

The Usability of the Virtual Reality Environment “Walk in Nature” for At-Home Use

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15EC Thesis

1st of July 2024

APA 7th Edition

Acknowledgements

To begin with, I would like to express my gratitude to my supervisors Dr. Christina Bode and Dr. Marcel Pieterse. Thank you, Christina, for providing help and feedback throughout the writing process, and challenging me to dive more into the literature. Thank you, Marcel, for the feedback, specifically regarding the final touches and analysis. The insights, especially in the last few weeks of the thesis project, were helpful. I would also like to thank Lucia Rabago Maye of the BMS lab for her technical support when something went wrong with the VR, and her patience in explaining the workings.

Furthermore, I want to thank Carmen Vulink, with whom I collaborated on with this project. I enjoyed working with you, and I want to acknowledge the support I experienced from you in this time.

Lastly, I would like to thank all friends and family who have supported me during this process, and the encouragement they gave me to finish it.

Abstract

Virtual reality has become a popular phenomenon in various areas, including the health care sector. For this purpose, a virtual reality environment called “Walk in Nature” (WiN) was developed in order to increase subjective vitality (Bareišytė, 2021). The present study researched the usability of the WiN environment when implemented at home, as well as potential barriers and concerns associated with implementing the VR, and the accompanying expectations. The study made use of a control group ($M_{\text{age}} = 21.9$, $SD_{\text{age}} = 1.14$, 46% female, 54% male) and an experiment group ($M_{\text{age}} = 21.3$, $SD_{\text{age}} = 0.9$, 75% female, 25% male). A survey which included questions of the UTAUT2 (Venkatesh, 2012) and open-ended questions was analysed to answer the research questions. Participants were students from the University of Twente and filled out the survey after trying the WiN VR environment. The mean scores of the constructs of the UTAUT2 were computed, which consisted of Performance Expectancy (PE), Effort Expectancy (EE), Facilitating Conditions (FC), Hedonic Motivation (HM), Habit (HT), and Behavioural Intention (BI). Spearman’s Rank correlation was computed between mean scores of BI and the other constructs of the UTAUT2. Resultingly, PE ($r(23) = .54$, $p < .01$) and HT ($r(23) = .80$, $p < .001$) were positively correlated with BI. Open questions were also included, which were analysed through thematic analysis (Braun & Clarke, 2006). Concerns were found regarding the available free space when using the VR environment, the set-up of the VR, and the provision of clear instructions. The VR environment could be developed more by adding exercises and modes to make it more engaging, as well as giving more variety in ways to use the WiN environment.

Keywords: virtual reality environment, usability, UTAUT2, home use

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Introduction

When receiving treatment or aid for illnesses or disabilities, most people prefer to recover and receive care at home, in a comfortable environment. For this reason, there has been a greater focus on providing at-home care for patients. However, there is often still guidance required in the recovery from health problems (Dostálová et al., 2021; Watz & Ingstad, 2022). A possible solution for this is Virtual Reality (VR), which has become increasingly popular in recent years (Lewis & Rosie, 2012). VR makes use of computer-modelled simulations that, in combination with a Head Mounted Display (HMD), can be used to create a three-dimensional environment (Lowood, 2024; Mehrfard et al., 2019). VR can be beneficial for various contexts at home, for example, the rehabilitation of motor skills and balance training after a stroke, muscle strength training, and physical fitness. Furthermore, at-home use of VR offers the possibility to better assess and train cognition by performing exercises in a safe and controlled manner (De Rooij et al., 2016; Huygelier et al., 2019; Qian et al., 2020). While the use of VR presents numerous opportunities for self-help at home, there is still a lack of information regarding the necessary requirements for achieving a successful implementation.

Usability Model

To research the needs of individuals for the implementation of VR at home, the extended Unified Theory of Acceptance and Use of Technology (UTAUT2) can be applied. The model proposes that the adoption of technology is determined through behavioural intention (Venkatesh et al., 2003; Marikyan & Papagiannidis, 2023). In particular for VR use, the factors performance expectancy and effort expectancy are relevant. These imply that individuals who perceive VR as beneficial to them and usable without too much effort may be more likely to adopt the VR. Furthermore, the users' attitude toward VR is influenced by their anticipated enjoyment (Fussell & Truong, 2021). In relation to Health Psychology, it is important for individuals to perceive their efforts in VR as a positive impact on their health, while ensuring it does not require excessive effort. Additionally, it is vital users know how to successfully implement VR environments, which is referred to as the facilitating conditions. A lack of knowledge on exercises in VR causes uncertainty in the usage and the patient's own ability to perform them (Palazzo et al., 2016). In addition to the factors included in the model, age, gender, and experience also moderate an individual's usage of the technology (Kunz & Santomier, 2019; Venkatesh et al., 2012). The UTAUT2 is an extension on the UTAUT and puts more focus on the user. The factors hedonic motivation, habit and price value were added to the original UTAUT (Venkatesh et al., 2012). According to Hartl and Berger (2017), the UTAUT2 is a suitable model for investigating VR, and the aforementioned factors may play a role in the

continued use of VR. The adoption of VR use is highly influenced by the hedonic motivation that comes with VR (Hartl & Berger, 2017; Kunz & Santomier, 2019). It is therefore important for the users to enjoy using a VR environment and its tasks. Furthermore, it is important for users to establish a routine in which they use the VR technology, as it positively effects the intention of using VR (Hartl & Berger, 2017).

To sum up, based on the model approach UTAUT2 discussed above, the factors that have the most influence on the attitude towards VR, and the adoption of usage, are the performance expectancy, effort expectancy, hedonic motivation, and habit. When implementing the use of a VR environment in the home of participants, it important to consider how these factors can be addressed.

Walk in Nature VR Environment

In 2021, the VR environment “Walk in Nature” (WiN) was developed for thesis research in order to improve subjective vitality. The environment consists of a walk in a forest environment and three tasks. In the first task, the breathing tree, the user was required to do breathing exercises to heal a sick-looking tree build in the environment. The second task involved a butterfly exercise (see Figure 1 and 2), in which the user had to touch various butterflies around them for the butterflies to fly away. The last task was a series of yoga exercises, where the user was presented with a yoga sequence, coached by a yoga instructor (see Figure 3 and 4).

Figure 1

Butterfly Exercise Instructions Control Group

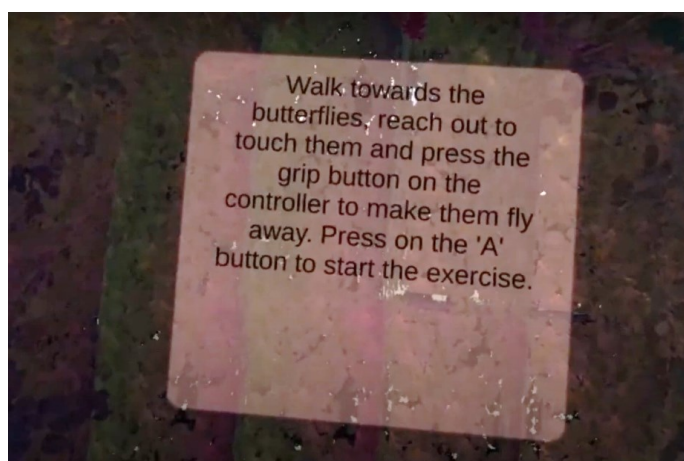


Figure 2

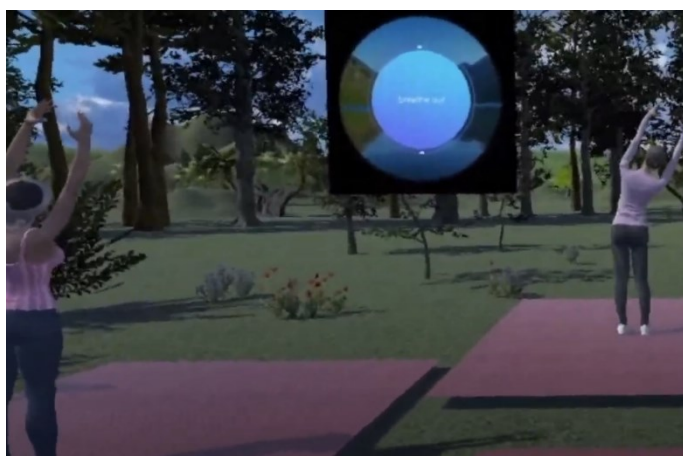
Grabbing the Butterflies

**Figure 3**

Yoga Exercise Instructions Control Group

**Figure 4**

Start of Yoga Exercise



Usability research indicated that the users of the WiN environment were able to experience immersion and being present, but some improvements could be made. Furthermore, effectiveness pilot studies revealed that participants showed improved subjective vitality and reduced tense arousal, but no change in energetic arousal (Bareišytė, 2021).

When relating the previous findings of the models to the “Walk in Nature”, it becomes clear that it is important for users to believe that the tasks will be beneficial for them. A study done by Halbig et al. (2022) showed that this is connected to the ease of use of an VR environment, along with the amount of instruction and support users receive while using the environment. It is thus important that clear information is provided regarding how the VR environment and headset works, as well as the benefit of the tasks for an individual’s health improvement. This also ties into the hedonic motivation, as the users should feel that performing the tasks aids them with their problem, rather than the problem becoming worse or the performance to be ineffective at all. Lastly, forming a habit is important in the use of a “Walk in Nature”. Continued use of the butterfly and yoga exercises can improve mobility, which is beneficial to the user. However, if the user does not perform the task habitually, it will not have any effect, which in turn may also decrease perceived usefulness.

There are several aspects to the implementation of the Walk in Nature environment in a home environment that need to be considered. First, the VR environment should be adjusted so that it is able to be used in an at-home setting, instead of a controller environment. This also includes keeping in mind factors such as the available free space. Furthermore, it is important that users are monitored, at minimum for the initial use of VR (Threapleton et al., 2016). This is due to safety reasons, as well as monitoring the progress users make (Miller et al., 2014; Threapleton et al., 2016). Furthermore, the provision of clear instructions regarding the set-up of the environment can facilitate the independent use of the VR environment (Threapleton et al., 2016).

Present Study

With these findings in mind, it is important to research how to implement the “Walk in Nature” environment for users at home. While the VR environment is now functional, it has not yet been researched how the “Walk in Nature” could be implemented, in order to be used in the home environment. For that reason, this study aims to determine what factors determine the behaviour intention of using the VR environment at home. It will make use of a control and experiment group, who will receive different instructions before and during the try-out of the WiN environment. Afterwards, the UTAUT2 will be administered. The research questions are as follows:

- 1) What factors are correlated with the intention of participants to adopt the “Walk in Nature” VR environment?
- 2) What are the potential barriers and concerns associated with implementing the VR environment for at-home use?
- 3) What do participants express to expect to be necessary for the VR environment to work for at-home use, as well as the results of using it?

Methodology

Participants

The sample included 25 participants, aged between 20 to 24 ($M = 21.56$, $SD = 1.04$). The participants included 10 males and 15 females, with 11 being Dutch, 9 German, and 5 other nationalities. The participants were acquired through convenience sampling. The inclusion criteria for participants were being over the age of 18 and having a proficiency in English. Individuals with medical conditions and/or sensitivities that can be aggravated by Virtual Reality were excluded from the study. The procedure is in accordance with the guidelines of the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences at the University of Twente (request nr: 240588). The participants were informed of the research purpose and gave their informed consent. Participants were able to participate in the research through the university’s Sona System and were able to gain 2 Sona credits.

Materials

The “Walk in Nature” VR-environment was used for this research. The VR environment was used via the Oculus Quest 2 HMD, which was connected with a Powerlink cable to a Dell Alienware laptop. The VR environment itself was developed with Unity. The participants were provided with an A4 paper containing text with instructions regarding VR, adopted from Coolblue (2024), and an instruction video. Furthermore, a survey was created in order to test the attitude of participants regarding the VR environment. The survey included 18 questions based on the UTAUT2, and three open questions. As the experiment was done in collaboration with another bachelor student focusing on the needed instruction for self-use of the VR environment, the survey also included the System Usability Scale (SUS) with 10 questions, as well as a knowledge test regarding the necessary steps in setting up a VR environment. The questions regarding Price Value and Social Influence of the UTAUT2 were left out, as this is not applicable with the WiN environment currently. The remaining constructs of the UTAUT2 are explained in Table 1. A Likert scale ranging from 1 to 5 with the values of “strongly disagree” to “strongly agree” was used for measurement. High scores on the Likert scale relate

to high scores on the constructs of the UTAUT2. In other words, the higher the score, the more the technology is seen as favourable. The used questionnaire can be found in Appendix A. The survey was provided to the participants through Qualtrics (<https://www.qualtrics.com>).

Table 1

Explanation Constructs of UTAUT2

Constructs UTAUT2	Meaning
Performance expectancy (PE)	The expectation of the degree to which the technology will help the user accomplish their goals.
Effort Expectancy (EE)	The perceived ease of use required to use the technology properly.
Facilitating Conditions (FC)	The expectation of the degree to which the users believe in the existence of organisational and technical infrastructures supporting the use of the technology
Hedonic Motivation (HM)	The perceived pleasure from using the technology
Habit (HT)	The degree to which users expect to perform tasks of the technology automatically.
Behavioural Intention (BI)	The intention to use a certain technology

Note. Venkatesh et al., 2003; Venkatesh et al, 2012

Procedure

Design

Participants were informed they would be trying out a VR environment. The study was done in collaboration with another bachelor student, so the experiment included an experiment and control group, as this was necessary for the other bachelor thesis. The participants were randomly assigned to one group. The experiment started with the discussion of the possible ethical issues and confidentiality. On the laptop provided, participants then gave their informed consent and filled in the demographic questions through the survey on Qualtrics. Afterwards, the control group received an A4 paper containing instruction describing steps needed for setting up and using a VR headset. The paper also included a picture of what the used VR controllers look like, along with an overview of the buttons. Additionally, the paper contained

more information regarding the WiN environment, and under which circumstances it would be used. The experiment group received an adapted A4 paper, with the explanation of the WiN environment on it, as well as some of the steps needed for set-up. Furthermore, a QR code was present on the paper, leading the participant to a video containing the remaining steps, with a voiceover further explaining what is happening in the video. Both instruction papers can be found in Appendix B.

After reading/watching the instructions, participants were able to try out the VR environment. The participants in the experiment group received more detailed instructions on the text boxes in the WiN VR environment itself, as well as added audio files with extra instructions. For the control group, the instructions in the VR environment stayed the same. After trying all the tasks of the WiN environment, participants were asked to fill in the rest of the survey via Qualtrics on the laptop provided.

Analysis plan

The raw data obtained from Qualtrics was imported to RStudio. Firstly, the descriptive statistics of the participants were analysed, which included demographic information such as age, gender, and nationality.

The first research question, “What factors are correlated with the intention of participants to adopt the “Walk in Nature” VR environment?” was analysed by computing the mean score for each construct. The mean scores were calculated for all participants together, as well as the control and experiment group respectively. This was done to see how the constructs scored in relation to the VR environment. Furthermore, as the survey made use of a Likert scale, Spearman’s Rank Correlation was used to measure the relation between BI and the other constructs, respectively. As the questionnaire did not include the same number of questions for each construct, the mean scores of the constructs were calculated for each participant. These resulting mean scores were then used to calculate Spearman’s Rho.

The second, “What are the potential barriers and concerns associated with implementing the VR environment for at-home use?”, and third research question, “What do participants express to expect to be necessary for the VR environment to work for at-home use, as well as the results of using it?”, were answered through the text analysis of the open questions, “Are there any barriers/concerns that you found that could hinder the implementation of the environment for at-home use?”, “What kind of expectations would you have regarding the at-home use of this VR environment?”, and “Is there anything else you would like to mention regarding the implementation of the VR environment for at-home use?”. The last question was not mandatory, as it was asked to give participants an opportunity to mention anything that

could not be said before. The text analysis was done through the thematic analysis developed by Braun & Clarke (2006). This analysis follows six steps, namely: (1) familiarisation with the data, (2) generation of codes, (3) generation of themes, (4) review of themes, (5) definition and naming of themes, (6) production report (Braun & Clarke, 2006). The code used in RStudio, and the resulting coding scheme can be found in Appendix C.

Results

Demographic statistics

The demographic data of the participants are shown in Table 2.

Table 2
Demographic Statistics Participants

	Instruction (N=13)	No Instruction (N=12)
Age (years)	21.9 (SD = 1.1)	21.3 (SD = 0.9)
Gender		
Male	7 (54%)	3 (25%)
Female	6 (46%)	9 (75%)
Nationality		
Dutch	6 (46%)	5 (42%)
German	5 (39%)	4 (33%)
Other	2 (15%)	3 (25%)
How often do you use VR?		
Never	1 (8%)	2 (17%)
I have tried it once	5 (39%)	2 (17%)
I have tried it a few times	6 (46%)	8 (67%)
1-5 hours a week	1 (8%)	0 (0%)
What social media do you use? ^a		
Instagram	12 (92.3%)	10 (83.3%)
Snapchat	7 (53.8%)	5 (41.7%)
TikTok	3 (23.1%)	8 (66.7%)
YouTube	12 (92.3%)	10 (83.3%)
Reddit	3 (23.1%)	4 (33.3%)
Pinterest	5 (38.5%)	7 (58.3%)

Note. The variable age is numeric, with the table showing the mean, and the standard deviation in brackets. The rest of the variables show the number of participants who selected the option, with the percentage in brackets.

^a Participants could select multiple options on this question. The answers ‘X’, ‘Facebook’, ‘Threads’ and ‘Tumblr’ are not mentioned here, as only one participant or less had chosen those options.

Constructs correlated with Behavioural Intention

To answer the first question, “What factors are correlated with the intention of participants to adopt the “Walk in Nature” VR environment?”, the results of the UTAUT2 were analysed. The mean scores for the different items of the UTAUT2 are shown in Table 3. It can be seen that participants found the VR environment easy to use (EE), believe that they have enough support available for using the environment (FC), and experience pleasure from using the environment (HM). On the other hand, participants do not feel like the VR environment will help achieve their goals well (PE), and do not think they will use this VR environment automatically in the future (HT).

Table 3

Mean scores of the usability constructs using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Constructs	Cronbach’s Alpha	Mean	SD
Performance Expectancy	0.9	2.6	1.2
<i>Control Group</i>	0.8	2.4	1.1
<i>Experiment Group</i>	0.9	2.8	1.3
Effort Expectancy	0.9	4.3	0.7
<i>Control Group</i>	0.9	4.1	0.6
<i>Experiment Group</i>	0.9	4.4	0.8
Facilitating Conditions	-	4.0	1.2
<i>Control Group</i>	-	3.8	1.3
<i>Experiment Group</i>	-	4.2	1.2
Hedonic Motivation	0.9	4.2	1.0
<i>Control Group</i>	0.9	4.1	1.1
<i>Experiment Group</i>	0.9	4.3	0.8

Constructs	Cronbach's Alpha	Mean	SD
Habit	0.6	2.3	1.3
<i>Control Group</i>	0.2	2.1	1.0
<i>Experiment Group</i>	0.7	2.1	1.2
Behavioural Intention	0.9	2.4	1.3
<i>Control Group</i>	0.8	2.6	1.1
<i>Experiment Group</i>	0.9	2.2	1.3

Spearman's Rank Correlation

The results of the Spearman's rank correlation of the relationship between the Behavioural Intention construct and each of the remaining constructs is presented in Table 4. It shows that the expectation of the extent to which the WiN environment can help participants achieve their goals (PE) and the expectation that participants will perform the tasks automatically (HT) are positively correlated with the intention to use the WiN environment. PE shows a moderate positive correlation with BI, and HT a strong positive correlation. On the other hand, the perceived ease of use (EE) and the expected support surrounding the VR environment (FC), and the perceived pleasure of users (HM) do not show a significant correlation with behavioural intention.

Table 4

Spearman's Rank Correlation between means BI and remaining constructs

	PE	EE	FC	HM	HT
BI	.54	-.07	-.29	.34	.80
p-value	< .01	.75	.16	.09	<.001

* p = 0.05, df = 23

Barriers and Concerns associated with Implementation

After analysing the responses on the open questions, various themes could be found. The coding scheme used can be found in Appendix C. All answers to the open questions can be found in Appendix D. Firstly, the open question "Are there any barriers/concerns that you found that could hinder the implementation of the environment for at-home use?".

Free space

The most prominent concern participants had was the possibly lack of free space users could experience. For example, participants responded with the following:

“I think a lack of space or ability to make space to not have any barriers in the way could be a barrier for some, especially if you want to use it for exercising where you need a good amount of space. (...)” (P208) and *“You need a lot of free space to use it at home, sometimes it could be problematic.”* (P103).

Set-up VR Environment

Next, participants expressed concerns regarding the set-up of the environment. It may be difficult to set up the VR technology as needed, especially for people struggling with technology, such as elderly.

“I think for most people under the age of 40 there are no big barriers when implementing the environment at home. However, I could see that people older than 40 could struggle with setting up the software, maybe even struggling to install it correctly and open it. My grandmother is 80 and I am pretty sure she would never be able to set up the VR without outside help.” (P209) and *“(…), it may be difficult for older generations to use the VR environment at home without someone's help in order to correctly and efficiently use it.”* (P212).

Movement hindrance

The VR headset itself also hinders the movement of participants and makes specifically the yoga task difficult to perform. Moreover, participants had difficulty with performing the yoga exercises as they were unable to see what they were doing.

“The yoga exercise felt a bit hard to do, since your own limbs are not visible while using the VR headset, it is hard to see what you are doing.” (P104) and *“I perceived the feeling of wearing the VR glassed uncomfortable. It felt heavy and hindering for the movements.”* (P211).

Instructions

Various participants also indicated the need for good instructions. For example, one participant said to always need to have an instruction sheet available:

“I would still need an instruction sheet to have at all times because I tend to be forgetful and might have difficulty connecting the VR headset with the computer.” (P102).

Furthermore, there seems to be a concern for good instructions for elderly or less technologically experienced individuals, for example:

“Furthermore, it may be difficult for older generations to use the VR environment at home without someone's help in order to correctly and efficiently use it. Therefore, depending on the environment, this can change the experience of activities and effectiveness towards the users.” (P212) and *“I think the tutorial was good but people who are not experienced with technical devices might be overwhelmed and need help still.”* (P208).

Motion sickness

Lastly, participants indicated motion sickness might be a small barrier, as it can make the user potentially stop using the VR environment:

“The technical usability as somethimes [sic] not so smooth, I can imagine that it makes people nauxious [sic]” (P107) and “(...) The motion sickness might be a small barrier, as the motion sickness can cause a user to stop using the VR for a while.” (P209).

Expectations associated with Implementation

Ease of use

After analysing the second open question “What kind of expectations would you have regarding the at-home use of this VR environment?”, it was seen the ease of use is a recurring theme. Participants stated that in order for the VR environment to be effective at home, it should be user-friendly, which is the experience of several participants.

“Should be easy to use (which it is).” (P204) and “(...) The environment seems easy enough to use that most users should not experience much of a barrier to using it.” (P111).

However, P105 indicated the opposite. Instead, people would find it difficult, specifically due to the technology:

“(...) For a lot of people it will be difficult to figure out the technological aspect. While it may seem quite easy if you are used to it. I think that a lot of people will find it difficult and might even be put off completely.”.

Instructions

With this question, participants once again highlighted the need for clear instructions. A few participants from the control group stated that the instructions should be more detailed, with one participant describing the need for a video guide:

“I would expect more detailed instructions” (P103) and “I believe it would need a video guide rather than just a guide written out on paper. Some people are visual learners and need a semi real life demonstration to start using something like this.” (P112)

One participant suggested that it would also be helpful to have a hotline or professionals on standby in order to provide guidance in case of questions regarding the VR environment.

“I think there should be ideally a hotline or professionals who can help set it up if needed.” (P208).

Set-up Environment

As with the previous open question, participants expressed the importance of the VR environment being easy to set up at home, accompanied by easy instructions.

“I would expect it to be very easy to set up, which was also the case in the experiment.” (P205) and *“easy instructions to make its use clear and easy to implement at home with my knowledge.”* (P206).

User Experience

Participants also expressed various expectations regarding the experience of using the VR environment. For example, participants expect it to be more comforting, fun, and relaxing experience to use at home:

“For at-home use, I expect that the use of the VR environment would be more comfortable; being in the comfort of my home, doing things at my own pace, I believe I can make use of VR well-being environments more effectively.” (P203) and *“The at home use of this VR environment can provide a fun and relaxing experience for people.”* (P104).

Additionally, participants think that the VR environment could help individuals do more at home than before:

“I expect it to be of help for people to be able to do a lot more from home than they could before.” (P207).

On the other hand, one participant expressed their expectation being lowered due to the VR headset itself:

“I would expect it to be used to help replicate meditation/yoga practices but again, my expectations of it running successfully is somewhat lowered because I’d have to do them with the headset.” (P108).

Usage

Participants stated the VR environment could be a good alternative for individuals who cannot go outside, if there is no other option:

“For people who can't go outside, this is a decent option. I myself would rather go outside, since the current vr experience in general is not amazing yet.” (P202) and *“It could help during the times of year when the weather outside is really depressing. In summer I would expect that going outside would have a better effect. The environment seems easy enough to use that most users should not experience much of a barrier to using it.”* (P111).

One participant also conveyed a desire for different kind of movement and exercises, as well as a differentiation in exercises that require less noise and/or space. This again ties into the concern regarding the lack of space.

“There should also be different kinds of movement and levels and ideally modes that do not make too much noise while moving or do not need as much space if possible.” (P208).

Exercises

The last open question “Is there anything else you would like to mention regarding the implementation of the VR environment for at-home use?”, one participant made it known that they had a more favourable experience with the butterfly exercise than the yoga exercise:

“I liked the butterfly task much more than the yoga task and I believe the butterfly task is more suitable to at-home physical therapy. The yoga task is better suited without a headset, and it would be better to do these yoga exercises e.g. via a YouTube video rather than VR.” (P212) and *“I think many people also like the aspect of imagining things so I believe it is more useful for yoga than meditation exercises.”* (113).

Usability

On the other hand, few participants also stated that the VR environment and its exercises is not for everyone:

“For me, the fact you cant see yourself is weird. Using mainly audio could be a more comfortable option.” (P202) and *“I think the VR set has a lot of potential to be implemented for at-home use, but the butterflies and the yoga is not for everyone i think, because i personally didn't really enjoy it that much or see myself doing it that frequently.”* (P205).

Again, participants mentioned it is a good alternative if an individual is unable to go outside and exercise, but would rather go outside themselves:

“As I also mentioned during my questionnaire. I really enjoy VR, I think it is really fun. However, at this point in my life, where I am still capable of going outside and exercising outdoors, this has my preference. Other than for gaming and entertainment, for which I have easier and less expensive resources, I do not see VR becoming a big part of my life for the foreseeable future.” (P105) and *“I think it is a very good idea specifically for people who dont want to go out of their house to yoga classes or do not feel comfortable attending them, as well as for people who like to kind of be out of reality for some time, it distracts you from stress in the real world and make you stop thinking about anything else that is going on in your head.”* (P109).

On the opposite side, participants could see this VR environment having potential and being used in the future:

“I think the potential is great and the usage enjoyable.” (P208) and *“All in all, environment is already really user-friendly and exciting, so I could imagine that in the future there are more and more people using it.”* (P209).

Discussion

The current study aimed to research what factors determine the behaviour intention of using the Walk in Nature VR environment. This research builds on existing research of Bareišytė (2021), to see how the developed “Walk in Nature” VR environment should be implemented for at-home use. It focused on the correlation between the constructs of the UTAUT2 when using the WiN environment, and the potential barriers, concerns and expectations associated with implementing the VR environment at home. Based on the quantitative and qualitative analysis of the survey regarding the usability of the WiN VR environment, it can be concluded that the environment is easy to use, has enough support to be used, and is experienced as pleasurable, while it does not help with achieving goals, nor do participants feel they can form a habit out of using the VR environment.

Constructs correlated with Behavioural Intention towards usage WiN

As stated by Fussell & Truong (2021), the factors effort and performance expectancy of the UTAUT2 are relevant for the adoption of VR use, as well as their anticipated enjoyment. As Toyoda et al. (2023) found in their study, effort expectancy and hedonic motivation influence the behavioural intention. It was stated that if users perceive the VR as easy and fun to use, users are more likely to adopt the technology. This is further supported by research by Williams et al. (2008), in which it was found the more pleasure was experienced during exercise, the more it is likely that the exercise will be continued in the future. Partially in line with these three studies, it was found in the current research that performance expectancy has a positive relation with the behavioural intention for usage of the WiN environment. On the other hand, a significant relation could not be found for effort expectancy and hedonic motivation. However, habit was also found to have a strong positive correlation with behavioural intention, which could also be found in research done by Huang (2023).

Moreover, while the WiN environment was found to be experienced as enjoyable, and the correlation between behavioural intention and habit became clear, it was also seen in this research that the expected ability to form a habit was less likely. A possible explanation for the inability to form a habit of using the WiN environment is the tasks themselves, which may be perceived as boring after long term use, potentially leading to users’ avoidance of using this VR environment any further (O’Hanlon, 1981). Though, this research’s participants consisted of young adults who, most likely, have an affinity with technology already. According to Groenveld et al. (2022), it may be that elderly people would find the WiN environment more interesting, as this could be a new experience for them.

As found in a literature review by Mouatt et al. (2020), research indicates VR exercise is less enjoyable and pleasurable compared to actual outside exercises. This may relate to the lack of perceived benefits found in this research, as with the option of going outside still being available, users might rather choose that option than use a VR environment. Identified reasons for this preference were the greater immersion and distraction outdoor exercises poses compared to VR exercises (Mouatt, 2020). Thus, this could also have affected the response to the questions regarding habits and behavioural intention. In that case, an improved of the surroundings of the WiN environment would be a consideration.

Barriers and Concerns

In this current study, various insights on the barriers and concerns were found which, after improvement, could lead to a better implementation of the WiN environment. Particularly, available free space was found to become a problem for the use of this VR, as was also mentioned in Threapleton et al. (2016). A possible solution to this problem could be the addition of different modes, which could, for example, involve less walking around. For the butterfly task, this could mean having the butterflies closer to the user, and only having the user turn around, and moving up and down. As the yoga exercises already require the user to stand in one spot, it should not be an issue for this task. The addition of different modes could also aid in the solving of the factor of habit forming. When the possibility of having different exercises and modes, individuals are less likely to experience boredom, making the environment more interesting to keep using. The addition of different modes could provide more challenges, and in turn more motivation to keep using the VR environment, as well as possibly decrease boredom (Nor et al., 2020).

In line with the systematic review done by Miller et al. (2014), there is a need for monitoring the use and progress of VR environment, and support for possible occurring problems. The current study confirmed to some degree that at-home use of VR may require the option of additional instructions and support, specifically for individuals that experience more trouble with VR. This support could, for example, be given in the form of a hotline. As Threapleton et al. (2016) mentioned, the use of illustrations to explain how to set-up the environment is more helpful towards a successful implementation than only text. This was also supported in the current study, with only the control group mentioning the need for an improvement in the instructions. It was thus indeed found that the instructions using a video explanation is more helpful in understanding than only an instruction sheet. Furthermore, the use of visual and audio instructions could also potentially improve the perceived usefulness (Halbig et al., 2022). Although these instructions were an improvement, it was not found

whether this current explanation is enough for people with less technical knowledge, who possibly could experience more trouble.

Expectations for Implementation

In this study, it was also found that the WiN environment could provide a relaxing, fun, and comforting experience for users at home, although, it was not clear what exactly made the environment pleasurable. However, in a study by Chan et al. (2023), which also involved a nature VR environment, it was found that a nature environment itself can reduce negative emotions, thus providing a relaxing experience. This could potentially be an explanation for the found experiences. Lastly, it was also seen that the butterfly task is found to be more suitable for at-home use than the yoga tasks. This may have been due to the fact that the headset hinders movement, making the yoga exercises more difficult to perform.

Strengths and Limitations

Various strengths were identified in this research. Firstly, not many studies have been conducted regarding the implementation of VR for usage at home. Therefore, this study contributes to filling the gap in existing body of research. Furthermore, the use of the UTAUT2 has also shown to be beneficial. The UTAUT2 covers various important aspects of the intention to use VR, and in combination with the feedback received from participants, has highlighted areas of improvement of the WiN environment.

There were however also limitations within this study. Firstly, the research was done in regard to how the WiN environment could be implemented for at-home use. However, a home situation was not simulated, but instead participants were asked to answer the questions of the survey imagining they were using it at home. Using the VR environment in a home (simulation) could influence the study results as there are various factors, such as roommates or pets, that were now controlled. Furthermore, the sample size used in the study was quite small for the UTAUT2 questionnaire. This could have reduced the validity of the results. However, for the open questions the sample size of 25 was sufficient, as between 9 and 17 interviews should be an adequate amount for good saturation (Hennink & Kaiser, 2022). Additionally, the participants were all students, possibly not making them the target group for this VR environment. If a target group sample was indeed used, they may possible have scored higher on performance expectancy, and making the results more valid.

Future directions

While increasingly more popular, the body of research of the at-home use of VR regarding health interventions is quite small. The current study contributes to the current knowledge of these VR studies by highlighting potential challenges and considerations that may

be helpful in improving the usability of VR environments, such as the “Walk in Nature” environment. Furthermore, it expands on the existing research regarding the use of UTAUT2 in predicting the behavioural intention of using technology. Here, it was found that performance expectancy and habit have a positive correlation with behavioural intention. Future research could focus on the usability of the WiN environment in an actual home environment, or simulation, as this current study was unable to. It would then be possible to research more in depth how VR could be used effectively in at home, along with investigating whether the outcomes of the UTAUT2 would differ from the current study.

While the “Walk in Nature” environment is heading in the right direction, there are still some areas of improvement which could be developed further. First, making the “Walk in Nature” environment more appealing. As said before, this could be achieved through the addition of more exercises or modes. As of now, the butterfly and the yoga tasks only have one mode. It would be an idea to add variety in the exercises, in order to make it more pleasurable and aid in habit forming. For the butterfly task, this could mean changing the environment, or making it more difficult/easy by changing the number of butterflies and where they are placed. As for the yoga task, this could be done by changing the yoga exercises itself and adding more variety. Furthermore, it could be nice to add difficulty levels, in order for a more advanced user to have more of a challenge, and for a beginner to start easier. Additionally, in this research, it became clear various users found the VR environment pleasurable and fun to use. However, it was not clear what elements exactly were the reason for these experiences. In the future, it could be investigated whether the exercises of the WiN environment themselves caused this perceived pleasure, or whether it was due to another factor, such as the use of VR in general.

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Appendix A

Questions Survey

Table A1 contains the questions used in the survey. The questions are adapted from the UTAUT2 (Venkatesh et al., 2012).

Table A1

UTAUT2 and open questions

Questions	Construct
I would find the VR environment useful in my daily life.	PE1
Using the VR environment would increase my chances of achieving things that are important to me.	PE2
Using the VR environment would help me accomplish my goals more quickly.	PE3
Learning how to use the VR environment is easy for me.	EE1
My interaction with the VR environment is clear and understandable.	EE2
I find the VR environment easy to use.	EE3
It is easy for me to become skilful at using the VR environment.	EE4
I have the knowledge necessary to use the VR environment.	FC2
Using the VR environment is fun.	HM1
Using the VR environment is enjoyable.	HM2
Using the VR environment is very entertaining.	HM3

I could see the use of the VR environment becoming a habit for me.	HT1
I could see getting addicted to using the VR environment.	HT2
I could see myself must using the VR environment.	HT3
I could see the VR environment becoming natural to use to me.	HT4
I would intend to continue using the VR environment in the future.	BI1
I would always try to use the VR environment in my daily life.	BI2
I would plan to continue to use the VR environment frequently.	BI3

Are there any barriers/concerns that you found that could hinder the implementation of the environment for at-home use?

What kind of expectations would you have regarding the at-home use of this VR environment?

Is there anything else you would like to mention regarding the implementation of the VR environment for at-home use?

Appendix B

Instruction sheets

Instructions VR Environment In this appendix the instructions for the control group and the experiment group are shown. The steps used in the instructions are adopted from Coolblue (2024).

Control Group

Previous research has shown that the Walk in Nature (WiN) VR-environment improves the well-being of its users and decreases their stress and anxiety. Because of this, the WiN intervention could be a useful tool when people are dealing with things such as chronic fatigue. The goal of this current study is to investigate how the WiN environment can be applied to an at-home situation where the user would have to use it completely independently. For this purpose, we are investigating the experiences of users with the intervention and how instructions influence these experiences.

When you put on the VR-headset, you will experience a simulation of a nature environment that includes the default starting environment and 2 tasks. The researchers will be manually switching you between these tasks, so please close your eyes when this happens in order to prevent nausea. The VR-headset can be put off again after the last task, the yoga exercise, is finished.

During the entire duration of this study, it is important that you imagine yourself in the following scenario:

You were provided with a VR-intervention called the 'Walk in Nature' and were asked to try it out at-home with the aim of using it regularly. When you open the box, you have been given, you see the following: a VR-headset with controllers, a cable, a charger, a laptop, and this instruction sheet. You now have to set-up and start using the intervention completely on your own, with the help of the instruction sheet.

Instructions on the use of the VR intervention

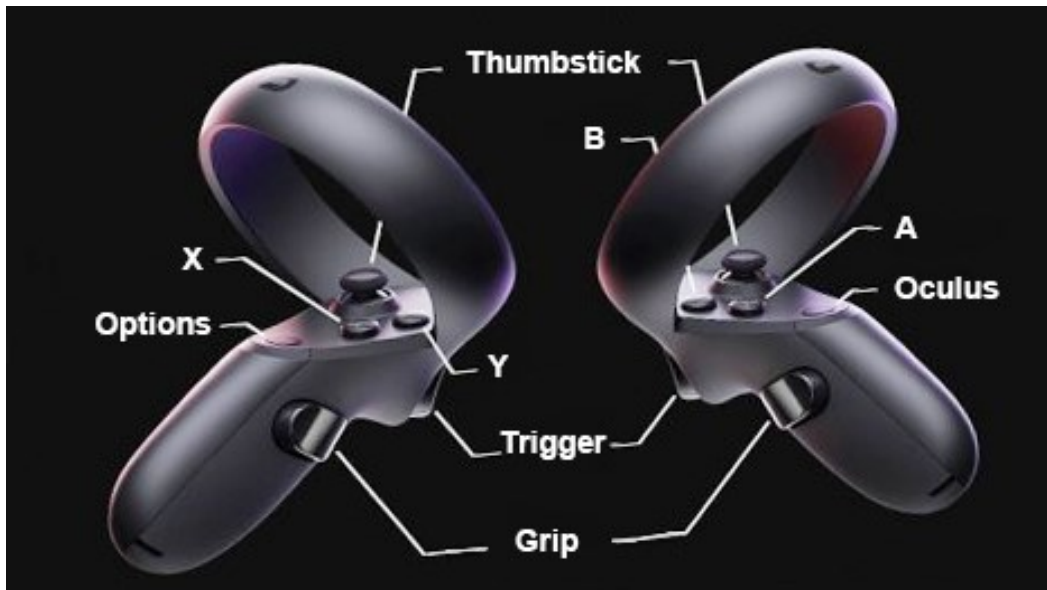
*When there is a * symbol before a heading, you do not have to follow these steps. However, it is important that you read through it all and try to remember it as you would need to for a situation such as the scenario mentioned above. Therefore, take your time when reading.*

Adjusting the fit of the headset

The VR-headset should sit on your head tightly so that it remains in place, but it should also feel comfortable. Therefore, you can adjust it with the sliders on the straps that are on the back of your head. To tighten the headset, move the sliders away from the centre and each other. To loosen the headset, move the sliders towards the centre and each other. After this is done, gently move the headset around on your head until the image on the screen in front of your eyes is clear. Lastly, make sure that the top strap that goes over your head is centred when being put on.

Controllers

The picture on the next page gives a good overview of the buttons present on the controller. During the Walk in Nature, only the 'A' button and Grip buttons are used. Your hands should be on the controller with your thumb near the 'X' / 'A' buttons and your index finger on the Trigger button. The rest of your hand should be at the back of the controller, with your middle fingers on the Grip button. Make sure you put your hands through the wristbands of the controller before you start playing.



* Turning on the VR-headset

The VR-headset can be turned on by pressing and holding the button on the right side of the headset for a few seconds.

* Connecting the VR-headset to the laptop

In order to connect the headset to your laptop, you have to do the following steps:

1. Download the Meta Quest app on your PC or laptop and open the software after the installation.
2. Connect the Link cable to the VR-headset. Make sure the cable doesn't get stuck between the headband.
3. Connect the other end of the cable to your PC or laptop and click 'Continue'.
4. Turn on your Meta Quest VR headset and go to your system settings via the menu.
5. Scroll down and choose Quest Link.
6. Go back to your home screen and open the settings via your fast menu at the bottom.
7. Select 'Quest Link' and click the switch.

* Setting up the barriers within the VR environment

In order to set-up the barriers of the environment within the VR-headset, you need to do the following steps:

1. Press the Oculus button on your right controller to go to the universal menu
2. Hover over the clock on the left-hand side of the universal menu.
3. When Quick settings appears, select it to open the Quick settings panel.
4. Select "Boundary".
5. Select "Stationary" or "Roomscale".
6. Follow the on-screen instructions to set up your boundary.

Experiment group

Previous research has shown that the Walk in Nature (WiN) VR-environment improves the well-being of its users and decreases their stress and anxiety. Because of this, the WiN intervention could be a useful tool when people are dealing with things such as chronic fatigue. The goal of this current study is to investigate how the WiN environment can be applied to an at-home situation where the user would have to use it completely independently. For this purpose, we are investigating the experiences of users with the intervention and how instructions influence these experiences.

When you put on the VR-headset, you will experience a simulation of a nature environment that includes the default starting environment and 2 tasks. The researchers will be manually switching you between these tasks, so please close your eyes when this happens in order to prevent nausea. The VR-headset can be put off again after the last task, the yoga exercise, is finished.

During the entire duration of this study, it is important that you imagine yourself in the following scenario:

You were provided with a VR-intervention called the 'Walk in Nature' and were asked to try it out at-home with the aim of using it regularly. When you open the box you have been given, you see the following: a VR-headset with controllers, a cable, a charger, a laptop, and this instruction sheet. You now have to set-up and start using the intervention completely on your own, with the help of the instruction sheet.

The QR Code below will bring you to an instruction video on how to use the VR intervention. You do not have to follow the last three steps, however, it is important that you try to remember the information as you would need to for a situation such as the scenario mentioned above. Therefore take your time when watching.



Or use this link: <https://youtu.be/Cs2E6krCsxk>

Source: (Coolblue, 2024)

Appendix C

In this appendix the used code of RStudio and the coding scheme used for the analysis of the results can be found.

RStudio Code

The following R code was used to analyse the demographic statistics and results of the research.

```
#load packages
library(tidyverse)
library(foreign)
library(janitor)
library(ltm)
library(dplyr)

#load data
library(readxl)
RData <- read_excel("RData.xlsx")
View(RData)

#####demographic data#####
DS <- RData %>% select("Age", "Gender", "Nationality")
view(DS)
DS %>% summary()
DS %>% tabyl(Gender)
DS %>% tabyl(Nationality)

#####total scores#####
TS <- RData %>% select(PE1:BI3)
view(TS)
summary(TS)
sum(TS)
mean(TS)

TS %>% summarise()
```



```

rowMeans(TS)
colMeans(TS)

#Scores in datasets
PE.score <- RData[c(11, 12, 13)]
EE.score <- RData[c(14:17)]
FC.score <- RData[c(18)]
HM.score <- RData[c(19:21)]
HT.score <- RData[c(22:25)]
BI.score <- RData[c(26:28)]
#Cronbach's Alpha
cronbach.alpha(PE.score)
cronbach.alpha(EE.score)
cronbach.alpha(HM.score)
cronbach.alpha(HT.score)
cronbach.alpha(BI.score)
#Scores Variables
longPE <- PE.score %>% pivot_longer(cols=c('PE1', 'PE2', 'PE3'),
  names_to='var',
  values_to='points')
longEE <- EE.score %>% pivot_longer(cols=c('EE1', 'EE2', 'EE3', 'EE4'),
  names_to='var',
  values_to='points')
longHM <- HM.score %>% pivot_longer(cols=c('HM1', 'HM2', 'HM3'),
  names_to='var',
  values_to='points')
longHT <- HT.score %>% pivot_longer(cols=c('HT1', 'HT2', 'HT3', 'HT4'),
  names_to='var',
  values_to='points')
longBI <- BI.score %>% pivot_longer(cols=c('BI1', 'BI2', 'BI3'),
  names_to='var',
  values_to='points')

summary(longPE)

```

```

summary(longEE)
summary(longHM)
summary(longHT)
summary(longBI)
#standard deviation
sd(longPE)
sd(longEE)
sd(longHM)
sd(longHT)
sd(longBI)
sd(FC.score)
#mode
find_mode <- function(x) {
  u <- unique(x)
  tab <- tabulate(match(x, u))
  u[tab == max(tab)]
}

longPEPoints <- longPE[c(2)]
longeepoints <- longEE[c(2)]
longhmopoints <- longHM[c(2)]
longHTpoints <- longHT[c(2)]
longBIpoints <- longBI[c(2)]
find_mode(longPEPoints)
find_mode(longBIpoints)
find_mode(longeepoints)
find_mode(longhmopoints)
find_mode(longHTpoints)
find_mode(FC.score)
#####Control/Experiment#####
#Mean/SD
LongVersionGroups <- read_excel("LongVersionGroups.xlsx")
View(LongVersionGroups)

```

```
LMSD <- LongVersionGroups[c(4)] #repeat with all 12 columns to get all means
LMSD <- na.omit(LMSD)
summary(LMSD)
sd(LMSD)

#CA
PECS <- PE.score[1:12,]
PEES <- PE.score[13:25,]
cronbach.alpha(PECS)
cronbach.alpha(PEES)

EECS <- EE.score[1:12,]
EEES <- EE.score[13:25,]
cronbach.alpha(EECS)
cronbach.alpha(EEES)

HMCS <- HM.score[1:12,]
HMES <- HM.score[13:25,]
cronbach.alpha(HMCS)
cronbach.alpha(HMES)

HTCS <- HT.score[1:12,]
HTES <- HT.score[13:25,]
cronbach.alpha(HTCS)
cronbach.alpha(HTES)

BICS <- BI.score[1:12,]
BIES <- BI.score[13:25,]
cronbach.alpha(BICS)
cronbach.alpha(BIES)

##### Spearman #####
PCorD %>% cor.test(BI, PE, method = 'spearman') #For each construct
```

Coding Scheme

In this appendix the coding scheme resulting from the thematic analysis can be found.

Table C1

Thematic analysis coding scheme

Question 1: Are there any barriers/concerns that you found that could hinder the implementation of the environment for at-home use?		
Theme	Participant	
Free space	103	You need a lot of free space to use it at home, sometimes it could be problematic
	105	- not having enough space to be able to move around freely in VR - the headset not being comfortable - feeling overwhelmed by setting up the system, especially older people who might not feel as comfortable with technology - people thinking it is 'weird', - the associated stigmas (that it is unhealthy to use it as an escape, young people use that for weird things) - the costs of VR (the headset itself but also the necessary PC/laptop and other equipment.
	110	[...] there also needs to be enough space for it to use it
	202	[...] Also, not everyone has a clear room available.
	208	I think a lack of space or ability to make space to not have any barriers in the way could be a barrier for some, especially if you want to use it for exercising where you need a good amount of space. [...]
	212	In order to utilise VR environment, we have to make sure that there is a great connection with a wide space to exercise. [...]
	207	Roommates/children could be a concern
	Setting up	203

- laptop/desktop, and ensure everything is set-up properly; I would like to simply do my exercises then and there.
- 106 time, getting used to setting it up when there are different applications, motion sickness,
- 101 To use the VR headset, it seems like you need a computer to access a virtual environment. Personally, I think it is a bit [omslachtig] (cumbersome?) to do all these steps if you want to do yoga exercises.
- Movement 104 The yoga exercise felt a bit hard to do, since your own limbs hinderance are not visible while using the VR headset, it is hard to see what you are doing.
- 108 The headset being the weight that it is and how it sits on your head, it was hard to put on by myself but not impossible and although the environment was immersive enough - the feeling of the headset on kept hindering it. It was hard to gain that sense of 'peace' because of the headset.
- 211 I perceived the feeling of wearing the VR glassed uncomfortable. It felt heavy and hindering for the movements
- Motion sickness 106 time, getting used to setting it up when there are different applications, motion sickness,
- 107 - the technical usability as somethimes not so smooth, i can imagine that it makes people nauxicious
- 109 There a few barriers for me, first is motion sickness and exactly this vr environment does not look very real for me
- 209 [...] The motion sickness might be a small barrier, as the motion sickness can cause a user to stop using the VR for a while.
- Longer duration 205 Maybe the repetitiveness of the yoga and butterflies, if you do this multiple times I would get bored by it but that may be because of my personal disinterest in yoga.

- Instruction/Help 208 I think the tutorial was good but people who are not experienced with technical devices might be overwhelmed and need help still.
- 212 Furthermore, it may be difficult for older generations to use the VR environment at home without someone's help in order to correctly and efficiently use it. Therefore, depending on the environment, this can change the experience of activities and effectiveness towards the users
- 102 I would still need an instruction sheet to have at all times because I tend to be forgetful and might have difficulty connecting the VR headset with the computer.
- 105 - not having enough space to be able to move around freely in VR
- the headset not being comfortable
 - feeling overwhelmed by setting up the system, especially older people who might not feel as comfortable with technology
 - people thinking it is 'weird',
 - the associated stigmas (that it is unhealthy to use it as an escape, young people use that for weird things)
 - the costs of VR (the headset itself but also the necessary PC/laptop and other equipment.
- 110 i think there has to be an explanation first about the red barriers when using the environment because when you dont know about the red barriers it can be dangerous.
- there also needs to be enough space for it to use it
- Immersion VR 108 The headset being the weight that it is and how it sits on your head, it was hard to put on by myself but not impossible and although the environment was immersive enough - the feeling of the headset on kept hindering it. It was hard to gain that sense of 'peace' because of the headset.

	109	There a few barriers for me, first is motion sickness and exactly this vr environment does not look very real for me
Cost	111	Maybe the cost of the hardware, but that's about it (and probably not even that big a deal)

Question 2: What kind of expectations would you have regarding the at-home use of this VR environment?

Theme	Participant	
Ease of use	102	I would expect it to be easy to use and with clear instructions.
	105	[...] For a lot of people it will be difficult to figure out the technological aspect. While it may seem quite easy if you are used to it. I think that a lot of people will find it difficult and might even be put off completely.
	110	that it is also applicable to small spaces
	111	[...]The environment seems easy enough to use that most users should not experience much of a barrier to using it.
	204	Should be easy to use (which it is).
	210	That the environment is userfriendly.
	212	Clear instruction to setting up the VR headset and download the application into laptop. Also, convenience of the fact that you can enjoy the activity anytime anywhere with the VR headset.
	Instructions	102
103		I would expect more detailed instructions
112		I believe it would need a video guide rather than just a guide written out on paper. Some people are visual learners and need a semi real life demonstration to start using something like this.
203		For at-home use, I expect that the use of the VR environment would be more comfortable; being in the comfort of my home, doing things at my own pace, I believe I can make use of VR well-being environments more effectively. For example, the VR yoga environment could be completed more effectively at home- setting down a yoga-mat, being in more casual attire,

- placing boundaries in an area I am very familiar with (not anxious about hitting things beyond the VR boundary), are all positives about at-home VR-use.
- 206 easy instructions to make its use clear and easy to implement at home with my knowledge
- 208 I think there should be ideally a hotline or professionals who can help set it up if needed. There should also be different kinds of movement and levels and ideally modes that do not make too much noise while moving or do not need as much space if possible.
- Easy to set up 205 I would expect it to be very easy to set up, which was also the case in the experiment.
- 206 easy instructions to make its use clear and easy to implement at home with my knowledge
- 212 Clear instruction to setting up the VR headset and download the application into laptop. Also, convenience of the fact that you can enjoy the activity anytime anywhere with the VR headset.
- Experience 101 I find it kind of alienating, with a robot voice talking to you and some sound that indicates when you have to breathe. It's a bit robot-like. Not very human.
- 104 The at home use of this VR environment can provide a fun and relaxing experience for people.
- 105 I expect that using VR is like buying a new gaming device. You use it a lot the first three months, and after those initial months you start using it less and less (unless there is a great incentive, that i am unaware of).
- I also expect that the people currently using it are those who already have an interest in this kind of technology. While people who might greatly benefit from it (for example elderly or physically disabled people) are more hesitant to try. For a lot of people it will be difficult to figure out the technological aspect. While it may seem quite easy if you are

used to it. I think that a lot of people will find it difficult and might even be put off completely.

- 106 calming, meditative
- 109 more realistic environment
- 201 That it relaxes me, it was of course a bit hard to relax here as there were two strangers watching me (no front, haha)
- 209 It should be user-friendly and not too expensive, so that a vast majority can use it.
Furthermore, it should also be a little bit exciting and fun, to make it more enjoyable for the user, so that the user is interested to use the VR again.
- 213 that it is fun
- Usage 107 that for example yoga classes i can use them at any time I want and be very flexible and be able to intergrate it into my daily life
- 108 I would expect it to be used to help replicate meditation/yoga practices but again, my expectations of it running succesfully is somewhat lowered because i'd have to do them with the headset.
- 111 It could help during the times of year when the weather outside is really depressing. In summer I would expect that going outside would have a better effect. The environment seems easy enough to use that most users should not experience much of a barrier to using it.
- 202 For people who can't go outside, this is a decent option. I myself would rather go outside, since the current vr experience in general is not amazing yet.
- 207 I think think vr brings many opportunities with it which I have not yet thought of. I expect it to be of help for people to be able to do a lot more from home than they could before.
- 208 I think there should be ideally a hotline or professionals who can help set it up if needed. There should also be different

kinds of movement and levels and ideally modes that do not make too much noise while moving or do not need as much space if possible.

211 For at home, there would not be any use for it. I would rather go outside then using VR

Question 3: Is there anything else you would like to mention regarding the implementation of the VR environment for at-home use?

Theme	Participant	
Exercises	104	For the experience of the yoga exercise it might be beneficial to have the instructions and the character models be a bit more in sync.
	112	I liked the butterfly task much more than the yoga task and I believe the butterfly task is more suitable to at-home physical therapy. The yoga task is better suited without a headset, and it would be better to do these yoga exercises e.g. via a youtube video rather than VR.
	113	I think many people also like the aspect of imagining things so I believe it is more useful for yoga than meditation exercises.
	202	For me, the fact you cant see yourself is weird. Using mainly audio could be a more comfortable option.
	205	I think the VR set has a lot of potential to be implemented for at-home use, but the butterflies and the yoga is not for everyone i think, because i personally didn't really enjoy it that much or see myself doing it that frequently.
Usability	101	Make sure the headset fits well!
	105	As I also mentioned during my questionnaire. I really enjoy VR, I think it is really fun. However, at this point in my life, where I am still capable of going outside and exercising outdoors, this has my preference. Other than for gaming and entertainment, for which I have easier and less expensive resources, I do not see VR becoming a big part of my life for the foreseeable future.

- 107 the positive sentences at the end were very nice and i can imagine that it is very enjoyable to use it as a little break from example studying at home
- 109 i think it is a very good idea specifically for people who dont want to go out of their house to yoga classes or do not feel comfortable attending them, as well as for people who like to kind of be out of reality for some time, it distracts you from stress in the real world and make you stop thinking about anything else that is going on in your head
- 110 maybe if there is motion detected in the house it should give a warning otherwise you can not know if someones home or something is happening at home
- 208 I think the potential is great and the usage enjoyable.
- 209 All in all, environment is already really user-friendly and exciting, so I could imagine that in the future there are more and more people using it.

Appendix D

Answers Open Questions

In this appendix the answers to the open questions are displayed in Table D1.

Table D1

Answers to the open questions

Participant	OQ1	OQ2	OQ3
101	To use the VR headset, it seems like you need a computer to access a virtual environment. Personally, I think it is a bit [omslachtig] (cumbersome?) to do all these steps if you want to do yoga exercises.	I find it kind of alienating, with a robot voice talking to you and some sound that indicates when you have to breathe. It's a bit robot-like. Not very human.	Make sure the headset fits well!

102	I would still need an instruction sheet to have at all times because I tend to be forgetful and might have difficulty connecting the VR headset with the computer.	I would expect it to be easy to use and with clear instructions.	No.
103	You need a lot of free space to use it at home, sometimes it could be problematic	I would expect more detailed instructions	Not really
104	The yoga exercise felt a bit hard to do, since your own limbs are not visible while using the VR headset, it is hard to see what you are doing.	The at home use of this VR environment can provide a fun and relaxing experience for people.	For the experience of the yoga exercise it might be beneficial to have the instructions and the character models be a bit more in sync.
105	<ul style="list-style-type: none"> - not having enough space to be able to move around freely in VR - the headset not being comfortable - feeling overwhelmed by setting up the system, especially older people who might not feel as comfortable with technology - people thinking it is 'weird', - the associated stigmas (that it is unhealthy to use it as an escape, young people 	<p>I expect that using VR is like buying a new gaming device. You use it a lot the first three months, and after those initial months you start using it less and less (unless there is a great incentive, that i am unaware of).</p> <p>I also expect that the people currently using it are those who already have an interest in this kind of technology.</p> <p>While people who</p>	<p>As I also mentioned during my questionnaire. I really enjoy VR, I think it is really fun. However, at this point in my life, where I am still capable of going outside and exercising outdoors, this has my preference. Other than for gaming and entertainment, for which I have easier and less expensive</p>

	use that for weird things) - the costs of VR (the headset itself but also the necessary PC/laptop and other equipment.	might greatly benefit from it (for example elderly or physically disabled people) are more hesitant to try. For a lot of people it will be difficult to figure out the technological aspect. While it may seem quite easy if you are used to it. I think that a lot of people will find it difficult and might even be put off completely.	resources, I do not see VR becoming a big part of my life for the foreseeable future.
106	time, getting used to setting it up when there are different applications, motion sickness,	calming, meditative	no
107	the technical usability as sometimes not so smooth, i can imagine that it makes people nauxious	that for example yoga classes i can use them at any time I want and be very flexible and be able to intergrate it into my daily life	The positive sentences at the end were very nice and i can imagine that it is very enjoyable to use it as a little break from example studying at home

- 108 The headset being the weight that it is and how it sits on your head, it was hard to put on by myself but not impossible and although the environment was immersive enough - the feeling of the headset on kept hindering it. It was hard to gain that sense of 'peace' because of the headset.
- 109 There a few barriers for me, first is motion sickness and exactly this vr environment does not look very real for me
- I would expect it to be used to help replicate meditation/yoga practices but again, my expectations of it running succesfully is somewhat lowered because i'd have to do them with the headset.
- more realistic environment
- i think it is a very good idea specifically for people who dont want to go out of their house to yoga classes or do not feel comfortable attending them, as well as for people who like to kind of be out of reality for some time, it distracts you from stress in the real world and make you stop thinking about anything else that is going on in your head

- 110 i think there has to be an explanation first about the red barriers when using the environment because when you dont know about the red barriers it can be dangerous.
- that it is also applicable to small spaces
- maybe if there is motion detected in the house it should give a warning otherwise you can not know if someones home or something is happening at home
- there also needs to be enough space for it to use it
- 111 Maybe the cost of the hardware, but that's about it (and probably not even that big a deal)
- It could help during the times of year when the weather outside is really depressing. In summer I would expect that going outside would have a better effect. The environment seems easy enough to use that most users should not experience much of a barrier to using it.

- 112 I found the headset incredibly uncomfortable to use. Especially for the yoga exercise, it felt like it could fall off - or it hurt the side of my nose while bending down.
- I believe it would need a video guide rather than just a guide written out on paper. Some people are visual learners and need a semi real life demonstration to start using something like this.
- I liked the butterfly task much more than the yoga task and I believe the butterfly task is more suitable to at-home physical therapy. The yoga task is better suited without a headset, and it would be better to do these yoga exercises e.g. via a youtube video rather than VR.
- 201 I think the settings on how tight the headset is were a bit poorly designed. It worked on paper but in reality it was hard to find the correct tightness.
- That it relaxes me, it was of course a bit hard to relax here as there were two strangers watching me (no front, haha)
- I think many people also like the aspect of imagining things so I believe it is more useful for yoga than meditation exercises.
- 202 Current vr headsets are not very comfortable. Especially when using it on longer durations. Also, not everyone has a clear room available.
- For people who can't go outside, this is a decent option. I myself would rather go outside, since the current vr experience in general is not amazing yet.
- For me, the fact you cant see yourself is weird. Using mainly audio could be a more comfortable option.

203	<p>If I wanted to meditate or do well-being exercises, I would find it a hindrance to take out a VR headset, connect it to my laptop/desktop, and ensure everything is set-up properly; I would like to simply do my exercises then and there.</p>	<p>For at-home use, I expect that the use of the VR environment would be more comfortable; being in the comfort of my home, doing things at my own pace, I believe I can make use of VR well-being environments more effectively. For example, the VR yoga environment could be completed more effectively at home-setting down a yoga-mat, being in more casual attire, placing boundaries in an area I am very familiar with (not anxious about hitting things beyond the VR boundary), are all positives about at-home VR-use.</p>	N/A
204	No	<p>Should be easy to use (which it is).</p>	No

- | | | | |
|-----|---|--|--|
| 205 | Maybe the repetitiveness of the yoga and butterflies, if you do this multiple times I would get bored by it but that may be because of my personal disinterest in yoga. | I would expect it to be very easy to set up, which was also the case in the experiment. | I think the VR set has a lot of potential to be implemented for at-home use, but the butterflies and the yoga is not for everyone i think, because i personally didn't really enjoy it that much or see myself doing it that frequently. |
| 206 | technical knowledge, finances, equipment | easy instructions to make its use clear and easy to implement at home with my knowledge | |
| 207 | Roommates/children could be a concern | I think think vr brings many opportunities with it which I have not yet thought of. I expect it to be of help for people to be able to do a lot more from home than they could before. | No |

- 208 I think a lack of space or ability to make space to not have any barriers in the way could be a barrier for some, especially if you want to use it for exercising where you need a good amount of space. I think the tutorial was good but people who are not experienced with technical devices might be overwhelmed and need help still.
- I think there should be ideally a hotline or professionals who can help set it up if needed. There should also be different kinds of movement and levels and ideally modes that do not make too much noise while moving or do not need as much space if possible.
- I think the potential is great and the usage enjoyable.
- 209 I think for most people under the age of 40 there are no big barriers when implementing the environment at home. However I could see that people older than 40 could struggle with setting up the software, maybe even struggling to install it correctly and open it. My grandmother is 80 and I am pretty sure she would never be able to set up the VR without outside help. The motion sickness might be a small barrier, as the motion sickness can cause a user to stop using the VR for a while. However when
- It should be user-friendly and not too expensive, so that a vast majority can use it. Furthermore, it should also be a little bit exciting and fun, to make it more enjoyable for the user, so that the user is interested to use the VR again.
- All in all, environment is already really user-friendly and exciting, so I could imagine that in the future there are more and more people using it.

	taking freaking breaks and being careful, it should not be a big problem after all.		
210	No the YouTube video was clear and the steps to setup the VR are straight forward. The only downside was that the vision was blurry sometimes.	That the environment is userfriendly.	
211	I perceived the feeling of wearing the VR glassed uncomfortable. It felt heavy and hindering for the movements.	For at home, there would not be any use for it. I would rather go outside then using VR	No
212	In order to utilise VR environment, we have to make sure that there is a great connection with a wide space to exercise. Furthermore, it may be difficult for older generations to use the VR environment at home without someone's help in order to correctly and efficiently use it. Therefore, depending on the environment, this can change the experience of activities and effectiveness towards the users.	Clear instruction to setting up the VR headset and download the application into laptop. Also, convenience of the fact that you can enjoy the activity anytime anywhere with the VR headset.	No I do not have anything else to mention.
213	No	that it is fun	No
