Exploring the Early Adopters of Augmented Reality Smart Glasses: The Case of Microsoft HoloLens

Mahdokht Kalantari and Philipp Rauschnabel

Abstract Not much research has been done to understand how consumers react to wearable technologies that mix virtual and real worlds in glasses-like wearable devices. Drawing up on various technology acceptance and media theories, the authors develop a model to understand how people react to Augmented Reality Smart Glasses (ARSGs) using the example of Microsoft HoloLens. Results show that consumer's adoption decision is driven by various expected benefits including usefulness, ease of use, and image. However, hedonic benefits were not found to influence the adoption intention. In addition, this research shows that the influence of the descriptive norms on the adoption intention outperforms the influence of the injunctive norms, which are established drivers of technology acceptance research. Theoretical and managerial implications of these findings are discussed.

Keywords Hololens · Augmented reality smart glasses · Mixed reality · Head mounted display · Acceptance · TAM

1 Introduction

Wearable technologies are currently receiving tremendous interest among all consumer segments. Market trends show an increasing growth in the sales of smartwatches, fitness trackers and VR glasses. CCS Insight (2016), a leading market research company in the wearables-related sector, has forecasted that in 2020, 411 million smart devices will be sold, worth a staggering $34 billion. According

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T. Jung and M.C. tom Dieck (eds.), *Augmented Reality and Virtual Reality*,
Progress in IS, DOI 10.1007/978-3-319-64027-3_16

to their forecast, shipments for AR and VR headsets will grow 15 times to 96 million units by 2020, at a value of $14.5 billion. Scholars are making first attempts to investigate these recent trends from an academic standpoint to understand why and how users react to wearable technologies (Rauschnabel and Ro 2016; Leue and Jung 2014). These devices are the next step in providing information, including virtual realities, realistically and they are more easily accessible to users. For example, rather than taking a smartphone out of one's pocket to read a text message, the message can be conveniently displayed on a user's wrist. Likewise, VR allows users to perceive themselves as being a different person in a different place (Craig 2013), making animations much more realistic than traditional screen-based technologies.

Recently, manufacturers announced their efforts to enter consumer markets with a novel technology that is termed 'Augmented Reality Smart Glasses' (ARSGs), which—broadly speaking—realistically integrates virtual objects into a user's view field in glasses-like devices. While Google Glass, one of the first commercially launched ARSGs, has received a lot of media attention, its success in consumer markets was limited. However, recent studies suggest that other devices such as Microsoft HoloLens are much more promising due to their holographic possibilities. In contrast to Google Glass, HoloLens does not have just one prism that overlays information; HoloLens realistically integrates 3D information into a user's perception of the real-world which no other commercially available technology can offer so far.

There is still a lack of understanding about the factors that drive consumer's acceptance and resistance to ARSGs. This is probably due to the novelty of AR in general and ARSGS in particular, but as initial research suggests, it may also be due to the fact that the existing theories are difficult to apply to ARSGs. Thus, in order to extend our understanding of consumers' adoption of ARSGs, we aim to answer the following two research questions using Microsoft HoloLens, the first commercially available holographic ARSG:

- RQ1: How do consumers perceive ARSGs, in particular Microsoft HoloLens?
- RQ2: Which factors influence the adoption of ARSGs, in particular Microsoft HoloLens?

To answer these research questions, we first review the relevant literature on technology acceptance and ARSGs consumer research. Based on this review, we propose a framework consisting of various benefits, risks, technology factors and norms as antecedents to ARSG adoption. We then test the proposed model using the example of Microsoft HoloLens. Results from descriptive analyses and a regression model indicate various, yet unknown, factors that explain how consumers react to ARSGs. These findings provide several contributions to the literature on ARSGs, wearables, and research about norms.

2 Theory and Prior Research

2.1 Augmented Reality and ARSGs

Initially, computer-related technologies were predominantly used in work-related contexts as task-oriented devices. Manufacturers quickly realized the potential of computer applications and the internet in personal settings; hence, information technology rapidly diffused to consumer markets. With the rise of mobile technologies, an 'always and everywhere online mentality' became ubiquitous (Ratten 2009). Recently, companies have developed a new generation of mobile devices that can be fixed to a user's body—wearables. Most wearables come in the form of accessories, with prominent examples being the Apple Watch (smartwatch) and the Fitbit (smart bracelet).

During recent years, a new generation of applications have been developed that integrate virtual elements with the physical environment. According to Craig (2013), Augmented Reality (AR) is defined as a "medium in which digital information is overlaid on the physical world that is in both spatial and temporal registration with the physical world and that is interactive in time". For example, smartphone users can use the Wikitude smartphone app and view a famous building. Wikitude then automatically includes relevant Wikipedia information in the user's viewfield. Thus, in contrast to VR,[1] AR is not closed off from reality, but melds the real and virtual worlds together (Javornik 2016a; Scholz and Smith 2016). Likewise, AR has been studied and applied in various contexts, such as tourism (Jung et al. 2015), museums (Tom Dieck and Jung 2015), retailing (Spreer and Kallweit 2014; Rese et al. 2016) and others (Stockinger 2016; Javornik 2016a, b).

Current developments in IT aim at combining AR with wearables in glasses-like devices. Microsoft HoloLens, Google Glass (now: Project Aura), Everysight Raptor, ODG R-7 and Epson Moverio are prominent examples of these developments, and Samsung, Zeiss, Amazon and other firms have filed patents for and announced the launch of smart glasses.

2.2 Technology Acceptance Research

Since the advent of computer technologies, researchers have been studying the dynamics and the influential factors on individual's acceptance of information technologies. Although various theories and approaches have been suggested in the field of information systems to address this issue, the Technology Acceptance

[1]With VR-devices (e.g. Oculus Rift), users immerse themselves in a virtual world that shuts out the external environment, totally immersing the user in the virtual reality.

Model (TAM) has received the highest level of attention and application among the researchers (Davis 1989; King and He 2006).

TAM is a simple, parsimonious and powerful model to explain the use of a new technology (King and He 2006). TAM is rooted in behavioural research about attitude and behaviour formation (e.g., Theory of Reasoned Action) and psychology research about behaviour regulation and change (e.g., Social Cognitive Theory) (Davis 1989; Davis et al. 1989). TAM proposes that the individuals' behavioural intention to adopt/use a new technology is determined both by perceived ease of use, defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis et al. 1989), and perceived usefulness, defined as "the degree to which a person thinks that using a particular system would enhance his or her job performance" (Davis et al. 1989). Furthermore, many studies indicate that perceived usefulness partially mediates the relationship between perceived ease of use and behavioural intention.

Although the parsimony of TAM is considered as a prominent strength for this model, it is also commonly criticized because this model neglects the various aspects of decision making across different technologies (Bagozzi 2007). Researchers have tried to extend TAM by including other parameters such as task (Chau and Lai 2003), social (Venkatesh and Davis 2000; Lewis et al. 2003), and demographics (Venkatesh and Morris 2000). A famous example is the proposal of the unified theory of acceptance and use of technology (UTAUT, Venkatesh et al. 2003) that integrates TAM with seven other decision making theories. Empirical testing results suggested a complex model with the addition of two determinants including social influence and facilitating conditions, and four moderators of key relationships.

TAM and its extensions have been valued for their application flexibility in different contexts. In particular, these models allow researchers to include variables that are only relevant in specific contexts. Therefore, in this paper, we use TAM as our framework and extend it with factors that are specifically relevant to the context of ARSGS. Particularly, as discussed in the model development section, we extend and apply TAM to ARSGs by integrating benefits, risks, technology factors, and social norms.

2.3 Prior Research on ARSGs

Scholars from various disciplines, including engineering (Chi et al. 2013; Behzadan et al. 2008), business (Rauschnabel and Ro 2016), MIS (Ernst et al. 2016), tourism (Jung and Han 2014), and others have studied various aspects and applications of ARSGs. For the purpose of this study, research that focuses on consumer acceptance is particularly important. Table 1 summarized these studies.

Table 1 Prior consumer- and acceptance research on ARSGs

Study	Research questions	Theory	Findings
Rauschnabel et al. (2015)	How does personality relate to consumer's reaction to Google Glass?	Big five theory, technology acceptance research	Personality predicts awareness of google glass and moderates the relationship between TAM-related factors and ARSG adoption
Rauschnabel and Ro (2016)	What drives the adoption of Google Glass?	Technology acceptance research	Perceived usefulness, ease of use, injunctive norms, and consumers' level of technology innovativeness drive consumers' evaluation and intended adoption of Google Glass
Eisenmann et al. (2014)	How do consumers react to Google Glass?	Exploratory case study	The study explores various facets of consumers' reactions to Google Glass, including design, functionality, barriers, and potential use cases, among others
Ernst et al. (2014)	Do consumers intend to substitute real objects with virtual, holographic ones?	Technology acceptance research	Substituting real things with holograms makes consumers more likely to adopt ARSGs because it makes ARSGs more useful and enjoyable
Stock et al. (2016)	Do health risks and enjoyment influence the intended use of HoloLens?	Technology acceptance	The negative effect of health risks on the intention to use HoloLens is not significant. However, higher levels of health risk lead to lower levels of perceived enjoyment, a predictor of intended use of HoloLens
Weiz et al. (2016)	Do perceived usefulness and injunctive norms determine the adoption of Google Glass?	Technology acceptance	There was no direct effect of injunctive norms on actual usage of Google Glass, but they were indirectly related via perceived usefulness
Hein and Rauschnabel (2016)	Can ARSGs be used in enterprise social networks?	Technology acceptance research on an individual and firm-level	The authors provided a conceptual model that identifies firm-level and individual-level factors that affect the implementation and individual's active and passive use of ARSGs in enterprise social networks

(continued)

Table 1 (continued)

Study	Research questions	Theory	Findings
Rauschnabel et al. (2016)	Are ARSGs fashion or technology?	Technology acceptance research, fashion research, categorization research	Most consumers perceive ARSGs as a combination of fashion and technology (Fashnology). Categorization is driven by familiarity with ARSGs in general
Hein et al. (2016)	How do consumers evaluate the societal consequences of ARSGs?	Exploratory	This study identifies several societal benefits and risks that drive consumers anticipated and desired diffusion of ARSGs
Leue et al. (2015)	How does google glass enhance visitors' learning outcomes in art galleries?	Exploratory	Interviews with participants indicated that google glass enhances the learning outcomes of visitors by making connections between art pieces and providing a deeper perspective as well as helping the visitors personalize their tours based on their interest in specific themes
tom Dieck et al. (2016)	What are the requirements of visitors of museums and art galleries for the development of wearable ARSGs applications?	Exploratory	Study findings reveal that the important factors in developing and implementing wearable AR applications in museums and art galleries are: content requirement, functional requirement, comfort, experience and resistance

3 Model Development

Figure 1 provides an overview of the proposed model. Inspired by the extant technology acceptance literature (e.g. King and He 2006; Davis et al. 1989; Venkatesh et al. 2012) and prior research on ARSGs (e.g., Rauschnabel et al. 2015, 2016; Ernst et al. 2016), the model proposes that consumer's intention to adopt ARSGs is driven by the benefits and risks of using them, other characteristics of the technology, and social norms. In the subsequent sections, we will provide hypotheses addressing each of these categories of antecedents.

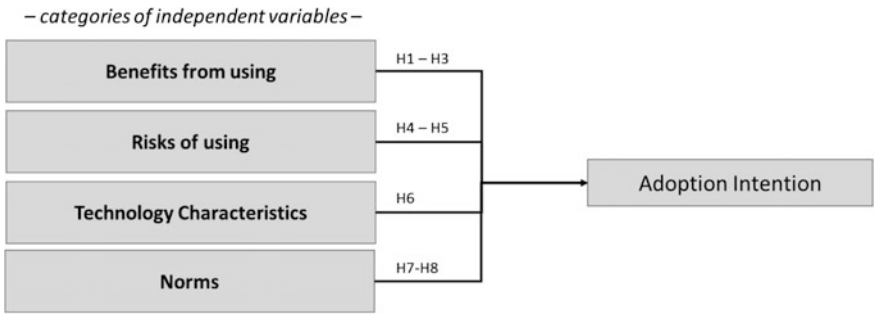

Fig. 1 Model overview

3.1 Benefits from Using

The technology acceptance literature argues that expected or perceived benefits from using a technology typically drive the adoption (King and He 2006; Venkatesh et al. 2012). We propose that three particular benefits are relevant in understanding consumers' adoption of HoloLens:

First, perceived usefulness, a powerful construct in the technology acceptance literature (King and He 2006) is proposed to influence the adoption intention. ARSGs, including HoloLens, can be used in various ways to increase a user's efficiency in accomplishing their tasks. For example, Hololens can be used for getting step-by-step remote instructions from an expert on a variety of issues from home repair to medical instructions. Hololens can also be used to build different types of 3D holographic models in the physical space for various design purposes. Another application of Hololens is helping users visualize how new furniture and/or decorations will look like in their homes. Hololens can also substitute physical screens and monitors as users can have a number of virtual screens with different sizes (Ernst et al. 2016). The other advantage of Hololens in comparison to physical screens is that users can watch movies or browse the internet on virtual screens no matter where they are in their homes and/or offices.

H1: Perceived usefulness is positively related to consumer's intention to adopt ARSGs.

Likewise, the technology acceptance literature proposes two other constructs that are likely to determine consumers' intended adoption of ARSGs: hedonic motivation and image.

The construct 'hedonic motivation' is defined as the extent to which using a technology is perceived as enjoyable and fun. Hololens offers several uses and applications that can appeal to a user's hedonic needs and motivations. Hololens can turn monotonous tasks into a game for the users. For example, they can replace the physical world around them with an interactive and scrolling scenery as they jog

on a treadmill. Hololens also offers a selection of mixed reality games that make use of the user's physical environment and have spatial sounds to guide the user through the game. Hololens provides users with the capability to combine gestures, voice, and the HoloLens gaze feature to create 3D objects. Users can also create short clips with special effects that can be viewed on Hololens.

H2: Hedonic motivation is positively related to consumer's intention to adopt ARSGs.

As ARSGs are not just used but also worn, the literature on Fashnology also proposes that factors related to other people seem to matter (e.g., Rauschnabel et al. 2016). For example, Chuah et al. (2016) show that the level of visibility of smartwatches drives consumers' adoption of them. In this study, we extend this research stream and propose that the image of wearing ARSGs matters. Inspired by the TAM literature (Venkatesh and Davis 2000), we define image as the extent to which using ARSGs is "perceived to enhance one's social status in one's social system" (Moore and Benbasat 1991) is perceived to impact the positive image of the user.

H3: Image is positively related to consumer's intention to adopt ARSGs.

3.2 Risks of Using

Technology acceptance scholars have identified various risks as relevant to people's adoption and use of technology. We propose that this is also true for ARSGs. In particular, two risk factors seem to play an important role: First, the general risk of using ARSGs from a technological perspective, as proposed by TAM Scholars (King and He 2006), and second, the risk of threatening a user's privacy (Rauschnabel and Ro 2016).

The first risk that we incorporated in our analysis is the technology risk. According to Featherman and Pavlou (2003), perceived technology risk has various aspects: psychological risk, risks due to uncertainties in purchase decision, and physical risk. Psychological risk addresses the potential anxiety or disappointment that can occur after the consumer purchases the technology. Risks that are due to the uncertainties in purchase decision are financial risk, time loss risk and technology performance risk. Consumers may feel that they have invested their money and time in purchasing a technology that does not meet their needs. Moreover, the technology may fail to perform as expected. Physical risk refers to the risk of personal injury after using the technology. In particular, these wearable technologies can affect a user's vision and mobility. ARSGs overlay information and holographic objects on a person's field of view which in turn leads to limiting the view to some extent and potentially causing distraction. ARSGs generally require

that users shift their focus quickly from the real world in the distance to the overlaid information and objects; therefore, some users may have difficulty adjusting focus. Users may also get distracted by the virtual objects and hence have longer reaction times than usual. An example of this hazard can be wearing ARSGs while driving which may lead to misjudging the speed of other cars and underestimating reaction times.

The second risk factor is particularly important as ARSGs are equipped with cameras, microphones and other sensors (Hein et al. 2016). This allows ARSGs to technically capture, process, and share the personal interactions of a user with third parties, such as hackers. Not surprisingly, media have also elaborated on this criticism, and scholars have discussed this issue conceptually. Recently, Rauschnabel et al. (2016a, b) analysed the impact of these risk factors on users' adoption intention and did not find a significant effect to confirm this empirically; however, a replication using a different research design could help with generalizing or falsifying this finding.

Therefore, we proposed that both risk factors—technology risk and privacy risk—are negatively related to HoloLens adoption

H4: Perceived technology risk is negatively related to consumers' intention to adopt ARSGs.
H5: Perceived privacy risk is negatively related to consumers' intention to adopt ARSGs.

3.3 Technology Characteristics

We also propose that several characteristics of ARSGs determine the intended use. One of the main factors in the original TAM model that has been known for its influence on adoption behaviour is perceived ease of use of the technology. The TAM scholars have widely studied the role of perceived ease of use as a determinant to adoption and use. Reviewing these studies shows that there is a general consensus in the scientific community that perceived ease of use has either a direct or indirect effect on consumers' behavioural intention to use new technologies in various contexts. This finding has also been supported in technology acceptance studies in the context of wearable technologies (Lee 2009; Leue and Jung 2014; Rauschnabel and Ro 2016). Therefore, we propose that perceived ease of use is also positively related to adoption intention in the context of Augmented Reality Smart Glasses.

H6: Perceived ease of use is positively related to consumers' intention to adopt ARSGs.

3.4 Norms

It is a widely replicated finding that people's behaviour is strongly influenced by other people. TAM researchers have established a construct called 'social influences' in their models which reflects an injunctive normative belief. Injunctive normative beliefs describe the extent to which a person believes that other people expect a person to engage in particular behaviours (Cialdini et al. 1990)—here: to adopt HoloLens (H7).

However, the literature on social norms also proposes a second type of norm: descriptive norms. With regards to ARSGs, descriptive norms describe the expected social conformity of using them—in other words, they indicate if a person believes that using ARSGs will be somehow common among his or her peers (H8).

With very few exceptions, most prior research on TAM and ARSGs have focused on injunctive norms; however, especially in the early stage of the product lifecycle, a comparison of the two types of norms provides an interesting contribution to the literature. Therefore, we propose:

H7: Injunctive norms are positively related to consumers' intention to adopt ARSGs.
H8: Descriptive norms are positively related to consumers' intention to adopt ARSGs.

4 Methodology and Research Design

One hundred and sixteen students of a North American university took part in an online survey on 'new media and technologies' for extra credits. The sample consists of 43% females, and respondents' average age was 23.2 (SD = 5.1). The study started with a short, approximately 2-minute video by Microsoft that explains Hololens followed by the constructs of interest and demographic variables.

Where possible, we used existing scales from the literature and adapted them to the context of HoloLens. We used 7-point Likert scales ranging from 1 = totally disagree to 7 = totally agree. All items and references are presented in the appendix. All coefficient alphas exceeded the recommended thresholds of .7, indicating sufficient reliability, as shown in Table 2 (diagonal). All the items were aggregated composite mean scores. Table 1 also presents the mean values, standard deviations, and correlations between the constructs.

Table 2 Correlations and descriptive statistics

		M	SD	1	2	3	4	5	6	7	8	9
1	Perceived usefulness	5.34	1.26	.93								
2	Hedonic motivation	5.65	1.26	.44**	.89							
3	Image	5.76	1.72	.35**	.15	.91						
4	Technology risk	3.78	1.30	−.22*	−.04	−.16	.89					
5	Privacy risks	4.57	1.51	−.16	−.02	−.11	.60**	.93				
6	Ease of use	4.98	1.28	.36**	.25**	.07	−.12	−.17	.94			
7	Injunctive norms	3.63	1.46	.43**	.16	.25**	−.19*	−.19*	.48**	.93		
8	Descriptive norms	3.38	1.45	.30**	.15	.38**	−.13	−.13	.27**	.53**	.95	
9	Adoption intention	3.49	1.49	.48**	.17	.42**	−.31**	−.21*	.41**	.55**	.63**	.88

**$p < .01$; *$p < .05$/diagonal: Cronbach's alpha

5 Results

RQ1 focuses on how consumers evaluate HoloLens. Table 1 presents the descriptive statistics, particularly mean and standard deviations. Results show that the surveyed respondents tend to evaluate the benefits substantially higher (perceived usefulness: m = 5.3; hedonic motivation: m = 5.65; image: m = 5.76) than the risks (technology: m = 3.78; privacy: m = 4.57). Respondents also expect that HoloLens is easy to use (m = 4.98), and evaluate them low in terms of social norms (injunctive: m = 3.63; descriptive: m = 3.38). Interestingly, the standard deviation is particularly high for image (SD = 1.72), indicating that HoloLens is associated with a very positive image for some respondents, and a very negative one for others.

With regards to RQ2, we applied using multiple regression analyses. The results are outlined in Table 2 and visualized in Fig. 2. An inspection of VIF factors did not indicate any concerns with multicollinearity (all VIF < 3), and the overall model fit F-test indicates an R squared significantly above zero ($p < .001$) (Table 3).

6 Discussion and Conclusion

This is one of the few studies that investigates consumers' acceptance of a novel technology: Microsoft Hololens, a recently launched ARSG device. Drawing up on established technology acceptance theories and taking into account the ARSG

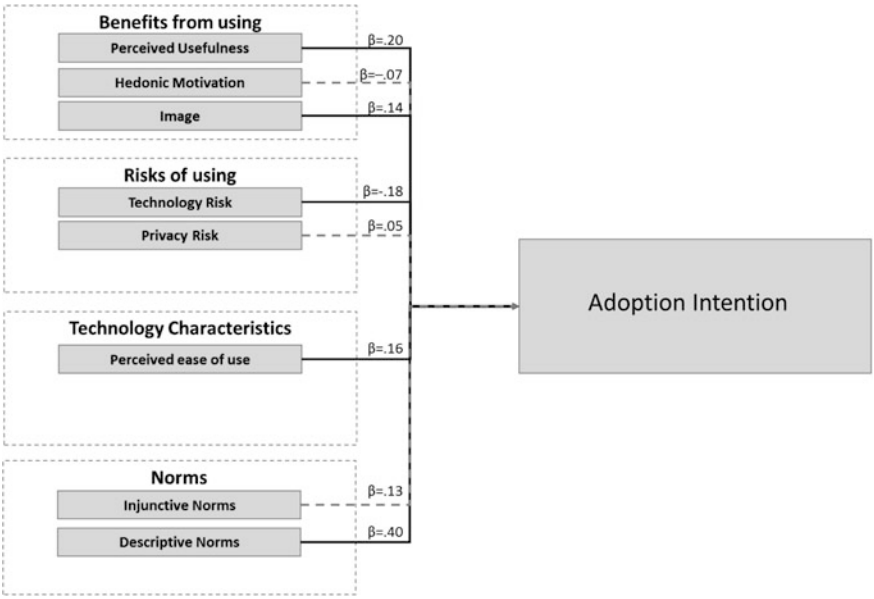

Fig. 2 Visualization of the results

Table 3 Regression analysis

	β	t	p
Perceived Usefulness	**0.20**	**2.49**	**0.01**
Hedonic Motivations	−0.07	−0.98	0.33
Image	**0.14**	**2.00**	**0.05**
Technology Risk	**−0.18**	**−2.21**	**0.03**
Privacy Risk	0.05	0.65	0.52
Perceived ease of use	**0.16**	**2.08**	**0.04**
Inductive Norms	0.13	1.59	0.12
Descriptive Norms	**0.40**	**5.09**	**0.00**
R Squared R Squared (adjusted)	.57 ($p < .001$) .543		

specific characteristics, this research proposes and empirically tests a model consisting of eight hypotheses to explain consumers' intended adoption of ARSGs. The results of this study show that perceived usefulness, image, ease of use, and descriptive norms are positively related to adoption intention whereas technology risks are negatively related to adoption intention. No significant effect was found for hedonic motivations, privacy risk, and inductive norms. Descriptive analyses also show that consumers tend to see more benefits than risks of ARSGs. Findings of this research have important implications for theory and practice as discussed below.

6.1 Theoretical Implications

The first theoretical contribution of this study is a comprehensive framework of antecedents to ARSG adoption. While prior research has often focused on a small number of factors (e.g., Weiz et al. 2016; Ernst et al. 2016; Rauschnabel et al. 2015), the model in this study incorporates benefits, risks, technology factors, and norms. By doing so, this study provides a much more comprehensive overview of factors relating to the adoption of ARSGs than proposed in the existing research. Counter-intuitively, the coefficient of hedonic motivation did not approach significance. This is surprising, as consumers generally value new technologies for being 'fun' to use (Venkatesh et al. 2012). A potential explanation is that hedonic motivations behave similarly to other antecedents in Rauschnabel and Ro (2016) by focusing on the evaluation of the device, rather than the behavioural intention.

The second contribution of this research is the focus on risks. Prior research on ARSGs has predominantly focused on benefits (e.g., Rauschnabel et al. 2015; Tom Dieck et al. 2016) or other established TAM factors (Rauschnabel and Ro 2016). Results of this study confirm Rauschnabel et al.'s findings (2016a, b) that people's perception of the privacy risks do not seem to matter in their intention to adopt. In addition, this study shows that general technology risks can affect the adoption intention. That is, while this research replicates the counter-intuitive finding that privacy risks are less crucial, it also shows that general risk factors matter. More research is needed to better understand the nature and antecedents to these risk factors.

The third contribution is the distinction of the descriptive versus injunctive norms (Cialdini et al. 1990). Prior research, including numerous TAM studies in related disciplines have predominantly looked at injunctive norms (e.g. Venkatesh et al. 2012). In this study, we integrated injunctive and descriptive norms. Results indicate that, at least in this study, descriptive norms seem to be more relevant in explaining the adoption intention. This is an important contribution for ARSG research, but also for the TAM domain as a whole. Findings suggest that scholars should consider descriptive norms in addition to injunctive norms.

Finally, most prior research has focused on Google Glass (Rauschnabel et al. 2015; Rauschnabel and Ro 2016; Eisenmann et al. 2014) or ARSGs in general (Rauschnabel et al. 2016). So far, not much research has studied ARSGs using the example of Microsoft HoloLens. Compared to HoloLens, Google Glass has a plain design, only one prism and is not able to realistically integrate 3D Holograms into a user's perception of the reality. HoloLens, however, offers these features, but in a much more 'bulky' device.

6.2 Managerial Implications

This study also provides a number of implications for ARSG manufacturers and app developers. In particular, in order to foster the adoption of ARSGs, manufacturers should focus on utilitarian benefits, ease of use, and the reduction of technology risks. Utilitarian benefits can be promoted by showing how a user's life can be improved in terms of efficiency—potential examples include opportunities for collaboration, organizer functions and so forth. In order to improve user-friendliness, app developers and manufacturers need to understand users' expectations of how to operate this novel form of media technology. So far, Microsoft HoloLens uses a variety of operation methods (voice commands, hand gestures, and mouse-like clicker devices) to provide users with options when it comes to working with Hololens. More challenging might be the way to reduce the technology risk as a whole. Therefore, Manufacturers should understand the factors that determine this overall risk.

In addition to that, focusing on descriptive norms in communication could be a promising strategy. Manufacturers can provide information about how our lives could look like in the future or communicate summaries of the promising forecasts in their advertisements.

6.3 Limitations and Future Research

Like any other study, this research has some limitations. First, the relatively small group of participants consisting of US students might limit the generalization and extrapolation of the findings to other consumer groups. In addition, the focus on HoloLens, the first commercially available 3D ARSG is a strength in terms of managerial implications because findings can be influenced by Hololens-specific usage circumstances. Finally, similar to most prior studies on ARSGs (see Table 1), we also provided respondents with only a description of ARSGS rather than an exposure to the real product. However, in contrast to most prior studies, we showed respondents a realistic video instead of a textual and abstract description of the ARSG concept. While some findings (e.g. a non-significant effect of privacy; see Rauschnabel and Ro 2016) were replicated, other findings remain surprising. For example, hedonic benefits did not impact adoption intention, but in Rauschnabel et al. (2016) they were found to influence usage intention. More research is needed to study the influence of these factors on various outcomes (e.g. usage intention in different contexts, adoption intention, attitude towards using, and so forth). This study found that technology risk is a crucial driver of ARSG adoption. This is an important contribution as prior research has not yet studied risk factors intensely. While this study confirms that technology risks matter, a subsequent follow up question remains unanswered: What exactly is technology risk when it comes to ARSGs? Future research therefore should focus on assessing the risks of ARSG

usage. Lu et al. (2005) provided a first multi-dimensional assessment of technology risks. Extending this to Fashnology—or in particular ARSGs—could lead to important contributions to the technology and Fashnology literature.

References

Bagozzi, R. P. (2007). The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the association for information systems, 8*(4), 3.

Behzadan, A. H., Timm, B. W., & Kamat, V. R. (2008). General-purpose modular hardware and software framework for mobile outdoor augmented reality applications in engineering. *Advanced Engineering Informatics, 22*(1), 90–105.

CCS Insight (2016). Wearables Momentum Continues. Retrieved Janurary, 2017. from http://www.ccsinsight.com/press/company-news/2516-wearablesmomentum. continues.

Craig, A. B. (2013). *Understanding augmented reality: concepts and applications*. Newnes.

Chau, P. Y., & Lai, V. S. (2003). An empirical investigation of the determinants of user acceptance of internet banking. *Journal of organizational computing and electronic commerce, 13*(2), 123–145.

Chi, H. L., Kang, S. C., & Wang, X. (2013). Research trends and opportunities of augmented reality applications in architecture, engineering, and construction. *Automation in construction, 33,* 116–122.

Chuah, S. H. W., Rauschnabel, P. A., Krey, N., Nguyen, B., Ramayah, T., & Lade, S. (2016). Wearable technologies: The role of usefulness and visibility in smartwatch adoption. *Computers in Human Behaviour, 65,* 276–284.

Cialdini, R. B., Reno, R. R., & Kallgren, C. A. (1990). A focus theory of normative conduct: recycling the concept of norms to reduce littering in public places. *Journal of Personality and Social Psychology, 58*(6), 1015.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319–340.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management Science, 35*(8), 982–1003.

Eisenmann, T., Barley, L., & Kind, L. (2014). Google Glass. *Harvard Business School Case Study*

Ernst, C. P. H., & Stock, B. (2016). *& dos Santos Ferreira, T.* The Role of Perceived Substitutability: The Usage of Augmented Reality Smartglasses.

Featherman, M. S., & Pavlou, P. A. (2003). Predicting e-services adoption: a perceived risk facets perspective. *International Journal of Human-Computer Studies, 59*(4), 451–474.

Hein, D. W. E., Jodoin, J., Rauschnabel, P. A., & Ivens, B. S. (2017). *Are Wearables Good or Bad for Society? An Exploration of Societal Benefits, Risks and Consequences of Augmented Reality Smart Glasses.* In Kurubacak, G. & Altinpulluk, H. (Eds.) *Mobile Technologies and Augmented Reality in Open Education*,. …….:IGI Global

Hein, D. W., & Rauschnabel, P. A. (2016). Augmented Reality Smart Glasses and Knowledge Management: A Conceptual Framework for Enterprise Social Networks. In *Enterprise Social Networks* (83–109). Springer Fachmedien Wiesbaden.

Javornik, A. (2016a). Augmented reality: Research agenda for studying the impact of its media characteristics on consumer behaviour. *Journal of Retailing and Consumer Services, 30,* 252–261.

Javornik, A. (2016b). It's an illusion, but it looks real!'Consumer affective, cognitive and behavioural responses to augmented reality applications. *Journal of Marketing Management, 32*(9–10), 987–1011.

Jung, T. H., & Han, D. I. (2014). Augmented Reality (AR) in Urban Heritage Tourism. e-Review of Tourism Research.

Jung, T., Chung, N., & Leue, M. C. (2015). The determinants of recommendations to use augmented reality technologies: The case of a Korean theme park. *Tourism Management, 49,* 75–86.

King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information & Management, 43*(6), 740–755.

Lee, H. M. (2009). A study on the acceptance of wearable computers based on the extended technology acceptance model. *The Research Journal of the Costume Culture, 17*(6), 1155–1172.

Leue, M. C., Jung, T., & tom Dieck, D. (2015). Google Glass augmented reality: Generic learning outcomes for art galleries. In *Information andCommunication Technologies in Tourism 2015*, (463–476). Springer International Publishing.

Leue, M., & Jung, T. H. (2014). A theoretical model of augmented reality acceptance. *e-Review of Tourism. Research, 5,* 1–5.

Lewis, W., Agarwal, R., & Sambamurthy, V. (2003). Sources of influence on beliefs about information technology use: An empirical study of knowledge workers. *MIS Quarterly, 1,* 657–678.

Lu, H. P., Hsu, C. L., & Hsu, H. Y. (2005). An empirical study of the effect of perceived risk upon intention to use online applications. *Information Management & Computer Security*, *13*(2), 106–120.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information systems research, 2*(3), 192–222.

Ratten, V. (2009). Adoption of technological innovations in the m-commerce industry. *International Journal of Technology Marketing, 4*(4), 355–367.

Rauschnabel, P. A., & Ro, Y. K. (2016). Augmented reality smart glasses: an investigation of technology acceptance drivers. *International Journal of Technology Marketing, 11*(2), 123–148.

Rauschnabel, P. A., Brem, A., & Ivens, B. S. (2015). Who will buy smart glasses? Empirical results of two pre-market-entry studies on the role of personality in individual awareness and intended adoption of Google Glass wearables. *Computers in Human Behavior, 49,* 635–647.

Rauschnabel, P. A., Hein, D. W., He, J., Ro, Y. K., Rawashdeh, S., & Krulikowski, B. (2016a). Fashion or Technology? A Fashnology Perspective on the Perception and Adoption of Augmented Reality Smart Glasses. *i-com*, *15*(2):179–194.

Rauschnabel, P. A.; He, J.; Ro, K. Krulikowski, B. (2016b): Expected Benefits and Perceived Risks of Augmented Reality Smart Glasses, Working Paper, University of Michigan: Ann Arbor, Dearborn, Flint.

Rese, A., Baier, D., Geyer-Schulz, A., & Schreiber, S. (2016). How augmented reality apps are accepted by consumers: A comparative analysis using scales and opinions. *Technological Forecasting and Social Change*. ……..

Scholz, J., & Smith, A. N. (2016). Augmented reality: Designing immersive experiences that maximize consumer engagement. *Business Horizons, 59*(2), 149–161.

Spreer, P., & Kallweit, K. (2014). Augmented reality in retail: assessing the acceptance and potential for multimedia product presentation at the PoS. *Transactions on Marketing Research, 1*(1), 20–35.

Stock, B., dos Santos Ferreira, T. P., & Ernst, C. P. H. (2016). Does Perceived Health Risk Influence Smartglasses Usage?. In *The Drivers of Wearable Device Usage* (pp. 13–23). Springer International Publishing.

Stockinger, H. (2016). The future of augmented reality-an Open Delphi study on technology acceptance. *International Journal of Technology Marketing, 11*(1), 55–96.

tom Dieck, M. C., & Jung, T. (2015). A theoretical model of mobile augmented reality acceptance in urban heritage tourism. *Current Issues in Tourism*, *1*:1–21.

tom Dieck, M. C., Jung, T., & Han, D. I. (2016). Mapping requirements for the wearable smart glasses augmented reality museum application. *Journal of Hospitality and Tourism Technology*, *7*(3): 230–253

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science, 46*(2), 186–204.

Venkatesh, V., & Morris, M. G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS Quarterly, 1,* 115–139.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 1,* 425–478.

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36*(1), 157–178.

Weiz, D., Anand, G., & Ernst, C. P. H. (2016). The Influence of Subjective Norm on the Usage of Smartglasses. In *The Drivers of Wearable Device Usage* (pp. 1–11). Springer International Publishing.