptance model | N=392 | SEM:<br>DV I: Behavioral intention<br>DV II: Attitude<br>IV: PEOU, fun, performance<br>Moderators: Self-efficacy, inherent novelty seeking, need for interaction, self-consciousness, perceived waiting time, social anxiety | PEOU of technology-based self-services need to be promoted if the target market is either low in self-efficacy or has a high interest in service interaction. Moreover, the incorporation of enjoyable features is especially important if the target market is high in novelty seeking, high in self-efficacy, high in self-consciousness or highly interested in service interaction. |
| Davis (1989) *[MIS Quarterly]* | Technology Acceptance Model | Development and validation of two new variables as determinants for technology acceptance | Expectancy-theoretic model, self-efficacy theory, behavioral decision theory | Study I: N=112<br><br>Study II (with scale refinement resulting from Study I): N=40 | Exploratory factor analysis with 20 items (Study I), respectively 12 items (Study II)<br><br>Multiple regression analysis:<br>DV: Self-reported system usage<br>IV: PU, PEOU | PU correlated more strongly with usage behavior than did the PEOU. Both variables showed significant relations to usage. |
| Davis (1993) *[International Journal of Man-Machine Studies]* | Technology Acceptance Model | Impact of design features on technology acceptance | Theory of reasoned action, technology acceptance model, attitude theory | N=112 | Multiple regression analysis:<br>DV I: Actual system usage<br>DV II: ATU<br>IV: PU, PEOU, system design features | PU was 50% more influential than PEOU in predicting usage behavior. |
| Davis, Bagozzi, and Warshaw (1989) *[Management Science]* | Technology Acceptance Model | Comparing two theoretical models on user acceptance of computer technology | Theory of reasoned action, technology acceptance model | N=107 | Multiple regression analysis:<br>DV I: Behavioral intentions<br>DV II: Attitude<br>IV: PU, PEOU (for TAM); subjective norm (for TRA) | TRA and TAM sufficiently predicted actual usage behavior through measuring behavioral intentions. PU was a much stronger predictor of peoples' intentions than was PEOU. Subjective norms showed no impact on behavioral intentions. Moreover, attitudes only partially mediated the effect of the antecedents on intentions. |

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| Davis, Bagozzi, and Warshaw (1992) *[Journal of Applied Social Psychology]* | Technology Acceptance Model | Extrinsic and intrinsic motivation to use computers in the workplace | Technology acceptance model, motivation theory, cognitive evaluation theory | Study I (word processing software): N=200<br><br>Study II (business graphics programs): N=40 | Exploratory factor analysis with 15 items<br><br>Multiple regression analysis:<br>DV I: Usage behavior<br>DV II: IU<br>IV: PU, PE, PEOU, output quality | PU and PE strongly affected usage intentions. The two variables also mediated the effect of perceived output quality and PEOU on usage intentions. |
| Deutskens et al. (2004) *[Marketing Letters]* | Online Questionnaire Design | Response rate and response quality of internet-based survey | - | N=730 | Games-Howell procedure comparing multiple response times<br><br>ANOVA to compare incentive groups, the impact of the questionnaire length, as well as the effect of presentation types<br>DV: Response rate, response quality<br>IV: Type of incentive, length of the questionnaire, presentation of the questionnaire, timing of the follow-up | The length of a questionnaire is important as short surveys had a higher response rate. The response rate was further increased by offering lotteries with high changes of winning. Furthermore, the implementation of visual elements enhanced the quality of the responses. |
| Erdem, Ben Oumlil, and Tuncalp (1999) *[Journal of Retail & Distribution Management]* | Store Attributes | Linkage between consumer values and the importance of store attributes | Theory of consumption values | N=603 | Factor analysis with 18 items (terminal and instrumental values), respectively 11 items (store attributes)<br><br>Canonical correlation analysis:<br>DV: Store attributes<br>IV: Terminal and instrumental values | There were three composite terminal values and two instrumental values: security, idealism, and personal gratification, respectively socially responsible and self-reliant intellectual. Furthermore, three factors were extracted for store attributes: status, merchandise, and price. One major finding of the correlation analysis stated that consumers who highly value personal gratification (pleasure, social recognition etc.) addressed high importance to the store status (store attributes, such as reputation and brands). |
| Fornell and Larcker (1981) *[Journal of Marketing Research]* | Structural Equation Modeling | Evaluating structural equation models with unobservable variables and measurement errors | Psychometric and econometric theory | Assumption for simulation: N=200 | Results of the correlation analyses and chi square tests are compared with the evaluation of the structural, measurement, and overall model for the two simulations | Due to the limitations of the chi-square statistic measurement, a more comprehensive testing system was developed allowing to test for statistical as well as operational significance. Thus, psychometric properties were measured in a first step, followed by the assessment of the chi square values. |
| Goldsmith and Hofacker (1991) *[Journal of the Academy of Marketing Science]* | Consumer Innovativeness | Development of a self-report scale to measure domain specific consumer innovativeness | - | Study I: N=309<br><br>Study II: N=274 | Study I: Item analysis based upon interitem correlations (of 11 items)<br><br>Study II: Reliability, dimensionality, and validity testing for reduced number of items | The reduced six-item innovativeness scale was internally consistent and unidimensional. The measurements can be successfully adapted across topics and product categories. Also, no adverse effects on the scale quality could be |

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| | | | | Study III: N=97<br><br>Study IV: N=462<br><br>Study V: N=70<br><br>Study VI: N=306 | (=6) from Study I<br>Study III: Reliability, dimensionality, and validity scale retesting for another topic (fashion; previous topics: records)<br>Study II and III: Correlation, exploratory factor, and confirmatory factor analyses<br>Study IV: Retesting the scale on non-student sample<br>Study V: Retesting the scale with specific focus on the effect of social desirability<br>Study VI: Convergent and discriminant validity testing | found for the student-only sample. |
| Goldsmith and Reinecke Flynn (1992) *[European Journal of Marketing]* | Consumer Innovators | Identifying innovators in consumer product markets | Diffusion theory (consumer theory) | N=135 | T-tests and correlation analysis to compare measures between early and later adopters (Focus on buying behavior, demographics, media usage, retail promotions, and shopping behavior) | Using the innovativeness scale, classification criteria for female fashion innovators/non-innovators could be found. The number of shopping trips and the spending amount were of great relevance for the retailer to identify suitable early adopters. Also, innovative shoppers valued style more than practicality. |
| Ha and Stoel (2009) *[Journal of Business Research]* | Technology Acceptance Model | Antecedents in consumer e-shopping acceptance | Technology acceptance model | N=298 | SEM:<br>DV I: Intention to e-shop<br>DV II: PU, attitude<br>IV: Trust, PEOU, PE, e-shopping quality | PU and attitude toward e-shopping impacted the intention to shop online. In contrast to PE and trust, no significant relation between perceived PEOU and attitude toward e-shopping was found. |
| Hagberg, Sundstrom, and Egels-Zandén (2016) *[International Journal of Retail & Distribution Management]* | Digitalization of Retailing | Development of conceptual framework examining the digital transformation in physical stores | - | - | Theoretical | Four elements were highly affected by the digital transformation: retailing exchanges (new way of communication), the nature of retail offerings (issues distinguishing between products and services), retail settings (place and time of shopping), and involved actors. |
| Haugstvedt and Krogstie (2012) *[Mixed and Augmented Reality (ISMAR), 2012 IEEE International Symposium on]* | Technology Acceptance of Augmented Reality | Technology acceptance for a mobile AR application with historical photographs and information | Technology acceptance model | Web survey: N=200<br><br>Street survey: N=42 | Analyses of descriptive statistics<br><br>Partial least square analysis (with data from web survey):<br>DV: Behavioral intentions<br>IV: PU, PEOU, PE | PU and PE showed similar strength in predicting adoption intentions. The qualitative feedback from the participants on the street further led to great insights on how to increase those two antecedents. |

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| Herzenstein, Posavac, and Brakus (2007) *[Journal of Marketing Research]* | Product Innovation | Adoption of new and really-new products | Theory of regulatory | Study I: N=250<br><br>Study II: N=203<br><br>Study III: N=22 | Study I: Chi-square tests to classify participants into promotion and prevention focused consumers<br><br>Study II: ANOVA<br>DV: Purchase intentions, performance uncertainty<br>IV: Risk salience, regulatory focus (promotion vs. prevention)<br><br>Study II: ANOVA<br>DV: Purchase intentions<br>IV: Product newness, regulatory focus | Promotion-focused consumers were more likely to own high-tech goods and new repeat-purchase items than did prevention-focused shoppers. Moreover, the purchase intentions for new products was impacted by concerns about the performance of the new technology. |
| Hirunyawipada and Paswan (2006) *[Journal of Consumer Marketing]* | Technology Adoption | Impact of consumer innovativeness and perceived risk on adoption intentions for high technology products | (Multi-level trait approach) | N=746 | SEM:<br>DV: Adopt, acquisition of novel information associated with new products<br>IV: Cognitive innovativeness, sensory innovativeness, domain-specific innovativeness, social risk, time risk, financial risk, physical risk, performance risk, psychological risk, network externality risk | Cognitive and domain-specific innovativeness positively impacted the adoption of new products. Consumers' propensities to acquire novel information about a new product were negatively influenced by financial risks, but positively enhanced by sensory innovativeness as well as social and physical risks. No significant effects were found for the other antecedents. |
| Hoeffler (2003) *[Journal of Marketing Research]* | Product Innovation | Improve preference measurement for really-new products | No | Study I: N=36<br><br>Study II: N=73<br><br>Study III: N=78 | Study I: MANOVA<br>DV: Product type, purchase intentions<br>IV: Uncertainty about estimating benefits, draw-backs, and social implications and uncertainty about the manufacturer's ability to deliver benefits, overcome drawbacks, and influence social implication<br><br>Study II: Correlation analyses to evaluate preference changes due to product trial<br><br>Study III: MANOVA to evaluate purchase intention in terms of type of preference measurement (e.g. conjoint and mental simulation) and trial (yes/no) | Respondents had greater uncertainty when evaluating the usefulness of really-new products than they had with incremental ones. Mentally simulating how the product fits into existing usage scenarios enhanced the preference stability. |
| Hu et al. (1999) *[Journal of Management Information Systems]* | Technology Acceptance | Examining the technology acceptance model using physician acceptance of telemedicine technology | Technology acceptance model | N=408 | SEM:<br>DV I: IU<br>DV II: Attitude<br>IV: PU, PEOU | PU significantly predicted attitude and intention. For PEOU, no significant effect was found. Attitude showed a moderate (but still significant) influence on IU. |

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| Ireland and Webb (2007) *[Business Horizons]* | Innovation Management | Creating competitive advantage through streams of innovation | - | - | Theoretical | Strategic entrepreneurship is an approach that can serve firms well in their efforts to rely on competitive advantages. Thus, firms must learn to combine the best of strategic management and entrepreneurship to create superior performance. |
| Kallweit, Spreer, and Toporowski (2014) *[Journal of Retailing and Consumer Services]* | Self-service Information Technology | Mediation effect of service quality within the technology acceptance model | Technology acceptance model, theory of reasoned action | N=225 | SEM:<br>DV I: Intention to reuse<br>DV II: ATU<br>Mediator: Perceived service quality<br>IV: PEOU, perceived information quality (adequacy of information and usefulness of content) | Perceived service quality partially mediated the effect of ATU on the intention to reuse. Thus, retailers could benefit from providing a high level of service quality features. The expected effect of attitude on the intention to reuse was confirmed. |
| Kang, Mun, and Johnson (2015) *[Computers in Human Behavior]* | Mobile In-store Technology | Downloading and usage intention toward mobile location-based retail apps | Innovation diffusion theory | N=853 | SEM:<br>DV I: Downloading and usage intentions<br>DV II (Mediator): Affective and cognitive involvement<br>IV: Time convenience, interactivity, compatibility, effort expectancy<br>Moderator: Experiential orientation | Two perceived characteristics of innovation had a significant impact on the affective involvement with mobile location-based retail apps: interactivity and compatibility. Moreover, mobile consumers with high experiential orientation showed greater affective involvement and usage intentions than those with limited experiences. |
| Keil, Beranek, and Konsynski (1995) *[Decision Support Systems]* | Technology Acceptance | Importance and relation between PEOU and PU regarding task considerations | Innovation diffusion theory, technology acceptance model, self-efficacy theory | N=118 | Correlation analysis and descriptive statistics:<br>DV: Self-reported system usage<br>IV: PPU, PEOU | The evaluation of a self-developed sales support technology confirmed that PU is a better determinant of system usage than is PEOU. The study also showed that PU is often not prioritized enough in the early development stages. Thus, a task analysis should be conducted prior to the design formation for PEOU. |
| Kleinschmidt and Cooper (1991) *[Journal of Product Innovation Management]* | Product Innovation | Relationship between product innovativeness and commercial success | Classification scheme for product innovativeness, familiarity matrix | N=195 (product market launches) | Categorization of products into six pre-defined product newness levels (display of product innovativeness)<br><br>Visual data illustration of relation between product innovation and profitability (success rate and ROI) and ANOVA | Products with high (new-to-the-world) or low (product modifications) levels of innovativeness were more likely to be accepted by the market than were products with a moderate level of innovativeness. Such middle-of-the-road products were less likely to be successful. |
| Lee and Yang (2013) *[Journal of Retailing and Consumer Services]* | Self-service Information Technology | Relationship between interpersonal service quality and self-service technology service quality and retail patronage | Theory of reasoned action | N=300 | SEM:<br>DV I: Actual retail patronage<br>DV II: Retail patronage intentions<br>IV: Interpersonal service quality, SST service quality<br>Moderators: Technology anxiety, need for interaction, age | Both IVs (interpersonal service quality and self-service technology service quality) showed significant positive effects toward retail patronage intentions. Certain consumer traits (e.g. technology anxiety and age) partially moderated the effect between the antecedents and the retail patronage intentions. |

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| Lemon and Verhoef (2016) *[Journal of Marketing]* | Customer Experience | Understanding customer experience throughout the customer journey | Relationship marketing theory, customer buying behavior process model | - | Theoretical | Customer experience showed to be a relatively new research field. The study combined the idea of customer experience with a customer's journey and studied the relation from many perspectives (e.g. in terms of customer satisfaction, relationship marketing). |
| Levitt and List (2007) *[Journal of Economic Perspectives]* | Social Preferences in Laboratory Experiments | Influence of social norms on the generalizability of laboratory experiment findings | Decision theory | - | Theoretical | Laboratory experiments do not always produce outcomes that are generalizable in real-world markets. For instance, pro-social behavior proved to be less likely in real-world settings. Researchers should employ an approach that combines lab-generated data with the data from natural settings. |
| Licoppe (2013) *[Mobile Media & Communication]* | Mobile In-store Technology | Use of locative media in urban public settings | - | - | Theoretical | Mobile locative media provide spatial proximity knowledge of users and hence, enable a new way of communicating via mobile devices. |
| Magnenat-Thalmann, Seo, and Cordier (2004) *[Journal of Computer Science and Technology]* | Human Body Modeling | Automatic modeling of virtual humans and body clothing | - | - | Theoretical | Graphics hardware and software techniques for modeling virtual humans are enhancing. They have the power to incorporate virtual human models in real-time applications. |
| Mardia (1970) *[Biometrika]* | Multivariate Skewness and Kurtosis | Measures of multivariate skewness and kurtosis with applications | Hotelling's $T^2$ test | - | Empirical analysis of t-test of normality formulas and outcomes regarding nonnormality issues | Hotelling's $T^2$ test showed to be more sensitive to the measure of skewness than to the measure of kurtosis. |
| Mathwick, Malhotra, and Rigdon (2002) *[Journal of Retailing]* | Dynamic Retail Experiences | Effect of consumer shopping tasks and retail information display properties on consumer perceptions of experiential value | Cognitive continuum theory, theory of dynamic task systems | N=512 | Multigroup analysis using LISREL to test the mean differences in experiential value perceptions<br><br>Tests of measurement invariance for the following experiential sources of value means (Internet vs. catalog): Economic value, efficiency, enjoyment, escapism, entertainment, visual appeal, service excellence | Consumers engaging in experiential shopping tasks appreciated enjoyment elements more than shoppers who were goal-oriented. |

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| Meuter et al. (2003) *[Journal of Business Research]* | Self-service Technology | Influence of technology anxiety on consumer use and experiences with self-service technologies | - | N=823 | Four multiple regression analyses (for respective SST cluster):<br>DV: Usage (travel/business, daily, Internet, limited)<br>IV: Technology anxiety, age, gender, income, education<br><br>Pearson correlation coefficients to assess the relationships between technology anxiety and overall satisfaction | In contrast to demographic variables, technology anxiety predicted self-service technology usage very consistently. Shoppers with high technology anxiety tended to utilize self-service technologies less likely. Furthermore, participants who had a satisfying user experience with the technology showed higher levels of satisfaction and usage intentions. |
| Meyer and Schwager (2007) *[Harvard Business Review]* | Customer Experience | Understanding the idea of customer experience | - | - | Theoretical | Companies should not solely focus on measuring customer satisfaction but rather on customer experience, as the later construct monitors the direct and indirect examination of customers in a more valuable way. Thus, customer experience management should be implemented into a firm's organizational structure. |
| Midgley and Dowling (1978) *[Journal of Consumer Research]* | Consumer Innovativeness | Segmenting the consuming population into innovators and non-innovators | Trait-behavior mode, theory of the diffusion of innovations, theory of innovative behavior | - | Theoretical | For innovative consumers with scores equal to or greater than 4 (on a scale of 6), innovative traits directly transferred to innovative behavior. For non-innovators with a scale below 4 it was random. |
| Moore and McElroy (2012) *[Computers in Human Behavior]* | Facebook Usage | The influence of personality on Facebook usage, wall postings, and regret | Big five dimensions of the five factor model | N=219 | Hierarchical regression analysis to test the effect of personality on Facebook usage and content<br>DV: Usage and content (time spent, frequency of use, actual number of friends, number of photos, self-postings, other-postings, regret)<br>IV: Personality (extraversion, agreeableness, conscientiousness, emotional stability, openness)<br>Control variables: Gender, Facebook experience | Gender and experience were important predictors of Facebook usage and content. Moreover, the type of personality determined the nature of Facebook usage (especially for wall-postings, regrets, and number of Facebook friends). |
| Morwitz, Steckel, and Gupta (2007) *[International Journal of Forecasting]* | Product Innovation | Correlation between purchase intentions and actual purchasing | Theory of planned behavior, theory of reasoned action | Meta-analyses:<br>Study I: N=40<br><br>Study II: N=60 | Dummy variable regression analyses:<br>DV: Behavior, intention<br>IV: Product type (level of newness, durable/non-durable), time between intention and behavior | The correlation between the intention and the actual purchase of a product was higher for existing than for new products. The same accounted for durable products compared to non-durable ones. |

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| Mun and Hwang (2003) *[International Journal of Human-Computer Studies]* | Technology Acceptance | Predicting the use of web-based information systems through self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model | Technology acceptance model, self-efficacy theory, social cognitive theory, theory of reasoned action | N=109 | Partial least squares method (SEM):<br>DV: Use<br>IV: IU, PU, PEOU, application specific self-efficacy, PE, learning goal orientation | Despite the traditional antecedents (PU and PEOU) of behavioral intentions and actual usage highlighting the important roles, self-efficacy, PE, and learning goal orientation proved to play a significant role in determining the actual system usage. In addition, the variable 'application specific self-efficacy' predicted the actual use of the system to a greater level than did the variable behavioral intention. |
| Newman (2014) *[Journal of Direct, Data and Digital Marketing Practice]* | Beacon Technology | Information on the functionality and application areas of Beacon technologies | - | - | Theoretical | The implementation of Beacons could improve the way smartphones are used in-store. The technology has the power to provide customers with an enjoyable and more stress-free customer experience. |
| Olsson et al. (2012) *[Journal of Ambient Intelligence and Smart Environments]* | Augmented Reality | User acceptance of five different mobile AR scenarios | User-centered design approach, technology acceptance model for mobile services, theory of diffusion of innovations | N=260 | Descriptive statistics analyses:<br>- Technology orientation and attitude<br>- Scenario (N=5) specific statements<br><br>Mann-Whitney analysis between the groups comparing technology orientation effects<br><br>Qualitative evaluation on usage intentions | Participants preferred using AR for pragmatic rather than pleasure-oriented cases. AR systems increased the productivity of the information search. However, concerns about autonomy loss and information flood were raised. Furthermore, the analysis showed that the technology orientation influences the overall acceptance of the technology. |
| Pantano, Iazzolino, and Migliano (2013) *[Journal of Retailing and Consumer Services]* | In-store Technologies | Investigation of potential risks and reduction recommendations | Risk breakdown structure, probability–impact grid | - | Theoretical: Development of a tool for identifying the critical risks (distinguishing between radical and incremental risks) | The study assessed potential risks and their interdependencies regarding the implementation of innovative in-store technologies at the point of sale. Despite the common risk of consumers not accepting the technology, other risks were identified of which a firm's risk management need to be aware of: e.g. the risk of consumers being bored, the out-of-date risk. |
| Pantano and Servidio (2012) *[Journal of Retailing and Consumer Services]* | Digitalization of Retailing | Modeling innovative points of sales through virtual and immersive technologies | Technology acceptance model | N=150 | SEM:<br>DV I: Consumer satisfaction<br>DV II (mediator): Store perception<br>IV: PE, PEOU | PE was the most significant predictor of a consumer's store perception and thus, also positively affected the level of customer satisfaction. Consumers perceived entertaining features of in-store technologies as motivating factors for store choice. |
| Pantano and Viassone (2014) *[Journal of Retailing and Consumer Services]* | Digitalization of Retailing | In-store technologies at the point of sale (retailer perspective) | - | N=47 | Content analysis to measure the frequency value of each need/expectation<br><br>Descriptive statistics analysis: Characteristics of firms that did not introduce innovations yet | Only 23% of retailers adopt advanced technologies at the point of sale. The majority is aware of the advantages (e.g. increase in sales and customer satisfaction) they contain, yet the high investments for such technologies hinder retailers to implement them. |

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| Parise, Guinan, and Kafka (2016) *[Business Horizons]* | Digitalization of Retailing | Leveraging digital technologies to transform the customer experience | S-O-R theoretical model | N=35 (retailers) | Mainly theoretical with conclusions from in-depth interviews with retailers and with findings from surveys with international shoppers conducted by Cisco Systems Consulting Services | The 'remote expert' (in-store cross-selling of complex products through consultation and knowledge sharing) and the 'digital assistant' (in-store engagement through entertaining technologies) were identified as the two main technology-based models that firms can use to exploit the needs of diverse customers. |
| Peck and Shu (2009) *[Journal of Consumer Research]* | Perceived Ownership and Endowment | Effect of mere touch on perceived ownership | Endowment effect | Study I: N=231<br><br>Study II: N=71<br><br>Study III: N=401<br><br>Study IV: N=334 | ANOVA (Study I: Non-owners; Study II: Owners):<br>DV: Perceived ownership, monetary valuation<br>IV: Touch/no-touch condition, imagery/no-imagery condition<br><br>ANOVA (Study III: Need-for-touch product; Study IV: No necessary need-for-touch product):<br>DV: Perceived ownership, affective reaction, object valuation<br>IV: Touch condition, participant's role ([nonowner]/seller [owner])<br><br>Regression analysis (Study III: Need-for-touch product; Study IV: No necessary need-for-touch product):<br>DV: Valuation<br>IV: Role, touch conditions, perceived ownership, affective reaction | Mere touch as well as imagery encouraging touch enhanced the perceived ownership of buyers. Moreover, being able to directly touch objects resulted in a positive sensory feedback, an increased perceived ownership and affective reaction as well as in a higher object valuation. |
| Peterson (2001) *[Journal of Consumer Research]* | College Students for Sampling | Implications of using college student subjects in social science research | - | N=34 (meta-analyses) | Second-order meta-analytic indications of college students and nonstudent response homogeneity | Responses of college student subjects were slightly more homogeneous. However, as no systematic patterns to the response differences were found, researches need to replicate their studies with nonstudent subjects before making any generalizations. |
| Piotrowicz and Cuthbertson (2014) *[International Journal of Electronic Commerce]* | Omni-channel Retailing | Importance of information technology in retail, new business models, and the future role of traditional stores | - | N=36 | Qualitative theme development during focus group meetings | The panel discussions revealed that retailers especially need to integrate their channels, invest into mobile technologies, emphasize on the role of social media, redesign their supply chain, and manage personalization requests and privacy issues. |

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| Rauschnabel and Ro (2016) *[International Journal of Technology Marketing]* | Augmented Reality | Investigation of technology acceptance drivers for AR glasses | Technology acceptance model, theory of reasoned action, unified theory of acceptance and use of technology | N=201 | Three-step hierarchical ordinary-least squares regression analysis (& PROCESS):<br>DV I: Adoption intentions<br>DV II: Attitude toward using smart glasses<br>IV: Social norms, self-presentation benefits, functional benefits, expected ease of use, brand attitude, privacy brand image, TI, knowledge about smart glasses, age, gender | Participants with high levels of TI were more likely to adopt AR glasses. Furthermore, functional benefits showed to be a strong predictor of technology adoption. |
| Rese, Schreiber, and Baier (2014) *[Journal of Retailing and Consumer Services]* | Augmented Reality | Technology acceptance modeling of AR at the point of sale through online reviews | Technology acceptance model | N=16,390 (online ratings for the mobile IKEA catalogue app)<br><br>N=275 (TAM) | Content analysis/text mining for pre-processing the textual data<br><br>Partial least squares:<br>DV I: Behavioral IU<br>DV II: ATU<br>IV: PU, PEOU, PE, perceived informativeness | In the context of AR technology acceptance, the traditional data collection through surveys can be replaced by the content analysis of publicly available online reviews. Online reviews provide researchers with a more realistic view regarding TAM constructs. |
| Rocamora (2011) *[Fashion Theory]* | Personal Fashion Blogs | Identity construction through personal fashion blogs | - | - | Theoretical | Personal fashion blogs are a type of media through which women can express their voice on appearance. It is a new outlook in the field of fashion, which is emerging due to the increased usage of technological innovations. |
| Roe and Just (2009) *[American Journal of Agricultural Economics]* | Internal and External Validity | Tradeoffs between experiments, field experiments, natural experiments, and field data | - | - | Theoretical | The study introduced a multimodal approach that eases the natural conflict between internal and external validity by employing both field and natural experiments. |
| Sato, Kitahara, and Ohta (2009) *[International Conference on Virtual and Mixed Reality]* | Virtual Mirror | Implementation of a prototype mixed reality mirror and a demonstration system | - | - | Theoretical | The mixed reality mirror is a promising method that can display 3D virtual objects without any wearable display devices. |
| Shankar et al. (2011) *[Journal of Retailing]* | Shopper Marketing | Role of shopper marketing in retail | (Segmentation models, model of in-store consumer decision making) | - | Theoretical | There are still many challenges that hinder the establishment of win–win–win solutions for the shopper–retailer–manufacturer cycle. For instance, the correct use of multiple channels and the right budget allocation for different out-of-store and in-store marketing activities were identified as challenges that need to be faced. |

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| Sheppard, Hartwick, and Warshaw (1988) *[Journal of Consumer Research]* | Theory of Reasoned Action | Meta-analysis of past research on the theory of reasoned action | Theory of reasoned action | N=174 | Meta-analysis of studies investigating the intention-behavior relationship as well as the relationship between attitudes and subjective norms-intentions | The Fishbein and Ajzen model has strong predictive utility across various situations and product categories. Yet, modifications need to be made with regards to goal intentions, choice situations, and differences between intention and estimation measures. |
| Sorescu et al. (2011) *[Journal of Retailing]* | Innovation Management | Innovations in retail business models | Value chain model, configurational theories, resource based view | - | Theoretical | Format, activities, and governance were identified as the three necessary components to review innovations in retail business models. Six design elements help to design those innovative business models: operational efficiency, operational effectiveness, customer lock-in, customer efficiency, customer effectiveness, customer engagement. |
| Spreer and Kallweit (2014) *[Transactions on Marketing Research]* | Augmented Reality | Assessing the acceptance and potential of AR at the point of sale | Technology acceptance model | N=96 | T-tests for independent samples to test group differences (AR usage/non-usage) regarding information assessment and completeness<br><br>Multiple regression analysis:<br>DV: Intention to reuse<br>IV: PU, PEOU, PE | PE was the strongest predictor of the intention to reuse the technology. PEOU did not show any significant effects. Retailers need to balance functional benefits and enjoyment-related elements in their AR technologies to ensure the consumer's acceptance. Overall, AR devices proved to increase information assessment at the point of sale. |
| Steenkamp and Gielens (2003) *[Journal of Consumer Research]* | Product Adoption | Consumer and market drivers of the trial probability of new consumer packaged goods | Innovation diffusion theory, signaling theory, (hazard model) | N=3,687 | Descriptive statistics analysis and t-tests to determine antecedents of trial probability<br><br>Predictors: Consumer characteristics, marketing communication, category characteristics etc. | Perceived complexity and relative advantage of a product seemed to enhance with the level of perceived product newness. In addition, age and education did not show a generalizable effect on product trialability. |
| Thompson, Hamilton, and Rust (2005) *[Journal of Marketing Research]* | Feature Fatigue | Effects of adding product features on consumers' evaluations of products | Economic theory | Study I: N=130<br><br>Study II: N=141<br><br>Study III: N=190 | Study I: ANCOVA(s)<br>DV: Product capability, product usability, product expected utility<br>IV: Number of features<br>Covariate: Expertise<br><br>Study II: Multiple regression analysis<br>DV: Product capability, product usability, product expected utility<br>IV: Number of features, expertise<br><br>Study III: ANCOVA(s)<br>DV: Product use, product capability, product usability, product evaluations, product satisfaction<br>IV: Number of features<br>Covariate: Expertise | With the increased number of features, consumers perceived the product as less usable. Firms should focus on having a limited number of features for their respective products. Thus, it is better to have more specialized products than to overload one product with too many features. |

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| | | | | | Path analysis:<br>DV: Capability, usability, overall evaluations, satisfaction (each before and after product use)<br>IV: Number of features, expertise, capability, usability | |
| Tornatzky and Klein (1982)<br>*[IEEE Transactions on Engineering Management]* | Product Innovation | Review and meta-analysis of innovation characteristics and innovation adoption implementation | - | N=75 | Frequency counts and descriptive statistics analyses:<br>DV: Adoption, implementation<br>IV: E.g. relative advantage, compatibility, complexity, divisibility, profitability, social approval, observability | Compatibility, relative advantage, and complexity were the three most consistent antecedents of innovation adoption – out of 30 tested independent variables. |
| Urban, Weinberg, and Hauser (1996)<br>*[Journal of Marketing]* | Product Innovation | Forecasting premarket consumer reactions for really-new products | Diffusion/decision-flow models, prelaunch forecasting models | Study I: N=587<br><br>Study II: N=1094 | Descriptive statistics analyses, conjoint analysis with certain product attributes (e.g. safety, value), and qualitative evaluations on product perceptions and purchase intentions | Forecasting reactions depended on measures taken from the information acceleration (e.g. word-of-mouth), market research data (e.g. target market size), measures of competitive preferences AND from managerial judgements reflecting planned marketing campaigns and infrastructure growth. |
| Van der Heijden, Verhagen, and Creemers (2003)<br>*[European Journal of Information Systems]* | Technology Acceptance Model | Understanding online purchase intentions from a technology-oriented and a trust-oriented perspective | Technology acceptance model, theory of reasoned action | N=228 | SEM:<br>DV I: Online purchase intention<br>DV II: Attitude toward online purchasing<br>IV: Perceived risk, PEOU, trust in online stores, PU | Out of the four tested independent variables only perceived risk showed a significant (negative) relationship to the dependent variable (attitude). PEOU only functioned as a significant predictor in the case of physical stores. No effect was found of perceived trust and usefulness on attitude in the online store context. |
| Venkatesh and Bala (2008)<br>*[Decision Sciences]* | Technology Acceptance Model | Revision of the initial technology acceptance model (version III) | Technology acceptance model, work motivation theory, action identification theory, behavioral decision theory, social network theory, leader–member exchange theory | N=156 (for different time periods) | SEM (partial least squares):<br>DV I: Use behavior, behavioral intention<br>DV II: PEOU, PU<br>IV: Subjective norm, image, job relevance, output quality, result demonstrability, PE, computer anxiety etc.<br>Moderator: Experience, voluntariness | PU was the strongest predictor of behavioral intention. PEOU showed mixed effects depending on the time periods. Moreover, experience was identified to be an important moderator on key relations (e.g. between perceived ease of use and behavioral intention). |

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| Venkatesh and Davis (2000) *[Management Science]* | Technology Acceptance Model | A theoretical extension of the technology acceptance model (version II) | Technology acceptance model, theory of reasoned action, theory of planned action, work motivation theory, action theory, and behavioral decision theory, image theory | N=156 (three different time periods) | Multiple regression analyses:<br>DV I: IU<br>DV II: PU<br>IV: PEOU, subjective norms, image, job relevance, output quality, result demonstrability<br>Moderator: Experience, voluntariness | Perceived usefulness explained around 60% of the variance. Thus, the variable strongly predicted usage intentions. Furthermore, social influence processes (e.g. subjective norms) as well as cognitive instrumental processes (e.g. job relevance) showed significant impact on user acceptance. |
| Venkatraman (1991) *[Journal of Retailing]* | Product Innovation Adoption | Impact of innovativeness and innovation type on adoption | - | N=245 | Logistic regression analysis:<br>DV: Adoption behavior (buy/not-buy)<br>IV: Cognitive and sensory innovativeness<br><br>Chi-square Wald test to determine adoption drivers: Sex, education, age, income, occupation, performance and economic risk, enjoyment risk, relative advantage, complexity, newness | For sensory innovators, product newness showed a significant positive effect on adoption intentions. For cognitive innovators, relative advantage was the most important adoption driver. They also had the motivation to deal with product complexity. |
| Verhoef, Kannan, and Inman (2015) *[Journal of Retailing]* | Omni-channel Retailing | Movement toward omni-channel retailing | Technology adoption research, diffusion theory | - | Theoretical | Omni-channel retailing is a new trend offering seamless shopping experiences to customers through the strong interplay between brands and channels. The following three research streams were identified to be of significant interest: the impact of channels on performance, the shopper behavior across channels, and the retail mix across channels. |
| Watchravesringkan, Nelson Hodges, and Kim (2010) *[Journal of Fashion Marketing and Management]* | Technology Acceptance for Fashion Products | Role of extrinsic and intrinsic motivational factors within the consumers' adoption of highly technological fashion products | Technology acceptance model | N=268 | SEM:<br>DV I: Purchase intentions<br>DV II: Utilitarian and hedonic attitudes<br>IV: PU, PEOU, perceived innovativeness, perceived fashionability | Consumers' adoption intentions for highly technological fashion products were influenced by both, extrinsic motivation (i.e. perceived ease of use and perceived usefulness) and intrinsic (i.e. perceived innovativeness and perceived fashionability) motivation. The study focused on intrinsic motives relating to product attributes rather than benefits (enjoyment). Moreover, the introduced division between utilitarian and hedonic attitudes proved to significantly affect purchase intentions. |

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| Wood and Moreau (2006) *[Journal of Marketing]* | Product Innovation | Influence of emotions on the evaluation and early use of innovations | Diffusion model | Study I: N=175<br><br>Study II: N=106 (for continuous innovation) | ANOVA:<br>DV: Complexity expectations, disconfirmation of complexity expectations<br>IV: Experience, demonstration<br><br>Multiple regression analyses:<br>DV: Emotions, evaluations<br>IV: Experience, demonstration, usage expectations, compatibility, net benefits | Consumer's expectations of experienced products can be affected by marketing communications or by prior usage experience. The variable 'usage expectations' proved to be a significant predictor of emotions. In addition, perceived complexity decelerated a consumer's time to trial. |
| Zhang et al. (2008) *[Proceedings of the 13th International Conference on Intelligent User Interfaces]* | Virtual Mirrors | Effectiveness of motion-tracking and clothes-recognition systems | (Machine learning approaches) | - | Theoretical | Different machine learning approaches are necessary to realize the responsive mirror concept. The system will provide shoppers with relevant information at the point of decision. |
| Zhao, Hoeffler, and Dahl (2012) *[Journal of Product Innovation Management]* | Product Innovations | Imagination difficulty and new product evaluation | Elaboration likelihood model | Study I: N=83<br><br>Study II: N=84<br><br>Study III: N=55<br><br>Study IV: N=113 | Study I: ANOVA<br>DV: Product evaluation<br>IV: Product difficulty, imagination difficulty<br><br>Study II and III: ANOVA<br>DV: Product evaluation<br>IV: Number of thoughts, product newness<br><br>Study IV: ANOVA<br>DV: Product evaluation<br>IV: Imagination difficulty, involvement<br><br>Binary regression analyzing the interaction between imagination difficulty and involvement | Imagination difficulty impacted how consumers assessed and evaluated products. The study showed that for really-new products, consumer perceived higher imagination difficulty resulting in a lower product evaluation. |

## Appendix E: Comparative Literature Table

| | Research Focus | | | | | Technology Acceptance Model Components | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Citation** | **Retail** | **Product Innovation** | **In-store Innovation** | **AR** | **Virtual Mirrors** | **PU** | **PEOU** | **PE** | **PN (complexity)** | **TI** | **Socio-demographic characteristics** | **ATU** | **IU** |
| This study | X | X | X | X | X | X | X | X | X | X | X | (X)[a] | X |
| Hagberg, Sundstrom, and Egels-Zandén (2016) | X | | | | | | | | | | | | |
| Lemon and Verhoef (2016) | X | | | | | | | | | | | | |
| Parise, Guinan, and Kafka (2016) | X | X | X | X | X | | | | | | | | |
| Rauschnabel and Ro (2016) | | X | | X | | X | X | | | X | X | X | X |
| Kang, Mun, and Johnson (2015) | X | X | X | | | X | | X | | X | | | X |
| Verhoef, Kannan, and Inman (2015) | X | | | | | | | | | | | | |
| Blázquez (2014) | X | | X | | | | | | | | | | |
| Kallweit, Spreer, and Toporowski (2014) | X | X | X | | | X | X | | | | | X | X |
| Newman (2014) | X | X | X | | | | | | | | | | |
| Pantano and Viassone (2014) | X | X | X | | | | | | | | | | |
| Piotrowicz and Cuthbertson (2014) | X | X | X | X | X | | | | | | | | |
| Rese, Schreiber, and Baier (2014) | X | X | X | X | | X | X | X | | | | X | X |

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| | Research Focus | | | | | Technology Acceptance Model Components | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Citation** | **Retail** | **Product Innovation** | **In-store Innovation** | **AR** | **Virtual Mirrors** | **PU** | **PEOU** | **PE** | **PN (complexity)** | **TI** | **Socio-demographic characteristics** | **ATU** | **IU** |
| Spreer and Kallweit (2014) | X | X | X | X | | X | X | X | | | X | X | X |
| Lee and Yang (2013) | X | X | X | | | | | | | X | X | | X |
| Licoppe (2013) | X | X | X | | | | | | | | | | |
| Pantano, Iazzolino, and Migliano (2013) | X | X | X | | | X | X | X | | | | | |
| Haugstvedt and Krogstie (2012) | | X | | X | | X | X | X | | | | | X |
| Moore and McElroy (2012) | | | | | | | | | | X | X | | |
| Olsson et al. (2012) | X | X | X | X | X | X | | | | X | X | | X |
| Pantano and Servidio (2012) | X | X | X | X | | | X | X | | | | | |
| Zhao, Hoeffler, and Dahl (2012) | | X | | | | | | | X | | | | |
| Arts, Frambach, and Bijmolt (2011) | | X | | | | X | X | | X | X | X | | X |
| Rocamora (2011) | X | X | | | | | | | | | | | |
| Shankar et al. (2011) | X | X | X | X | | | | | | | | | |
| Sorescu et al. (2011) | X | X | | | | | | | | | | | |
| Watchravesringkan, Nelson Hodges, and Kim (2010) | X | X | | | | X | X | | | X | | X | X |
| Begole et al. (2009) | X | | X | | X | | | | | | | | X |

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| | Research Focus | | | | | Technology Acceptance Model Components | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Citation** | **Retail** | **Product Innovation** | **In-store Innovation** | **AR** | **Virtual Mirrors** | **PU** | **PEOU** | **PE** | **PN (complexity)** | **TI** | **Socio-demographic characteristics** | **ATU** | **IU** |
| Chiu et al. (2009) | X | | | | | X | X | X | | | | | X |
| Ha and Stoel (2009) | X | | | | | X | X | X | | | | X | X |
| Sato, Kitahara, and Ohta (2009) | | | | | X | | | | | | | | |
| Venkatesh and Bala (2008) | | X | | | | X | X | X | | X | | | X |
| Zhang et al. (2008) | X | X | | | X | | | | | | | | |
| Herzenstein, Posavac, and Brakus (2007) | | X | | | | | | | X | | | | X |
| Ireland and Webb (2007) | | X | | | | | | | | | | | |
| Meyer and Schwager (2007) | X | X | | | | | | | | | | | |
| Morwitz, Steckel, and Gupta (2007) | | X | | | | | | | X | | | | X |
| Hirunyawipada and Paswan (2006) | | X | | | | | | | | X | | | X |
| Wood and Moreau (2006) | | X | | | | X | X | X | | X | | | |
| Bruner and Kumar (2005) | | X | | | | X | X | X | | | | X | X |
| Thompson, Hamilton, and Rust (2005) | | X | | | | X | | | | | | | |
| Magnenat-Thalmann, Seo, and Cordier (2004) | | | | | X | | | | | | | | |
| Hoeffler (2003) | | X | | | | X | | | X | | | | X |

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| | Research Focus | | | | | Technology Acceptance Model Components | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Citation** | **Retail** | **Product Innovation** | **In-store Innovation** | **AR** | **Virtual Mirrors** | **PU** | **PEOU** | **PE** | **PN (complexity)** | **TI** | **Socio-demographic characteristics** | **ATU** | **IU** |
| Meuter et al. (2003) | X | X | X | | | X | | | | X | X | | X |
| Mun and Hwang (2003) | | X | | | | X | X | X | | | | | X |
| Steenkamp and Gielens (2003) | X | X | | | | X | | | X | | X | | |
| Van der Heijden, Verhagen, and Creemers (2003) | X | | | | | X | X | | | | | X | X |
| Burke (2002) | X | X | X | | | | | | | | | | |
| Chen, Gillenson, and Sherrell (2002) | X | X | | | | X | X | | | | | X | X |
| Dabholkar and Bagozzi (2002) | | X | | | | X | X | X | | (X)[b] | X | X | X |
| Mathwick, Malhotra, and Rigdon (2002) | X | | | | | | | X | | | | | |
| Amit and Zott (2001) | | X | | | | | | | | | | | |
| Childers et al. (2001) | X | | | | | X | X | X | | | | X | |
| Citrin et al. (2000) | X | | | | | | | | | X | | | X |
| Venkatesh and Davis (2000) | | X | | | | X | X | | | X | | | X |
| Erdem, Ben Oumlil, and Tuncalp (1999) | X | | | | | | | | | | | | |
| Hu et al. (1999) | | X | | | | X | X | | | | | X | X |
| Alba et al. (1997) | | X | X | | | | | | | | | | |

*(Continues)*

| | Research Focus | | | | | Technology Acceptance Model Components | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Citation** | **Retail** | **Product Innovation** | **In-store Innovation** | **AR** | **Virtual Mirrors** | **PU** | **PEOU** | **PE** | **PN (complexity)** | **TI** | **Socio-demographic characteristics** | **ATU** | **IU** |
| Azuma (1997) | | | | X | | | | | | | | | |
| Urban, Weinberg, and Hauser (1996) | | X | | | | | | | | | | | X |
| Keil, Beranek, and Konsynski (1995) | | | X | | | | X | X | | | | | X |
| Dabholkar (1994) | | | | | | | X | X | X | | | X | X |
| Davis (1993) | | X | | | | X | X | | | | | X | |
| Adams, Nelson, and Todd (1992) | | | | | | X | X | | | | | | X |
| Crowley, Spangenberg, and Hughes (1992) | | | | | | | | | | | | X | |
| Davis, Bagozzi, and Warshaw (1992) | | | | | | | X | X | X | | | | X |
| Goldsmith and Reinecke Flynn (1992) | | X | X | | | | | | | X | | | |
| Ajzen (1991) | | | | | | | | | | | | X | X |
| Batra and Ahtola (1991) | | | | | | | | | | | | X | X |
| Goldsmith and Hofacker (1991) | | X | X | | | | | | | X | | | |
| Kleinschmidt and Cooper (1991) | | | X | | | | | | | | | | |
| Venkatraman (1991) | | | X | | | X | X | X | X | X | X | | X |
| Davis (1989) | | | | | | | X | X | | | | | X |

*(Continues)*

| | Research Focus | | | | | Technology Acceptance Model Components | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Citation** | **Retail** | **Product Innovation** | **In-store Innovation** | **AR** | **Virtual Mirrors** | **PU** | **PEOU** | **PE** | **PN (complexity)** | **TI** | **Socio-demographic characteristics** | **ATU** | **IU** |
| Davis, Bagozzi, and Warshaw (1989) | | | | | | | X | X | | | | X | X |
| Sheppard, Hartwick, and Warshaw (1988) | | | | | | | | | | | | X | X |
| Tornatzky and Klein (1982) | | X | | | | X | | | X | | | | X |
| Bagozzi (1981) | | | | | | | | | | | | X | X |
| Midgley and Dowling (1978) | | | | | | | | | | X | | | |

*Note: [a]Attitude was initially included in the studied framework, yet, had to be excluded from the path analysis due to poor model fit.*

*[b]Technology innovativeness was partly studied within the context of inherent novelty seeking.*

*An "X" indicates that the study empirically assesses a respective topic and/or the impact of a particular TAM component.*

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