Research Papers

ECIS 2017 Proceedings

Spring 6-10-2017

ESCAPING REALITY: EXAMINING THE ROLE OF PRESENCE AND ESCAPISM IN USER ADOPTION OF VIRTUAL REALITY GLASSES

Eva Hartl
Ludwig-Maximilians-Universität München, Munich, Germany, hartl@bwl.lmu.de

Benedikt Berger
Ludwig-Maximilians-Universität München, Munich, Germany, benedikt.berger@bwl.lmu.de

ESCAPING REALITY: EXAMINING THE ROLE OF PRESENCE AND ESCAPISM IN USER ADOPTION OF VIRTUAL REALITY GLASSES

Research paper

Hartl, Eva, Ludwig-Maximilians-Universität München, Munich, Germany, hartl@bwl.lmu.de

Berger, Benedikt, Ludwig-Maximilians-Universität München, Munich, Germany benedikt.berger@bwl.lmu.de

Abstract

The development of virtual reality (VR) glasses such as the Oculus Rift has made VR technologies available to the mass market. The rapid diffusion of VR glasses holds the potential to disrupt the way media is consumed. Yet little is known about their acceptance by consumers. This study seeks to explore the user acceptance of VR glasses, considering the specifics of hedonic information systems in consumer settings. Focusing on user personality, namely the users' desire to escape reality, we developed a framework based on the extended unified theory of acceptance and use of technology (UTAUT2) and tested it in a laboratory study with 155 participants. The structural equation model results show that VR glasses' ability to induce presence, a sense of being in another environment, is a key characteristic of the technology that influences the adoption. We found the users' escapism tendency to be a distinctive user personality trait for determining the adoption of VR glasses. Our study provides insights into the adoption of technology in early diffusion stages and the role of technology characteristics and personality traits in adoption decisions. Finally, our findings have important implications for practitioners in the VR industry.

Keywords: Virtual Reality Glasses; Technology Adoption; Hedonic Information System; Personality.

1 Introduction

Although the first virtual reality (VR) applications were developed in the 1970s, it was not until the emergence of VR glasses that the technology became sufficiently advanced and cost-effective to be introduced to the mass market. VR glasses are headsets that entirely cover the users' field of view and fully immerse them in a virtual environment. Since the first models such as the Oculus Rift, the Samsung Gear VR, or the HTC Vive and corresponding content platforms were made available to consumers, VR glasses have seen a rapid diffusion. Following forecasts of the market research company IDC (2016) the worldwide market volume will increase from 9.6 million units in 2016 to over 110 million units in 2020. To profit from this market growth as much as possible, providers of VR glasses need to understand why consumers adopt and use this technology and design their products and content platforms accordingly. However, owing to the early stage of VR glasses' diffusion, insights in consumer behavior are scarce.

VR glasses are advertised as providing unique and enjoyable experiences, which classifies them as hedonic information systems. Hedonic information systems provide self-fulfilling value to users (Van der Heijden, 2004, p. 696). They are strongly connected to leisure activities and predominantly used in household settings. Unlike utilitarian systems, users' intrinsic motivations drive and predict the adoption of hedonic systems (Van der Heijden, 2004). Owing to the voluntariness of the household use context extrinsic motivators become less influential and technology adoption is influenced by individual user differences such as hedonic tendencies, personal innovativeness, or personality traits (Agarwal and Karahanna, 2000, Rauschnabel et al., 2015, Van der Heijden, 2004, Wu and Holsapple, 2014).

In the case of VR glasses, most of their use is expected to evolve around gaming, and gamers are predicted to be the pioneers in adopting VR glasses (Deloitte, 2016, PwC, 2016). VR glasses are highly applicable to the needs of gamers because, compared to other consumer technologies, they can induce high levels of presence. Presence is the user's sense of being in the virtual environment (Witmer and Singer, 1998). Presence serves gamers' desire to escape reality, which is commonly referred to as escapism (Yee, 2006). However, the influences of presence as a technology characteristic and escapism as a personality trait in technology adoption have not been studied so far. Therefore, this study seeks to shed light on the acceptance of VR glasses by answering the following research question.

RQ: How do presence and escapism affect the user adoption of VR glasses?

In response to our research question, we set up a research model based on the extended unified theory of acceptance and use of technology (UTAUT2), which addresses the consumer context and considers hedonic usage motives. Specifically, we adapted UTAUT2 to the VR context by including presence as antecedent of the determinants for the adoption intention and introducing escapism as a moderator on the influence of presence. To test our research model, we conducted a survey with 155 participants who were given the opportunity to test VR glasses in an instructed trial before answering the questionnaire. Apart from providing first insights on user acceptance of VR glasses, this study advances adoption theory by investigating the interplay between technology characteristics and personality traits. Furthermore, our results have important methodological implications for adoption research in early stages of technology diffusion and practical implications for providers of VR classes and the respective content.

The remainder of this work is structured as follows. First, we review the relevant literature on virtual reality and the evolution of technology adoption models. Subsequently, we develop a research model for the adoption of VR glasses in a consumer context based on UTAUT2. After describing the study methodology, we present and discuss the findings of our study, which closes with limitations and suggestions for further research.

2 Theoretical Background and Prior Research

2.1 Virtual Reality in IS research

The existing literature on VR can be classified into two research streams. The first stream is more technology-driven and defines VR as integrating "real-time computer graphics, body tracking devices, visual displays, and other sensory input devices to immerse a participant in a computer-generated virtual environment" (Rothbaum et al., 1995, p. 626). VR technology comprises two central components: head-mounted displays (HMD), which we today commonly call VR glasses, and sensors, which track the users' movements and allow them to interact with the virtual environment (Katcchi and Sachdeva, 2014). Early research on VR predominantly took a design science approach and focused on the development of prototypes and complementary technology or tested the applicability of VR in diverse application fields, such as phobia therapy, collaboration, and training (e.g. Churchill and Snowdon, 1998, Cruz-Neira et al., 1993, Kozak et al., 1993, Rothbaum et al., 1995).

The second research stream has a consumer-centric perspective and focuses on the user's virtual experience. From this perspective, VR can be defined as "a real or simulated environment in which a perceiver experiences telepresence" (Steuer, 1992, p. 7). The users' perception of VR technology has not been investigated in depth so far. However, three constructs have emerged that researchers perceive as important for users' VR experience: immersion, interactivity, and presence (Walsh and Pawlowski, 2002). Interactivity refers to the extent to which users of a medium can influence the form and content of a VR environment (Steuer, 1992). Both immersion and presence refer to the users' perception of how enveloped by the virtual environment they are. We follow the distinction suggested by Slater and Wilbur (1997) and define immersion as an objective description of the technology's capability to deliver an inclusive, extensive, and vivid illusion of reality to the users. Presence is a more subjective description, a "state of consciousness, the (psychological) sense of being in the virtual environment" (Slater and Wilbur, 1997, p. 4).

While literature agrees on the importance of all three constructs for the user's VR experience (e.g. Bowman and McMahan, 2007, Schuemie et al., 2001, Slater and Wilbur, 1997, Walsh and Pawlowski, 2002), research on VR has focused predominantly on the construct of presence and conducted research on the effects of presence on the user's VR experience. The effects of presence on the user's VR experience have been of particular interest to researchers and it has been found that presence influences the intensity of emotions felt in and induced by the virtual environment (Regenbrecht et al., 1998, Riva et al., 2007, Slater et al., 1999). Presence is not only a key element of the user's VR experience, but also a distinguishing technology characteristic of VR glasses. Because VR glasses fully cover the user's view and allow users to view content in 3D, they are capable of inducing a higher sense of presence than other display devices (Nah et al., 2011, Witmer and Singer, 1998). In this study, we take the consumer-centric perspective of VR technology and examine the role of presence for the adoption of VR glasses.

2.2 Technology acceptance for VR

Technology acceptance research aims to explore the determinants of individuals' technology adoption. The literature on technology adoption is grounded in the theory of reasoned action (TRA) by Fishbein and Ajzen (1975). Based on this foundation, Davis (1986) developed the technology acceptance model (TAM) as a framework for studying the adoption of information technology (IT) in a corporate environment. Since its introduction, TAM has been broadly applied, validated, and extended, leading to a vast number of models that have been modified to fit a specific context. This situation motivated Venkatesh et al. (2003) to review and synthesize existing models to the unified theory of acceptance and use of technology (UTAUT). According to UTAUT, technology use depends on the individual's behavioral intention to use, which is determined by four factors: performance expectancy, effort expectancy, social influence and facilitating conditions. Technology acceptance research, including UTAUT, has originated from a corporate context. However, such theories cannot be applied in a consumer context, in which the technology itself, its usage and the use situation differ significantly from a corporate environment. To account for these differences, Venkatesh et al. (2012) developed UTAUT2, an extension of UTAUT by the constructs of price value, habit and hedonic motivation.

Containing a hedonic determinant for adoption qualifies UTAUT2 as highly suitable for studying the adoption of VR glasses. The application fields and manufacturers' advertisement of VR glasses suggest that VR glasses offer consumers predominantly hedonic benefits, characterizing the technology as a hedonic system. For hedonic systems, especially in a consumer household context, hedonic factors were found to be a strong predictor for adoption and can even be expected to replace constructs of utilitarian usefulness as main driver for adoption (Van der Heijden, 2004). With equal findings for the related technologies of gaming and virtual worlds (Goh and Yoon, 2009a, Van der Heijden, 2004, Wu and Holsapple, 2014) it is reasonable to expect hedonic factors to also influence the adoption of VR glasses. A special focus of our study is therefore on studying the adoption specifics of a hedonic technology and the role of hedonic factors for user adoption.

To the best of our knowledge, no research has been done on the adoption of VR glasses in a consumer context. However, results from the related fields of augmented reality (AR), virtual environments and gaming are to some extent transferable to VR. AR is technologically similar to VR in its use of HMDs to enable an interaction with virtual objects. Contrary to VR glasses, AR devices do not fully cover the user's field of view but rather enrich the real environment by displaying virtual objects (Dörner et al., 2014). The adoption of AR devices was found to be influenced by both utilitarian and hedonic benefits received from usage as well as social conformity. These effects were moderated by the user's personality, e.g. personal innovativeness (Rauschnabel et al., 2015, Yusoff et al., 2011). Further findings can be transferred from virtual environments, specifically from virtual worlds. Virtual worlds are a subgroup of virtual environments with a social focus, allowing users to interact with each other. Typical examples are multi-player online games. Goh and Yoon (2009b) found that the most promising constructs for explaining virtual world adoption came from the first UTAUT. In addition to UTAUT constructs, hedonic elements such as perceived enjoyment were found to influence the adoption of virtual worlds, further underlining the suitability of UTAUT2 (Nah et al., 2011, Shen and Eder, 2008, Verhagen et al., 2012, Vogel et al., 2008, Wu and Holsapple, 2014). Similar to AR adoption, the user's personality was found to also influence the adoption intention of virtual worlds and game play. A commonly studied personality trait that was found to influence the adoption of virtual worlds was escapism, the user's desire to escape reality (Verhagen et al., 2012, Wu and Holsapple, 2014). Escapism as an underlying motivator for game play was also found to be the most important driver for gaming adoption (e.g. Hassouneh and Brengman, 2014, Yee, 2006, Young, 1998). Overall, it is reasonable to conclude that the user's personality will influence also the adoption of VR glasses.

3 Research Model

3.1 Adaption of the original UTAUT2 to the VR context

Based on the theoretical foundations outlined in the previous chapter, we propose an extended version of UTAUT2 which takes specific characteristics of VR technology into account. Our research model examines how the user's personality leads to different evaluations of VR technology characteristics and impacts its adoption. Following Venkatesh and Davis (2000), we extended UTAUT2 by including technology design factors as external variables. Building on the work of Davis (1986), we argue that design features and key characteristics of the information system directly influence the determinants of technology adoption. Our literature review identified the ability to induce high levels of presence as the defining characteristic of VR glasses compared to other media consumption technologies (e.g. Riva et al., 2007, Steuer, 1992, Walsh and Pawlowski, 2002). We therefore modeled presence as antecedent of the UTAUT2 constructs of performance expectancy and hedonic motivation. In addition, we accounted for individual differences in the behavioral intention to adopt VR glasses by including the users' personality trait of escapism in our model. With escapism being a user personality trait that was found to influence the adoption of related technologies, we also expect escapism to influence the adoption of VR glasses and include it as moderator. Our research model is depicted in Figure 1.

In contrast to the original UTAUT2 proposed by Venkatesh et al. (2012) we followed previous research that studied adoption at an early stage of technology diffusion (e.g. Hartmann and Vanpoucke, 2017, Oechslein et al., 2014) and defined behavioral intention as the dependent variable of our model. Due to the early diffusion stage of VR glasses at the time of our study, we considered the setting of our study as too hypothetical for price considerations to accurately influence the behavioral intention and dropped the construct price value. All other constructs and relationships from the original UTAUT2 were maintained. In line with Venkatesh et al. (2012), we formulate following hypotheses:

H1a: Performance expectancy has a positive influence on the behavioral intention to adopt VR glasses

H1b: Hedonic motivation has a positive influence on the behavioral intention to adopt VR glasses

H1c: Effort expectancy has a positive influence on the behavioral intention to adopt VR glasses

H1d: Social influence has a positive influence on the behavioral intention to adopt VR glasses

H1e: Habit has a positive influence on the behavioral intention to adopt VR glasses

H1f: Facilitating conditions has a positive influence on the behavioral intention to adopt VR glasses

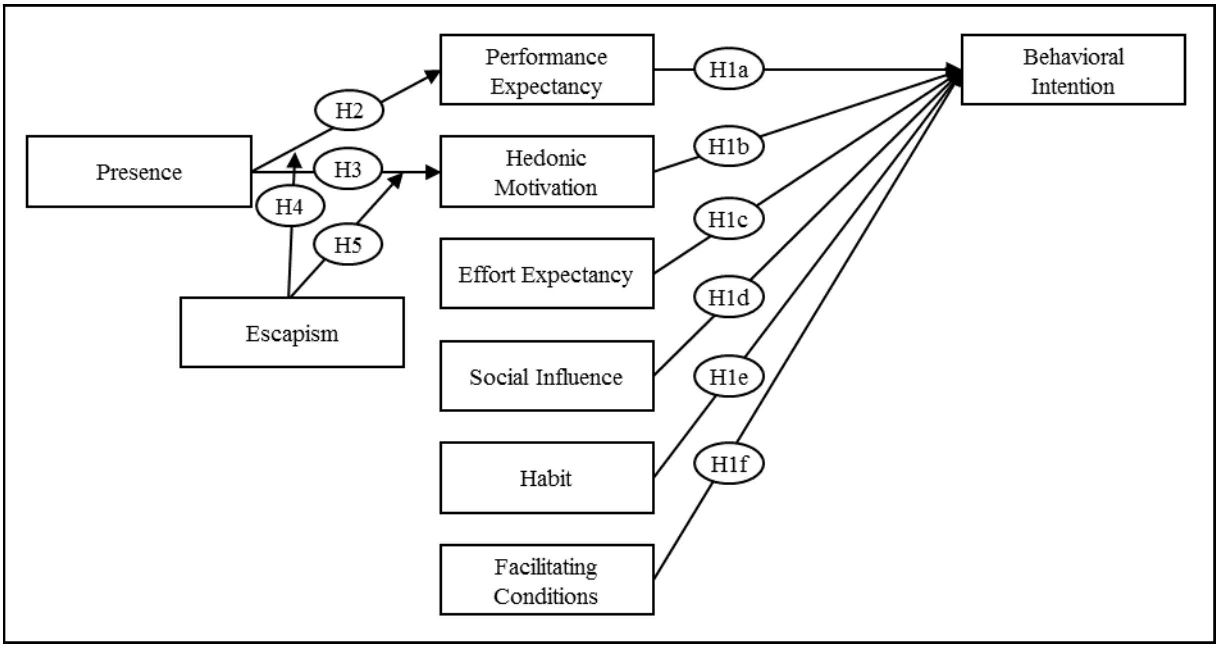


Figure 1. Research model.

3.2 The role of presence

Presence is the "subjective experience of being in one place or environment, even when one is physically situated in another" (Witmer and Singer, 1998, p.225). Compared with the concept of immersion, which also comprises immersive technological features, presence has the advantage of emphasizing the subjective immersion experience and is therefore independent from the model of VR glasses studied (Slater and Wilbur, 1997).

The sense of being present in the virtual environment is a key element of the VR experience, we therefore expect users to evaluate the effectiveness of VR glasses based on the sense of presence induced by the glasses. Presence reflects the VR glasses' relative advantage over other display systems. Compared to 2D desktop displays, VR glasses offer a higher sense of presence to the user, which allows them to perform certain tasks faster and more efficient than with other display devices (Pausch et al., 1997). Both, relative advantage over other systems and the perceived effectiveness of the system is covered by the UTAUT2 construct of performance expectancy, the benefits consumers receive from using a technology for performing certain activities (Venkatesh et al., 2012). We thus argue that a higher sense of presence will result in higher performance expectancy, and hypothesize:

H2: Presence has a positive influence on performance expectancy

Virtual experiences can evoke the same emotions as real experiences. Carrying out amusing activities, and experiencing positive emotions within the virtual reality can bring joy to the users of VR glasses (Schuemie et al., 2001). These pleasant emotions evoked in the virtual environment were found to be perceived more strongly when there was a higher sense of presence (Regenbrecht et al., 1998, Riva et al., 2007). Also, the immersion itself can be expected to bring joy to users of VR glasses, because they perceive themselves present in an arguably more exciting environment (Barnes and Pressey, 2011, Zhou et al., 2011). Building on these findings, we argue that a higher sense of presence induced by VR glasses increases the joy derived from using them, captured by the construct of hedonic motivation. Presence will therefore positively influence users' hedonic motivation. Thus, our next hypothesis is:

H3: Presence has a positive influence on hedonic motivation

3.3 The moderating role of escapism

Escapism is the "individual's desire to escape unpleasant realities or to distract his/her attention from real life problems" (Goh and Yoon, 2009b). VR glasses offer users the opportunity to escape their everyday life. The success of the escape into the VR can be determined by presence, the sense of being in another environment. We therefore expect users with high escapism tendencies to perceive VR glasses as more beneficial than users with lower levels of escapism, because the glasses' ability to induce presence allows them to escape their unpleasant realities. In addition, VR glasses offer escapists an enjoyable experience by immersing them in an arguably more favorable virtual environment and distracting them from their real life troubles (Barnes and Pressey, 2011, Zhou et al., 2011). This distraction from negative real life emotions is perceived more strongly, the higher the perceived presence in the virtual environment is. It is reasonable to assume that users scoring high in escapism will enjoy this distraction more than those scoring low in escapism, because the former gain additional value from fleeing real life. We thus hypothesize:

H4: The effect of presence on performance expectancy is moderated by escapism

H5: The effect of presence on hedonic motivation is moderated by escapism

4 Research Methodology

4.1 Study design

To test our research model, we conducted a survey among participants in a controlled laboratory experience of VR glasses. We chose this setting for our study, because VR glasses have been released to the mass market only recently and, despite their rapid diffusion, the user population in Germany at the time of our study was still small. However, direct product experience has been shown to be an important driver for the consumer's evaluation (Marks and Kamins, 1988, Wu and Shaffer, 1987). It is arguable whether an evaluation of the technology solely based on technology descriptions such as product videos or pictures is well-founded. We perceived it as essential to provide study participants with the opportunity to test VR glasses themselves before being asked about their adoption intention. Therefore, our study proceeded as follows. We invited participants in groups of four to a computer lab, where each of them was provided with a Samsung Gear VR. Subsequently, they received a standardized introduction to the glasses' basic functions and were then guided through the VR menu with pre-scripted instructions. Both introduction and instructions were developed with the help of research assistants from the IS discipline to ensure sufficient understanding and guidance with a minimum of given instructions. As soon as the participants were familiar with the navigation in VR they started a guided 10-minute-trial, including three different types of VR content. Caution was taken in selecting the content for the trial; our aim was to provide a representative overview of the technology's fields of application and to reduce potentially occurring motion sickness (Hettinger and Riccio, 1992). The participants viewed a 360° documentary video, played a 3-minute game and watched a 360° picture slide-show (Oculus, 2016a, 2016b, Unicef, 2016). After the trial, participants answered a questionnaire on one of the desktop computers in the lab. This procedure took about half an hour in total per group.

4.2 Measures

For our questionnaire, we relied on established scales, which we adapted slightly to match the VR context, to ensure content validity. As in their original deployment, all instruments were multi-item constructs measured on 7-point Likert-type scales. The items for the UTAUT2 constructs were taken from the study of Venkatesh et al. (2012). To date, both presence and escapism are rarely examined concepts, thus definitions and measures vary widely. Therefore, we adopted scales that have previously been successfully tested in similar virtual consumer contexts. For measuring the presence construct, we adopted the scale of Nah et al. (2011). Escapism was measured adapting the scale of Wu and Holsapple (2014). As control variables, we included age, personal innovativeness in IT (PIIT) (Agarwal and Prasad, 1998) and assessed gaming by asking for the frequency of online game play. Following Verhagen et al. (2012), the translation of the scales to German was validated with the help of two bilingual speakers using back translation.

4.3 Data collection

We set up the post-experience questionnaire using the survey software Qualtrics. Prior to the lab study we conducted a pre-test of the questionnaire to correct errors and ensure comprehensibility. Participants for the main study were recruited using the mailing list of a large public university in Germany, student groups on Facebook, and flyers handed out on university campus. As compensation for taking part in the survey participants received €5 upon completion of the questionnaire.

The data was collected over two weeks in June 2016. A total of 155 participants completed the questionnaire. The average age of the participants was 24, 53% were male, and 90% stated to be students. 75% of participants had no experience with VR glasses and 15% stated they had used them only once before. The lack of experience with the use of VR glasses can be ascribed to the technology's early stage of diffusion (Rogers, 1995). With the majority of participants lacking previous experience with VR glasses, the necessity of the laboratory study set-up including a trial was underlined. A manual inspection of the answer sets showed no missing data and no indication of inconsistent or straight-lining answer behavior. Thus all 155 answer sets were retained for further analysis.

5 Data Analysis and Results

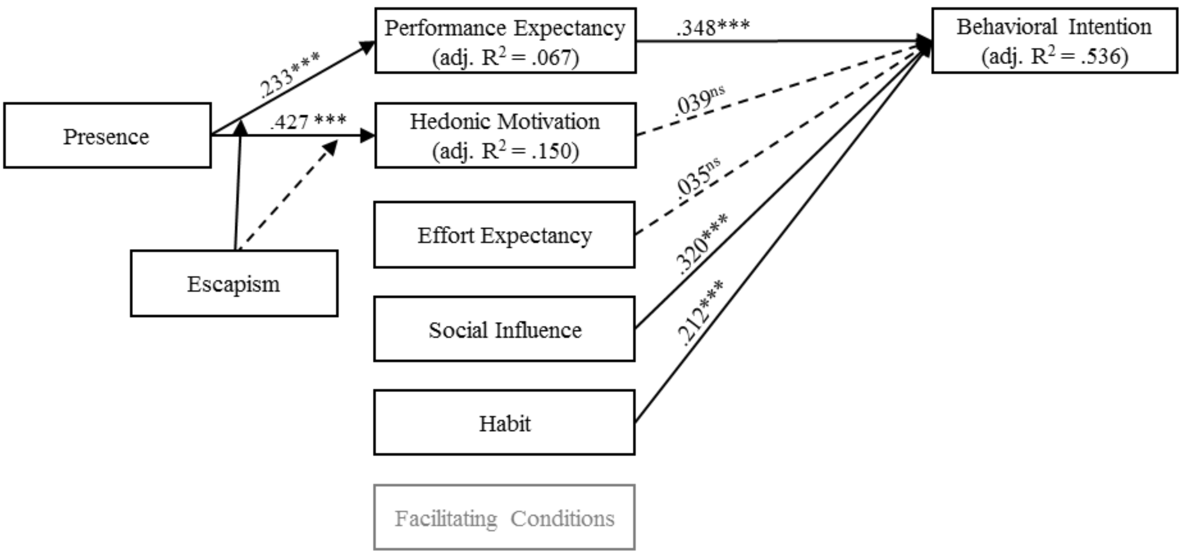
We analyzed the collected data using structural equation modeling (SEM) with the partial-least-squares (PLS) algorithm implemented in SmartPLS 3.0 (Ringle et al., 2015). PLS-SEM has the advantage of imposing lower sample size restrictions than covariance-based methods and therefore suits our study design (Chin, 1998, Hair et al., 2014). Before testing the structural model, including our hypotheses, we analyzed our measurement model.

5.1 Measurement model analysis

Given that we used established scales in our measurement model, we conducted a confirmatory factor analysis of all constructs. A summary of the results is provided in the appendix. To assess whether our constructs were reliable, we assessed internal consistency reliability by means of Cronbach's alpha and composite reliability as well as indicator reliability based on the outer loadings. All of these values should exceed a threshold of 0.7 (Hair et al., 2014), which was given for all constructs and indicators except facilitating conditions and presence. Two indicators of presence did not meet the reliability threshold. Nevertheless, we decided to keep these indicators since their loadings were significant and an exclusion would have led to lower construct validity. Next, we assessed the validity of our constructs. The average variance extracted of all constructs except facilitating conditions was above 0.5 (Hair et al., 2014), indicating convergent validity. Furthermore, the square root of AVE exceeded the latent variable correlations for all constructs, thus discriminant validity was given (Fornell and Larcker, 1981). Owing to the lack of reliability and credibility of the facilitating conditions construct, we had to exclude it from further analysis. However, we conducted a post-hoc analysis regarding the measurement specification of facilitating conditions, which we will discuss at the end of this section.

5.2 Structural model

We computed variance inflation factors (VIF) to account for potential impacts on the estimation of weights in the structural model. All obtained values were significantly below 5, indicating that multicollinearity problems were not a major issue in our study (Hair et al., 2014). Subsequently, we estimated the path coefficients of our structural model and determined their significance by applying a bias-corrected bootstrapping without sign change and 5,000 samples. The results of this procedure are reported in Figure 2. Model fit for the structural model in PLS-SEM was assessed by its predictive capabilities, i.e. how well it predicts the endogenous construct (Hair et al., 2014). To evaluate the predictive accuracy of the structural model, we examined the coefficient of determination (adj. R^2 value) and Cohen's f^2. Effect sizes are considered as small, medium or large for f^2 values above 0.02, 0.15 and 0.35 respectively (Cohen, 1988).



Notes:
*** p < .01; ns = non significant; dotted lines show ns effects // n= 155
Grey construct (Facilitating Conditions) was excluded from the structural model due to lacking reliability

Figure 2. Results of the structural equation model.

As expected, performance expectancy, social influence and habit had a significant, positive effect on the behavioral intention to adopt VR glasses, supporting H1a, H1d and H1e. In contrast, hedonic motivation and effort expectancy did not have a significant effect on behavioral intention, thus H1b and H1c were not supported. Considering the extension of UTAUT2, presence had a significant positive effect on performance expectancy and hedonic motivation. Therefore, H2 and H3 were supported. We found escapism to positively moderate the effect of presence on performance expectancy, such that the effect will be stronger with increasing levels of escapism, supporting H4. H5 could not be supported as no significant moderation of escapism on the effect of presence on hedonic motivation was found. Moreover, we considered moderating effects of age, PIIT, escapism and gaming frequency on the relationships between the UTAUT2 constructs and behavioral intention but only found a significant effect for age. In line with the findings of Venkatesh et al. (2012), age negatively moderated the effect of performance expectancy on behavioral intention and positively moderated the effect of social influence on behavioral intention in our model. A multi-group analysis showed no significant moderation effects for gender. Overall, the constructs explained a substantial share of the variance in behavioral intention (adj. $R^2 = 0.536$). All significant effects in our model showed at least small effect sizes.

5.3 Post-hoc analysis: discrepancies on facilitating conditions

We were forced to exclude the construct of facilitating conditions from further calculations due to lacking reliability and validity. The construct of facilitating conditions and its measures (see Table 1) originate from UTAUT2 and have previously been tested and applied successfully, with only few studies finding a lack of reliability (e.g. Salinas-Segura and Thiesse, 2015). So far, facilitating conditions has always been operationalized as a reflective measurement model. The lack of internal consistency reliability led us to revisit the operationalization of the variable and we found that, after the convention by Jarvis et al. (2003), the measurement model indeed has a rather formative character. Comparing the items reveals that they do not necessarily have to be correlated. For instance, a consumer could have the knowledge, but not the resources necessary to use a technology. Thus, dropping an indicator may alter the construct's meaning. Moreover, we argue that the direction of causality is from the measures to the construct. Having the necessary resources, knowledge and the help from others facilitates the adoption of the technology. Therefore, the measures lead to the existence of facilitating conditions and not, as assumed by a reflective measurement, are an expression thereof. Previous research applying the facilitating conditions constructs predominantly studied technology acceptance in a post-adoption stage or in a later stage of diffusion. In this situation, all conditions of necessary knowledge, resources and help available from others may be fulfilled and measuring facilitating conditions reflectively was successful. However, in our setting of a recently launched technology, not all conditions seem to be given simultaneously which reveals the items' formative character and would explain the lacking interrelatedness of the items. It is therefore essential to reexamine the measurement of facilitating conditions.

FC	Facilitating conditions (FC) "refer to consumers' perceptions of the resources and support available to perform a behavior" (Venkatesh et al. 2012, p. 159).
FC_1	I have the resources necessary to use VR glasses.
FC_2	I have the knowledge necessary to use VR glasses.
FC_3	I can get help from others when I have difficulties using VR glasses.
FC_4	VR glasses are compatible with other technologies that I use.

Table 1. The construct of facilitating conditions and its measurement items.

In an exploratory post-hoc analysis, we operationalized the facilitating conditions construct as a formative measurement model and ran the model with the collected data again. The results are displayed in Figure 3 and support our proposition that the facilitating conditions construct might have been misspecified by previous research. We were not able to evaluate the quality of the formative measurement model with the data at hand, but strongly encourage future research to investigate this issue further.

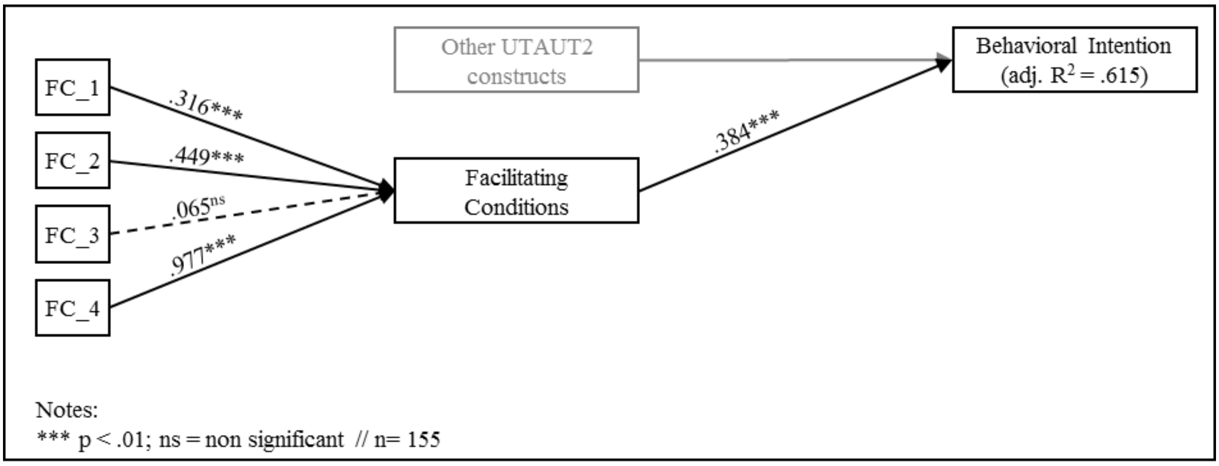


Figure 3. Exploratory approach for a formative measurement model of facilitating conditions.

6 Discussion

The aim of this study was to investigate the influence of presence and escapism on user-adoption of VR glasses. To answer this research question, we extended UTAUT2 to account for the specific characteristics of the VR context. The results of our survey among 155 testers of VR glasses showed that the VR glasses' ability to induce a sense of presence is indeed an important design feature that influences the users' adoption intention. Users seemed to relate to their perceived sense of presence when evaluating VR glasses. The more present users feel in the virtual reality, the more useful and enjoyable VR glasses are to them.

As expected, we found the users' personality trait of escapism to influence the adoption of VR glasses. Contrary to previous research on the effects of personality on technology adoption (Agarwal and Karahanna, 2000, Karahanna et al., 1999, Venkatesh et al., 2003), we did not find the users' escapism tendency to influence the effects of the UTAUT2 constructs on the behavioral intention. Instead, we found escapism to influence the effect of presence on performance expectancy, indicating that user personality affects the evaluation of technologies' design features. Users with high escapism tendencies are motivated to escape their reality and VR glasses allow them to achieve this goal. The more VR glasses immerse escapist users into the virtual reality, the more useful the glasses are perceived and the more likely they are to be adopted by escapists. Hence, escapism is a distinctive user personality trait for the adoption of VR glasses. As a motivational user characteristic, escapism can explain not only the adoption of VR by gamers, but also by video viewers or others that have the common motivation to escape reality.

Among the UTAUT2 constructs, we identified performance expectancy, social influence, and habit as important determinants for the adoption of VR glasses. These findings are in line with previous research applications of UTAUT2 (Oechslein et al., 2014, Venkatesh et al., 2012). Contrary to our expectations and previous research, we found the construct of effort expectancy to not significantly influence the adoption intention. This finding might have two causes. Firstly, the instructions that guided participants in our VR glasses trial might have made the technology especially easy to use. Secondly, our participants were digital natives, who grew up using constantly evolving technological devices (Presky, 2001). Therefore, our respondents may have been overly confident of being able to overcome usability issues, so that effort expectancy no longer influences the adoption decision. Another surprising result of our study was that we found no significant effect of hedonic motivation on the behavioral intention, although hedonic factors were expected to be the predominant determinant for the adoption of VR glasses. This result contradicts previous findings in literature (e.g. Jarvinen et al., 2016, Venkatesh et al., 2012), although none of these findings are directly applicable to purely hedonic information systems such as VR glasses. In contrast to previous assumptions, the effect of hedonic motivation on the adoption of this kind of technology appears to be non-linear. Instead, users perceive hedonic benefits as a necessary prerequisite that has to be fulfilled to even consider the adoption of hedonic information systems. Following the mean values of the indicators of hedonic motivation, almost all study participants perceived VR glasses as highly entertaining. Thus, the prerequisite for adoption was given and additional perceived joy did not seem to influence the adoption intention any further. A methodological finding of our study is the lack of reliability of the facilitating conditions construct. As argued in the previous section, we trace this back to the misspecification of this construct's reflective measurement model. Founded on the conventions by Jarvis et al. (2003), we argue that the construct's items hold a formative character. This reasoning was supported the results of an exploratory post-hoc analysis, in which we operationalized the construct using a formative measurement model. A misspecification of the measurement model can lead to severe biases (Law and Wong, 1999). With UTAUT and UTAUT2 popularly used in technology adoption research, a potential misspecification of facilitating conditions could severely question the validity previous findings for the construct.

7 Contribution

7.1 Implications

Our research contributes to the scarce research on user acceptance of technologies in early stages of the diffusion process (Rogers, 1995) and the product life cycle. It is yet to be confirmed, whether commonly applied technology acceptance frameworks like the UTAUT2 are applicable to technologies at their infancy (Hartmann and Vanpoucke, 2017). The results of our study question the applicability of UTAUT2 for hedonic technologies at their infancy, yet future research is encouraged to investigate this issue further. Methodologically, this study contributes to technology acceptance literature by raising the question whether the construct of facilitating conditions has previously been modeled incorrectly. Moreover, the experience of digital natives in adopting new technologies seems to decrease the importance of effort expectancy in adoption decisions. Therefore, we urge researchers to investigate and reexamine these two constructs in future work. Furthermore, we contribute to VR literature by deepening the understanding of VR adoption and laying the foundation for future research on consumer-centric VR experiences. We showed that presence as a design feature of VR glasses influences adoption. Extending UTAUT2 by system design features was essential for explaining how personality influences adoption because only in the model’s extension was the user’s escapism tendency found to influence effects.

Finally, our findings hold important implications for practitioners. Because our research is amongst the very few studies on hedonic technology acceptance in an early diffusion stages, our findings are especially relevant for practitioners planning their market launch approach. We find utilitarian benefits to remain the main driver of user adoption. This implies that practitioners should shift their marketing focus from promoting hedonic features to highlight the functional benefits of VR glasses and expand the amount of functional content available. Our research supports the notion that presence is a key feature of VR glasses that determines their adoption. Therefore, practitioners are advised to emphasize high capabilities to induce presence in future VR technology development. Most importantly, our research identifies escapism as the users’ distinguishing personality trait. Practitioners can now segment and specifically target consumers with high escapism tendencies which allows for more efficient targeting strategies. However, not only gamers but also video viewers can be expected to be escapists. Consequently, VR glasses marketing campaigns should be extended beyond gamers.

7.2 Limitation, future research and conclusion

Although our research valuably adds to existing literature on virtual reality and adoption, this study is subject to several limitations. First, we conducted our study with a student sample. Students are a promising customer group for VR glasses, because many of them are interested in new technologies and virtual media. However, the use of VR glasses is not limited to students as a target group and our findings might therefore not be generalizable to all potential users of VR glasses. Future research is encouraged to reinvestigate this issue with a sample showing a wider range in demographics. Further, questioning a student sample specifically limits the range in study participants’ age as most students are around the same age. Because age is commonly found to affect technology adoption (Venkatesh et al. 2003; Venkatesh et al. 2012), our findings might not be generalizable to all potential VR glasses users. Future research is strongly encouraged to re-examine our model with a more heterogeneous sample in terms of age. Second, we showed that the VR glasses’ characteristic feature of inducing high levels of presence plays an important role in the evaluation of the technology’s benefits. Yet further system characteristics of VR glasses might also be of importance. Future research is encouraged to identify and explore these and include them in our research model to increase its explanatory value. Third, we were not able to measure the actual use of VR glasses. Due to the early diffusion stage of the technology, participants did not own or had previously used VR glasses at the time of the data collection themselves. Our findings on behavioral intention are influenced by the technology’s infancy. Despite giving participants the opportunity to test VR glasses for a realistic evaluation of the technology, the findings might not be transferable to personally owned technology or technology in later diffusion stages and more mature stages of the product life cycle. Future research is encouraged to investigate the adoption of VR glasses at a later diffusion state to examine the effects on use intention and actual use. Finally, our study only captured a one-time glimpse of the VR glasses' acceptance, but the importance of determinants for user acceptance might vary by situation and over time. Specifically, the novelty fascination of VR glasses can be expected to diminish over time and future research might find different importance of determinants for the adoption of VR glasses. Future research could reinvestigate the adoption of VR glasses at various situations of the user's technology acceptance process or via longitudinal studies.

Overall, our research adds to the understanding of the adoption intention of hedonic information systems at an early diffusion stage. While understanding consumers' intention to adopt VR glasses is an important step in explaining their acceptance by users, behavioral intention is only a prerequisite for technology adoption and not the only factor influencing the technology's success. It is equally important to understand the determinants of actual or continuous use once VR glasses are acquired and future research is encouraged to examine the post-adoption behavior of VR glasses users.

Appendix

Construct		Mean	STDV	Stand. factor loadings	Composite reliability	Cronbach's alpha	AVE
Presence	P_1	5.09	1.61	0.842	0.812	0.723	0.528
	P_2	4.74	1.74	0.855			
	P_3	4.14	1.92	0.566			
	P_4	4.70	1.66	0.593			
Escapism	E_1	3.58	1.83	0.960	0.960	0.938	0.889
	E_2	3.83	1.83	0.950			
	E_3	3.61	2.00	0.917			
Performance Expectancy	PE1_1	4.37	1.74	0.825	0.907	0.864	0.709
	PE1_2	2.85	1.46	0.866			
	PE1_3	2.83	1.55	0.824			
	PE1_4	4.46	1.71	0.852			
Hedonic Motivation	HM_1	6.52	1.06	0.929	0.944	0.919	0.810
	HM_2	4.94	1.45	0.754			
	HM_3	6.47	1.04	0.942			
	HM_4	6.26	1.29	0.959			
Effort Expectancy	EE_1	6.47	1.05	0.847	0.905	0.872	0.704
	EE_2	6.52	0.94	0.916			
	EE_3	6.39	0.99	0.775			
	EE_4	6.48	1.07	0.813			
Social Influence	SI_1	2.89	1.76	0.911	0.948	0.926	0.820
	SI_2	2.88	1.72	0.950			
	SI_3	3.69	1.84	0.859			
	SI_4	3.35	1.87	0.900			
Habit	H_1	4.57	1.52	0.823*	0.897	0.830	0.743
	H_2	4.31	1.76	0.859			
	H_3	3.10	1.82	0.889			
	H_4	2.41	1.63	0.837			
Facilitating Conditions**	FC_1	5.08	1.95	0.463**	0.673**	0.525**	0.376**
	FC_2	6.23	1.03	0.665**			
	FC_3	4.92	1.83	0.253**			
	FC_4	3.95	1.84	0.886**			
Behavioral Intention	BI_1	4.19	1.85	0.969	0.971	0.956	0.919
	BI_2	4.64	1.89	0.944			
	BI_3	4.30	1.92	0.962			

* excluded due to high cross-loadings; ** excluded due to lacking reliability
all other values refer to after the exclusion of FC and H_1

Table 2. Overview of measures for construct reliability and validity

References

Agarwal, R. and E. Karahanna (2000). “Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage.” *MIS Quarterly* 24 (4), 665-694.

Agarwal, R. and J. Prasad (1998). “A conceptual and operational definition of personal innovativeness in the domain of information technology.” *Information Systems Research* 9 (2), 204-215.

Barnes, S. J. and A. D. Pressey (2011). “Who needs cyberspace? Examining drivers of needs in second life.” *Internet Research* 21 (3), 236-254.

Bowman, D. A. and R. P. McMahan (2007). “Virtual reality: How much immersion is enough?” *Computer* 40 (7), 36-43.

Chin, W. W. (1998). *The Partial Least Squares Approach for Structural Equation Modeling. In: Modern Methods for Business Research.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Churchill, E. F. and D. Snowdon (1998). “Collaborative virtual environments: An introductory review of issues and systems.” *Virtual Reality* 3 (1), 3-15.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. 2nd Edition. Hillsdale, NJ: Lawrence Erlbaum Associates.

Cruz-Neira, C., et al. (1993). “Surround-screen projection-based virtual reality: The design and implementation of the cave.” In: *Proceedings of the 20th Annual Conference on Computer Graphics and Interactive Techniques*, 135-142.

Davis, F. D. (1986). *A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results*, Sloan School of Management, Massachusetts Institute of Technology.

Deloitte (2016). *Virtual reality (VR): A Billion Dollar Niche*. TMT Predictions 2016: Deloitte Touche Tohmatsu Limited.

Dörner, R., et al. (2014). “Virtual reality und augmented reality (VR/AR).” *Informatik-Spektrum* 39 (1), 30-37.

Fishbein, M. and I. Ajzen (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Reading: Addison-Wesley Pub.Co.

Fornell, C. and D. F. Larcker (1981). “Evaluating structural equation models with unobservable variables and measurement error.” *Journal of Marketing Research* 18 (1), 39-50.

Goh, S. H. and T. E. Yoon (2009a). “Encouraging participation: Facilitators and inhibitors of virtual world acceptance.” In: *Proceedings of the 15th Americas Conference on Information Systems (AMCIS 2009)*, Paper 306.

Goh, S. H. and T. E. Yoon (2009b). “User acceptance of virtual worlds: Towards an integrative framework.” In: *MG 2009 Proceedings*, Paper 10.

Hair, J. F. J., et al. (2014). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)* 2nd Edition. Los Angeles: Sage Publications.

Hartmann, T. and E. Vanpoucke (2017). “User acceptance of technologies in their infancy: The case of 3d printing business models.” *Journal of Organizational and End User Computing* 29 (2), 1-24.

Hassouneh, D. and M. Brengman (2014). “A motivation-based typology of social virtual world users.” *Computers in Human Behavior* 33 (1), 330-338.

Hettinger, L. J. and G. E. Riccio (1992). “Visually induced motion sickness in virtual environments.” *Presence: Teleoperators and Virtual Environments* 1 (3), 306-310.

IDC (2016). *Idc Forecasts Virtual Reality Hardware to Soar Past the $2 Billion Mark in 2016*. http://www.idc.com/getdoc.jsp?containerId=prUS41199616 (visited on 21/11/2016).

Jarvinen, J., et al. (2016). “Consumer acceptance and use of instagram.” In: *Proceedings of the 49th Hawaii International Conference on System Sciences (HICSS 2016)*, 2227-2236.

Jarvis, C. B., et al. (2003). “A critical review of construct indicators and measurement model misspecification in marketing and consumer research.” *Journal of Consumer Research* 30 (2), 199-218.

Karahanna, E., et al. (1999). “Information technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs.” *MIS Quarterly* 23 (2), 183-213.

Katcchi, S. and P. Sachdeva (2014). “A review paper on Oculus Rift.” *International Journal of Current Engineering and Technology* 4 (5), 3589-3592.

Kozak, J. J., et al. (1993). “Transfer of training from virtual reality.” *Ergonomics* 36 (7), 777-784.

Law, K. S. and C. S. Wong (1999). “Multidimensional constructs in structural equation analysis: An illustration using the job perception and job satisfaction constructs ” *Journal of Management* 25 (2), 143-160.

Marks, L. J. and M. A. Kamins (1988). “The use of product sampling and advertising: Effects of sequence of exposure and degree of advertising claim exaggeration on consumers' belief strength, belief confidence, and attitudes.” *Journal of Marketing Research* 25 (3), 266-281.

Nah, F. F.-H., et al. (2011). “Enhancing brand equity through flow and telepresence: A comparison of 2d and 3d virtual worlds.” *MIS Quarterly* 35 (3), 731-747.

Oculus (2016a). *Oculus 360 Photos*. https://www.oculus.com/experiences/rift/1004798886239391/ (visited on 09/11/2016).

Oculus (2016b). *Smash Hit*. https://www.oculus.com/experiences/gear-vr/942006482530009/ (visited on 09/11/2016).

Oechslein, O., et al. (2014). “An application of UTAUT2 on social recommender systems: Incorporating social information for performance expectancy.” In: *Proceedings of the 47th Hawaii International Conference on System Science (HICSS 2014)*, 3297-3306.

Pausch, R., et al. (1997). “Quantifying immersion in virtual reality.” In: *Proceedings of the 24th Annual Conference on Computer Graphics and Interactive Techniques*, 13-18.

Presky, M. (2001). “Digital natives, digital immigrants part 1.” *On the Horizon* 9 (5), 1-6.

PwC (2016). *Virtual Reality: Nimmt der Gamingmarkt eine Pionier-Rolle ein?* Digital Trend Outlook 2016: PricewaterhouseCoopers AG.

Rauschnabel, P. A., et al. (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.

Regenbrecht, H. T., et al. (1998). “Measuring the sense of presence and its relations to fear of heights in virtual environments.” *International Journal of Human-Computer Interaction* 10 (3), 233-249.

Ringle, C. M., et al. (2015). SmartPLS 3, Boenningstedt.

Riva, G., et al. (2007). “Affective interactions using virtual reality: The link between presence and emotions.” *CyberPsychology & Behavior* 10 (1), 45-56.

Rogers, E. M. (1995). *Diffusion of Innovations*. New York: Free Press.

Rothbaum, B. O., et al. (1995). “Effectiveness of computer-generated (virtual reality) graded exposure in the treatment of acrophobia.” *American Journal of Psychiatry* 1 (52), 626-628.

Salinas-Segura, A. and F. Thiesse (2015). “Extending UTAUT2 to explore pervasive information systems.” In: *Proceedings of the 23rd European Conference on Information Systems (ECIS 2015)*, Paper 154.

Schuemie, M. J., et al. (2001). “Research on presence in virtual reality: A survey.” *CyberPsychology & Behavior* 4 (2), 183-201.

Shen, J. and L. Eder (2008). “Intentions to use virtual worlds: An exploratory study.” In: *Proceedings of the 14th Americas Conference on Information Systems (AMCIS 2008)* Paper 140.

Slater, M., et al. (1999). “Public speaking in virtual reality: Facing an audience of avatars.” *IEEE Computer Graphics and Applications* 19 (2), 6-9.

Slater, M. and S. Wilbur (1997). “A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments.” *Presence: Teleoperators and Virtual Environments* 6 (6), 603-616.

Steuer, J. (1992). “Defining virtual reality: Dimensions determining telepresence.” *Journal of Communication* 42 (4), 73-93.

Unicef (2016). *Unicef 360° - Karamoja Rising - Sylvia's Story* https://www.youtube.com/watch?v=fG4luBDSTLM (visited on 02/06/2016).

Van der Heijden, H. (2004). "User acceptance of hedonic information systems." *MIS Quarterly* 28 (4), 695-704.

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

Venkatesh, V., et al. (2003). "User acceptance of information technology: Toward a unified view." *MIS Quarterly* 27 (3), 425-478.

Venkatesh, V., et al. (2012). "Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology." *MIS Quarterly* 36 (1), 157-178.

Verhagen, T., et al. (2012). "Understanding users' motivations to engage in virtual worlds: A multipurpose model and empirical testing." *Computers in Human Behavior* 28 (2), 484-495.

Vogel, D., et al. (2008). "Chinese virtual world adoption: Attitudes, experiences and issues." In: *Proceedings of the 12th Pacific Asia Conference on Information Systems (PACIS 2008)*, Paper 53.

Walsh, K. R. and S. D. Pawlowski (2002). "Virtual reality: A technology in need of is research." *Communications of the Association for Information Systems* 8 (1), 292-313.

Witmer, B. G. and M. J. Singer (1998). "Measuring presence in virtual environments: A presence questionnaire." *Presence: Teleoperators and Virtual Environments* 7 (3), 225-240.

Wu, C. and D. R. Shaffer (1987). "Susceptibility to persuasive appeals as a function of source credibility and prior experience with the attitude object." *Journal of Personality and Social Psychology* 52 (4), 677-688.

Wu, J. and C. Holsapple (2014). "Imaginal and emotional experiences in pleasure-oriented it usage: A hedonic consumption perspective." *Information & Management* 51 (1), 80-92.

Yee, N. (2006). "Motivations for play in online games." *CyberPsychology & Behavior* 9 (6), 772-775.

Young, K. S. (1998). "Internet addiction: The emergence of a new clinical disorder." *CyberPsychology & Behavior* 1 (3), 237-244.

Yusoff, R. C. M., et al. (2011). "User acceptance on mixed reality technology." *Issues in Information Systems* 12 (1), 194-205,.

Zhou, Z., et al. (2011). "Individual motivations and demographic differences in social virtual world uses: An exploratory investigation in second life." *International Journal of Information Management* 31 (3), 261-271.