Timothy Jung
M. Claudia tom Dieck
Philipp A. Rauschnabel *Editors*

Augmented Reality and Virtual Reality

Changing Realities in a Dynamic World

Springer

Progress in IS

"PROGRESS in IS" encompasses the various areas of Information Systems in theory and practice, presenting cutting-edge advances in the field. It is aimed especially at researchers, doctoral students, and advanced practitioners. The series features both research monographs that make substantial contributions to our state of knowledge and handbooks and other edited volumes, in which a team of experts is organized by one or more leading authorities to write individual chapters on various aspects of the topic. "PROGRESS in IS" is edited by a global team of leading IS experts. The editorial board expressly welcomes new members to this group. Individual volumes in this series are supported by a minimum of two members of the editorial board, and a code of conduct mandatory for all members of the board ensures the quality and cutting-edge nature of the titles published under this series.

More information about this series at http://www.springer.com/series/10440

Timothy Jung · M. Claudia tom Dieck ·
Philipp A. Rauschnabel

Editors

Augmented Reality and Virtual Reality

Changing Realities in a Dynamic World

Editors
Timothy Jung
Faculty of Business and Law
Manchester Metropolitan University
Manchester, UK

M. Claudia tom Dieck
Faculty of Business and Law
Manchester Metropolitan University
Manchester, UK

Philipp A. Rauschnabel
Digital Marketing and Media Innovation
Bundeswehr University Munich
Neubiberg, Bayern, Germany

International Augmented and Virtual Reality Conference 2019

Scientific Committee

Danielle Allen, Manchester Metropolitan University
Juliann Allen, Louisiana Tech University
Mario Ascencao, Haaga-Helia AUS
Barry Babin, Louisiana Tech University
Zeph van Berlo, University of Amsterdam
Christian Bushardt, Louisiana Tech University
Namho Chung, Kyung Hee University
Ella Cranmer, Manchester Metropolitan University
Dario tom Dieck, Manchester Metropolitan University
M. Claudia tom Dieck, Manchester Metropolitan University
Peter Eachus, University of Salford
Ernest Edifor, Manchester Metropolitan University
Anuashine Chefor Ellis, Louisiana Tech University
Damyon Garrity, Manchester Metropolitan University
Alex Gibson, Dublin Institute of Technology
Alice Graeupl, Manchester Metropolitan University
Dai-In Han, Breda University of Applied Science
David Harborth, Goethe University Frankfurt
Paula Hodgson, The Chinese University of Hong Kong
Ana Javornik, Newcastle University
Sarah Jones, Birmingham City University
Timothy Jung, Manchester Metropolitan University
Paul Ketelaar, Radboud University
Si Jung Kim, University of Nevada, Las Vegas
Yen-Soon Kim, University of Nevada, Las Vegas
Safak Korkut, University of Applied Sciences and Arts Northwestern Switzerland
Nina Krey, Rowan University
Nynke van der Laan, Tilburg University

Jennifer Locander, University of Mississippi
Xander Lub, Breda University of Applied Science
Cynthia Mejia, University of Central Florida
Andy Miah, University of Salford
Natasha Moorhouse, Manchester Metropolitan University
Mary O'Rawe, Dublin Institute of Technology
Christos Pantelidis, Manchester Metropolitan University
Sebastian Pape, Goethe University Frankfurt
Philipp A. Rauschnabel, Universitaet der Bundeswehr Muenchen
Amin Saleh, Louisiana Tech University
Michael Schwertel, Cologne Business School
Anne Roos Smink, University of Amsterdam
Helen Southall, University of Chester
Sebastian Stadler, TUM Create
Alasdair Swenson, Manchester Metropolitan University
Pasi Tuominen, Haaga-Helia AUS
Sabinah Wanjugu, Louisiana Tech University
Gary Warnaby, Manchester Metropolitan University
Jessika Weber, Breda University of Applied Science
Jolly Wong, Shanghai University
Shuang Wu, Louisiana Tech University
Louis Zmich, Louisiana Tech University

Preface

The fifth International Augmented and Virtual Reality Conference was held in Munich, Germany, for the first time in 2019. Under the theme of 'Changing Realities in a Dynamic World,' the conference had more than 100 presentations within the areas of Augmented and Virtual Reality in marketing, business, health, education, design, retail, technology adoption, eSports and much more.

This book is a collection of the latest trends in AR and VR presented at the conference, and we hope that the conference and this book will serve as a valuable source for future research and discussion on important issues such as privacy, technology adoption and application design. In addition, this book aims to inform businesses about the latest developments in the areas of AR and VR.

Munich, Germany

Dr. Timothy Jung
Dr. M. Claudia tom Dieck
Prof. Dr. Philipp A. Rauschnabel

Contents

AR and VR App Design and Content Creation

AR and VR in Business, Retail and Marketing

Brand Experience via Mobile AR App Marketing

Eunyoung (Christine) Sung

Abstract The current study adapts holiday mobile marketing to consumer AR experiences by adding an additional dynamic: shared social experience. It therefore contributes to the literature related to both holiday mobile marketing and AR marketing. The study tested the efficacy of holiday AR technology marketing by enhancing authentic brand experiences and engagement. The study aims to apply the Experience Economy framework to AR marketing with additional constructs in order to understand consumer brand experience processes (mediation effects) by measuring consumer responses.

Keywords Holiday AR app marketing · Experience economy theory · New brand experience

1 Introduction

The advent of smart mobile technologies has brought the virtual and real worlds even closer together than previous technologies did (Rauschnabel, 2018). In the marketing and advertising industries, new Augmented Reality (AR) and Virtual Reality (VR) technologies, coupled with Artificial Intelligence (AI) (Hackl & Wolfe, 2017), are among the biggest disrupters. Smartphones and tablets have made AR ubiquitous (Hackl & Wolfe, 2017). It superimposes digital content into users' real environments to augment users' experiences of their surrounding environments (Georgiou & Kyza, 2017). As Hackl and Wolfe (2017) described, "AR overlays graphics or video on top of what people see in the real world using computer vision and object recognition" (p. 9). Users of Android and Apple phones and tablets can download AR apps, making these consumers accessible via AR marketing campaigns.

Experience economy theory (Pine & Gilmore, 1999) has been used to measure consumer experience in using AR (tom Dieck, Jung, & Rauschnabel, 2018), with the importance of creating memorable experiences (Kang & Gretzel, 2012, etc.).

E. (Christine) Sung (✉)

College of Business & Entrepreneurship, Montana State University, Bozeman, USA
e-mail: ChristineSung@montana.edu

This theory categorizes people's objectives in seeking experiences according to four motives: entertainment, education, aesthetics, and escapism.

In the current study, we adapt holiday mobile app marketing to consumers AR experiences by an additional experience, *shared social experience*, as our contribution to the AR economy experience literature. Especially during the holidays, company competition for consumer attention is fierce, and firms can better compete when using creative mobile technology marketing (Brendan, 2013). Thus, AR app marketing via mobile could be a great tool of authentic interactive holiday marketing used to create shared social experiences that will get consumer engagement in the holiday season.

The current study contributes to the literature by combining holiday mobile marketing with AR app marketing. We apply the Experience Economy framework to AR app marketing with a new additional *shared social experience* in order to understand consumer brand experience processes (mediation effects) by measuring consumer responses.

2 Theory

2.1 AR Technology Marketing and Consumer Engagement

Marketers persistently try to improve engagement between consumers and brands. Engaged consumers make more transactions per purchase, make more frequent purchases, and become more passionate for the brand (Rosetta Consulting, 2014). Moreover, consumer engagement strategy moves beyond monetary transactions and develops long-term relationships with consumers (Venkatesan, 2017) to make firms achieve a sustainable competitive advantage (Kumar & Pansari, 2016).

One emerging method of consumer engagement involves technology. In a previous study, technology was a good method to increase engagement among users (tom Dieck et al., 2018). The importance of visual marketing in business such as videos, visible cues, and visible impact using technology such as AR (tom Dieck et al., 2018) has been emphasized in research. To examine AR influences on consumer engagement, experience economy theory has been highlighted in previous tourism research (Pine & Gilmore, 1999; tom Dieck et al., 2018); thus, the theory has been applied to our AR holiday mobile advertising.

2.2 Experience Economy Theory

Based on experience economy theory, people seek experiences due to the four motives of entertainment, education, aesthetics, and escapism (Pine & Gilmore, 1999). By applying this theoretical framework to the current study, these experiences with AR would drive consumer engagement with an AR-promoted brand or product. First, in

the education motive visitors in a previous study participated in tourism activities to have their knowledge and skills increase (Oh, Fiore, & Jeoung, 2007); this is an effective learning tool to remember as confirmed by other studies as well (Moorhouse, tom Dieck, Jung, 2018; tom Dieck, Jung, & Han, 2016). In applying to our study, an education experience via AR is one in which consumers are able to learn about a holiday-promoted product. Second, enjoyable experiences, or entertainment, are a passive form to promote content; one study that found participants use apps for enjoyable experiences (Jung, tom Dieck, Lee, & Chung, 2016). Third, escapism explains that participants momentarily forget the moment in the real world and immerses in the authentic experiences (Song, Lee, Park, Hwang, & Reisinger, 2015). Fourth, esthetics refer to a user's full immersion (Pine & Gilmore, 1999). In the context of the AR experience among visitors, researchers found that three of the four realms of experience economy framework, except esthetic experience, influenced overall tour experiences (Jung et al., 2016). In the current study, we hypothesize about all four realms of experience economy in the context of holiday AR marketing as follows:

H1: Entertainment experience is positively related to holiday AR ad satisfaction.
H2: Education experience is positively related to holiday AR ad satisfaction.
H3: Esthetics experience is positively related to holiday AR ad satisfaction.
H4: Escapism experience is positively related to holiday AR ad satisfaction.
H5: Satisfaction has a positive impact on new brand experience.
H6: Satisfaction has a positive impact on purchase intention.
H7: Satisfaction has a positive impact on shared social experience intention.

3 Methods

3.1 Study Design and Procedure

A consumable product category (beer brand "Heineken") was chosen for this study. The experiment was conducted with 62 participants who were business majors at a U.S. university.

A scenario-based online experimental study was conducted in the lab with participants' own mobile phones. A testable AR app (in beta) that we made was available in the Google Play store for Android phone users and the App Store for iPhone users. Each participant brought their current mobile phone. The instructor explained what AR is and provided step-by-step instructions to download and install the mobile app with a clickable link.

Once the AR app was installed and functional, participants pointed the AR app in their phones at the Heineken brand logo on a bottle of Heineken. Digital content from the AR app began to appear in their view of their real environment.

3.2   Data Analysis

PLS-SEM was used to test hypotheses in our suggested SEM model. PLS-SEM was used due to the complexity of the structural model to avoid inadmissible solutions, so this method gives adequate statistical power with an admissible solution (Hair, Hult, Ringle, Sarstedt, & Thiele, 2017) of the current experimental study. Our sample size in PLS-SEM was acceptable based on the following guideline: "10 times the largest number of structural paths [should be] directed at a particular construct in the structural model" (Hair et al., 2017, p. 24).

3.3   Measurements

Questionnaires were modified based on the following sources: three items of entertainment (Manthiou, Lee, Tang, & Chiang, 2014), three items of esthetics (Loureiro, 2014), four items of education (Loureiro, 2014), four items of escapism (Loureiro, 2014), three items of satisfaction (Mehmetoglu & Engen, 2011), and two items of purchase intention (Yoo & Donthu, 2001).

3.4   Measurement Model Tests

To test the measurement model, SmartPLS was used. To provide the measurement adequacy, the convergent and discriminant validities, composite reliability (CR), and average variance extract (AVE) were provided. The convergent and discriminant validities of the constructs were acceptable.

For construct validity, all factor loadings were above 0.50 which is the cut-off line (Bagozzi & Yi, 1988) and CRs are above 0.90. Each indicator fell into each expected latent construct and factor-loadings are between 0.79 and 0.95 ($p < 0.05$) (Anderson & Gerbing, 1988). For discriminant validity, the AVE are between 0.769 and 0.906 indicating that all constructs were greater than squared correlations between constructs (Fornell & Larcker, 1981). In addition, there was no concern for common method variance.

4   Results

The overall model fit indices of SEM were based on the results of bootstrapping in a sample of up to 1000 cases in PLS-SEM.

In testing Hypotheses 1 through 4 based on experience economy theory, H1 entertainment ($\beta = 0.728$, t $= 5.327$, $p < 0.001$) and H2 education ($\beta = 0.262$, t $= 2.91$,

$p < 0.01$) on satisfaction were supported ($p < 0.05$). In line with previous findings (e.g., significant paths of entertainment, education, and escapism on outputs, as found in Jung et al., 2016), the current study also found that two (i.e., education and entertainment) of the four realms of experience economy influenced consumer satisfaction on AR holiday promotion experiences. Entertainment was the strongest influence, as previously found (Jung et al., 2016). Thus, consumers responded this holiday AR marketing as entertaining and educational.

Hypotheses 5 through 7 were supported indicating that AR ad satisfaction influenced new brand experience ($\beta = 0.738$, t $= 11.475$, $p < 0.001$), purchase intention ($\beta = 0.513$, t $= 2.948$, $p < 0.01$), and shared social experience ($\beta = 0.475$, t $= 4.516$, $p < 0.001$).

5 Conclusions

First, based on the results, new brand experience through shared AR ad experience leads to purchase intention. In terms of managerial implications, positive new brand experience only matters when consumers are able to enjoy their authentic experiences with others in their social groups. Thus, marketers should make AR ad content for products that consumers can consume in social settings. The selected product stimuli (beverage/food) for holiday promotion was an especially good product category for AR holiday advertising to make new brand experiences since holidays are a time where consumers enjoy food/beverage together with friends and families.

These results, namely that new brand experience by shared AR experience in social setting leads to purchase intention, is our contribution to the AR literature as it works well with consumable holiday-promoted products for the purpose of sharing (e.g., authentic experience, consumable products, holiday). In addition, consumers are willing to generate their authentic experiences in their social groups, helping brand WOM. Those shared feelings or experiences motivate consumers to buy the AR-promoted branded product while enjoying these new brand experiences with others.

References

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin, 103*(3), 411.

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science, 16*(1), 74–94.

Brendan, O. (2013). Christmas in July? 7 must dos for holiday mobile marketing. *Promotional Marketing*. Retrieved from https://www.chiefmarketer.com/christmas-in-july-7-mustdos-for-holiday-mobile-marketing/

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 39–50.

Georgiou, Y., & Kyza, E. A. (2017). The development and validation of the ARI questionnaire: An instrument for measuring immersion in location-based augmented reality settings. *International Journal of Human-Computer Studies, 98,* 24–37.

Hackl, C., & Wolfe, S. (2017). *Marketing new realities: An introduction to virtual reality and augmented reality marketing, branding, and communications*. Meraki Press.

Hair, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., & Thiele, K. O. (2017). Mirror, mirror on the wall: A comparative evaluation of composite-based structural equation modeling methods. *Journal of the Academy of Marketing Science, 45*(5), 616–632.

Jung, T., tom Dieck, M. C., Lee, H., & Chung, N. (2016). Effects of virtual reality and augmented reality on visitor experiences in museum. In Inversini, A. & Schegg, R. (Eds.), *Information and communication technologies in tourism* (pp. 621–635). Wien, New York: Springer International Publishing.

Kang, M., & Gretzel, U. (2012). Effects of podcast tours on tourist experiences in a national park. *Tourism Management, 33*(2), 440–455.

Kumar, V., & Pansari, A. (2016). Competitive advantage through engagement. *Journal of Marketing Research, 53*(4), 497–514.

Loureiro, S. M. C. (2014). The role of the rural tourism experience economy in place attachment 648 and behavioral intentions. *International Journal of Hospitality Management, 40*(1–9), 649.

Manthiou, A., Lee, S., Tang, L., & Chiang, L. (2014). The experience economy approach to festival marketing: Vivid memory and attendee loyalty. *Journal of Services Marketing, 651* 28(1), 22–35. 652.

Mehmetoglu, M., & Engen, M. (2011). Pine and Gilmore's concept of experience economy and its dimensions: An empirical examination in tourism. *Journal of Quality Assurance in 654 Hospitality & Tourism, 12*(4), 237–255. 655

Moorhouse, N., tom Dieck, M. C., & Jung, T. (2018). Technological innovations transforming the consumer retail experience: a review of literature. In *Augmented reality and virtual reality* (pp. 133–143). Cham: Springer.

Oh, H., Fiore, A. M., & Jeoung, M. (2007). Measuring experience economy concepts: Tourism 674 applications. *Journal of Travel Research, 46*(2), 119–132.

Pine, B., & Gilmore, J. H. (1999). *The experience economy*. Boston, MA: Harvard Business School Press.

Rauschnabel, P. A. (2018). Virtually enhancing the real world with holograms: An exploration of expected gratifications of using augmented reality smart glasses. *Psychology & Marketing, 35*(8), 557–572.

Rosetta Consulting. (2014). *The economics of engagement* (pp. 1–9). Retrieved from http://www.rosetta.com/assets/pdf/The-Economics-of-Engagement.pdf.

Song, H. J., Lee, C. K., Park, J. A., Hwang, Y. H., & Reisinger, Y. (2015). The influence of tourist 705 experience on perceived value and satisfaction with temple stays: The experience economy 706 theory. *Journal of Travel & Tourism Marketing, 32*(4), 401–415.

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.

tom Dieck, M. C., Jung, T. H., & Rauschnabel, P. A. (2018). Determining visitor engagement through augmented reality at science festivals: An experience economy perspective. *Computers in Human Behavior, 82*, 44–53.

Venkatesan, R. (2017). Executing a customer engagement strategy. *Journal of the Academy of Marketing Science, 45*(3), 289–293.

Yoo, B., & Donthu, N. (2001). Developing a scale to measure the perceived quality of an Internet shopping site (SITEQUAL). *Quarterly Journal of Electronic Commerce, 2*(1), 31–45.

Inside Advertising: The Role of Presence in the Processing of Branded VR Content

Zeph M. C. van Berlo, Eva A. van Reijmersdal, Edith G. Smit and L. Nynke van der Laan

Abstract Virtual reality (VR) has become a new playground for brands and advertisers. However, empirical evidence for the effectiveness of VR branded content is still scarce. The aim of this study is therefore to examine the effectiveness of branded content in virtual space and the role of presence in the processing of brand information when playing a branded VR game. An experiment ($N = 81$) was conducted (using HTC Vive hardware) and showed that playing branded VR games can improve (implicit) brand memory. Moreover, the study showed that the increase in immersion experienced from playing a branded VR game strengthens players' brand memory.

Keywords Brand memory · Virtual reality (VR) · Presence · Immersion

1 Introduction

In the early summer of 2016, influential technology entrepreneur and philanthropist Elon Musk sparked controversy by stating that 'the odds that we are in base reality is one in billions' (Solon, 2016). Where he eluded at the idea that we might already live in a simulated reality (much like the plot of the 1999 blockbuster The Matrix), Musk predicted that, with the current rate of technological development, virtual reality (VR) will one day be indistinguishable from reality.

While VR is currently still far from being indistinguishable from the real world, head-mounted display (HMD) VR technology, also often referred to as *immersive VR* (Seibert & Shafer, 2018), does aim to mimic reality. By utilising various perceptual illusions in a simulated virtual world, this technology creates an experience that feels real for a person wearing an HMD headset.

An example of such an illusion would be the use of stereoscopic imaging to create the illusion of depth. By projecting a slightly different image into each of the player's

Z. M. C. van Berlo (✉) · E. A. van Reijmersdal · E. G. Smit
Amsterdam School of Communication Research (ASCoR), University of Amsterdam, Amsterdam, The Netherlands
e-mail: Z.M.C.vanBerlo@uva.nl

L. N. van der Laan
Department of Communication and Cognition, Tilburg University, Tilburg, The Netherlands

eyes, HMD VR technology utilizes the way human brains tend to process visual information: both eyes send slightly different visual information to the brain, where this information is then fused into one coherent image—an image that includes depth. This slight difference, which is called binocular disparity, can easily be experienced without any VR gear: hold up your finger and focus on it with one eye closed, then switch and close your other eye instead while keeping the same focus. Seemingly your finger moved slightly when switching between eyes, where in reality your finger remained in the same position. Exactly this disparity in visual information from the two eyes enables the brain to detect depth and is utilised by HMD VR technology to create the 'illusion of depth' in virtual reality.

Of course this is just a single example, though by utilising several of such illusions HMD VR technology enables users to engage with a virtual space that 'feels' real. The technology creates, what Lombard and Ditton (1997) defined as, a 'perceptual illusion of nonmeditation', which means that user's phenomenal awareness of both the technology and the external real-world are diminished by the medium (Riva et al., 2007). In the academic literature, this idiosyncratic sensation of 'being there' in the virtual environment (instead of in the real-world) is often called *presence* (Sanchez-Vives & Slater, 2005).

Presence is believed to enhance the vividness and intensity of people's experience in VR (Gabana, Tokarchuk, Hannon, & Gunes, 2017) and is something that can be valuable for advertisers and brands due to its potentially persuasive attributes. Correlational evidence for this was found in a recent study by Tussyadiah, Wang, Jung, and tom Dieck (2018), who showed that presence is positively related to increased attitudes and behavioural intentions in the context of VR tourism marketing. Moreover, research has shown that in specific cases presence can enhance memory performance of information presented in VR (Lin, Duh, Parker, Abi-Rached, & Furness, 2002), which can also be valuable for advertisers looking to drive brand awareness.

Only recently, researchers (e.g., Chen & Wang, 2019; Martínez-Navarro, Bigné, Guixeres, Alcañiz, & Torrecilla, 2019; Roettl & Terlutter, 2018; Wang & Chen, 2019) have started to explore the potential opportunities for brands to utilise HMD VR for commercial purposes. Most of these studies have however focused on in-game VR advertising and other multi-brand applications of VR advertising, leaving much still unknown about the effectiveness of branded VR content from a single brand. Moreover, the potential mediating role of presence in such persuasive contexts has remained largely unexamined. This study therefore aims to contribute to the understanding of the role of presence by examining how it affects the processing of brand information when playing branded VR games from a single brand—also known as VR advergames.

2 Theoretical Framework

2.1 *Branded Virtual Reality Games*

Branded VR games are defined as covert advertising messages designed to look like regular VR games. They are to VR games what advertorials are to editorial content, meaning that despite their aesthetic similarities, they conceptually differ from regular VR games in the sense that they have a persuasive intent and regular VR games do not (Evans & Park, 2015). In other words, regular VR games are designed to entertain, where branded VR games are designed to persuade—with entertainment being their means rather than their end.

The effectiveness of this type of advertising is often attributed to its interactive nature (Terlutter & Capella, 2013). By utilising game mechanics and game design, gamified advertising is believed to drive consumers' engagement with the branded content and ultimately facilitate the persuasive process—driving various brand responses like brand recognition (e.g., Van Berlo, Van Reijmersdal, & Rozendaal, 2017) and brand attitude (e.g., Wise, Bolls, Kim, Venkataraman, & Meyer, 2008).

Moreover, in gamified branded content brand indicators (like logos) often serve as a functional part of the game, rather than simply being displayed in the background (Terlutter & Capella, 2013). This means that when playing branded VR games, interacting with a brand is often essential to the task that is being performed by the player—for example winning the game. This functional interaction with the brand is expected to improve the encoding of this information, which would then facilitate the retrieval of this information from memory in the future. The following hypothesis is therefore proposed:

H1. Playing branded VR games positively influences brand memory.

2.2 *The Role of Presence in a Persuasive Context*

When studying VR effects, one of the most important psychological mechanisms to consider is presence. An often used definition is given by Witmer, Jerome, and Singer (2005), who describe presence as 'a psychological state of "being there" mediated by an environment that engages our senses, captures our attention, and fosters our active involvement' (p. 298). Furthermore, they suggest that presence can be conceptualised using four interconnected factors: involvement, sensory fidelity, immersion, and interface quality.

Where this four-factor conceptualisation of presence can be criticised, for example because the factors sensory fidelity (i.e. coherence of sensory stimuli) and interface quality (i.e. performance of the technology) conceptually seem predictors rather than indicators of presence, it does offer a complete operationalisation of a person's

experience when playing a branded VR game—and seems therefore suitable when examining the role of presence in this context. The other two factors, involvement and immersion, are psychological states that are, according to Witmer et al. (2005), necessary conditions for presence; involvement as a state in which all attention is focused on (elements of) the VR experience and immersion as the feeling of being completely submersed in the virtual environment.

The likelihood of a person experiencing presence is affected by the richness of a medium and by the user's perception of control while engaging with this rich media content (Klein, 2003). For players of HMD VR games, this means that the multi-sensory stimulation and overall interactive experience many HMD VR games offer, increase the likelihood of players experiencing presence (Seibert & Shafer, 2018). In addition to these two factors, Riva et al. (2007) identified that people's emotions also influence the intensity of this experience in a reinforcing relationship; meaning that experiencing higher levels of arousal strengthens a person's feeling of presence when playing a HMD VR game—and vice versa.

This positive relationship between arousal and presence was recently corroborated in an e-commerce context (Martínez-Navarro et al., 2019) and is important to consider when examining the effectiveness of branded VR games. In particular, because the brand indicators (e.g., logos) embedded in these games are believed to elicit emotional responses from players. Maxian, Bradley, Wise, and Toulouse (2013), showed that exposure for as little as six seconds to logos from well-liked brands elicit arousal. Branded VR games are thus expected to elicit stronger emotional responses than otherwise identical non-branded VR games. Considering the symmetrical relationship between arousal and presence, this would mean that playing branded VR games, compared to non-branded VR games, would elicit overall higher levels of arousal and stronger feelings of presence. In sum, branded VR games from well-liked brands are thus believed to induce stronger feelings of presence than non-branded (yet otherwise identical) VR games.

This increase in presence is believed to improve memory performance and the processing and encoding of information presented in VR (Lin et al., 2002). In a commercial context, this would suggest that people who experience stronger feelings of presence, from interacting with well-liked brand information in a branded VR game, will subsequently be better able to remember this brand information. In sum, presence is thus believed to mediate the effect of playing branded VR games and enhance the successful encoding and consolidation of brand memory—ultimately resulting in better overall brand memory. The following hypothesis is proposed:

H2. The effect of playing branded VR games on brand memory is mediated by presence.

3   Method

3.1   Participants and Procedure

To test the hypotheses an experiment was conducted with a single factor (branded VR game vs. non-branded VR game) between-subjects design. The sample consisted of 81 young adults (72.8% female) with an average age of 22.04 years old ($SD =$ 2.74). The participants were randomly assigned to play one of two versions of a VR game on an HTC Vive with two hand-held controllers. The HTC Vive is HMD VR hardware, which enables its users to look around a virtual space (360°) and to interact with virtual objects within the VR experience. Moreover, participants were able to physically move around inside the virtual environment, within a maximum play area of about twelve square meters. After completing the game, the participants were asked to participate in a five-minute long bogus taste-test and then fill out a questionnaire containing the items measuring brand memory and presence, demographic information, and the manipulation check.

3.2   Stimulus Material

The data that were used in this study were collected during a larger VR project (N = 202). For that project three versions of a VR game were developed of which two were used in this study. The first was a branded VR game ($n = 40$) with an embedded prominently placed logo of the popular chocolate brand Milka. The second served as a control game ($n = 41$) and did not contain any branded content. Except for the brand information, both versions of the game were identical.

Players started the game in a virtual living room with a dining table in front of them. To win the game, they had to solve three rounds of puzzles by using differently sized and shaped puzzle pieces that resembled chunks of a (virtual) chocolate bar. Each puzzle consisted of seven pieces, which were arranged on the dining table at the start of each round. By using the hand-held controllers, players could pick up the pieces and place them inside an outline of the puzzle they were completing. In the branded version of the game the outlines contained the chocolate brand's logo. When a puzzle piece was placed correctly it would remain in the outline; an incorrectly placed piece would fall back onto the table. Most players completed the game within five minutes.

3.3 Measures

3.3.1 Brand Memory

To measure brand memory, a word fragment completion task was used (Rajaram, Srinivas, & Travers, 2001). Twenty minutes after playing one of the two VR games, the participants were asked to complete a set of six incomplete brand names (for example 'R _ _ T E _ _P _ _ T' for 'Ritter Sport') for which the third name was always that of the target brand. Each brand name was shown for one second, after which an answer box appeared for the participants to type their answer. Correct completions were coded '1' and incorrect completions with '0' by one of the researchers. About half of the participants (50.6%) correctly completed the name of the target brand.

In line with the research design of this study, an implicit measure for brand memory was chosen to evaluate brand memory rather than an explicit one (like brand recall). This way the effect in the experimental group, that interacted with the brand while playing the branded VR game, could be compared with a baseline—the control group, that did not interact with the brand but did play a similar VR game.

3.3.2 Presence

A 32-item four-factor presence scale by Witmer et al. (2005) was used to measure presence. The reliability of the factors was checked and three of the four factors proved reliable: involvement ($M = 5.28$, $SD = 0.65$, Cronbach's alpha $= 0.79$), sensory fidelity ($M = 4.68$, $SD = 1.11$, Cronbach's alpha $= 0.64$), and immersion ($M = 5.83$, $SD = 0.70$, Cronbach's alpha $= 0.77$). Correlations between these factors ranged from 0.32 to 0.62 and are comparable to those in the original paper—indicating a moderate to strong association between the factors. No index variable was created for interface quality (Cronbach's alpha $= 0.49$) due to the poor reliability of the proposed factor.

3.3.3 Perceived Brand Exposure

Serving as manipulation check, participants were then asked to indicate whether they believed to have been exposed to a brand while playing the VR game. They could answer this question with *yes*, *no*, or *not sure*. *Yes* was coded as '1' and both *no* and *not sure* were coded as '0' by one of the researchers.

4 Results

4.1 Manipulation and Randomisation Checks

To verify that the manipulation was successful, perceived brand exposure was compared between the experimental and control conditions (10.0%). The results ($\chi^2 = 52.16, p < 0.001$) indicated that in the branded VR condition, significantly more people perceived to have been exposed to a brand (90.0%) compared to the non-branded VR condition (10.0%); meaning that the manipulation was successful.

Moreover, to check whether the sample data were distributed equally across the two conditions, a randomisation check was performed with the demographic variables age and sex. No differences were found for age, t (79) $= -1.12, p = 0.312$) and biological sex ($\chi^2 = 0.00, p = 0.946$) between the two conditions—suggesting that the participants were successfully randomly assigned.

4.2 Main Analyses

To test both hypotheses, a multiple mediation model (Preacher & Hayes, 2008) was estimated using PROCESS (Hayes, 2013; Model 4) that predicted brand memory. A condition variable was used as independent variable and the three factors of presence were included in parallel as mediators. The model was specified following suggestions by Long and Ervin (2000), with 95% percentile confidence intervals (10.000 bootstrap samples) and heteroscedasticity-consistent standard errors and covariance matrix estimators (HC3). An overview of the results can be found in Table 1.

Table 1 Direct and indirect effects mediation model brand memory

		Brand memory				
		b	SE	z	p	95% CI
Direct effects						
Branded VR game		**0.98**	0.48	2.04	0.041	0.04, 1.92
Presence	Involvement	−0.28	0.53	−0.54	0.590	−1.31, 0.75
	Sensory fidelity	0.02	0.25	0.08	0.937	−0.47, 0.51
	Immersion	**0.95**	0.48	1.98	0.048	0.01, 1.89
Indirect effects						
Presence	Involvement	−0.04	0.12	–	–	−0.28, 0.23
	Sensory fidelity	0.00	0.09	–	–	−0.19, 0.19
	Immersion	**0.32**	0.25	–	–	0.00, 0.95

Note To account for the dichotomous nature of brand memory, z-distributions were used rather than t-distributions. Regression coefficients in bold are significant

In line with the predictions, participants who played the branded VR game (65.0%) performed better in the word completion task than those in the VR control game condition (36.6%, $p = 0.041$). This implies that playing a branded VR game improves players' brand memory and results in better retrieval of the brand name. Additionally, as shown in Table 1, only the presence factor immersion positively mediated the effect of playing the branded VR game on brand memory. Non-significant results were found for involvement and sensory fidelity. In sum, this means that the data support Hypothesis 1 and partially support Hypothesis 2.

5   Discussion

An experiment was conducted to examine the workings of branded VR games in HMD VR and the role of presence in the processing of the embedded brand information. The results indicate that playing a branded VR game is positively associated with future retrieval of the brand's name from memory and that immersion experienced from playing a branded VR game strengthens the encoding of this information. Overall, this indicates that branded VR games can be used effectively to communicate brand information.

5.1   Presence in a Persuasive Context

When determining the role of presence in a persuasive VR context, the results seem to indicate that only immersion facilitates the processing of brand memory. In other words, immersion experienced from playing a branded VR game seems to drive brand memory.

Even though all four factors of presence were expected to affect brand memory, the current findings could be explained by considering insights from the cognitive capacity model (Lang, 2000). In short, the central theorem of this model suggests that a person's cognitive capacity is limited and that cognitive processes require (and compete for) this finite capacity—similarly to the random-access memory of a computer, its maximum capacity limits the amount of tasks that can (successfully) be performed simultaneously at any single point in time.

Playing a VR game requires players to perform several complex and often cognitively demanding tasks; from interacting with the virtual objects to simply making spatial sense of the simulated virtual space. In other words, when playing a VR game, one's cognitive capacity available for additional cognitive tasks (like successfully processing brand information) is generally believed to be limited. This was demonstrated in a recent study comparing the effectiveness of in-game advertising across various platforms (Roettl & Terlutter, 2018), which reported adverse effects of exposure to brand placements in VR, when compared to desktop and stereoscopic 3D, on overall brand memory.

In line with the cognitive capacity model, a higher accuracy in brand memory could suggest that a player had more cognitive capacity available to process the brand information during the game. From this perspective, the results of the current study could suggest that the increase in immersion from playing a branded VR game is related to the availability of cognitive capacity among player. Future research would be required however to determine whether immersion diminishes the cognitive capacity available to process the VR environment, because the current study design did not allow to test for the causal relationship between presence and cognitive capacity.

Furthermore, the results suggest that involvement and sensory fidelity do not affect brand memory directly. Important to consider however, is that Witmer's conceptualisation of presence (Witmer et al., 2005) and the correlations between the factors of presence, do indicate that sensory fidelity and involvement are related to the players' levels of immersion. This would imply that both involvement and sensory fidelity might influence brand memory indirectly via their relationship to peoples' levels of immersion. Although the current research design does not offer concluding evidence for this relationship, it seems advisable not to ignore the factors involvement and sensory fidelity in future research.

5.2 Limitations and Suggestions for Future Research

While this study offers novel insight into the workings of presence in a persuasive context, it does come with some limitations. Foremost, the scale that was used to measure presence did not prove to deliver four reliable factors, as was suggested by the original authors (Witmer et al., 2005). In addition to the only borderline reliable measure for sensory fidelity, failing to construct a reliable measure for interface quality might have affected the explanatory powers of the effects of presence. It is possible that interface quality mediated (part of) the effect of branded VR games on brand memory, although since this factor could not be considered in the model this conclusion cannot be drawn with the current data. Besides, it is also possible that, considering that the scale was developed and validated with less modern VR hardware, the items measuring interface quality do not entirely align anymore when measuring presence in an HMD VR context.

Considering that VR technology—and thus the quality of the virtual interface—has improved considerably since Witmer et al. (2005) published their paper, it is not unlikely that the importance of interface quality as a factor for measuring presence has slightly decreased over time. Future research into the effects of presence in a HMD VR context could therefore consider utilising different operationalisations of presence. A recent study by Tussyadiah et al. (2018) offered an extensive overview of various measures for presence and suggests to use the conceptualisation by Wirth et al. (2007) when studying HMD VR. This conceptualisation focuses on the dimensions (1) self-location and (2) possible actions to measure presence. Alternatively a shorter and more recent version of their original scale can be used (Hartmann et al., 2016).

5.3 Implications for Theory and Practice

The results of this study demonstrate that branded VR games from well-liked brands can positively affect brand memory. Immersion was identified as a possible underlying mechanism for the effectiveness of this type of VR advertising, which could be explained by considering the limited capacity model (Lang, 2000). Note that when compared to previous research into VR advertising, the results seem to suggests that people process VR advertising messages from single brands (e.g., VR advergames) differently from VR advertising messages that include multiple brand placements (e.g., in-game VR advertising). For both theory and practice it seems therefore important to consider the amount of brand information that is included in the VR advertising message, for this could potentially influence its effectiveness.

For practitioners, the results show that branded VR games can be an effective tool to promote brand memory. Moreover, it seems that the effectiveness of branded VR games can be improved by fostering a more immersive VR experience. The data indicate that players who were more immersed into the branded VR game were better able to retrieve the brand's name from memory afterwards, implying that immersion facilitated the processing of the brand information while playing. The coherence of sensory stimuli while playing and players' involvement with the virtual experience did not seem to directly influence brand memory.

5.4 Concluding Remarks

Considering Musk's prediction that virtual reality will one day become indistinguishable from our reality (Solon, 2016), VR technology and application are likely here to stay. This suggests that for the years to come, investing in and understanding VR will become more important for both the academy and practice. While today, a perfect union of the virtual and the real still seems far away, the current empirical evidence seems to suggest that the power of modern HMD VR does not necessarily relates to its ability to *look* like reality, but rather to its ability to *feel* like reality.