INSTITUTO UNIVERSITÁRIO DE LISBOA

A Glimpse into the Future: The influence of Virtual Reality and Augmented Reality on the Fitness industry

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Master of science in Marketing

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PhD in Marketing, PhD in Tourism, Álvaro Días, Professor, ISCTE-IUL
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BUSINESS
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Department of Marketing, Strategy and Operations

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Resumo

A indústria de fitness passou por uma transformação significativa nos últimos anos e continua a desenvolver-se rapidamente, em parte devido a tecnologias como Realidade Virtual (RV) e Realidade Aumentada (RA). Esta dissertação investiga quais são os fatores comportamentais que influenciam a motivação e a intenção de continuar a usar RV e RA entre os praticantes de fitness que utilizam esta tecnologia.. Baseia-se em duas estruturas influentes, o Technology Acceptance Model (TAM) e a Stimulus-Organism-Response (SOR) Framework. As variáveis analisadas são *perceived usefulness, perceived ease of use, the physical activity enjoyment scale, the behavioral regulation in exercise questionnaire*, e a *theory of planned behavior*. Para a investigação foi realizado um questionário online no qual frequentadores de ginásios holandeses (N=257) foram interrogados sobre a sua experiência com VR e AR. O questionário foi dividido em dois ramos. O primeiro ramo de perguntas foi apresentado aos entrevistados que já usaram VR e AR para fitness antes (N = 107), enquanto o segundo ramo foi exibido aos entrevistados que não tiveram experiência anterior com VR e AR relacionado ao fitness (N = 150). Os resultados mostram que o hedonismo tem uma influência significativa na motivação e na intenção de continuar a jornada de fitness a usar VR e AR. Além disso, a *perceived usefulness* da VR e AR influencia significativamente a intenção do usuário de continuar a usar essas tecnologias para fitness. Ambos os resultados estão alinhados com pesquisas anteriores.

Palavras-chave: Realidade Virtual, Realidade Aumentada, Fitness, Hedonismo, Motivação

Classificação JEL: Marketing (M31); Mudança tecnológica (O33)

Abstract

The fitness industry has experienced a significant transformation in the recent years and is still developing rapidly, partly due to technologies like Virtual Reality (VR) and Augmented Reality (AR). This dissertation investigates what behavioral factors influence motivation and intent to sustain the use of VR and AR among VR and AR fitness users. It draws upon two influential frameworks: the Technology Acceptance Model (TAM) and the Stimulus-Organism-Response (SOR) framework. The variables that have been analyzed are perceived usefulness, perceived ease of use, the physical activity enjoyment scale, the behavioral regulation in exercise questionnaire, and the theory of planned behavior. For the research, an online questionnaire has been conducted in which Dutch gym-goers (N=257) were interrogated about their experience with VR and AR. The questionnaire was split into two branches. Branch one was shown to respondent that have used VR and AR for fitness before (N=107), while branch two was shown to respondent that had no prior experience with VR and AR related to fitness (N=150). The results show that hedonism has a significant influence on motivation and the intention to continue one's fitness journey using VR and AR. Furthermore, perceived usefulness of VR and AR has a significantly influences the user's intention to continue using these technologies for fitness. Both results are aligned with previous research.

Keywords: Virtual Reality, Augmented Reality, Fitness, Hedonism, Motivation

JEL Classification: Marketing (M31); Technological change (O33)

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Glossary of abbreviations, acronyms, and initialisms

AR = Augmented Reality

BREQ-2= The Behavioral Regulation in Exercise Questionnaire

PACES= Physical Activity Enjoyment Scale

PEOU= Perceived ease of use

PU= Perceived usefulness

TAM = Technology Acceptance Model

TPB= Theory of Planned Behavior

VR = Virtual Reality

1. Introduction

While the fitness industry has been heavily impacted by the COVID-19 pandemic, this industry continues to evolve and adapt itself (Hover, & van Eldert, 2019). Because of the COVID-19 pandemic, the online and digital side of fitness has been growing rapidly (Thompson, 2021). With the growth of this side of the fitness industry, behaviors are likely to change. That is why this paper investigates what behavioral factors influence motivation and intent to sustain the use of VR and AR among VR and AR fitness users. Besides this, it is important for gyms to have alternatives when they need to close due to COVID-19 or other crises. This paper will give gym owners suggestions on how they can approach these problems. In addition to gym owners, other stakeholders from the fitness industry, such as fitness equipment designers and software developers, can also benefit from this study.

This study aims investigates what behavioral factors influence motivation and intent to sustain the use of VR and AR among VR and AR fitness users. This will be done by analyzing the VR and AR acceptance within the fitness industry using the Technology Acceptance Model (TAM) by Davis (1989). It has been decided to conduct this research since there are not a lot of studies about VR and AR within the fitness industry. The findings of this research will have strong societal relevance. By investigating the behavior of different entities towards VR and AR within the fitness industry, a better understanding will be created to aid developers when creating new technology for the fitness industry. Moreover, this study will extend existing knowledge about consumer behavior towards VR and AR in the fitness industry.

This paper is especially relevant for gym owners. If gyms know the potential of VR and AR in the fitness industry, they can distinguish themselves from the competition by offering an exceptional experience. Besides gym owners, companies that provide wearable technology regarding fitness and heath can also benefit from this study.

This paper is structured in six main chapters. The first chapter presents the topic of the paper, the research problem, and the relevance of the research. The second chapter shows the literature review which explores the concepts of VR and AR. Besides this, this chapter delves into the theoretical models used in this paper. The last part of this chapter presents the conceptual model and states the hypothesis used in this study. In chapter three the research methodology is presented

including information regarding the research approach, measures, data collection, design of the questionnaire and sampling. Chapter four includes the results of the research followed by the hypothesis validation. Chapter five presents the discussion based on the results. Lastly in chapter six the conclusion of this research is shown including theoretical contributions, managerial implications, and the limitations of this research.

2. Literature review

In the literature review the foundation of knowledge on the topic of this paper will be provided. This chapter will examine different theoretical perspectives on VR and AR in the fitness industry.

2.1. Virtual Reality

Over the past years, VR has witnessed remarkable significant growth since its introduction. Projections indicate that the worldwide VR market is expected to grow with a compound annual growth rate (CAGR) of 15% from the year 2022 to 2030. This means that this technology will keep expending itself over the coming years at a fast pace (Grand View Research, 2022).

When defining Virtual Reality, this paper assumes the definition of Howard Rheingold (1991). According to Rheingold, Virtual Reality as an experience in which one is "surrounded by a three-dimensional computer-generated representation and is able to move around in the virtual world and see it from different angles, to reach into it, grab it, and reshape it." Rheingold (1991) is a credible source for the definition of Virtual Reality because of his expertise in VR and his pioneering work related to VR. His book "Virtual Reality: Exploring the Brave New Technologies of Artificial Experience" (1991) also offers a comprehensive exploration of VR.

This technology is used in several industries, including real estate, education, healthcare, architecture, and the automotive industry. The fitness industry did not stay behind on adopting VR, as this technology has already been implemented in several ways in this industry (Thompson, 2022). An example of VR in fitness is Supernatural. Supernatural is an immersive VR fitness game which provides the user with workouts in different places around the globe (Savoie, 2022).

In a study by Kruse et al. (2021) researchers compared the effectiveness of traditional 2D fitness exercise videos to an immersive VR exergames (Virtual reality fitness game) among older adults (N = 25). This study has been conducted to determine if a VR exergame can be an alternative for 2D fitness videos, especially during the COVID-19 pandemic. The researchers allowed the participants try both conditions (VR and the video) with a 10-minute break between each condition. The researchers chose to compare the VR exergame with a 2D fitness exercise video as it increases external validity since a lot of people performed their workouts through exercise videos during the COVID-19 pandemic. When comparing these two methods the researchers evaluated several variables, including enjoyment, perceived workload, attention, movement and cybersickness.

Around 60% of participants preferred the workout video over the VR exergame. The movement plots of the experiment support this preference since the movements in the video were more intense than in the VR exergame, making the video more appropriate for long-term training. The movement plots also showed that some participants performed the exercises of the 2D video at different speeds or with the wrong arm. This shows that it is hard to check whether an exercise is performed correctly when working out with a the 2D video. This was not the case for the VR exergame since feedback can be given immediately. During the VR exergame, the participants of the study viewed it more as a game rather than an exercise. This also reflects in the physiological and movement measurements since the heart rate and movement values for the video were significantly higher in comparison to the VR exergame. In this experiment, cybersickness increased after the 2nd or 3rd module in the VR exergame. This is also aligned with previous research which show that cybersickness is higher for inexperienced VR users (Stamm & Vorwerg, 2021)

In conclusion, these VR exergames can be an effective alternative to traditional 2D fitness exercise videos. However, the VR exergames are not expected to replace the 2D fitness exercise videos. An important aspect to consider when reviewing this research is that the research solely includes older adults and, therefore, does not represent other age groups.

2.2. Augmented Reality

Just like Virtual Reality, Augmented Reality (AR) is also growing rapidly and is expected to continue growing in the coming years (Alsop, 2022). With this trend in mind, it is anticipated that AR will have a transformative impact on the fitness industry. When looking at the definition of AR, the definition of R. Azuma et al. (1997) is assumed. Azuma et al. (1997) defines Augmented Reality as a system that combines the virtual and the real world, that correlates in real-time and that operates in the 3D.

Even though AR was originally invented to navigate spacecrafts, it now serves other uses too, one of which is the integration of physical activity within mobile gaming (Yianni, 2018). One very successful AR mobile game that incorporates physical activity is Pokémon Go (2016). Pokémon Go uses location-based AR that motivates players to travel in the real world to catch and battle virtual Pokémon (Niantic, 2016). Research has demonstrated the significant health benefits of Pokémon Go, particularly in terms of increasing moderate-to-vigorous physical activity (MVPA) levels and reducing sedentary behavior. While the observed increase in MVPA may be relatively small, it is still statistically meaningful (Nigg, Mateo, & An, 2017).

Basic Fit, the largest gym chain in the Netherlands, has also embraced the AR trend (Statista Research Department, 2022; Nijland, 2022). Basic Fit and Snapchat have collaborated to release an Augmented Reality lens that enables individuals without motivation or equipment to easily engage in a quick workout. The lens features three exercises: knee lifts, squats, and lunges, each lasting 10 seconds for a total workout duration of 30 seconds. The lens has been used over 1 million times across all countries where Basic Fit operates, with users primarily opting for shorter workout sessions, averaging around 10 seconds (Nijland, 2022).

2.3. Theoretical models

2.3.1. The Physical Activity Enjoyment Scale (PACES)

In many cases, people consider fitness activities to be monotonous due to their repetitive nature. Studies indicate that a significant proportion, approximately 44%, of individuals choose not to engage in exercise because they do not find it enjoyable. (Hoare et al., 2017). It is expected that AR will bring gamification into fitness, which will make fitness more fun. Therefore, when examining the impact of VR and AR on fitness, it is important to investigate the role of hedonism. Besides this, enjoyment during physical activity is important because individuals are more likely to maintain their exercise regimen when they experience enjoyment throughout the activity (Jekauc, 2015; Dishman et al., 2005).

Measuring the enjoyment of someone might be difficult since it is subjective. To measure the enjoyment someone feels during physical activity, the Physical activity enjoyment scale (PACES) (Kendzierski & DeCarlo, 1991) can be used. This model has been successfully validated amongst children (Moore et al., 2009), female adolescents (Motl et al., 2001), and older adults (Mullen et al., 2011). These studies have provided evidence for the construct validity of the PACES, demonstrating that the scale effectively measures enjoyment of physical activity across different genders and age groups. The results from these studies have also shown that individuals who report greater levels of enjoyment also tend to engage in physical activity more frequently and are more committed to participate in physical activity.

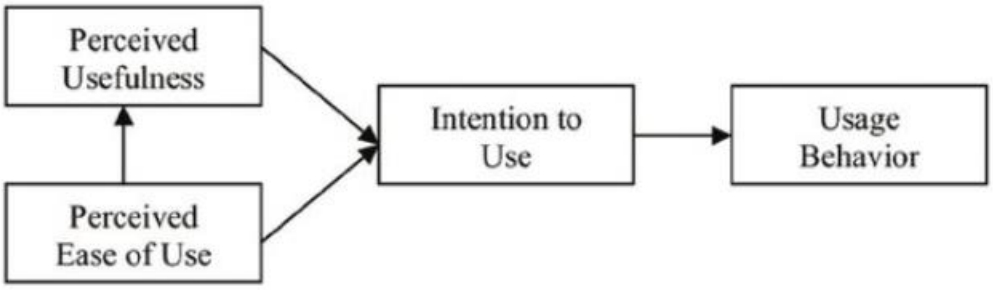
2.3.2. Technology Acceptance Model (TAM)

The successful integration of VR and AR technologies in the fitness industry relies not only on technological advancements but also on user acceptance and adoption. To understand the factors influencing the acceptance of VR and AR technologies within the fitness context, it is essential to draw upon established theoretical frameworks. One of the most widely recognized and influential models in the field of technology acceptance is the Technology Acceptance Model (TAM) by Fred Davis (1989). By examining the applicability of TAM to the adoption of VR and AR in the fitness industry, this chapter aims to shed light on the key determinants that shape users' intentions to embrace and utilize these technologies.

TAM has been created to measure the acceptance and adoption of information technologies. The model has two main variables that influence the intention to use a new technology. These two main variables are perceived ease of use (PEOU) and perceived usefulness (PU) (Davis, 1989).

Davis (1989) defines perceived ease of use as 'the degree to which a person believes that using a particular system would be free of effort'. When Davis (1989) talks about Perceived usefulness he defines it as 'the degree to which a person believes that using a particular system would enhance his or her job performance'.

Figure 2.1. Original Technology Acceptance Model Source: Davis (1989)



The original TAM consists of the four variables displayed in Figure 2.1. However, TAM has been extended multiple times by several researchers. This has been done to extend on its explanatory power and to apply the model to different contexts. Some noticeable extensions include TAM 2 (Venkatesh & Davis, 2000) and Unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003).

2.3.3. The Behavioral Regulation in Exercise Questionnaire (BREQ-2)

Motivation plays an important role in someone's commitment and engagement in fitness activities. Understanding how VR and AR impacts an individual's motivation, as it can improve long-term engagement and enhance the user experience.

To measure and individuals' motivation the Behavioral Regulation in Exercise Questionnaire (BREQ-2) by Markland and Tobin (2004) can be used. This questionnaire has been designed to assess an individual's motivation when participating in physical activity. BREQ-2 has been created by Markland and Tobin in 2004 and is an extension of the original BREQ which has been created by Mullan et al. (1997). The questionnaire exists of 19 items which are divided among five factors. These five factors are: Amotivation, external regulation, introjected regulation, identified regulation and intrinsic motivation. This questionnaire is scored on a 5-point lickert scale from 0 to 4 where 0 equals "not true for me" and 4 equals "Very true for me" (Markland et al, 2004).

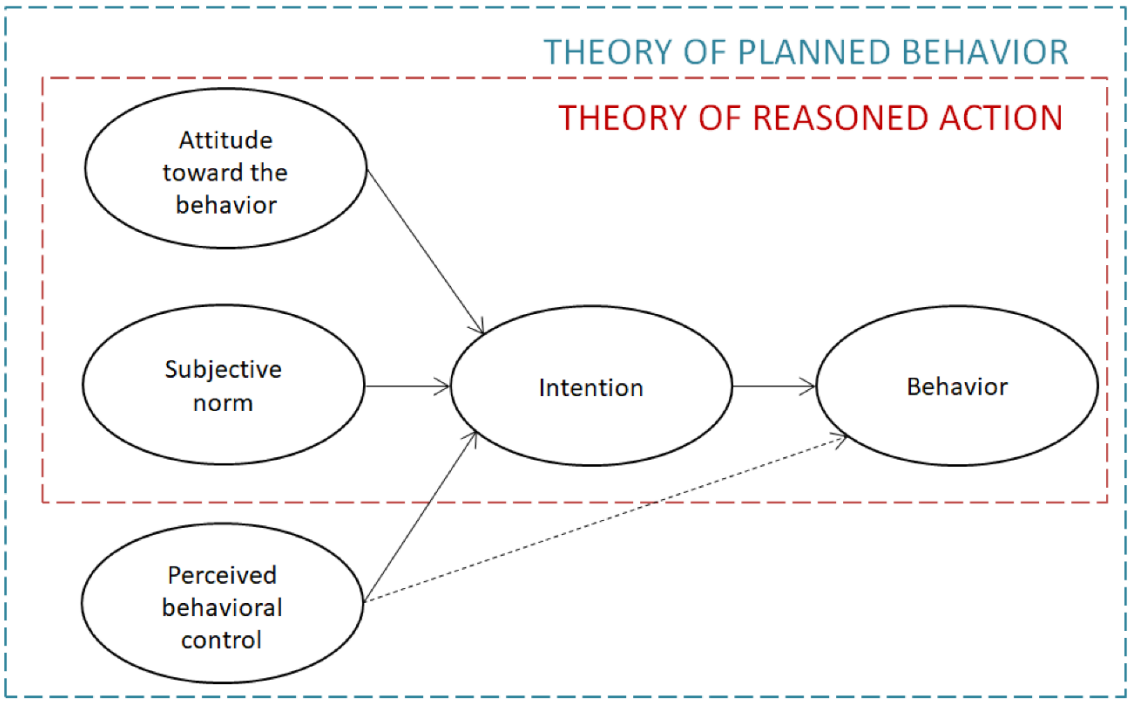
Several studies have demonstrated the validity and reliability of the BREQ-2. For instance, A research done in the Spain (Moreno-Murcia et al. 2007) to validate BREQ-2 has shown that the questionnaire meets all the necessary criteria regarding reliability and validity. This makes the questionnaire suitable for several domains of physical activity within the Spanish context. Another study aimed to evaluate the reliability and construct validity of college students' responses to the BREQ-2 demonstrated that the questionnaire is a satisfactory fit for assessing the exercise motivation factors in this specific group of American college students (D'Abundo et al, 2014). Considering the various studies conducted across different countries and age groups that have validated the BREQ-2, it can be concluded that the questionnaire possesses sufficient validity and reliability to effectively measure an individual's motivation towards exercise.

2.3.4. Theory of Planned Behavior (TPB)

The future behavior of gym-goers regarding VR and AR is an important aspect to consider for this paper. If this future behavior is understood gym owners can take advantage of this knowledge and gain competitive advantage. To measure this, the Theory of Planned Behavior (TPB) by Ajzen (1991) can be used. TPB is an extension of the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975). The reason TRA has been extended because of a limitation in this model. The model lacked a way to measure the confidence in someone's ability to execute a certain behavior. This element has now been added to TPB and is referred to as Perceived Behavioral Control (PBC). TPB is widely used in social science due to its validity (Han et al. 2018; Kim et al. 2019)

TPB focusses on three main dimensions which are attitude toward the behavior, subjective norm and perceived behavioral control. Attitude Toward the Behavior (AB) refers to the way an individual evaluates a certain behavior. In this paper AB focuses on gaining insight into an individual's perceived advantages and disadvantages in incorporating VR and AR into their fitness routine. Subjective Norms (SN) involves the perceived social pressure one might experience regarding a behavior. This social pressure can come from friends, family, or society. Perceived Behavioral Control (PBC) focusses on the perception of an individual's ability to perform a specific behavior. In the context of this paper, it refers to the perception of individuals regarding how easy or difficult it is to integrate VR and AR into their fitness routine. Lastly there is Behavioral Intention (BI), BI is a factor that is shaped by AB, SN and PBC and is a predictor of the actual behavior in TPB (see Figure 2.2). BI is when an individual consciously plans to continue or avoid a certain behavior.

Figure 2.2. Transition from the Theory of Reasoned Action to the Theory of Planned Behavior. Source: by Tommasetti et al (2018) adapted from Azjen (1991)

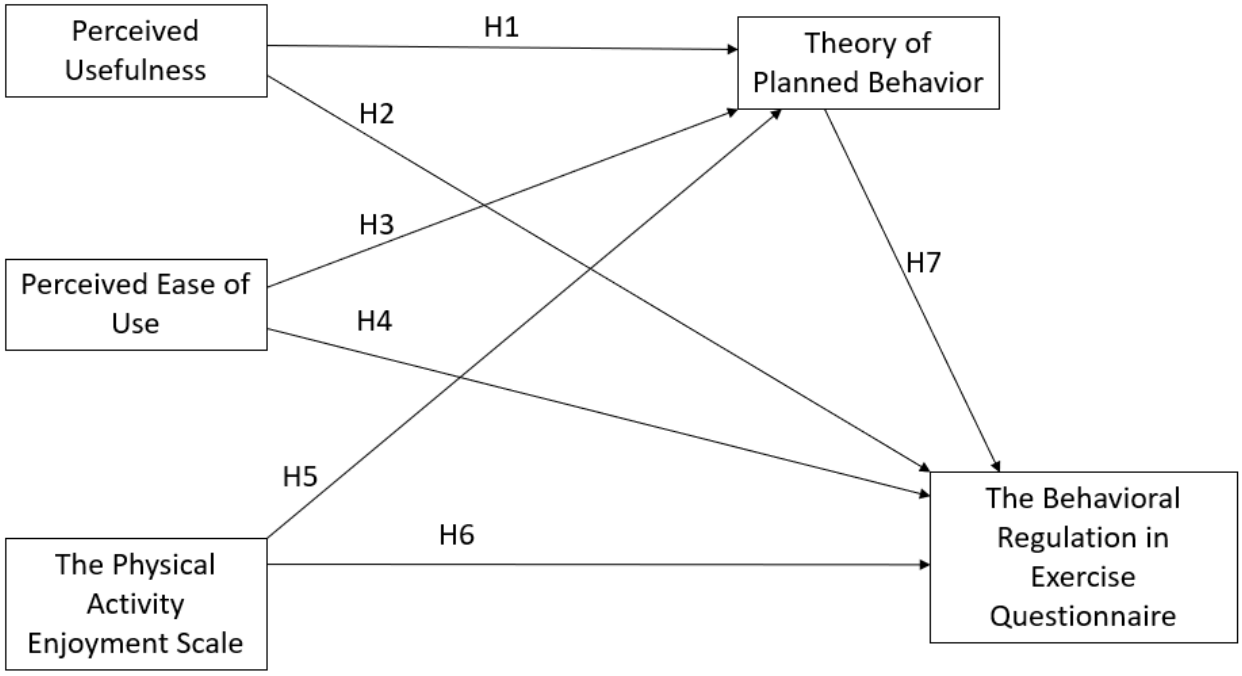


TPB has been validated in several studies. An example is a study by Michels and Kugler (1998) where they studied the exercise behavior among older adults it has been concluded that TPB is a valid model for predicting the intention to engage in exercise and the actual execution of exercise among older adults.

2.4. Conceptual model

Figure 2.3 presents the conceptual model, which is constructed based on the comprehensive literature review. This paragraph aims to provide an explanation for the selection of these specific variables and to present the hypotheses associated with the model.

Figure 2.3. Conceptual model. Source: Interpreted by the author.



In this study, a conceptual model was employed to investigate the influence of VR and AR on the fitness industry. The concpetual aimed to examine the relationships between perceived usefulness, perceived ease of use, the physical activity enjoyment scale, The behavioral regulation in exercise questionnaire, and the theory of planned behavior. Perceived usefulness, perceived ease of use, and the physical activity enjoyment scale were considered as independent variables, as they were expected to exert direct effects on BREQ-2 and TPB. The selection of these variables for my conceptual model is grounded in research conducted by Beldad & Hegner (2018) and Capasa et al (2022) which talk about Virtual Reality in the context of sports and Wearable fitness technology. In this research these variables have been adapted to the context of fitness.

The hypothesis of the conceptual model is as followed:

H1: Perceived usefulness has a positive effect on the theory of planned behavior.

H2: Perceived usefulness has a positive effect on the behavioral regulation in exercise questionnaire.

H3: Perceived ease of use has a positive effect on the theory of planned behavior.

H4: Perceived ease of use has a positive effect on the behavioral regulation in exercise questionnaire.

H5: The physical activity enjoyment scale has a positive effect on the theory of planned behavior.

H6: The physical activity enjoyment has a positive effect on the behavioral regulation in exercise questionnaire.

H7: The theory of planned behavior has a positive effect on the behavioral regulation in exercise questionnaire.

3. Methodology

3.1. The Dutch Fitness industry

Over the past two decades, there has been a significant surge in the popularity of fitness. In The Netherlands, specifically, fitness participation has experienced notable growth since 2001. The percentage of individuals aged 12 to 79 engaging in weekly fitness activities increased from 12% in 2001 to 21% in 2016 (Hover, & van Eldert, 2019). In fact, as of 2022, fitness, along with hiking, stands as one of the most practiced sports in the country, with approximately 20% of the population actively involved.

In addition to the growth of the fitness industry there are also constantly new trends and developments within the industry. The American College of Sports Medicine (ACSM) publishes, since 2007, annual research with the fitness trends of the coming year. In their worldwide survey of fitness trends for 2022, several trends have been identified that are useful for this research (Thompson, 2021). The number one trend in the fitness industry is wearable technology. These technologies include new innovations such as oxygen saturation, blood pressure and body temperature (Thompson, 2021 p. 12). Besides wearable technology, a development into mobile exercise apps has also been found (Thompson, 2021 p. 18). These wearable technologies can be useful for this research since these technologies can be combined with VR and AR to facilitate the use of these technologies. The COVID-19 pandemic has also had influence on the trends and development within the fitness industry since home exercise gyms and outdoor activities have also become more popular (Thompson, 2021 p. 15). Given the situation the world is currently in it is also important to consider the COVID-19 pandemic. If other waves of the virus occur VR and AR will probably mostly be used at home rather than in gyms since gyms have a high probability to close their doors during the peak of the pandemic.

3.2. Research approach

To achieve the aim of this study, quantitative research was chosen. This has been chosen due to its efficiency in studying large samples, uncovering patterns, and measuring relationships between variables (Malhotra et al., 2007). Ethical considerations were ensured by obtaining consent and maintaining the responses and information of the participant private and confidential. Data analysis was performed using SmartPLS 4.0 for structural modeling and IBM SPSS Statistics 29 for descriptive statistics.

3.3. Measures

Several validated scales have been used to address the research objectives. In Table 3.1 the measurement scales are presented. All items of the scales mentioned in Table 3.1 were measured on a 7-point Likert scale ranging from: 1- completely disagree to 7- completely agree.

Table 3.1. Name of the variable, authors, and number of items. Source: Own elaboration from literature review

Factor	**Authors**	**Number of items**
Dependent variables:		
The Behavioral Regulation in Exercise Questionnaire	Adapted from Markland and Tobin (2004)	9 items
Theory of Planned Behavior	Adapted from Ajzen (1991)	6 items
Independent variables:		
Perceived ease of use	Adapted from Davis (1989)	3 items
Perceived usefulness	Adapted from Davis (1989)	3 items
The Physical Activity Enjoyment Scale	Adapted from Kendzierski & DeCarlo (1991)	13 items

The motivation to continue fitness journey was measured using the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2) from Markland and Tobin (2004). The nine items used were divided into five dimensions which are amotivation, external regulation, introjected regulation, identified regulation and intrinsic motivation. The intention to continue using VR and AR for fitness has been measured with the use of the Theory of Planned behavior of Ajzen (1991). The six items were divided into four dimensions: attitude, subjective social norm, perceived behavioral control and intention to continue. Perceived ease of use and Perceived usefulness are both measures from the Technology acceptance model (TAM) of Davis (1989). Hedonism has been measured using the Physical Activity Enjoyment Scale of Kendzierski and DeCarlo (1991).

3.4. Data Collection

For this research, an online questionnaire has been selected for data collection. This decision is based on the fact that online questionnaires have a wider reach, it is more convenient for the participants and its more time and cost efficient. The questionnaire has been distributed on social networks and on a research platform named SurveyCircle. Additionally, offline distribution was carried out through posters placed in gyms and universities in The Netherlands (see Appendix A). These locations were chosen thanks to their diverse demographics, accessibility, and fitness context. The posters include a QR code where the respondent will be redirected to the online questionnaire. The online questionnaire has been launched on March 31st, 2023, and closed July 6^{th,} 2023, which means that it has been active for three months and seven days.

3.5. Design of questionnaire

The questionnaire (see Appendix B) was designed according to a structured approach to capture relevant data to investigate the influence of VR and AR on the fitness industry. The questionnaire consisted of multiple sections and two branches and has been translated to Dutch (See Appendix C). Each branch shows the participants a set of question based on their self-reported experience with VR and AR technology in a fitness context. The questionnaire starts with 2 screener questions to determine to which branch the respondent will be redirected.

Branch one was shown to respondents who have used VR and AR in fitness context and includes four Likert scale questions where insight can be gained on all variables of the conceptual model (See Table 3.1). Branch two was shown to respondents who have never used VR and AR in fitness context. This branch includes 4 multiple choice questions to determine the likelihood of the respondents to use VR and AR in the future and to identify any potential barriers for them to engage with VR and AR for fitness. The selection of the potential barriers are based on researching the most common barriers for VR and AR users (Cyrankiewicz, 2021; Gilbert, 2022). The last section of the questionnaire includes demographic, psychographic and behavioral information about the respondents. This section consists of four questions that gather information about the respondents' gender, age, frequency of gym attendance, and the primary reason for their gym visits. In the introduction of the questionnaire the topic of the questionnaire was explained including the definition of VR and AR with examples and photos. This section also included a clear and concise informed consent statement mentioning voluntary participation, data confidentiality, and anonymity.

Before creating the final questionnaire, three pilot tests have been conducted amongst different respondents that have used VR and AR for fitness before. These respondents were presented the initial questionnaire, and the researcher was present to analyze their behavior and ask for feedback. Based on the feedback and behavioral analysis several refinements have been made to the questionnaire. The questionnaire was too long, and this was noticeable by the attitude and remarks of the respondents. To solve this several questions have been shortened and some items were deleted while still making sure all dimensions can be properly analyzed. Besides this, the definition of VR and AR with examples have been added to the introduction since some responds were not familiar with both terms.

To ensure the validity and reliability of the questionnaire, the original scales were adapted for each construct except for the "BREQ-2" for the sake of consistency. Additionally, content validity was ensured through reverse coding to avoid response bias and enhance measurement accuracy.

3.6. Sampling

This research used convenience sampling due to its efficient way to collect data from easily accessible individuals within the context of fitness. The total sample size consists of 257 respondents of which 107 respondents had prior experience with VR and AR in a fitness context and 150 respondents had no prior experience with these technologies in the context of fitness.

The target audience consists of individuals between the age of 18 and 65 years old who go to the gym and who have different levels of experience with VR and AR. This age group has been chosen because it provides a diverse representation of working adults across different life stages and fitness goals.

Inclusion criteria included individuals that live in the Netherlands and are fluent in Dutch, have experience with fitness, and were willing to participate in the questionnaire. Exclusion criteria included individuals under the age of 18 and over the age of 65 years old, those who do not have any fitness experience, and those who did not consent to participate in the questionnaire.

Challenges encountered during the sampling process include self-selection bias because of the convenience sampling. Additionally, there were a few respondents that engage in satisficing. These respondents carelessly filled out the questionnaire without paying attention. These participants have not been included in the analysis.

4. Results

In this chapter a comprehensive analysis of the questionnaire results is presented. These results have been obtained through SmartPLS 4.0 (Ringle et al., 2022) to test the proposed conceptual model of this paper. Partial Least Squares has been used for the analysis since it provides a more effective analysis and a deeper understanding of the connection among all constructs (Sarstedt et al., 2014). Another reason Partial Least squares has been chosen is because the sample size of this research is too low.

4.1. Respondents' Profiling and Data Analysis

In Table 4.1 the profiling of the respondents that have had prior experience with VR and AR within the context of fitness is presented. In Appendix D the profiling of the respondents without prior experience with VR and AR within the context of fitness is presented.

Table 4.1. Demographic, psychographic, and behavioral information of respondents with prior VR and AR experience. Source: Own elaboration from SPSS

N=107	**Demographic**	**%**
Gender		
	Male	51
	Female	49
Age		
	18-25	65.3
	26-35	10.2
	36-45	12.2
	46- 55	10.2
	55>	2
Gym frequency		
	1 time or less per week	22.4
	2-3 times per week	46.9

	4-5 times per week	28.6
	6 times per week or more	2
Gym goal*		
	Lose weight	31.9
	Gain muscle	58.5
	Improve stamina and physical fitness	42.2
	To socialize	8.5

*Note: Percentages do not add up to 100% since this is multiple answer question.

When analyzing the survey responses of respondents who have never used VR and AR before, it can be observed that the vast majority, 77%, are willing to use VR and AR for fitness. The primary concerns among these respondents include costs (46%), the perceived usefulness of the technologies in fitness (46%), and the potential for nausea or dizziness (41%). The complete results for respondents without prior experience in VR and AR can be found in Appendix E. The results in the following chapters are based on the respondents with prior experience with VR and AR in fitness.

4.2. Reliability and Validity

In order to evaluate the quality of the conceptual model, the model has been tested on several factors. To test the reliability and validity of the model, convergent validity and discriminant validity were evaluated which are displayed in Table 4.2. (Hair et al., 2017).

Table 4.2. Composite reliability, average variance extracted, correlations and discriminant validity checks. Source: Own elaboration from PLS

Variables	α	CR	AVE	1	2	3	4
The Behavioral Regulation in Exercise Questionnaire (1)	0.774	0.869	0.689	**0.831**	0.871	0.719	0.796
The Physical Activity Enjoyment Scale (2)	0.864	0.898	0.596	0.791	**0.772**	0.565	0.606
Perceived Usefulness (3)	0.781	0.872	0.695	0.587	0.480	**0.833**	0.878
Theory of Planned Behavior (4)	0.791	0.864	0.615	0.646	0.526	0.801	**0.785**

Note: Metrics of this table include Cronbach Alpha (α), Composite reliability (CR), and Average Variance Extracted (AVE). The square roots of AVE are presented in bold. The effects between the constructs are shown below the diagonal, while above the diagonal, you can find the HTMT (Heterotrait-Monotrait) ratios.

Cronbach alphas and composite reliability have been used to evaluate the internal consistency reliability. The values of both measures are greater than 0.7 for all variables, which means that the variables of the conceptual model are reliably measuring the underlying constructs and they are highly correlated to each other. The average variance extracted (AVE) surpasses the value of 0.5, which means that the conceptual model has great convergent validity (Bagozzi & Yi, 1988). The discriminant validity has been tested using two methods. In the first method the square root of the average variance extracted from each variable is calculated. These values can be found in the diagonal line presented in bold numbers. These values are higher than the correlations between constructs which means discriminant validity has been achieved. The second method is by utilizing the heterotrait-monotrait ratio (HTMT) criterion, as proposed by Hair et al. (2017) and

Henseler et al. (2015). Discriminant validity is achieved when these values are below 0.9 (Gold et al., 2001). Given that the values are under this threshold it can be concluded that discriminant validity has been achieved. The VIF values range between 1.33 and 3.13. All these values are lower than 5 which indicates low to moderate collinearity between the variables (Hair et al., 2017). The R^2 in the variables BREQ and TPB are 0.703 and 0.671, respectively. According to Chin (1998) R^2 values above 0.67 are substantial. These R^2 values suggest that the research model has a strong ability to explain the variations in both BREQ and TPB within the context of VR and AR for fitness.

Table 4.3. Structural model assessment. Source: Own elaboration from PLS

Path	**Path coefficient**	**Standard errors**	***t* statistics**	***p* values**
PACES -> BREQ	0.611	0.092	6.678	0.000
PACES -> TPB	0.193	0.089	2.164	0.031
PEOU -> BREQ	-0.031	0.096	0.327	0.744
PEOU -> TPB	0.064	0.134	0.476	0.634
PU -> BREQ	0.109	0.117	0.930	0.353
PU -> TPB	0.677	0.134	5.058	0.000
TPB -> BREQ	0.250	0.115	2.171	0.030

Table 4.4. Bootstrap results from indirect effects. Source: Own elaboration from PLS

Indirect effect	**Estimate**	**Standard errors**	***t* statistics**	***p* values**
PU -> TPB -> BREQ	0.169	0.093	1.814	0.070
PACES -> TPB -> BREQ	0.048	0.032	1.502	0.133
PEOU -> TPB -> BREQ	0.016	0.037	0.428	0.669

The results in Table 4.3 show that PACES has a significant positive effect on BREQ ($\beta = 0.611$, $p < 0.001$), which supports H6. PACES also has a significant positive effect on the TPB ($\beta = 0.193$, $p < 0.05$), this supports H5. Besides this the structural model assessment shows that perceived usefulness has a significant positive effect on TPB ($\beta = 0.677$, $p < 0.001$) and that the

TPB has a significant positive effect on BREQ ($\beta = 0.205$, $p < 0.05$), these support H1 and H7, respectively.

A bootstrap analysis has been conducted to test whether the indirect effects of specific variables have statically significant effect on BREQ through TPB (see Table 4.4). It can be seen that the variable of Perceived usefulness has indirect effect on BREQ through TPB with a p value of 0.070. Even though this value does not meet the requirement to be statistically significant ($p < 0.05$), it is near the threshold of 0.05. This means that there could be a potential indirect effect which future research could clarify.

4.3. Cross-validated predictive ability test

A Cross-validated predictive ability test (CVPAT) has been performed to assess the predictability of the conceptual model. This test has also been conducted to evaluate the model's reliability and validity. Besides this the results of this test will also show if the model can predict future behavior. In Table 4.5 the CVPAT results are displayed. The table includes the average loss, t values and p values for the variables BREQ and TPB, and for the whole model.

Table 4.5. Cross-validated predictive ability test. Source: Own elaboration from PLS

Variable	**Average loss difference**	***t* value**	***p* value**
BREQ	-0.975	3.190	0.003
TPB	-0.873	4.233	0.000
Overall	-0.917	4.853	0.000

The p values for BREQ, TPB and the overall model are all under the significance level of 0.05 which means that the observed average loss difference is statistically significant. These results show that the conceptual model has a strong predictive ability. For this reason, these results are especially beneficial for drawing managerial implications. Managers should therefore invest in these technologies to create an immersive fitness experience. This way managers are able to gain a competitive advantage and gain new customers.

Figure 4.1. Importance-performance map of the conceptual model per variable. Source: generated from PLS

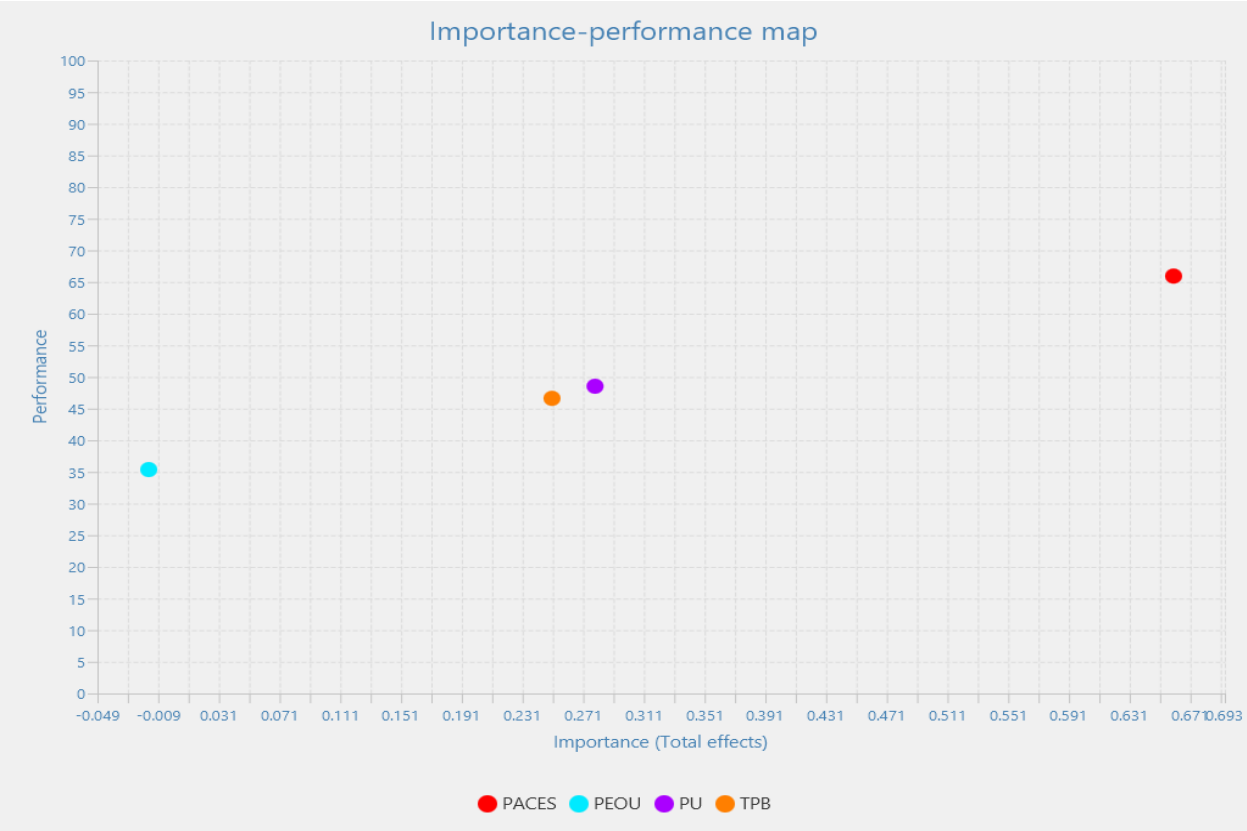
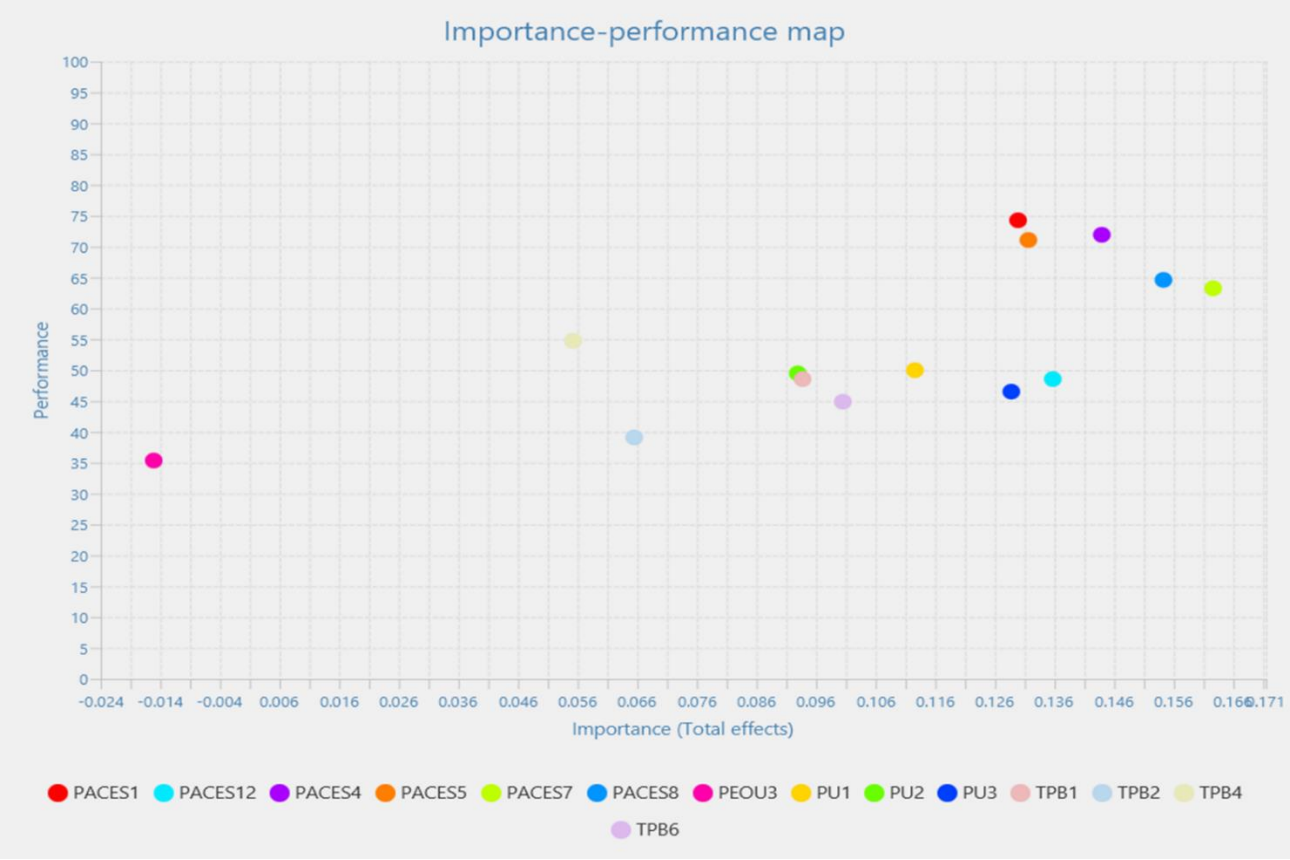


Figure 4.2. Importance-performance map of conceptual model divided per item. Source: Generated from PLS



In Figure 4.1 the importance-performance map is presented of the conceptual model. It can be seen that PACES is the variable with the highest importance among all variables with a value of 0.660. Perceived ease of use has very little importance to the conceptual model since it scored a value of -0.015. This means that Hedonism has a lot of importance to one's motivation and their intention to continue their fitness journey and the perceived ease of use has little to no importance to one's motivation and their intention to continue their fitness journey. For a more detailed analysis of the importance-performance map, Figure 4.2 can be consulted. This figure provides a detailed overview of the most important items of each of these variables. PACES 7, 8 and 4 are the three items with most importance and they represent the statements 'My body felt good', 'It was useful', and 'I found it pleasurable', respectively. The item with least importance is PEOU 3 representing the statement 'When using VR/AR while exercising, I encounter many technical problems'.

4.4 Hypothesis validation

In this section the Hypothesis validation is presented to check if the theory matches the empirical reality. In Table 4.6 the hypothesis validation is presented joined with the significance of each hypothesis.

Table 4.6. Hypothesis validation

Hypotheses	**Sig.**	**Results**
H1: Perceived usefulness has a positive effect on the theory of planned behavior.	0.000	Accepted
H2: Perceived usefulness has a positive effect on the behavioral regulation in exercise questionnaire.	0.353	Rejected
H3: Perceived ease of use has a positive effect on the theory of planned behavior.	0.634	Rejected
H4: Perceived ease of use has a positive effect on the behavioral regulation in exercise questionnaire.	0.744	Rejected
H5: The physical activity enjoyment scale has a positive effect on the theory of planned behavior.	0.031	Accepted
H6: The physical activity enjoyment has a positive effect on the behavioral regulation in exercise questionnaire.	0.000	Accepted
H7: The theory of planned behavior has a positive effect on the behavioral regulation in exercise questionnaire.	0.030	Accepted

5. Discussion

To address the research objective regarding what behavioral factors influence motivation and intent to sustain the use of VR and AR among VR and AR fitness users, the items of the questionnaire have been tested to determine which are the most important factors for motivation and the intention to continue using VR and AR for fitness. Furthermore, this study aims to see how these factors are interconnected.

The results of this study indicate that PACES has a significant positive effect on BREQ. This suggests that individuals who find using VR and AR for fitness enjoyable are more motivated to continue their fitness journey using these technologies. Research by Navarro et al. (2020) also shows that hedonism has a significant positive effect on motivation which support the results of this paper. During study of Navarro et al. (2020), PACES and BREQ have also been used to validate the psychometric structure and analyze the motivation according to enjoyment and other factors. All correlations between each construct of PACES and BREQ were significant except for introjected regulation. Another paper that supports these results is the one of Ntoumanis (2005). According to Ntoumanis (2005), when individuals experience enjoyment, they are more likely to be intrinsically motivated. Besides motivation, the results also suggest that PACES has a significant positive TPB. A study by Basuki et al. (2021) also shows that there is a significant positive effect between these two variables.

The effect between PACES and TPB and the effect between PACES and BREQ in the context of fitness could have several reasons. Firstly, it could be a psychological reward. Participating in fun activities activates the brain's reward system. As a result of this dopamine is released which reinforces motivation linked to the use of these technologies. Secondly, individuals could experience reduced perceived effort. The enjoyment of the VR and AR exercises can make the workout feel less hard and tiring. The decreased perception of the effort that it takes to participate in the workout can make individuals want to keep exercising using these technologies. Lastly, after having had a positive and enjoyable experience with VR and AR workouts individuals might look forward to having this experience again. The anticipation of future pleasure will therefore reinforce their intention to continue using these technologies for fitness. Given these results gym owners and developers of gym equipment can use this information to make their services and products more enjoyable.

Besides PACES, the results also show that the perceived usefulness has a significant influence on TPB. When looking at the study of Safeena et al. (2013) it can be seen that the perceived usefulness also positively influences TPB. The research (Safeena et al., 2013) seeks to identify the determinants influencing consumers' acceptance of internet banking services and uses both TAM and TPB as models. While this research is primarily focused on an organizational context, perceived usefulness can still influence TPB in a non-organization setting, such as within the fitness industry. It is worth noting that the study by Safeena et al. (2013) also reported a positive influence of PEOU on TPB which, surprisingly, in this research no correlation has been found. However, a study by Lowry et al. (2012) does align with the results presented in this research. The research of Lowry et al. (2012) concludes that PEOU has no direct influence on TPB, but PEOU is mediated by enjoyment, perceived usefulness, and curiosity. The reason as to why no correlation has been found in this paper between these two variables, might be due to demographical factors or context. Future research might give more clarification regarding this topic.

The results of this research also demonstrate that this model has high predictability which means it is able to predict the future behavior of users of VR and AR in the context of fitness. This is valuable for a number of reasons. Firstly, it shows that the model is reliable and valid, and it verifies that the constructs are measured accurately. Secondly, these results show that the model can be a good tool for managers within the fitness industry to make well-informed decision concerning technology adoption and the design of their services. The decisions that can be made with this knowledge can increase customer retention, reduce costs, and improve user experience. Lastly, the predictability of the model can be valuable from an academic perspective. The model could serve as a foundation for future research that investigates the influence of VR and AR on the fitness industry. Even though the model is predictive, it still might not capture all factors that could influence the behavior of the target group. Future research could potentially validate this.

6. Conclusion

6.1. Theoretical contributions

This section presents the theoretical contributions which derived from the findings of this paper. This paper contributes to literature in several ways. First, this study may serve as a bridge to the gap between fitness behavior theories like BREQ-2 and technology acceptance theories like TAM. Second, this research advances current literature since little research has been done regarding VR and AR in fitness. The papers that do talk about VR and AR in fitness usually focus on mobile fitness applications, so this research took a different approach. Lastly, since hedonism is a factor that has significant influence on the users' intention to adopt VR and AR in fitness, this paper could contribute to refining the Technology Acceptance Model or similar models that do not include hedonism.

6.2. Managerial implications

The findings of this paper highlight the crucial role of hedonism in motivation and an individual's intention to continue using VR and AR for fitness. Besides this the results also revealed that that the perceived usefulness of VR and AR has a big influence on the user's intention to continue using these technologies for fitness. Since VR and AR technologies continue to grow and are becoming more popular in the fitness industry, understanding these factors is key. The following managerial implications suit as guidance for gym owners and other businesses as how they can leverage the potential of enjoyment to increase the motivation of their clients.

Firstly, it is important to develop and use VR and AR technologies that offer an engaging and fun experience. This can be done by implementing gamification elements and visually appealing content. Besides this, competition elements can be incorporated into these technologies to further increase motivation (Tauer & Harackiewicz, 2004). An example of technologies that already incorporate these elements is runBEAT (CSE, 2023) by the Finish company CSE entertainment. runBEAT is a gamified treadmill that lets you compete with other runners and work towards your goals or test your limits.

Secondly, it is recommended that gyms inform their (potential) clients about the usefulness of training with VR and AR. This can be achieved by showcasing the positive results achieved by others and highlighting the advantages of VR and AR training. Gyms should communicate these benefits through social media, integrated apps, and in-person demonstrations of VR and AR fitness equipment installed in their facilities. These approaches will engage clients and provide them with firsthand experience of these technologies.

Furthermore, social interactions should be encouraged. It is recommended that gym owners and VR and AR application developers incorporate features that will increase social interactions between users. Multiplayer exergames and leaderboards can be implemented to achieve this. An example of this is the augmented reality exergame that the Canadian tech company SAGA has developed. Their exergame turns the wall into a giant multiplayer game where players can throw real balls on the walls to break the blocks and gain points. This technology is already in use in schools in Quebec, Canada. The benefit if Saga's exergame as opposed to runBEAT, is that this exergame requires less capital and it can be used at different locations. In addition, Saga's exergame has a lower probability of equipment misuse and damage.

To maintain a good reputation of these technologies in the gyms, it is key to collect continuous user feedback. This can be done by implementing an analytics tool, which can also be used for other purposes. First, it can monitor user engagement and pinpoint which aspects of the VR/AR experience users like most. Second, it can track the performance of the user in real-time. This improves the quality of the workout, and it reduces the risk of injuries since it can directly provide guidance to the user to improve their form. Furthermore, the data obtained can personalize workouts to adapt to the needs of each user. Lastly, Staff needs to be trained to assist clients when using these technologies. This includes helping clients to put on the equipment, explain how the software works, and clearing up any concerns users might have regarding the technology. Clear communication is required to make sure users will feel at ease when using VR and AR in gyms.

According to the questionnaire results, 77% of respondents without prior experience with VR and AR in the context of fitness expressed a willingness to incorporate these technologies into their fitness routine. This is a big opportunity for gym owners to change their strategy so that it will attract and retain these interested potential clients. To achieve this some concerns, need to be addressed. The first concern is the cost. Nearly half of these respondents mentioned cost as their main worry. Gyms could offer trial memberships or exclusive discounts for the VR and AR

experiences to tackle this concern. Moreover, clear communication is important as mentioned earlier. 46% of these respondents mentioned that they have doubts about the usefulness of these technologies. Informing them through marketing campaign to clear their concerns is crucial at this point. 41% of these respondents also mentioned that they fear getting motion sickness. Managers can decrease these concerns by offering experiences that prioritize comfort and alternatives for those with motion sickness.

6.3. Limitations and future research

Despite all valuable insight that this research has provided, it is also subject to limitations. The first limitation is the sample size of this research. Even though the total sample size consists of 257 respondents, only 107 respondents had previous experience with VR and AR for fitness. This limited sample size causes a reduced statistical power and therefore might not represent the entire population. Moreover, this study mainly includes young adults (ages between 18 and 25 years old) with 65% and will therefore not sufficiently represent all age groups. Future research should consider using a larger and more diverse sample size to improve the external validity of the research.

This study neither includes an in-depth investigation of the external factors that might affect the use and effectiveness of VR and AR technologies in fitness. These factors may include the kind of device the respondent has used for VR and AR and the level of tech savviness of the respondent. Future research should consider these factors.

Another limitation of this research is the fact that the difference in behavior for VR and AR has not been analyzed. Future research can analyze this and compare the behavioral outcomes.

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8. Appendix

Appendix A

QR poster of the questionnaire

Translation: “Help me graduate by filling out this short survey! Thank you in advance!”

Appendix B

Questionnaire in English

Questionnaire template English

Duration of questionnaire: 2-5 minutes
Start fieldwork: 31-3-2023
End fieldwork: 6-7-2023

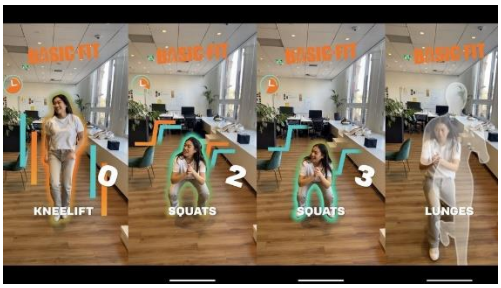
Introduction

[INFO]

Dear participant,
For my MSc. in Marketing at ISCTE-IUL, I investigate the impact of Virtual Reality (VR) and Augmented Reality (AR) in the fitness industry. That's why I'm asking you to take part in this survey. The survey only takes 2-5 minutes to complete, and all information provided is anonymous and confidential. If you agree with these terms and conditions you can continue to complete this survey, otherwise you can close the survey.
If you have any questions about the survey or research, you can contact me at Martina.jurrian@gmail.com

In case you are not familiar with the definitions of VR & AR I will give you the meanings here
- VR is a technology that immerses users in a computer-generated environment, usually through a headset. Examples include video games and training simulations on Oculus and Playstation VR.

(Beat saber on Oculus)
- AR adds digital information to the real world, usually through a smartphone or tablet. Examples include Snapchat filters and Pokémon Go.



(Basic Fit Snapchat Filter)

Screener question

Base: All respondents

Q1 [S]

I have used Virtual Reality or Augmented Reality for fitness purposes before

1. Yes
2. No

Base: If Q1= 1 (has used VR and AR before)

Q2 [S] (Basis: als Q1 = 1)

Which of the two previously mentioned technologies have you used for fitness purposes?

1. Virtual Reality
2. Augmented Reality
3. Both

Main questionnaire (has used VR and AR before)

Base: If Q1= 1 (PU & PEOU)

Q3 [MAXDIFF]

Please rate the following statements on a scale of 1 to 7 (1 being “completely disagree” and 7 being “completely agree”)

1. VR/AR helps me reach my fitness goals faster (PU)
2. VR/AR helps me improve my form during exercise (PU)
3. VR/AR motivates me to continue exercising (PU)
4. When using VR/AR during exercise, everything is clear and understandable (PEOU)
5. When using VR/AR while exercising, it’s easy to get it to do what I want (PEOU)
6. When using VR/AR while exercising, I encounter many technical problems (PEOU)

Base: If Q1= 1 (PACES)

Q4 [MAXDIFF]

The following statements are about the emotions you felt when you used VR/AR during exercise. (Indicate how you felt during the VR/AR workout, 1=completely disagree 7=completely agree)

1. I enjoyed it
2. I was bored

3. I didn’t like it
4. I found it pleasurable
5. It gave me energy
6. It made me depressed
7. My body felt good
8. It was useful
9. It was exciting
10. It frustrated me
11. It was not interesting at all
12. It gave me a strong feeling of success
13. I rather wanted to do something else

Base if: Q1= 1 (BREQ-2)

Q5 [MAXDIFF]

The following statements are about how motivated you felt when training with VR/AR. Please indicate how you felt during the VR/AR workout (1=completely disagree 7=completely agree).

1. I don't see why I should train with VR/AR (Amotivation)
2. I think exercising with VR/AR is a waste of time (Amotivation)
3. I exercise with VR/AR because other people say I should (External regulation)
4. I feel pressure from my friends/family to exercise with VR/AR (External regulation)
5. I feel guilty if I don't train with VR/AR (Introjected regulation)
6. I'm embarrassed when I miss a VR/AR training session (Introjected regulation)
7. I appreciate the benefits of training with VR/AR (Identified regulation)
8. I think it's important to regularly use VR/AR for fitness (Identified regulation)
9. I train with VR/AR because it's fun (intrinsic motivation)

Base: If Q1= 1 (TPB)

Q6 [MAXDIFF]

Please indicate how you felt during the VR/AR workout (1=completely disagree, 7=completely agree).

1. I think VR/AR workouts help me to reach my fitness goal (Attitude)
2. I believe VR/AR workouts are just as effective as traditional workouts (Attitude)
3. I feel like I should be exercising with VR/AR because it's the norm in my social circle (Subjective norm)
4. I can easily incorporate VR/AR into my fitness routine (Perceived Behavioral Control)
5. I feel uncomfortable when exercising in public with VR/AR (Perceived Behavioral Control)
6. I plan to use VR/AR regularly for fitness in the future (Behavioral Intention)

Main questionnaire (has NOT used VR and AR before)

Base: If Q1 = 2

Q7 [S]

Would you be open to using VR/AR for fitness?

1. Yes
2. No

Base: If Q1= 2

Q8 [S]

How likely are you to use VR/AR for fitness if it was accessible and affordable?

1. Very likely
2. Somewhat likely
3. Neutral
4. Somewhat unlikely
5. Very unlikely

Base: If Q1= 2

Q9 [M]

What concerns do you have about using VR/AR for fitness? (Select all that apply)

1. Costs
2. Nausea/Dizziness
3. Difficulty of use
4. The usefulness
5. Concerns about safety and injury
6. I don't have any worries [S]
7. Other, namely [O]

Base: If Q1= 2

Q10 [S]

What would be a reason for you to use VR/AR for fitness purposes?

1. It is fun
2. It helps me improve my form and technique
3. It motivates to continue my fitness journey
4. I do not want to use VR/AR for fitness

Demographic, Psychographic and Behavioral information

Base: all respondents

Q11 [S]

What is your gender?

1. Male
2. Female
3. Other

Base: all respondents

Q12 [O]

What is your age?
……

Base: all respondents
Q13 [S]
How often do you go to the gym?

1. 1 time per week or less
2. 2-3 times per week
3. 4-5 times per week
4. 6 or more times per week

Base: all respondents
Q14 [M]
What is the main reason you go to the gym? (max 2 options)

1. To lose weight
2. To gain muscle mass
3. To improve stamina and physical fitness
4. To socialize
5. Other, namely [O]

End of survey

Thank you for taking the time to participate in this survey.
Your answer has been registered.

If you came here via SurveyCircle, this is the Survey code: 4XWT-ZWN9-NLN2-KRM1
https://www.surveycircle.com/4XWT-ZWN9-NLN2-KRM1

Appendix C

Questionnaire in Dutch

Questionnaire template Dutch

Duration of questionnaire: 2-5 minutes
Start fieldwork: 31-3-2023
End fieldwork: 6-7-2023

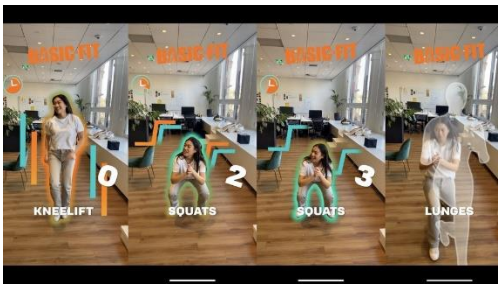
Introduction

[INFO]

Beste deelnemer,
Om mijn MSc. in Marketing bij ISCTE-IUL, doe ik onderzoek naar de impact van Virtual Reality (VR) en Augmented Reality (AR) in de fitnessindustrie. Daarom vraag ik je om deel te nemen aan deze enquête. Het invullen van de enquête duurt slechts 2-5 minuten en alle verstrekte informatie is anoniem en vertrouwelijk. Als je akkoord gaat met deze voorwaarden kan je verder gaan met het invullen van deze enquête, zo niet dan kan je de enquête afsluiten.
Als je vragen hebt over de enquête of het onderzoek, kan je contact opnemen met mij via Martina.jurrian@gmail.com

In geval je niet zeker bent van de definities van VR & AR geef ik je hier de betekenissen
- VR is een technologie die gebruikers onderdompelt in een door de computer gegenereerde omgeving, meestal via een headset. Voorbeelden hiervan zijn videospellen en training simulaties op Oculus en Playstation VR.

(Beat saber on Oculus)
- AR voegt digitale informatie toe aan de echte wereld, meestal via een smartphone of tablet. Voorbeelden hiervan zijn Snapchat-filters en Pokémon Go.



(Basic fit Snapchat Filter)

Screener question

Base: All respondents

Q1 [S]
Ik heb Virtual Reality of Augmented Reality al een keer eerder gebruikt voor fitnessdoeleinden

1. Ja
2. Nee

Base: If Q1= 1 (has used VR and AR before)

Q2 [S] (Basis: als Q1 = 1)
Welke van de twee eerdergenoemde technologieën heb je gebruikt voor fitnessdoeleinden?

1. Virtual Reality
2. Augmented Reality
3. Beide

Main questionnaire (has used VR and AR before)

Base: If Q1= 1 (PU & PEOU)

Q3 [MAXDIFF]
Please rate the following statements on a scale of 1 to 7 (where 1 is “completely disagree” and 7 is “completely agree”)

1. VR/AR helps me achieve my fitness goal faster (PU)
2. VR/AR helps me improve my form during exercise (PU)
3. VR/AR motivates me to continue working out (PU)
4. When using VR/AR during exercise everything is understandable and clear (PEOU)
5. When using VR/AR during exercise I find it easy to let it do what I want (PEOU)
6. When using VR/AR during exercise I encounter many technical problems (PEOU)

Base: If Q1= 1 (PACES)

Q4 [MAXDIFF]

1. Ik heb ervan genoten
2. Ik verveelde me
3. Ik vond het niet leuk
4. Ik vond het plezierig

5. Het gaf me energie
6. Ik werd er depressief van
7. Mijn lichaam voelde goed
8. Ik heb er iets aan gehad
9. Het was heel spannend
10. Het frustreerde me
11. Het was helemaal niet interessant
12. Het gaf me een sterk gevoel van succes
13. Ik had het gevoel dat ik liever iets anders zou doen

Base if: Q1= 1 (BREQ-2)

Q5 [MAXDIFF]

De volgende uitspraken gaan over hoe gemotiveerd u zich voelt bij het trainen met VR/AR. Geef aan hoe je je voelde tijdens de VR/AR-workout (1=helemaal mee oneens 7=helemaal mee eens).

1. Ik zie niet waarom ik zou moeten trainen met VR/AR (Amotivation)
2. Ik vind sporten met VR/AR tijdverspilling (Amotivation)
3. Ik sport met VR/AR omdat andere mensen zeggen dat ik dat zou moeten doen (External regulation)
4. Ik voel druk van mijn vrienden/familie om te sporten met VR/AR (External regulation)
5. Ik voel me schuldig als ik niet train met VR/AR (Introjected regulation)
6. Ik schaam me als ik een VR/AR-trainingssessie mis (Introjected regulation)
7. Ik waardeer de voordelen van trainen met VR/AR (Identified regulation)
8. Ik vind het belangrijk om regelmatig VR/AR te gebruiken om te sporten (Identified regulation)
9. Ik train met VR/AR omdat het leuk is (intrinsic motivation)

Base: If Q1= 1 (TPB)

Q6 [MAXDIFF]

Geef aan hoe je je voelde tijdens de VR/AR-workout (1=helemaal mee oneens 7=helemaal mee eens).

1. Ik denk dat VR/AR-workouts me helpen om mijn fitnessdoel te bereiken (Attitude)
2. Ik geloof dat VR/AR-workouts net zo effectief zijn als traditionele workouts (Attitude)
3. Ik heb het gevoel dat ik zou moeten sporten met VR/AR omdat het de norm is in mijn sociale kring (Subjective norm)
4. Ik kan VR/AR gemakkelijk in mijn fitnessroutine opnemen (Perceived Behavioral Control)
5. Ik voel me ongemakkelijk als ik in het openbaar train met VR/AR (Perceived Behavioral Control)
6. Ik ben van plan VR/AR in de toekomst regelmatig te gebruiken voor fitness (Behavioral Intention)

Main questionnaire (has NOT used VR and AR before)

Base: If Q1 = 2

Q7 [S]

Zou je ervoor open staan om VR/AR te gebruiken voor fitness?

1. Ja
2. Nee

Base: If Q1= 2

Q8 [S]

Hoe waarschijnlijk is het dat je VR/AR gebruikt voor fitness als het toegankelijk en betaalbaar was?

1. Zeer waarschijnlijk
2. Enigszins waarschijnlijk
3. Neutraal
4. Enigszins onwaarschijnlijk
5. Zeer onwaarschijnlijk

Base: If Q1= 2

Q9 [M]

Welke zorgen heb je over het gebruik van VR /AR voor fitness? (Selecteer alles wat van toepassing is)

1. Kosten
2. Misselijkheid/ duizeligheid
3. Gebruiksmoeilijkheid
4. De nuttigheid
5. Zorgen over veiligheid en letsel
6. Ik heb geen zorgen [S]
7. Other, namely [O]

Base: If Q1= 2

Q10 [S]

Wat zou voor jou een reden zijn om VR/AR te gebruiken voor fitness?

1. Het is leuk
2. Het helpt mijn vorm en techniek te verbeteren
3. Het motiveert me om door te gaan met fitnessen
4. Ik wil VR/AR helemaal niet gebruiken voor fitness

Demographic, Psychographic and Behavioral information

Base: all respondents

Q11 [S]

Wat is uw geslacht?

1. Man
2. Vrouw

3. Anders

Base: all respondents
Q12 [O]
Wat is uw leeftijd?
……

Base: all respondents
Q13 [S]
Hoe vaak gaat u naar de sportschool?

1. Minder dan 1 keer per week
2. 2-3 keer per week
3. 4-5 keer per week
4. 6 of meer keer per week

Base: all respondents
Q14 [M]
Wat is uw belangrijkste doel wanneer u naar de sportschool gaat? (max 2 opties)

1. Gewicht verliezen
2. Spiermassa kweken
3. Het verbeteren van uithoudingsvermogen en conditie
4. Om te socialiseren
5. Anders, Namelijk [O]

End of survey

Bedankt voor de tijd die u heeft genomen om aan deze enquête deel te nemen.
Uw antwoord is geregistreerd.

Ben je hier gekomen via SurveyCircle dan is dit de Survey code: 4XWT-ZWN9-NLN2-KRM1
https://www.surveycircle.com/4XWT-ZWN9-NLN2-KRM1

Appendix D

Profiling of respondents without experience with VR and AR

Table D1. Demographic, psychographic, and behavioral information of respondents without prior VR and AR experience

N=150	**Demographic**	**%**
Gender		
	Male	56
	Female	44
Age		
	18-25	66.4
	26-35	24.8
	36-45	4.7
	46- 55	1.3
	55>	2.7
Gym frequency		
	1 time or less per week	38.7
	2-3 times per week	38.7
	4-5 times per week	19.3
	6 times per week or more	3.3
Gym goal*		
	Lose weight	31.3
	Gain muscle	57.3
	Improve stamina and physical fitness	44
	To socialize	2.7

*Note: Percentages do not add up to 100% since this is multiple answer question.

Appendix E

Relevant information of respondents that have not used VR and AR before

Table E1. Would you be open to using VR/AR for fitness?

N=150	**%**
Yes	77.3
No	22.7

Table E2. How likely are you to use VR/AR for fitness if it was accessible and affordable?

N=150	**%**
Very likely	8
Somewhat likely	52
Neutral	11.3
Somewhat unlikely	16
Very unlikely	12.7

Table E3. What concerns do you have about using VR/AR for fitness? (Select all that apply)

N=150	**%**
Costs	46
Nausea/Dizziness	40.7
Difficulty of use	24
The usefulness	46
Concerns about safety and injury	16
I don't have any worries	7.3
Other, namely	2.7

Note: Percentages do not add up to 100% since this is multiple answer question.

Table E3. What would be a reason for you to use VR/AR for fitness purposes?

N=150	**%**
It is fun	33.3
It helps me improve my form and technique	28
It motivates to continue my fitness journey	18
I do not want to use VR/AR for fitness	20.7