

# VRelaxScape

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*Bachelor Thesis*

Hanze University of Applied Science, Groningen

Communication & Multimedia Design | Major Game Design & Development

Procedurally generated world for relaxation.

By Alan Kettenring Hart

27-05-2019

Client: Viemr

# VRelaxScape

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*A procedurally generated world for relaxation.*

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"If I have seen further it is by standing on the shoulders of Giants."

Isaac Newton, 1675

"Yeet"

# Version Control

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Action	Description	Date	Version #
Created the document	Started with the outline of the document	12-Nov-18	0.0.1
Fill with content	Started on the preliminary research. Consulting internal document, consulting with client, consulting with stakeholders, performing desk research.	12-Nov-18	0.0.2
Concept phase one complete	Wrapped up the key concept research and requested feedback from Coach and Harmen,	16-Jan-19	0.0.3
Received feedback from Harmen de Weerd	Incorporated the feedback I have received from Harmen.	21-Jan-19	0.0.4
Meeting with expert	Had an interview with Dr. Wim Veling, professor at UMCG. Gave insight into some design requirements for inducing relaxation.	28-Jan-19	0.0.5
First GLS	Concept phase one document ready for GLS1. Acquired feedback from session. Received a yellow light due to lack of research into procedural generation.	29-Jan-19	0.0.6
Removed redundant research.	Removed two key concepts that did not add any valuable research to the project. Focus has been put on a new key concept for procedural generation and healing environment.	31-Jan-19	0.1.0
Finished healing environment concept	Put some time into researching healing environment. Added some useful design requirements.	4-Feb-19	0.1.1
Added new cover art	New cover art on the front page, reflecting what I want the final product to look like	7-Feb-19	0.1.2
Added all of the author information	Added author information like my name, student number, keywords, client, etc.	7-Feb-19	0.1.3
Added information from brainstorm session	Wrote down the results from the brainstorm session. Items include possible interaction objects, as well as a concrete direction for look and feel.	25-Feb-19	0.1.4
Created leading design specifications	Leading design specifications for concepts has been added. All concepts need to adhere to these abstractions.	26-Feb-19	0.1.5
Added color palettes	The color palettes have been added to give the reader some form of sense towards what the application is going to look like.	27-Feb-19	0.1.6
Specified concepts	Integrated design concepts into the document. First leading design specifications have been made that must be followed regardless of the concept.	07-Mar-19	0.2.0
Updated introduction phase two	Added some information regarding introducing the desired solution direction, giving way to the concept.	14-Mar-19	0.2.1

Added some additional info; Leading design specs	Added some contextual information to the table. Grouping the DR & EDR to make them more general	14-Mar-19	0.2.2
Finished up phase two	Added the last details for conceiving phase. Concepts have been introduced and final selection substantiated.	20-Mar-19	0.2.3
Moved to the next phase in the document	Started outlining the next phase in the document; prototyping.	20-Mar-19	0.3.0
Wrapped up prototyping phase	Finished up the core of prototyping phase. Includes some pseudo code.	5-Apr-19	0.3.1
Outline phase four	Filled in the basic outline of the evaluation phase. Contents like methodology, and reasoning are explained here, as well as results from testing	10-Apr-19	0.4.0
Incorporation of feedback.	Received feedback on my graduation from Sean, updated APA references, fixed some of the in-text citations, defined concept selection more adequately, touched up some discrepancies in tenses of text, validated adjective selection and choice, updated evaluation section to include methods used.	23-Apr-19	0.4.1
Filled in more information in the evaluation section	Evaluation section now contains a lot of data graphs and explanation on how these are interpreted.	24-Apr-19	0.4.2
Title fix	Changed the indentation in the appendix section so it looks better in the table of contents.	24-Apr-19	0.4.3
Added recommendations and outline phase five	Added recommendations section in the evaluation phase. Also added the title page and cover art for the next and final phase; critical reflection.	24-Apr-19	0.4.4
Abstract	Added the abstract to the document to give the document a nice summary of the process and results.	29-Apr-19	0.5.0
Recommendations	Added some concept art to visualize the recommendations.	29-Apr-19	0.5.1
Critical Reflection	Added general outline for the final phase.	1-May-19	0.6.0
Critical Reflection	Added contents for the first four sections in phase five.	3-May-19	0.6.1
Recommendations	Finished up the recommendations at the end of phase four.	3-May-19	0.6.2
Critical Reflection	Finished up phase five section.	6-May-19	0.6.3
Abstract	Touched up the abstract to be more in line with CMD dresscode.	6-May-19	0.6.4
Hand in formative	Did quick proofread before sending in for formative assessment.	6-May-19	1.0.0
Rewrite	Rewrote and restructured phase four of the document. Now data represents a clearer and more meaningful connection made to the hypothesis.	23-May-19	1.1.0

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## Abstract

Viemr, in partnership with UMCG (Universitair Medisch Centrum Groningen) and the Dolphin Swim Club, have developed VRelax over the past two years. VRelax is an application on the Samsung GearVR and Oculus Go. People can use this application to relax and reduce stress. Through the right combinations of auditory and visual stimuli in VR the user experiences a relaxing effect. The application solely makes use of 360° videos. Because of this there is little interaction in the application and as a result does not offer enough content in the long run. The client wanted to diversify and offer its users more freedom for interaction, while still focusing on relaxation. The client was interested in finding out if procedural generation could be a beneficial addition to the project.

Meetings were held with stakeholders; client, target audience, experts, to establish what the exact needs were. After all of the necessary information had been determined, the possible solution direction needed to be substantiated to demonstrate the desired solution direction was viable. Research questions are posed to guide towards the solution direction; pointing out that for it to be the most effective, focus must be put on two things; relaxation through distraction, and healing environment design.

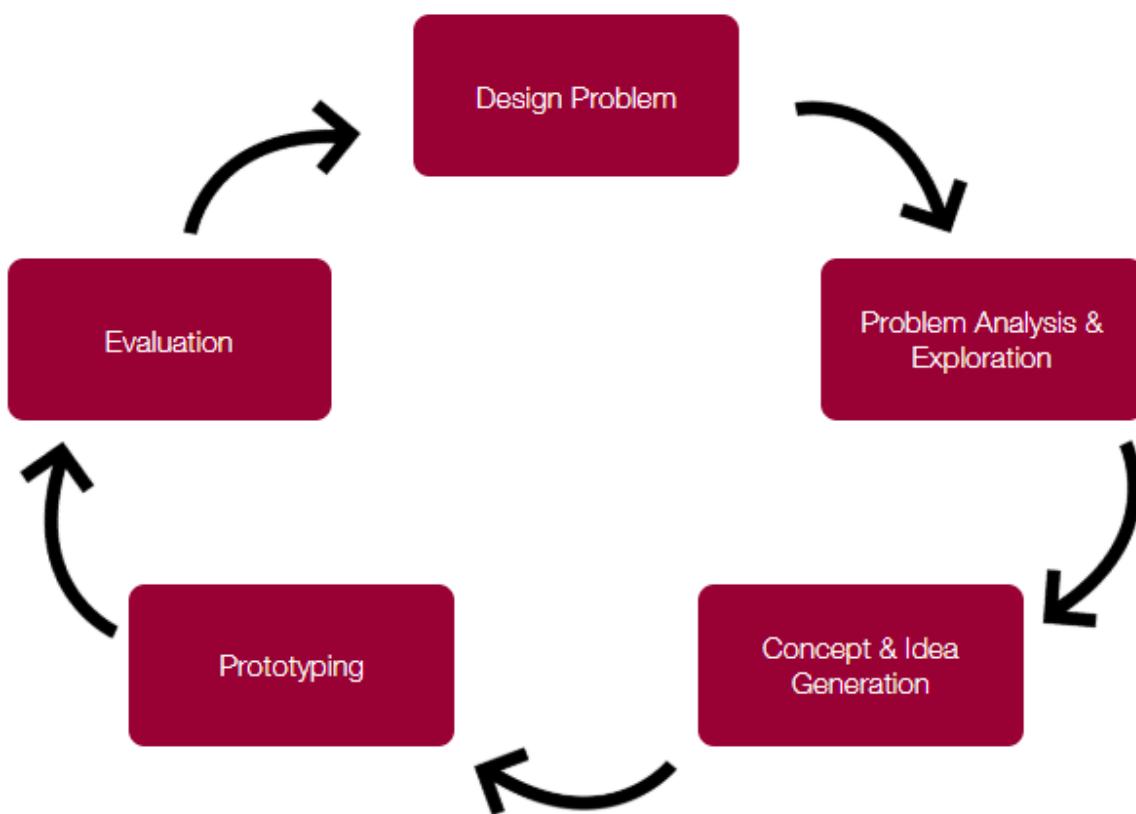
Two concepts are laid out and a selection of one is substantiated. Infinitely being able to explore a world is something that is very appealing for the client and stakeholders. Development of the prototype happened over the course of two months; starting from an empty scene in Unity, to a fully generated world that allows its user to explore in any direction, a world that was designed to make its user feel more relaxed by using pleasant sounds, and simple interactions for distraction.

Evaluations of the prototype lead to interesting results. Through desirability testing and supporting evaluation measurements it was able to prove the prototypes effectiveness. Through the self-report efforts the prototype shows promising results, users show an improved state of mind after having utilized it for just ten minutes. Even though users reported an improved state of mind, supporting measurements of their heartrates generally showed the contrary, but the mean of the heartrates did improve slightly after utilization of the prototype. Further discussions have been held with experts to gain insight on their view of the current prototype, and where it could possibly head in the future. In the end the null hypothesis can be rejected for someone's state of relaxation, as there is a significant statistical difference between someone's reported state of relaxation after they had utilized the prototype.

## Introduction to the Project Contents

Viemr works with many different companies on many different types of projects. Some projects are rooted in advertising, while others are more practically oriented for use in e-health. One such product made by Viemr is VRelax. This interactive video player can be used by people to reduce stress and relax. There's one really large issue that the company is facing with the product, and that is its shelf life. Since VRelax relies on 360° to engage the users, Viemr would have to regularly create and update new 360° videos. Creating such videos is a very expensive, requiring a large labor force and a lot of time and research. Therefore, Viemr wants to look at possible alternatives that could potentially alleviate this issue.

This document itself will cover the entire development process and is divided into five phases.



I-01 – The design cycle

The structure of this document will follow a design cycle (International Baccalaureate Organization (UK) Ltd, n.d.), starting with the problem, and eventually ending with the evaluation of a digital interactive prototype. Each phase is intertwined with the preceding, each laying the foundation for the next phase in the process.

## Phase One – Problem Analysis & Exploration

This phase will focus on what the client (Viemr) wants, and what stakeholders want. During this phase, desk research will be employed alongside interviews and testimonies of the target audience, Viemr, and stakeholders to define design requirements for the prospective concept.

At the end of this phase there will be a list of design requirements as to which the prototype must comply to in order to solve the client's problem. These requirements would have been acquired through thorough research and will be grounded in a theoretical background. These requirements should act as guidelines in the design process to ensure a viable product that addresses the main problem/challenge.

## Phase Two – Concept & Idea Generation

As a succession of phase one, phase two will be about the creation of concepts and ideas that adhere to the design requirements that have been generated in the preceding phase. These concepts will be elaborated on and using heuristics based on the requirements a fitting concept will be chosen for the development of a prototype. During this phase the client and stakeholders will be involved in the process to ensure their wishes are heard and considered.

## Phase Three – Prototyping

In phase three, a prototype will be developed. The reason is for the next phase; evaluation. The prototype will serve as a base product and will be utilized as the subject for evaluation in the next phase.

## Phase Four – Evaluation

Within the confines of phase four, the developed prototype will be evaluated to ascertain its value as a commercial product, and to ascertain how well it serves its purpose as discussed in phase one.

## Phase Five – Critical Reflection

The final phase of the graduation project has its focus on so-called critical reflection. This part is a review of the design process and research that has been conducted throughout the project. Here there will be a reflection upon what worked, what did not work, and what opportunities still remain, and what pitfalls are still present.

Furthermore, this document also will have an additional *Bibliography* and an *Appendix* and will be utilized as needed. The *Bibliography* contains a list of all works cited, and *Appendix* shall contain research/evaluation results as well as any additional documents or images that were created for the benefit of the project.

## Important Data

Problem Analysis & Exploration	19-11-2018 – 25-1-2019
Meeting with client/stakeholders to document their preferences and wishes.	Somewhere between 3-12-2018 – 25-1-2019
Meeting with client and graduation coach	Somewhere between 3-12-2018 – 18-1-2019
Greenlight Session 1	28-1-2019 – 15-2-2019
Concept & Idea Generation	28-1-2019 – 15-2-2019
Brainstorm session with client	6-2-2019
Greenlight Session 2	4-3-2019 – 29-3-2019
Prototyping	After GLS2 – 12-4-2019
Testing & Evaluation	15-4-2019 – 26-4-2019
Critical Reflection	29-4-2019 – 3-5-2019
Hand-in of draft graduation document	By 6-5-2019
Finalizing of graduation portfolio	6-5-2019 – 26-5-2019
Submission of graduation portfolio	By 27-5-2019

# Phase One

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*Problem Analysis & Exploration*

*Image retrieved from: [https://commons.wikimedia.org/wiki/File:Research\\_Scene\\_Vector.svg](https://commons.wikimedia.org/wiki/File:Research_Scene_Vector.svg)*

## Problem Analysis & Exploration

In this chapter, the client will be introduced. Alongside the client, there will also be content regarding the problem faced by the client, and what information would be required to begin conceiving a possible solution for them.

### Client

*Viemr is a specialist in Virtual Reality and Augmented Reality solutions. They jump into the deep and explore the unknown, open-minded, goal-oriented and full of passion. They are always looking for the wow factor. With over seven years of global experience, their team has created the most innovative, high-profile and award-winning campaigns for the biggest brands. They make beautiful things for beautiful customers. – Viemr (<https://viemr.com/about-viemr/>)*

Viemr, currently, only has five full-time employees, but they have worked with some really big names; Red Bull, Audi, Nike, Emirates and more. Furthermore, they are also partnered with ATOS and they have partnerships with other development and production companies.

The role of the client in regards to the graduation project is a supportive one. They will facilitate brainstorm sessions, provide feedback and advice, and also offer the possibility of access to their knowledge network to further facilitate the progress of the project.

### Problem/Opportunity

Viemr, in partnership with UMCG (Universitair Medisch Centrum Groningen) and the Dolphin Swim Club, have developed VRelax over the past two years. VRelax is an application on the Samsung GearVR and Oculus Go. People can use this application to relax and reduce stress. Through the right combinations of auditory and visual stimuli in VR the user experiences a relaxing effect. Currently the application solely makes use of 360° videos. There is little interaction in the application, and as a result the application becomes boring after a few uses.

The application that Viemr provides does not offer enough content in the long run. The application relies solely on 360° video material, and thus, the application has a very limited amount of interaction due to videos being only viewable. Because videos only are ever new the first time they are viewed, novelty quickly wears off and the application becomes less effective. Being able to engage the user for longer periods of time is a key component to gauge the success of the product. Some users might want to employ it at night to sleep, and others might want to use it at the end of the day to decompress. Being able to personalize content (think of turning on or off night mode, or choosing a specific style of environment) they can have the optimal experience for them. The solution direction, for both customers and the client, is to have more freedom of choice in the long-run.

Viemr wants a digital interactive product in the form of a VR application on the Oculus Go that makes use of a procedurally generated environment that can adapt over time and distance to allow the user the freedom to explore endlessly. A procedurally generated environment can potentially be completely different every time the user starts the application. However, the procedure that is followed to generate

the world can be set up in such a manner that the relaxing elements are always present. This would allow the user to always have a different environment with a focus on relaxation.

**DR0.** It has to be a digital product.

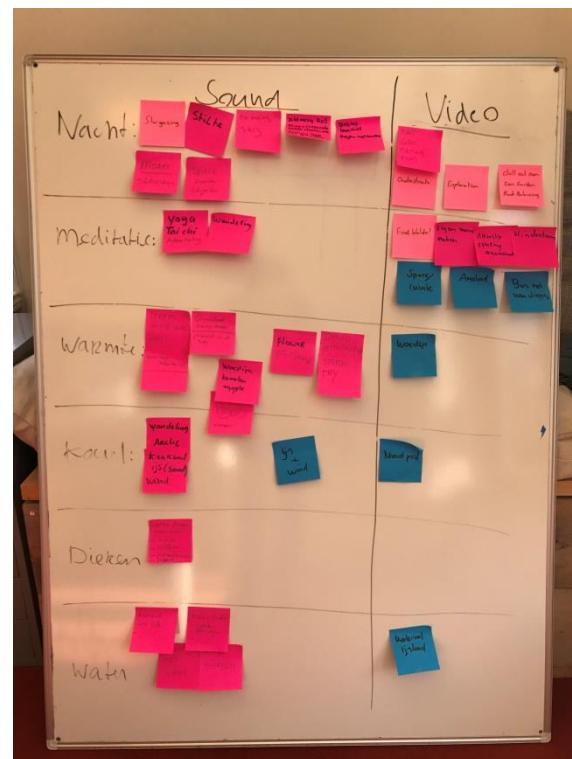
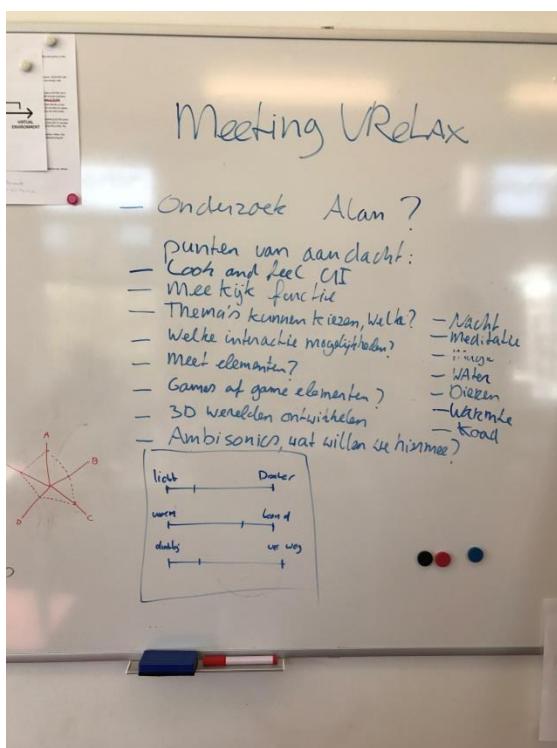
**DR1.** The application is in VR.

**DR2.** The application is built on the Oculus Go.

**DR3.** The application's world environment is procedurally generated.

**DR4.** The application can be used more than once.

By carrying out preliminary research on VR as a relaxation medium, the target audience, finding academic literature related to gamification, stress, and relaxation techniques, it should become clear what requirements need to be upheld in the digital prototype to ascertain its viability.



I02 – Brainstorm Session 1& 2.

One of the possible venues for a solution is an interactive 3DVR world that can change over time to allow the user to experience fresh content (procedural generation), instead of having a one-time use application. This 3DVR environment can implement relaxation techniques and sensations that are testable. The user can move around in the world through pointing and clicking and interact with objects or initiate an exercise. The time of day can also be changed within the environment at will.

Ideas for content in the 3DVR environment range from being able to choose the setting of the environment, down to being able to set the general shapes that occur in the world. Furthermore, it might be beneficial to let the user set the time of day, or change the weather. Generally, the idea can

encompass a lot of content and features. The method that was employed to generate these ideas was a communitive brainstorm. Stakeholders and employees at Viemr contributed in this session. The brainstorm session was intended to generate ideas and possible directions that the project could go in. One of the venues that came up was the possibility of having an adaptive environment that can change over time, or allowing the user more control over the environment.

## Target Audience

Currently, health professionals are looking towards alternatives for stress relief. Instead of prescribing medication, doctors can also prescribe so-called e-health solutions (Government of the Netherlands, 2018). These solutions can be applications or other forms of media that help prevent burnouts and assist in a person's self-management of stress. People want control over what they consume, be it entertainment, food, or even medicine.

This project has already existed for quite a while, and as such, within Viemr and the UMCG the target audience has already been identified and determined. The main target audience for this project would be the working population in the Netherlands who would go to the doctor with complaints of stress/high tension/complaints of burnout related illness. Age can vary from 8 – 60, any type of background and any gender. People with physical issues and illness are not eligible for treatment through this method.

Within the Netherlands the government is promoting e-health alternatives for the self-treatment and self-management of stress. Because of this demand for applications and services, there is a need for the target audience to have access to a variety of applications that they can then choose from. People want control over what they consume, be it entertainment, food, or even medicine and medical alternatives. Making one application to fit such a broad audience is a daunting task, and most likely impossible. However, if we look at what the majority of this group consists of, we can determine how we accommodate a large portion of this group.

## Stakeholders

The overarching project from Viemr is VRelax, and this project has been in the make for over two years. During the course of the project there have been significant investments made to bring the project to realization.

**Viemr (Stefan Vogelzang)** – This project will be made for Viemr, and as one of the co-founders of Viemr Stefan will be taking on the role of client for the duration of the project. Stefan has a vast network of knowledge that can facilitate the progress of the project.

**UMCG (Wim Veling)** – Wim is the main researcher that is involved with VRelax. He has done some major testing and evaluation of VR devices for psychological treatment and was also heavily involved in the development process of VRelax.

## Knowledge Needed

There are several things that need to be sorted out and grounded in evidence to ascertain whether or not 3DVR environment would be a suitable solution for inducing relaxation for the user.

Firstly, we need to look at VR as a relaxation method. This would determine if this is potentially a suitable medium for the user to attain a relaxed state of mind. Then we need to look at what can potentially cause stress and fatigue as to steer away from stimuli that could potentially worsen the state of the user. And finally, what kind of environment, exercises are best suited for VR as a medium to induce relaxation. Most of these questions can be answered with desk research, analysis of previous studies can support as well as interviews with the target audience and experts in the field of mental health.

**Main Question:** What are the key attributes that need to be upheld to construct a relaxing environment in VR?

- H1.** After the use of a VR medium to induce relaxation, a user will report feeling more relaxed after use.
- H2.** The user will not have become more frustrated after the use of the VR medium.
- H3.** Relaxation methods and techniques that are practiced in VR have a positive effect on the user.

### Research Questions

- Is VR a suitable medium for inducing relaxation?
- How does procedural generation work?
- What does it mean to be relaxed?
- What requirements does the environment have to uphold to be relaxing?
- Why would people use this instead of taking medicine?

### Search Strategy

When searching through literature the first action to take is to inspect the author. Have they published anything else besides this? What is the level of English they use in their text? What institution or what kind of website has this been published on? Finding answers to all of these questions help determine how much this source can be trusted. Furthermore, in the literature of these authors, if work is cited from someone else in their text, those sources must be checked as well to confirm their credibility.

To further confirm sources' credibility it should also, in most cases, be possible to find cross-references. Either if this work has been cited somewhere else, or find similar results in another person's work.

Most of the literature that will be incorporated shall be obtained through the Hanze Media Library. However, Google Scholar shall also be beneficial to the acquisition of information related to the searches.

## Research

During the preliminary research it is important to demarcate what needs to be researched in order to gain the best insight and to waste a minimal amount of time. Demarcation is the practice of translating the client's question into a researchable question, a problem analysis (Verhoeven, 2011).

Within the scope of the project there needs to be a clear picture as to why and how virtual reality can be applied to help relieve stress, what causes stress, and what methods are currently used to help people with these kinds of issues. These issues need to be sorted out in order to determine whether or not this project should be made for VR, what the best practices are for relaxing, how people become stressed and suffer from burnout, and how the virtual world should be presented to the user.

### **Virtual Reality and Virtual Reality as a Relaxation Method**

What is virtual reality (VR)? The term VR has existed since the late 1980s when it was popularized by Jaron Lanier, a pioneer of the field, who has contributed to a number of products within the VR industry. As (Lowood, 2018), Encyclopedia Britannica defines VR as follows; "Virtual reality (VR), the use of computer modeling and simulation that enables a person to interact with an artificial three-dimensional (3-D) visual or other sensory environment. VR applications immerse the user in a computer-generated environment that simulates reality through the use of interactive devices, which send and receive information and are worn as goggles, headsets, gloves, or body suits."

How is VR constructed? To create a virtual reality a user must place themselves in the digital realm. To achieve this, the user most often uses a headset that completely encompasses their field of vision to where they can only visually perceive their new virtual environment. These goggles or headsets are usually accompanied by some form of a controller to allow the user to interact with the environment around them, as well as some form of auditory stimuli (Riener & Harders, 2012).

The range of possible applications for virtual reality is practically limitless. VR facilitates the simulation of environments in three dimensions (up/down, left/right, forward/backward) where the user is mostly free to explore and interact with the world around them. Users of a VR application or world would experience a sense of presence, a sense of being there in that world (Baños, et al., 2000). Since the creation of VR it has evolved and diversified its application areas. Most commonly the application of VR has found its way in military training, medical training, surgery simulation, and as a means of psychological treatment. A wonderful aspect of VR is that this technology enables users to interact, and immerse themselves, in an environment through stimulation of the senses (Baños, et al., 2013).

To get the best experience for the user and to induce the highest level of presence possible, it is important to stimulate as many senses as possible (Hoffman, et al., 1998). VR has already been used in the field of psychology to induce various moods and emotions, a so-called "mood-induction-procedure" (MIP) (Baños, et al., 2013). This idea was used to induce positive emotions, like joy and relaxation, in a specific target audience. Other studies have shown that using tactile and/or olfactory stimulus to treat phobias or posttraumatic stress disorder is very beneficial to the user during exposure therapy (Carlin, Hoffman, & Weghorst, 1997) (Hoffman, Hollander, Schroder, Rousseau, & Furness III, 1998) (Hoffman, Gercia-Palacios, Carlin, Furness III, & Botella-Arbona, 2003) (Rizzo, et al., 2010). In one study, each

participant used the MIP for the course of four sessions spread out over a week, each lasting 30 minutes. The study had promising results showing an increase in positive emotions and a decrease in negative emotions. In a more recent study, participants did the same over a period of two weeks with six sessions total. And once again, participants showed improvement of both joy and relaxation (Baños, et al., 2014).

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**DR5.** The VR application incorporates at least two senses.

**DR6.** The VR application causes a sense of presence/immersion.

**DR7.** The VR application reduces stress levels of the user.

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Another very comprehensive study that was conducted about relaxation and anxiety reduction through the use of VR shows promising results. During this study participants were divided into four different groups. The first group VR (sound & vision), VR + smell, VR + touch, and finally VR + touch & smell. Furthermore, this study went out to prove several different hypotheses. The main hypothesis of this study was set to prove after the use of a VR-MIP relaxation scores will increase significantly. Second was that touch and smell will enhance the experience for participants. Third, participants report a high sense of presence/immersion after the experience. And finally, that the stimuli of smell and touch also greatly enhance the presence/immersion of participants (Serrano, Baños, & Botella, 2016). In the conclusions the researcher notes that VR-MIP is effective in inducing relaxation, and that it is possible to do this in a controlled manner.

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**DR8.** The VR application incorporates tactile sensations.

**DR9.** A session can last at least twenty (20) minutes.

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## Procedural Generation

Procedural content generation (PCG or PG) is a method of content creation for specific domains that allows for automatic generation of content following a specific set of rules. (Lelis, Reis, & Gal, 2018) When PG is applied to computer games it can automatically create entire levels, textures, and objects, all things that are traditionally handcrafted by professional designers (Shaker, Togelius, & Nelson, 2016). PCG algorithms have already been employed in the game industry in several genres, such as dungeon crawlers, RTS, physics based puzzles, racing, and arcade games (Valtchanov & Brown, 2012) (Togelius, et al., 2013) (Ferreira & Toledo, 2014) (Cardamone, Loiacono, & Lanzi, 2011) (Cook & Colton, 2011) (Mariño & Lelis, 2016).

Procedural content generation is a descriptive name. Content that is generated by following a set procedure. There are many, many different ways this can be implemented. Every individual polygon can be generated for every individual object, or perhaps objects are already predefined and the procedure just defines where objects are placed. Even if a game world is procedurally generated, a designer can still have control over how content is generated by changing the rules that are followed. This can have influence on textures, but also the shapes of objects. Most commonly used in a process for procedurally generating terrain, is something called Perlin noise. This noise pattern was first published in *An image Synthesizer* (Perlin, 1985).



I03 – Comparison between perlin noise (left) and traditional noise (right). Retrieved from:  
[&](https://upload.wikimedia.org/wikipedia/commons/d/da/Perlin_noise.jpg)  
[&](https://www.tubefilter.com/wp-content/uploads/2018/01/white-noise.jpg)

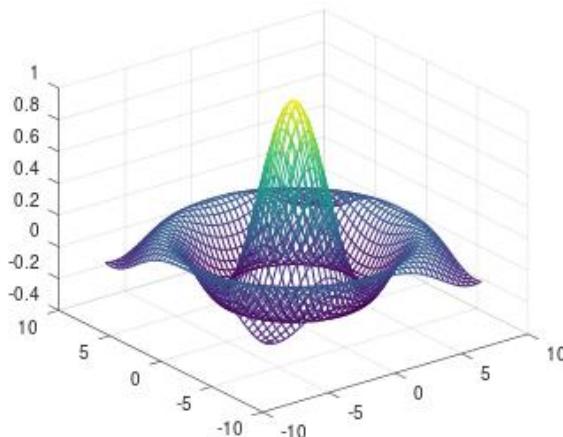
Perlin noise is excellent to use for terrain generation because of its gradient properties, allowing for gradual transition from high to lower values and vice versa. Noise is very useful for procedural generation because in grayscale value, pure white means 1, and pure black means 0. This can translate to a multiplication of a value that can then influence terrain height or the decision for the procedure to take action.

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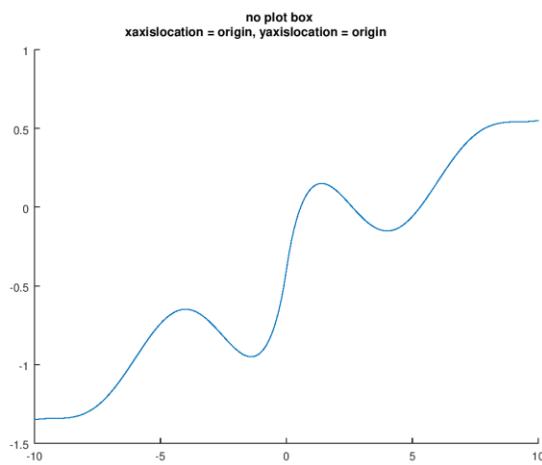
**DR10.** The procedural generation of the terrain makes use of Perlin noise.

---

A noise level that is used to generate a terrain is composed of several layers named octaves. If you were to convert Perlin noise into a three dimensional object it would look something like this:



I04 – 3D representation of a perlin noise segment. Retrieved from:  
[&](https://www.gnu.org/software/octave/img/example-mesh.svg)



*I05 – 2D cut representation Perlin noise segment. Retrieved from:  
[https://octave.sourceforge.io/octave/function/images/axis\\_901.png](https://octave.sourceforge.io/octave/function/images/axis_901.png)*

Using a single Perlin noise is not sufficient for creating a detailed terrain, and to mediate this problem we amplify the octave by adding additional waves to this. The waveform has two values, the Y axis is referred to as amplitude, and the X axis is the frequency. Amplitude means how dramatic the changes are in time, and frequency is how often changes can occur. Using one single Perlin noise will not instantly result in something desirable and thus we layer multiple levels of noise to create a jagged surface and more irregularities.

For the purpose of generating an interesting terrain for the prototype it would be useful to use at least three octaves for influence, one for the general outline of the terrain, and two additional octaves for medium and small details. Furthermore, to influence the overall combined octave that will be used by the terrain generator we use two values; lacunarity, which controls the frequency of octaves, and persistence, which controls the amplitude of octaves (Lague, 2016).

For an octave's frequency we state  $f = L^{n-1}$ . L is lacunarity and n is the count of the octave.

As for an octave's persistence, we state  $A = p^{n-1}$ . A is amplitude and n is the count of the octave.

Lacunarity is a value that changes factorial over the amount of different octaves.

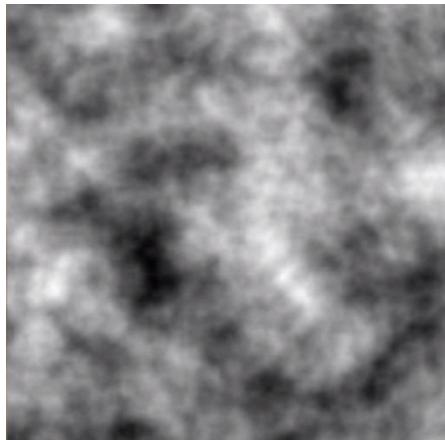
**DR11.** Generation algorithm uses three octaves.

**DR12.** Octaves are influenced by frequency.

**DR13.** Octaves are influenced by persistence.

**DR14.** Frequency must always be a positive number above zero.

**DR15.** Persistence must always be between zero and one.



I06 – Perlin noise generated with 3 octaves. Retrieved from:  
<https://www.youtube.com/watch?v=MRNFcywkUSA>

The image shown above is a Perlin noise that has been generated with three octaves that follow the formulae of frequency and persistence. Compared to I03 this generated map has much more interesting detail than the default Perlin noise, while also still having subtle drop-offs of values. This creates something that is much more interesting than just random noise, while also still allowing for variation to occur over distance.

## Healing environment

A healing environment is a surrounding environment that has a focus on the health of patients, families, employees, and promotes mental health through the reduction of stress. Healing environments are particularly employed in healthcare. The goal of such an environment is to help people heal better and faster, or at the very least make the healing process less unpleasant. There is strong evidence that nature and fresh air contribute towards this effect as well (van Dijk, Wat is een healing environment?, 2019).

When creating a healing environment focus is put on using natural elements like nature, daylight, fresh air, peace and quiet. Furthermore, there is also often use of specific colors within these types of environments that apparently have an influence, but these still lack hard scientific knowledge, and even suggest that it is hard to scientifically underpin choices for evoking specific emotions through color.

Some studies show a direct link between nature and the improvements of health, particularly with the reduction and handling of stress. To even further prove a point, there are even links between a reduction in perceived pain and viewing nature. The explanation used for this phenomenon is that nature sends a message to our brains telling us it is okay to relax, also known as restorative effects (van Dijk, 2019).

Elements of what a healing environment can include are, but not limited to:

- Exposure to nature such as interior or exterior gardens.
- Aquariums.
- Art with a nature theme.

- Soothing colors.

---

**DR16.** The environment should resemble a natural scene.

---

## Relaxation

The term relaxation is well known, but what does it really mean? What does it mean to be relaxed, and how is it achieved? Is relaxation a frame of mind, a psychological experience, or a behavior that can be learned and taught?

Relaxation is the mental and physical freedom from tension or stress. It is a state that may be present or absent throughout the body, affecting skeletal muscles, skin conductance, increased heart rate, respiratory rate, blood pressure, and cognitive activities such as thoughts, perceptions and emotional states. It is possible for tension to exist in one area of the body while relaxations occur in another part, although relaxation in one location tends to promote or encourage relaxation in other areas (McCaffery, 1979).

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**DR17.** The application reduces heart rate.

**DR18.** The application reduces respiratory rate.

**DR19.** The application reduces physical tension.

---

The physical state of relaxation is often recognized due to absence of tension, measured through physiological changes or through subjective self-report, or a combination of both methods.

## User Experience

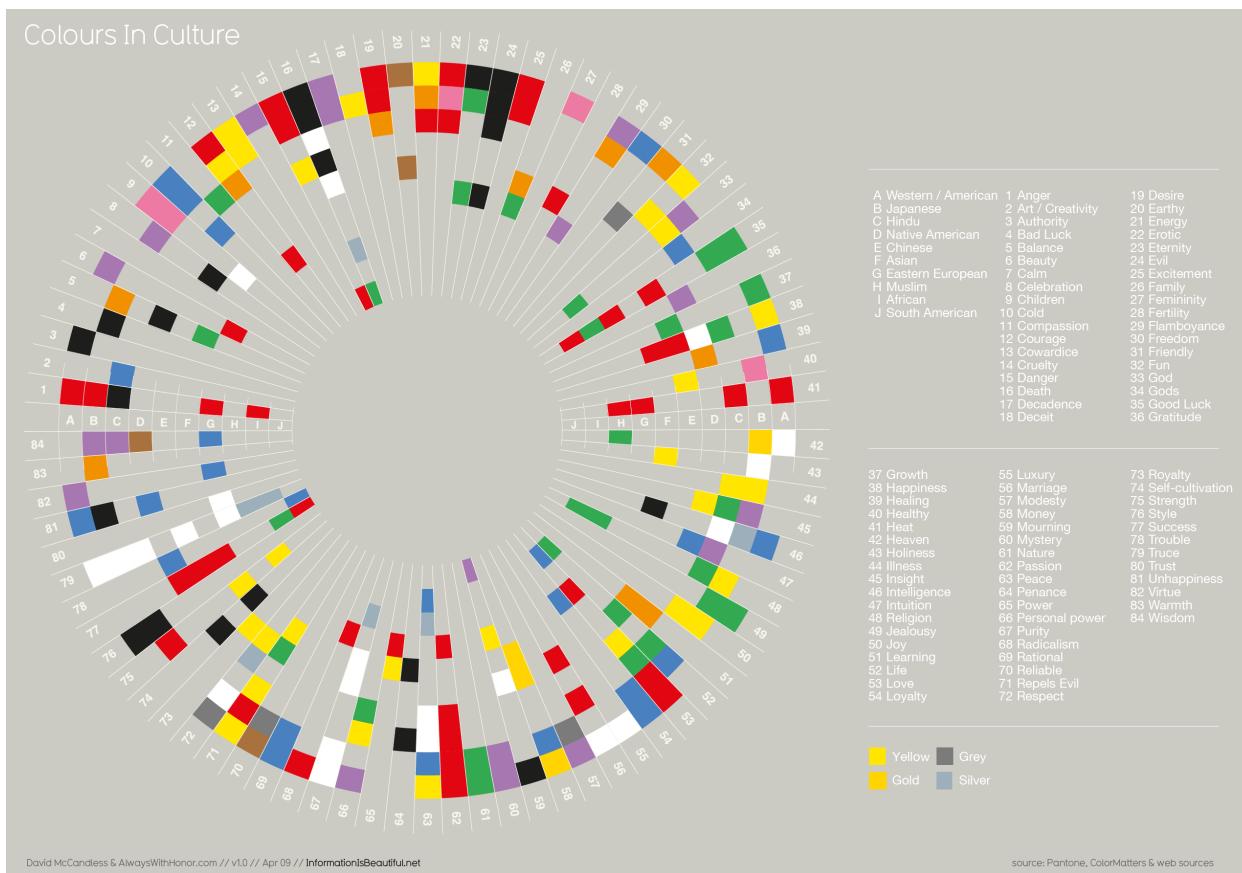
The world that would surround the player is very important when it comes to dealing with stress and anxiety. The focus of the environment needs to be on relaxation, in an effort to reduce heart rate, reduce respiratory rate, and reduce physical tension. When the user is affected by these three indicators, it is possible to say that someone has achieved a relaxed state of being. However, simply stating the intended state for the user, unfortunately, yields no results. The solution that will be built for the intended goal must be rationalized with and built around a desired user experience. It is also worth noting that colors have a different meaning based on cultural backgrounds (Weinschenk, 2011) (McCandless, Doughty-White, & Wdowski, 2009).

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**DR20.** The used colors should adhere to the Western/American color association pallet as defined in *Colours in Culture* (McCandless, Doughty-White, & Wdowski, 2009).

**DR21.** The environment should evoke positive feelings.

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107 – Color table. Retrieved from: <https://informationisbeautiful.net/visualizations/colours-in-cultures/>

According to philosopher and author of the book *The Art Instinct: Beauty, Pleasure, and Human Evolution* Denis Dutton, you often see paintings of pastoral scenes in musea, art galleries, hotels, or even office buildings because people generally find them naturally beautiful. Humans are drawn to this because scenery like this most likely meant that survival in the area would be easier. The ideal landscape for humans in the past was one where there was plenty of water, animals, and shelter. Seeing scenes like this invokes a primal feeling of serenity and beauty (Weinschenk, 2011) (Dutton, 2010).

#### DR22. The environment should resemble a lush pasture of savannah.

User experience is a small part of a larger concept called human-computer interaction (HCI). When a human and a computer are used together to accomplish something we can consider it HCI. Usability is an aspect within HCI that is devoted to ensuring that human-computer interaction is effective, efficient, and satisfying for the user (Hartson & Pyla, 2012). Performance and productivity oriented factors related to usability, such as learnability and ease of use, are very important in most software and many commercial products. It is important for users to efficiently and effectively have HCI with minimum errors and frustration (Hartson & Pyla, 2012).

#### DR23. The application should be easy to use.

#### DR24. The user can easily manipulate the application with few errors and little frustration.

The graphic design of a system; the colors, images, and other media, invoke emotional reactions in their users that may or may not contribute to the goal of the system. Each user's reaction to a given system may be different; one might be bored by soft pastel colors, while another could experience a feeling of calmness and reassurance (Hartson & Pyla, 2012).

## Input from Client and Stakeholders

Within the preliminary research process the client and stakeholders have been interviewed for guidance and input.

### Interview with client 9-1-19

A meeting was scheduled with the client to check up on progress being made towards the preliminary research for VRelaxScape. The current results have been discussed and the client is pleased with the current direction it is headed in. Client has given some information on similar products that can be accessed to gather inspiration, and has also offered to seek contact with Wim Veling, another stakeholder in VRelax and a professor at the UMCG. It is unsure at this point in time what the world should look like for the user, and Wim might be able to offer some guidance.

At the end of the interview an agreement was made that some preparation needs to be done before the interview with Wim Veling can take place. Concrete questions regarding presence and visualization are the most important, and the interview will not be about technical aspects.

### Meeting with Dr. Wim Veling and client 28-1-19

This meeting with Dr. Wim Veling was to gain insight into how he thinks the environment would impact the user, and what the world should look like. In the past Dr. Veling has overseen another project called CleVR. This application would be employed to train people social skills and how to deal with frustration. Its use is not necessarily the same and what VRelaxScape would be, but the core concept of putting someone in VR to simulate a situation is relatable.

The interview will be unguided so the information flows organically. Because Dr. Veling is so highly accomplished his opinion weighs heavily. The main guiding question for the interview is the main research question. Furthermore the interview will be recorded and a transcript will be included in the appendix. The revelations and results that are formed from the interview are found here.

List of guiding questions:

- What are the key attributes that need to be upheld to construct a relaxing environment in VR?
- What are your experiences with sounds?
- Can you tell me about the kind of effects un-realistic scenery might have?
- Do you think that having a more realistic environment would be better than having a stylized one?
- What do you do help your patients relax?
- Are there any exercises that you teach your patients to use in daily life?

- How long would you recommend a session last?
- How would you measure if someone is relaxed?

Results from interview:

- There needs to be a good available variation of content. Because what causes relaxation for one person might not work for the other. (Timestamp 00:02:35, 00:06:34, 00:15:03)
- Relaxation can also be a side-effect of distraction. (Timestamp 00:03:35)

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**EDR1.** The application needs variation of content.

**EDR2.** The application may also focus on distraction as well as relaxation.

**EDR3.** The user must be sufficiently engaged to fill their “working memory”

**EDR4.** There needs to be a balance between engaging and stimulation.

---

## Design Requirements

Here all of the design requirements have been listed for ease of access and legibility. The design requirements listed here have been extracted from academic research and client based requirements.

**DR0\***. It has to be a digital product.

**DR1:** The application is in VR.

**DR2:** The application is built on the Oculus Go.

**DR3.** The application's world environment is procedurally generated.

**DR4.** The application can be used more than once.

**DR5.** The VR application should incorporate at least two senses.

**DR6.** The VR application causes a sense of pressense/immersion.

**DR7.** The VR application reduces stress of the user after a session.

**DR8.** The VR application incorporates tactile sensations.

**DR9.** A session can last at least twenty (20) minutes.

**DR10.** The procedural generation of the terrain makes use of perlin noise.

**DR11.** Generation algorithm uses three octaves.

**DR12.** Octaves are influenced by frequency.

**DR13.** Octaves are influenced by persistence.

**DR14.** Frequency must always be a positive number above zero.

**DR15.** Persistence must always be between zero and one.

**DR16.** The environment should resemble a natural scene.

**DR17.** The application reduces heart rate.

**DR18.** The application reduces respiratory rate.

**DR19.** The application reduces physical tension.

**DR20.** The used colors should adhere to the Western/American color association pallet.

**DR21.** The environment should evoke positive feelings.

**DR22.** The environment should resemble a lush pasture of savannah.

**DR23.** The application should be easy to use.

**DR24.** The user can easily manipulate the application with few errors and little frustration.

**EDR1\*\*.** The application needs variation of content.

**EDR2.** The application may also focus on distraction as well as relaxation.

**EDR3.** The user must be sufficiently engaged to fill their “working memory”.

**EDR4.** There needs to be a balance between engaging and stimulation.

\* = Design Requirement

\*\* = Expert Design Requirement

## Phase Two

*Concept & Idea Generation*

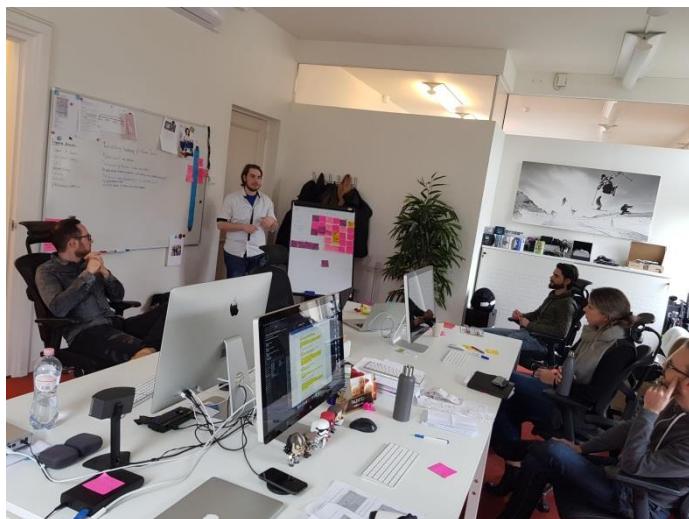
Image retrieved from: <https://www.flickr.com/photos/111692634@N04/15423276943>

## Concept Process

After the acquisition of design requirements through preliminary research and expert research, the time comes to form them into possible solutions. To do this the designer must ideate a creative solution that upholds the most important requirements, while not letting the eventual result suffer from poor communication. Furthermore, the client will also be involved in the ideation process as expert evaluator to assist in the creation of the proposed application.

## Solution Direction

Based off the preliminary research done in phase one, we can make quite a few assumptions for the desired solution direction. A desirable solution, in line with the research done in phase one, is a procedurally generated VR world environment. Furthermore, the developed concept must also be able to uphold the technical requirements posed by the Oculus Go. The proceeding step for this direction is to concept how that world might look like in order to meet the remaining design requirements.



### Brainstorming

Firstly, a brainstorm session started the creative process to determine the beginnings for concepts. Procedural generation was at the core of the prototype, and as such the brainstorm session was about how to best utilize this technology.

In the first phase of the project, an initial brainstorm session had been held. The results of which are visible I02. This initial session guided the direction for the research and possible solution directions for the project.

I08 – Second brainstorm session.

Further brainstorm sessions had been held after the preliminary research phase to assist towards content generation, and defining what control the user would have within the application itself.

This brainstorm session also resulted in concepts for different interactions that could possibly take place within the VRelaxScape environment, for instance interacting with a rack of bells to create sounds.

To allow the user to have some form of familiarity each time they start the VRelaxScape, it would be useful to have a default spawn position. Due to the theme that has been set it was found that a small campsite would be fitting to the theme. The campsite would contain a tent, fire pit, bedroll, a tree, and some logs that can be interacted with.

The main intended result from the brainstorm session was to create a list of possible interaction ideas, a list of content that could potentially be added into the prototype, and a short list of assets that can be present as well.

The panel of people participating in the brainstorm session were as follows; the client, stakeholders, a few members from the target audience and the project designer.

## Interaction Opportunities

Interacting with the world around the user is of utmost importance to achieve distraction for the user. To mediate this, interaction possibilities are noted down here to provide reference for possible solution directions.

- Fireplace.
  - Rack of bells.
  - Wind chimes.
  - Sandbox.
  - Catch butterflies.
  - Burst clouds.
  - Clouds.
  - Flowers.
  - Garden.
  - Dandelion.
  - Special collectable items.
    - Sea shells.
    - Glowing rocks.
  - Change time of day.

## World Props

The world needs to be in a low-poly style due to hardware limitations of the oculus go. Stylized low-poly art can be very beautiful, and allows the mind to interpret more, leading to better immersion and higher memory workload for the brain.

- At least three different types of trees.
  - At least three different types of grass.
  - Clouds.
  - Water.
  - Start point of the world.
    - Tent.
    - Fireplace.
    - Shovel.



## *109 – Results from second brainstorm.*

- Bedroll.
- Unique tree.
- Terrain.
- Foliage

## Sounds

The focus for ambient sound should be on calming effects. Easy music will be playing in the background. Interactions go hand in hand with sounds to provide adequate feedback to the user.

- Click or pop sound.
- Birds chirping.
- Fire crackle.
- Bells of different pitches.
- Wind chimes.
- Footsteps for movement.
- Ambient Music

## MoSCoW

This is an acronym for Must Should Could Won't. With this method we can narrow down what requirements would be absolutely necessary for the concept to include, and identify the ones that are not as necessary (Mulder, 2019).

### Must

These design requirements must always be present within the concept that is proposed to be able to solve the issue proposed by the client.

**DR0.** It has to be a digital product.

**DR1:** The application is in VR.

**DR2:** The application is built on the Oculus Go.

**DR3.** The application's world environment is procedurally generated.

**DR4.** The application can be used more than once.

**DR5.** The VR application should incorporate at least two senses.

**DR6.** The VR application causes a sense of immersion.

**DR7.** The VR application reduces stress of the user after a session.

**DR10.** The procedural generation of the terrain makes use of Perlin noise.

**DR11.** Generation algorithm uses three octaves.

**DR12.** Octaves are influenced by frequency.

**DR13.** Octaves are influenced by persistence.

**DR14.** Frequency must always be a positive number above zero.

**DR15.** Persistence must always be between zero and one.

**DR21.** The used colors should adhere to the Western/American color association pallet.

**DR23.** The environment should resemble a lush pasture of savannah.

**EDR1.** The application needs variation of content.

## Should

These design requirements are desired, but not necessarily detriment to the project.

- DR9.** A session can last at least twenty (20) minutes.
- DR16.** The choice of color doesn't necessarily matter.
- DR17.** The environment should resemble a natural scene.
- DR18.** The application reduces heart rate.
- DR19.** The application reduces respiratory rate.
- DR20.** The application reduces physical tension.
- DR24.** The application should be easy to use.
- DR25.** The user can easily manipulate the application with few errors and little frustration.
- EDR4.** There needs to be a balance between engaging and stimulation.

## Could

These design requirements could perhaps be added to the project, but most likely will not be added due to time constrictions.

- DR8.** The VR application incorporates tactile sensations.
- DR22.** The environment should evoke positive feelings.
- EDR2.** The application may also focus on distraction as well as relaxation.

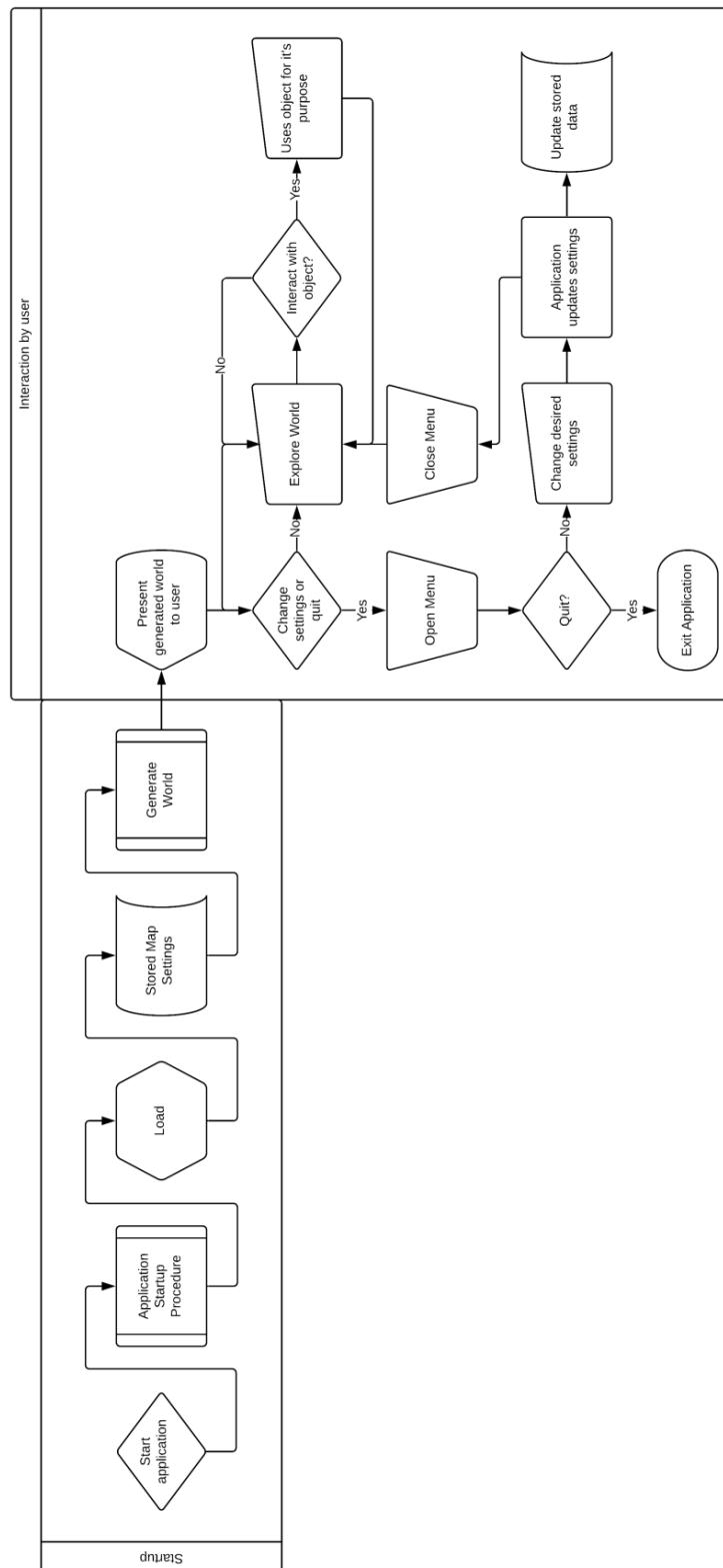
## Won't

These design requirements will not be taken into account due to the scope of the project and available development time for the prototype.

- EDR3.** The user must be sufficiently engaged to fill their "working memory".

## Leading Design Specifications

Group	Requirements	Specifications
<b>Technical Requirements</b>	<b>DR0</b> <b>DR1</b> <b>DR2</b> <b>DR3</b> <b>DR4</b>	Creating an application for the Oculus Go means that the application will be, per definition, a digital product. The Oculus Go is a standalone VR headset. Because of the hardware limitations of the Oculus Go, the application's main scene may not exceed a total triangle count of 100.000. This means that the whole scene must be built in a low poly fashion to be able to run on the Oculus Go. Furthermore, the application must be able to run at least a stable 60FPS to 75FPS.
<b>Tactile Requirements</b>	<b>DR5</b> <b>DR6</b> <b>DR7</b>	The Oculus Go has built in stereo speakers. Because the application will be VR with head tracking, there is already incorporation of two senses; vision, and movement. Sound must also be present in the application and the Oculus Go headset can easily facilitate this.
<b>Functional Requirements</b>	<b>DR10</b> <b>DR11</b> <b>DR12</b> <b>DR13</b> <b>DR14</b> <b>DR15</b>	The procedural generation engine will make use of a mathematical function built into Unity named Perlin noise. Perlin noise provides gradual change of value based on a sample position in a Vector2. This returned value can then be used to generate a mesh for the terrain and define the probability of an object being placed somewhere. By combining multiple levels of Perlin noise (octaves) influenced by frequency and persistence, it is possible to create a very natural looking landscape.
<b>Visual Requirements</b>	<b>DR16</b> <b>DR17</b> <b>DR18</b> <b>DR19</b> <b>DR20</b> <b>DR21</b> <b>DR22</b> <b>DR23</b> <b>EDR1</b> <b>EDR2</b>	The environment must resemble that of a natural scene. The color palette can be bright and colorful pastel colors, or calm natural colors. The user should be able to choose between the two palettes. Variation of content refers to different types of objects that can be in the world. Different types of trees, grass, and intractable objects.
<b>Interaction Requirements</b>	<b>DR24</b> <b>DR25</b> <b>EDR3</b> <b>EDR4</b>	The application should have very simple forms of interaction and the interaction needs to be very intuitive. Give feedback to the player to indicate that they might be able to interact with a certain object, but also let them discover.



I10 – Application flow chart.

## Concepts

This section will introduce two concepts that attempt to solve the proposed issue in phase one. Every concept has some leading design features that are prominent regardless of the concept, and the graphical style is dependent on hardware capability.

### Leading Design Features



I11 – Concept Environment 1. Retrieved from: <https://80.lv/articles/emeck-can-ozben-low-poly-environment/>

The world that surrounds the user is very important, because they want to immerse themselves in the application, and the intent is to calm them, the environment should evoke positive feelings and have the world reflect this idea.



I12 – Concept Environment 2. Retrieved from: <https://80.lv/articles/emeck-can-ozben-low-poly-environment/>

As defined in the leading design specifications, the environment has to be built in a low poly fashion because of hardware limitations. The Oculus Go has very specific standards that need to be upheld, and one of those is that the application can run at a speed of at least 60 frames per second. To achieve such a high target FPS it is advised to have no more than 100.000 triangles in a single scene.

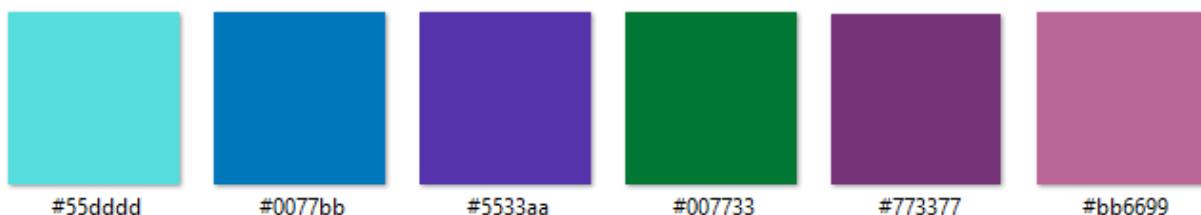


I13 – Concept Environment 3. Retrieved from:

<https://assetstore.unity.com/packages/3d/environments/low-poly-style-environment-72471>

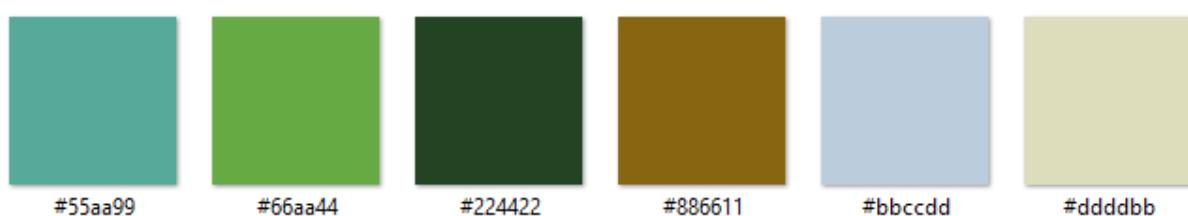
## Color Palette

Pastel



I14 – Pastel Color Scheme.

Natural



I15 – Natural Color Scheme.

## ∞Scape

∞Scape is set within an infinitely large terrain. The user can traverse in any given direction forever. As the user travels through the world, new terrain loads in, while the space behind them unloads. The user is free to explore in any direction and free to try to interact with as many objects as they please. There are dust motes that are floating around the player, and regardless of where they are the motes will be visible to create a sense of depth in the world. The intent of the application is to evoke a calm and relaxed state of mind for the user. To do this the application focuses on calm and relaxing sounds, but also on distraction.

### Interactions

The user will have several different types of interactions that can take place in the world.

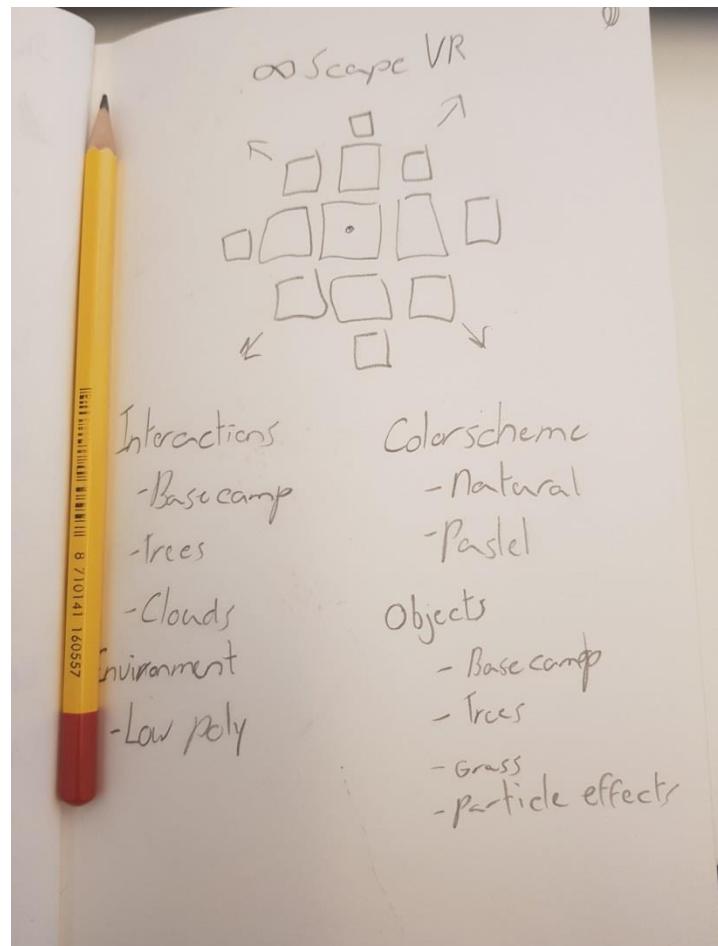
- Basecamp
- Trees
- Clouds
- Flowers
- Musical bells

### Pro's

- Infinite terrain
- Endless exploration
- Highly customizable
- Immersive
- Gives control to user
- High replayability
- Expandable content
- Virtually limitless variation of worlds

### Con's

- Infinite terrain
- High technical difficulty
- Hard set technical limitations



I16 – InfinityScape Concept on paper

## IslandScape

IslandScape is set on an island like map. Everything the user can do is contained within the island. General layout of the map is the playable area is in the center, and the edges of the map are mountains or an endless expanse of water. The main mechanic of this concept is the procedurally generated terrain. The terrain contains trees and intractable events. The user can move through the world by pointing and clicking on one of the buttons of the Oculus Go controller. The user is free to explore in any direction and free to try to interact with as many objects as they please. There are dust motes that are floating around the player, and regardless of where they are the motes will be visible to create a sense of depth in the world. The intent of the application is to evoke a calm and relaxed state of mind for the user. To do this the application focuses on calm and relaxing sounds, but also on distraction.

### Interactions

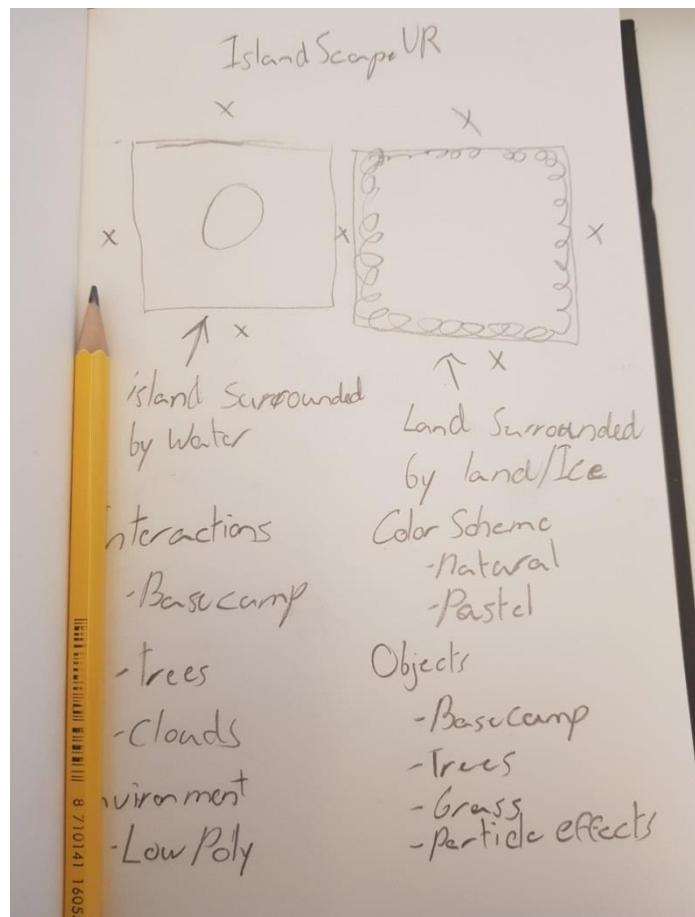
- Gathering
  - “Upgrade” basecamp
  - Shells
  - Rocks
  - Flowers
  - Plants
- Clouds

### Pro's

- Customizable
- Immersive
- All interaction in same area
- Easier for backtracking

### Con's

- Limited play zone
- High technical difficulty
- Hard set technical limitations
- Always the same layout
- Limited exploration
- Limited themes



I17 – IslandScape Concept on Paper

## Selection Substantiation

Both developed concepts are, at their core, very similar. Because of the leading design specifications, most of the core gameplay loop stays the same, however, there are big differences in the exploration possibilities.

The main goal of the project is to alleviate a problem the client is facing, this being that the current application has a very limited shelf life. Both concepts have been created with the leading design specifications in mind, and to that extent, they are both fitting candidates. However, they are not identical and there are both upsides as well as downsides to each of the concepts. During the ideation phase, and the preliminary research phase, a strong emphasis was put on relaxation through distraction. Because of this strong emphasis an argument could be made that the application needs to offer as much content as possible to achieve this intended user experience. The prospect of having an infinitely large world to explore and interact with is much more appealing, for both the client and stakeholders, than having a limited play area. Play area scale is a large deciding factor for the chosen concept for a prototype,

That being said, InfinityScape will be the subject for the prototyping phase. Phase three will go into more detail how the prototype will be realized, and will further substantiate the design choices that have been made during the development process. We have determined how well this fits within the leading design specifications and requirements, by approaching both the client and stakeholders to gauge whether or not this is a desirable solution.

Group	Requirements	Specifications
Technical Requirements	DR0 DR1 DR2 DR3 DR4	Creating an application for the Oculus Go means that the application will be, per definition, a digital product. The Oculus Go is a standalone VR headset. Because of the hardware limitations of the Oculus Go, the application's main scene may not exceed a total triangle count of 100.000. This means that the whole scene must be built in a low poly fashion to be able to run on the Oculus Go. Furthermore, the application must be able to run at least a stable 60FPS to 75FPS.
Tactile Requirements	DR5 DR6 DR7	The Oculus Go has built in stereo speakers. Because the application will be VR with head tracking, there is already incorporation of two senses; vision, and movement. Sound must also be present in the application and the Oculus Go headset can easily facilitate this.
Functional Requirements	DR10 DR11 DR12 DR13 DR14 DR15	The procedural generation engine will make use of a mathematical function built into Unity named Perlin noise. Perlin noise provides gradual change of value based on a sample position in a Vector2. This returned value can then be used to generate a mesh for the terrain and define the probability of an object being placed somewhere. By combining multiple levels of Perlin noise (octaves) influenced by frequency and persistence, it is possible to create a very natural looking landscape.
Visual Requirements	DR16 DR17 DR18 DR19 DR20 DR21 DR22 DR23 EDR1 EDR2	The environment must resemble that of a natural scene. The color palette can be bright and colorful pastel colors, or calm natural colors. The user should be able to choose between the two palettes. Variation of content refers to different types of objects that can be in the world. Different types of trees, grass, and intractable objects.
Interaction Requirements	DR24 DR25 EDR3 EDR4	The application should have very simple forms of interaction and the interaction needs to be very intuitive. Give feedback to the player to indicate that they might be able to interact with a certain object, but also let them discover.

## Phase Three

*Prototyping*

Image retrieved from: <https://blog.prototypr.io/what-the-hell-is-rapid-prototyping-fe101e446a78>

## Making the Prototype

The prototype will be made in the Unity game engine. This engine has been chosen for several reasons, however, the most prominent reason is because of the knowledge base available of both experience and expertise for the engine. Furthermore, Unity also allows for easy deployment to android, which is necessary to build for the Oculus Go.



I18 – Unity Logo. Retrieved from: <https://www.n3rdabl3.com/2019/01/unity-improbable-epic-games-feud/>

Unity3D is a very versatile engine that is built in C++. However, it's internal interpreter works with C#, so most scripts that are used in development of a project are written in C#.

The prototype can be broken down into several different parts.

- Terrain
  - Height variation
  - Textures

Terrain generator will be built according to the design requirements posed in phase one.

- Trees
  - Placement
  - Variation

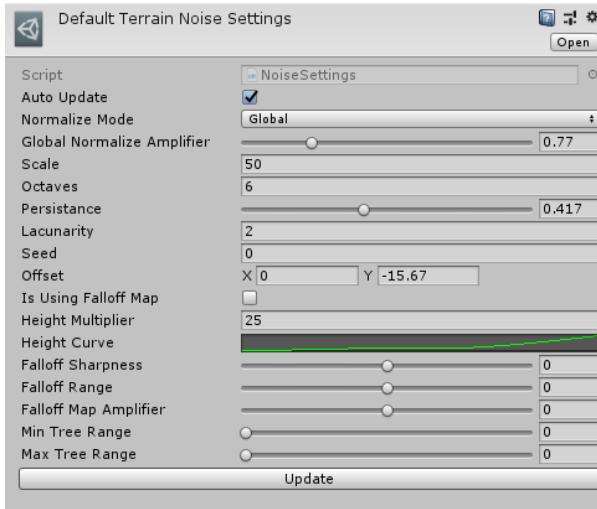
Trees offer variation in scenery for the user, helping towards creating a pleasant user experience.

- Interaction
  - Interactable event placement
  - Enable the utilization of the Go controller.

Interaction opportunities are key to the success of the product, because relaxation can be induced through distraction.

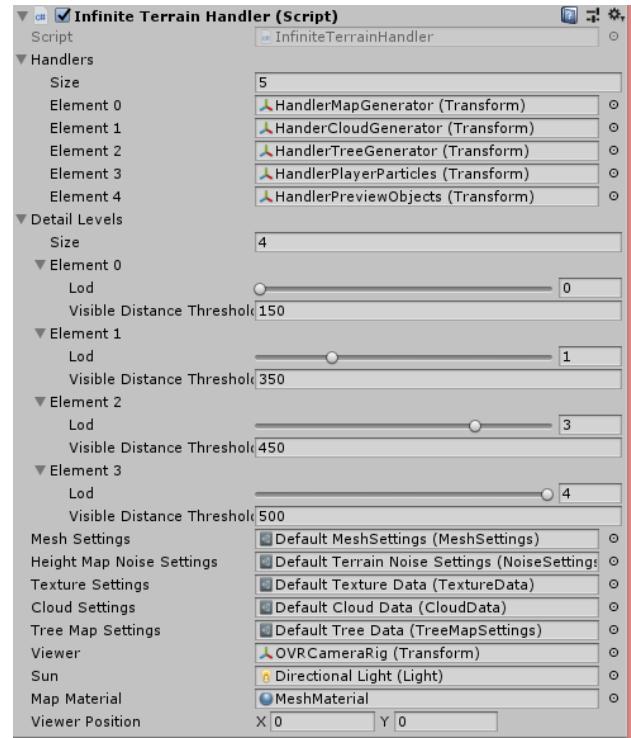
- Basecamp
  - Starting location for the player

First, the core of the application will be built; the terrain generator. The terrain generator is the core of the whole application. Remembering that the whole world needs to be in a low poly fashion, the terrain generator needs to reflect this. The terrain generator generates terrain based on input values to the noise generator.



I19 – Inspector Window from Unity 1.

The noise settings on the left are what dictate what happens with the mesh generation for the terrain.



I20 – Inspector Window from Unity 2.

## Terrain Handler

The world is divided into chunks. Each chunk can be loaded and unloaded independently from one another. The terrain handler handles the spawning and despawning behavior of the chunks based on the player position.

```
//This is pseudo code, and is only to give a representation of functionality.

function UpdateVisibleChunks()
{
    foreach(chunk in visibleChunks)
    {
        if(chunk.distance > maxVisibleDistance)
            chunk.setActive(false);
        else
            chunk.setActive(true);
    }
}
```

Each chunk has a different sample coordinate in the noise class that is used to generate the different mesh shapes of the world map. Noise class requires settings to be passed so it can determine the

behavior. Noise settings contain variables regarding normalization mode, scale, octaves, persistence, lacunarity, PRNG seed, and settings for the falloff map.

```
//This is pseudo code, and is only to give a representation of functionality.

float[,] GenerateNoiseMap(width, height, noiseSettings, sampleCenter)
{
    float[width,height] noiseMap;

    for (int y = 0; y < height; y++)
    {
        for (int x = 0; x < width; x++)
        {
            perlinValue = Mathf.PerlinNoise(x, y);
            noiseHeight += perlinValue * noiseSettings.amplitude

            noiseMap[x,y] = noiseHeight;
        }
    }

    return noiseMap;
}
```

Next is the noise map that needs to be generated to determine where the trees will be placed in the world. Since there is already a noise generator, we can simply generate a new noise map data for the trees, compare the height variations to the terrain noise map, and where the maps are in a minimum and maximum range, we set the probability to 1 and if it's out of the range we set the probability to 0. The newly generated comparison map will have two color tones. White, for where the trees will be visible, and black where there will be no trees.

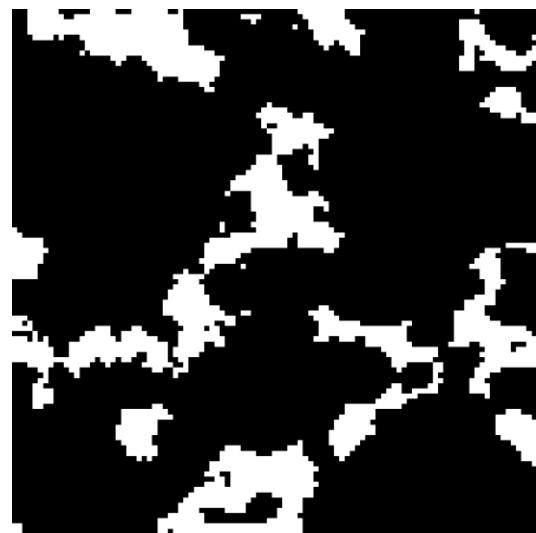
```
//This is pseudo code, and is only to give a representation of functionality.

function GenerateMapByComparison(width, height, firstMapSettings, secondMapSettings)
{
    float[,] firstMap = GenerateNoiseMap(firstMapSettings)
    float[,] secondMap = GenerateNoiseMap(secondMapSettings)

    float[width,height] comparedValues;

    for (int i = 0; i < i_width; i++)
    {
        for (int j = 0; j < i_height; j++)
        {
            if(firstMap[x,y] within minMaxRange && secondMap[x,y] within minMaxRange)
                comparedValues[x,y] = 1
            else
                comparedValues[x,y] = 0
        }
    }
}
```

This is what the compared noise map looks like. Instead of the map interpolating from black to white, it gets a hard border and only displays extremes. This allows the lookup table to be accessed very easily. White represents a value of 1, and black represents a value of 0. Where the white value is found when checking a tree is placed, and where black is found we ignore this coordinate.

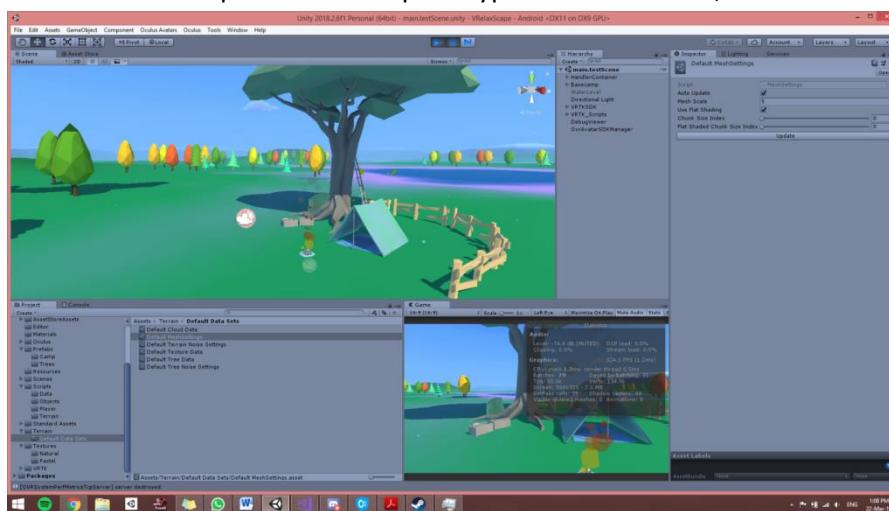


I21 – Compared Noise Map

```
//This is pseudo code, and is only to give a representation of functionality.

function PlaceTreesInChunk(settings)
{
    for (int i = 0; i < height; i++)
    {
        for (int j = 0; j < width; j++)
        {
            if(treeHeightMap[i,j] == 1)
            {
                placeTree(coordinate);
            }
        }
    }
}
```

The end result of all of these components of the prototype looks as follows;



I22 – Screenshot from Unity.

The total triangle count at this point in time is roughly 60.000 on screen at any given moment. This means there is still a good 40.000 triangles that can still be utilized to fill in the world with interactable objects and other detail/world props.

After having implemented the infinite terrain feature and tree population, the application was tested for stability regarding the frames per second. Ideally the target FPS is at least sixty (60) frames per second, up to seventy-two (72) frames per second. At the time of testing the application

Next the user needs to be able to interact with objects. Interactions are going to be very simple for two reasons, firstly, because research has shown that simple interactions are very effective as a distraction, and secondly, because of the available development time for the prototype. There are going to be three different interaction events.

- Bell rack
- Fire place
- Cloud bursting

The bell rack will be a way for the user to make music. There will be a rack with 7 or so different bells that each makes a unique sound, and the user can interact with them each individually to create sounds. The fire place is at base camp and can be turned off or on. To turn it on the user can place a log on it, and to turn it off the user can use a bucket of water on it. And the last form of interaction with objects is going to be cloud bursting. The user points at a cloud and makes it disappear. A nice little particle effect gives adequate feedback to the user. Of course the user also needs a way to move through the world, and as such, locomotion will therefore also be implemented.

```
//This is pseudo code, and is only to give a representation of functionality.

function BellReactToUserInput()
{
    playSound();
    playAnimation();
}
```

The fire place right at the starting location can be interacted with. It can be started and stopped by using the two nearby objects on it. One blue cube can be found representing water, and a red cylinder representing fire. The fire place has an area of interaction where it will check if one of the two items is within its bounds. If it is then it acts accordingly.

```
//This is pseudo code, and is only to give a representation of functionality.

function OnCollisionObject(object)
{
    if(object == interactTarget.water)
    {
        TurnOff();
    }
    else if(object == interactTarget.Fire)
    {
        TurnOn();
    }
}
```

## Expert Evaluation “Ex-Ante”

Due to the range of possibilities that this project could have taken form of, it was important to get the opinion of an expert – or several, regarding whether or not the developed concepts might be acceptable for the target audience. This type of evaluation is referred to as “Ex-ante” meaning “before the event”. What this type of evaluation means for the project is an evaluation that is carried out on the concept without being fully developed (Johannesson & Perjons, 2014).

Ex-ante provided several benefits for evaluation. The most prominent benefit being it could be carried out with relative ease and rapidness. For this type of evaluation there is no requirements for large resources or even access to users. In this light, ex-ante was ideal for evaluating the provisional prototype concept to assess it quickly and inexpensively. However, it is important to keep in mind that through ex-ante evaluation, it is relatively easy to result in false positives. An unfinished prototype, and in this case a concept, might be potentially judged as being better than it actually could be.

### Experts partaking in the ex-ante evaluation:

Stefan Vogelzang (Client)

Fabian Debats (Client)

### Notes

- This looks good. However, the prototype definitely needs to be able to run on the Oculus Go. So keep in mind that there are definite hardware limitations.
- The framerate is too low for this to be usable.
- Having an unnatural color palette could be something very appealing to users. It would really transport them to a different world, further reinforcing relaxation through distraction. However, make sure you do not use too many bright neon colors because this could result in overstimulation and actually cause the opposite desired effect.
- You have not mentioned anything about sound. In our experience, sound is one of the most, if not the most, important feature of VR. Through sound, you can really initiate a meaningful experience.

---

**ADR1.\*** There should be calming background music.

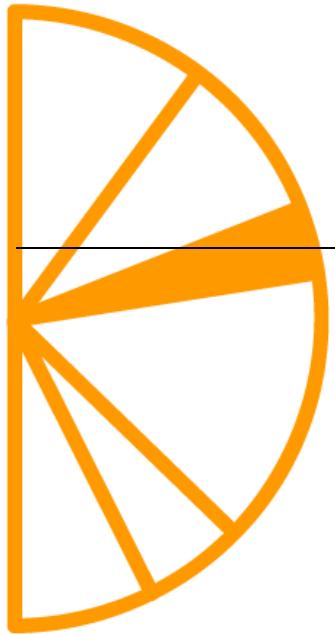
**ARD2.** The user needs audio feedback when they interact with the environment.

**ARD3.** The user needs to experience the application at a higher framerate.

---

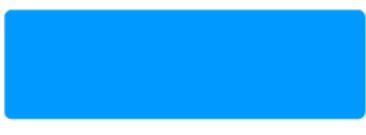
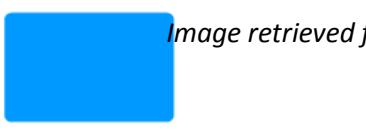
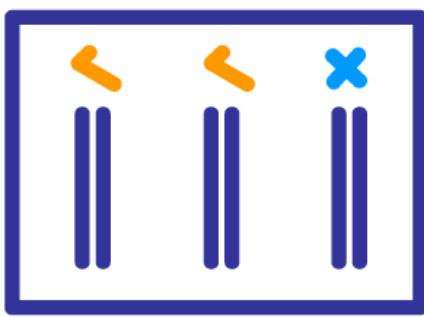
Group	Additional Design Requirements	Specifications
<b>Sound Requirements</b>	<b>ADR1</b> <b>ADR2</b>	Audio stimuli are another very important factor in VR. This aspect can further solidify the design of the product, and help to increase the amount of presence for the user in the application.
<b>Technical Requirements</b>	<b>ADR3</b>	The application needs to have the LWRP (Low Weight Render Pipeline) implemented to decrease the render time per frame, such that the application ensures a much smoother experience for the user.

The advice that came out of the ex-ante evaluation with clients helped further improve the product to ensure a pleasant user experience.



## Phase Four

*Evaluation*



*Image retrieved from: <https://en.unesco.org/youth/toptips/planner/monitoring>*

## Testing Methodology

Now comes time to evaluate the proposed prototype by means of thorough evaluation. Several different measurements will hopefully enlighten issues and point towards proving how successful the product is.

In phase one the hypothesis was stated:

"After the use of a VR medium to induce relaxation, a user will report feeling more relaxed after use."

To set out to prove this we must first lay out how this evidence will be gathered. First the core method of evaluation will be explained, then supporting measurements, alongside substantiation for choice.

### Desirability Testing

To measure the goal of how someone feels about something, the evaluation method of "Desirability Testing" will be employed. The eventual state of mind goal for the application is a certain attitude, a state of being relaxed. Because this is also a very personal feeling, qualitative answers are more fitting, as these can lead to deeper insight.

Desirability testing provides people a way to identify and articulate how a certain design makes them feel. To do this participants pick from a range of positive, neutral, and negative adjectives that help them to tell the story of their experience (Benedek & Miner, 2002) using simple, handheld index cards, with adjectives written on them. To begin, write each adjective/descriptive phrase on its own index card, and place all of the cards randomly on a table. Show participants a prototype mock-up, and ask them to pick the 3, 4, or 5 adjectives that best describe how they feel about the design. Then record their selections, and ask the participant to talk about what each card means to them as it relates to the design (Hanington & Martin, 2012).

When this process is applied repeatedly with twenty-five or more participants, it is possible to compare the words that are most frequently chosen, and explore the groupings of positive, neutral, and negative word clusters. There are multiple ways to visualize the results (Barnum & Palmer, 2010), and you can continue to refine and retest the design prototypes until there are enough responses that elicit the intended emotional responses.

### Pre/Post-test

An additional method that will be employed to gain insight on the participant's state of mind is through self-report (Verhoeven, 2011). By filling out a quick questionnaire before and after testing, it is possible to find relative differences between someone's state of mind before and after using the application.

## Likert Scale

This method of measurement gets its name from its inventor; psychologist Rensis Likert (Likert, 1932). In a Likert scale type of questionnaire, participants' responses are scored within a range, indicating the intensity of their feelings for a given item.

The Likert scale is an excellent candidate for gathering information. It is easily understandable, and generates numerical data for easy comparison and compilation. This scale shows relative questions and asks the participant to gauge their feelings on a scale from one to five. One usually representing complete disapproval and five usually represents complete approval. In the case of this project the likert scale was set as one (1) being the representation of strongly disagree, and five (5) representing strongly agree.

## Heart Rate Monitor

While personally gauging if someone is relaxed through them answering questions, the body actually also emits evidence without the participant trying. If someone is relaxed their heart rate drops. By measuring a participant's heart rate before and after use of the prototype, it is then possible to gain information on someone's state of wellbeing. If their heart rate has reduced after having played the prototype it could show some correlation between the two.

## Further Reasoning

The information that is gathered can be anonymous. That is a good thing for many reasons, and the main reason is to reduce evidential bias. When this information is being analyzed there should be no discrimination between participants and each individual's results are equally important.

To further try to mediate evidential bias and tampering, participants will not be explicitly told what is being measured until all their data has been acquired. This is in an attempt to prevent a participant to change their natural behavior and keep them from having a predisposition.

## Protocol

Following is the protocol that was employed to gather data from willing participants during the evaluation phase.

1. Invite the participant to read information & consent form.
  - a. Information regarding how to utilize the application.
  - b. Ask for consent.
2. Answer any questions participant might still have.
3. Present the pre-test questionnaire to the participant.
4. Retrieve the filled out pre-test questionnaire.
5. Measure current heart rate.
6. Instruct the participant on how to utilize the Oculus Go.
7. Let them use the prototype for the duration of ten (10) minutes.
8. After ten (10) minutes are up, request the participant to remove the goggles.
9. Measure current heart rate.
10. Present the post-test questionnaire to the participant.
11. Retrieve filled out post-test questionnaire.
12. Present the selected possible adjectives to the participant in three (3) sections.
  - a. The cards within each group are randomized.
  - b. Left column positive.
  - c. Middle column neutral.
  - d. Right column negative.
13. Ask participant to pick no more than five (5) cards to describe their experience.
  - a. Note down what they choose.
  - b. Ask the participant to explain what they mean with their choice.
  - c. Note down responses.

## Materials

The prototype is self-contained in the Oculus Go. The Oculus Go consists of several components. First and foremost, the goggles to allow VR simulation, speakers built into the sides, and the Go controller to allow for interaction to take place, a small heart rate monitor that can be attached to participant's finger.

The adjectives that are utilized by desirability testing were selected based on the desired outcome of the prototype itself. The intended goal of the prototype is to mostly fall within the positive category. As such, the selected adjectives are heavily related to a particular state of mind. The negative adjectives are based on their positive counterparts. Most of the negative adjectives have their opposites represented in the positive list of adjectives and vice versa. As for the neutral adjectives, these are based on less desirable outcomes, without leaning towards a negative side.

Further materials used are paper for noting down the results, and twenty-six different cards; ten positive adjectives, ten negative adjectives, and six neutral adjectives.

- Positive
  - Appealing
  - Beautiful
  - Cute
  - Easy
  - Good
  - Happy
  - Positive
  - Relaxing
  - Soft
  - Warm
- Negative
  - Angry
  - Anxious
  - Appalling
  - Bad
  - Difficult
  - Exciting
  - Hard
  - Nervous
  - Sad
  - Stressful
- Neutral
  - Alright
  - Calm
  - Indifferent
  - Neutral
  - Short
  - Unimpressive

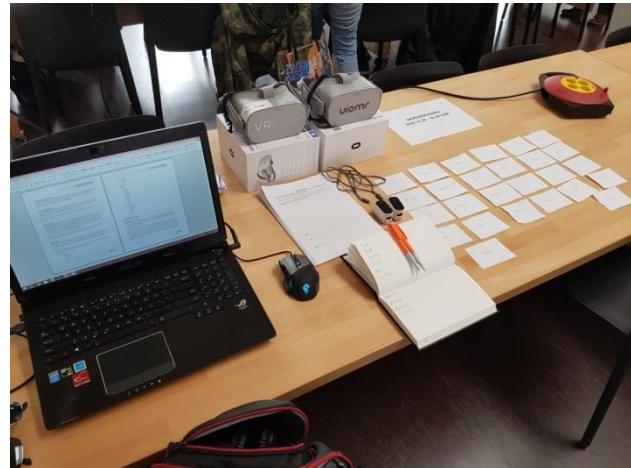
## Process

Initially testing the prototype and protocol resulted in some interesting data. Firstly, the prototype was met with enthusiasm. The test itself is structured correctly, however, the play time had to be increased. Participants' heart rate increased rather than decreased, whereas the opposite was expected from that measurement. However, through the self-report Likert scale it was indicated that they felt more relaxed.

The design of the prototype scored rather well.

The pilot test pointed out that the design is definitely in the right direction.

At this point in time the application had been tested with five (5) participants to streamline the testing protocol and procedures. The first change that is needed is to increase the use time of the prototype. After measuring participants' heart rate, and expecting a decrease, noticing an increase was rather surprising.



I23 – Picture from Pilot Test.

If someone is more relaxed, their heart rate should reflect this as well, and not only be apparent through self-report. Another important piece of information to note is that the participants in the pilot test had to utilize the prototype while standing. This was due to the unavailability of swivel chairs where this testing session was held. Standing is objectively more physically intense compared to sitting down and rotating around in a chair.

Another reason that a participants' heart rate might go up is that VR is exciting. It is strange for the body to be transported into an entirely new world, and because of this novelty and excitement, increasing the amount of time someone utilizes the prototype should mediate this problem further.

After having refined the initial testing procedure, another testing session had been arranged with physiologists and psychology students. In total the data has been gathered from fifteen (15) participants. The following testing session was held with the updated test protocol where they would utilize the prototype for the duration of ten (10) minutes.

The UMCG was very cooperative during the testing process; however, they could not expose nor provide the project with enough participants to fulfill the intended target of 25 testers. This mostly had to do with privacy issues and not wanting to overexpose patients to something that could potentially worsen someone's state of mind by testing with something unproven.

## Results

Looking at chart 1 to the right, where information is combined from 15 respondents, you can see the mean answers alongside error bars with 95% confidence intervals to all of the questions from the self-report. There is a noticeable improvement in participants reported state of mind regarding relaxation and mood. Nervousness and stress levels are reportedly lower, as well as participants reporting feeling more enthusiastic and more relaxed after use. However, there is also something interesting to note here that there is a slight increase in reported irritation levels.

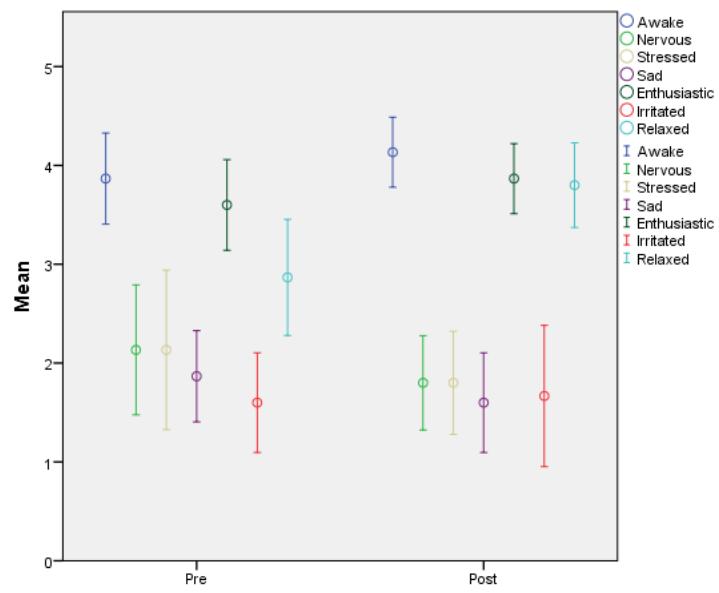


Chart 1, Error Bars: 95% CI

In Chart 2 below, you can see the mean heartrates with error bars at 95% confidence interval of all of the participants. Even though participants reported being in a more relaxed state of mind, their heartrates did not necessarily reflect this as well. Looking at the mean in chart 2 down below, there is a slight overall decrease in heartrate, but nothing significant. The range between the average heartrate decreases in the post results, however there is a higher minimum error level compared to the pre measurements.

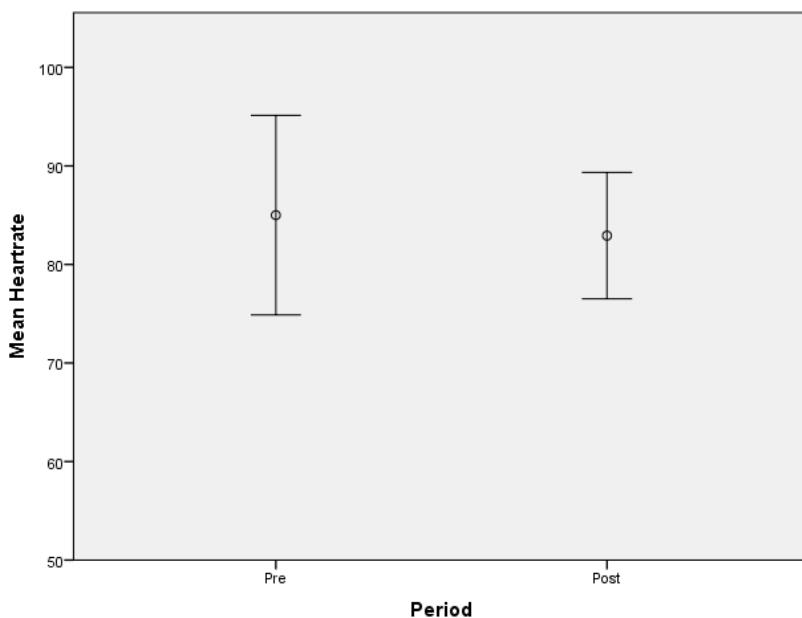


Chart 2, Error Bars: 95% CI

### Group Statistics

	Period	N	Mean	Std. Deviation	Std. Error Mean
Awake	Pre	15	3.87	.834	.215
	Post	15	4.13	.640	.165
Nervous	Pre	15	2.13	1.187	.307
	Post	15	1.80	.862	.223
Stressed	Pre	15	2.13	1.457	.376
	Post	15	1.80	.941	.243
Sad	Pre	15	1.87	.834	.215
	Post	15	1.60	.910	.235
Enthusiastic	Pre	15	3.60	.828	.214
	Post	15	3.87	.640	.165
Irritated	Pre	15	1.60	.910	.235
	Post	15	1.67	1.291	.333
Relaxed	Pre	15	2.87	1.060	.274
	Post	15	3.80	.775	.200

*Table 1 – Group Statistics Independent t-test.*

In the Table 1 above, you can see group statistics analysis; it consists of the same data set utilized in Chart 1 on the previous page. You can see the sample size for all of the categories have the same size of 15 respondents for both the pre- and post-test questionnaires, and the standard deviation is within acceptable ranges compared to the mean difference of the pre- and post-test answers.

### Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Awake	Equal variances assumed	.538	.469	-.983	28	.334	-.267	.271	-.823	.289
	Equal variances not assumed									
Nervous	Equal variances assumed	1.203	.282	-.880	28	.386	.333	.379	-.443	1.109
	Equal variances not assumed									
Stressed	Equal variances assumed	2.093	.159	.744	28	.463	.333	.448	-.584	1.251
	Equal variances not assumed									
Sad	Equal variances assumed	.024	.879	-.837	28	.410	.267	.319	-.386	.920
	Equal variances not assumed									
Enthusiastic	Equal variances assumed	1.607	.215	-.987	28	.332	-.267	.270	-.820	.287
	Equal variances not assumed									
Irritated	Equal variances assumed	1.089	.306	-.163	28	.871	-.067	.408	-.902	.769
	Equal variances not assumed									
Relaxed	Equal variances assumed	1.204	.282	-2.753	28	.010	-.933	.339	-1.628	-.239
	Equal variances not assumed									

*Table 2 – Independent Samples t-test*

Looking at all of the figures in table 2 on the previous page, we can conclude that overall, there is no statistically significant difference between the participants' state of mind after utilizing the prototype, except for their reported state of relaxation. Here, since the significance value is lower than 0.05 there is a significant statistical difference between before utilization and after utilization of the porotype. Thus, overall we must accept the null hypothesis that there is no significant difference between the specified groups, except for the Mann-Whitney U test result of the participants' relaxation reports.

Looking at the hypothesis stated in the first chapter of this document;

"After the use of a VR medium to induce relaxation, a user will report feeling more relaxed after use."

We can confirm this hypothesis by looking at the significance value generated in Table 2.

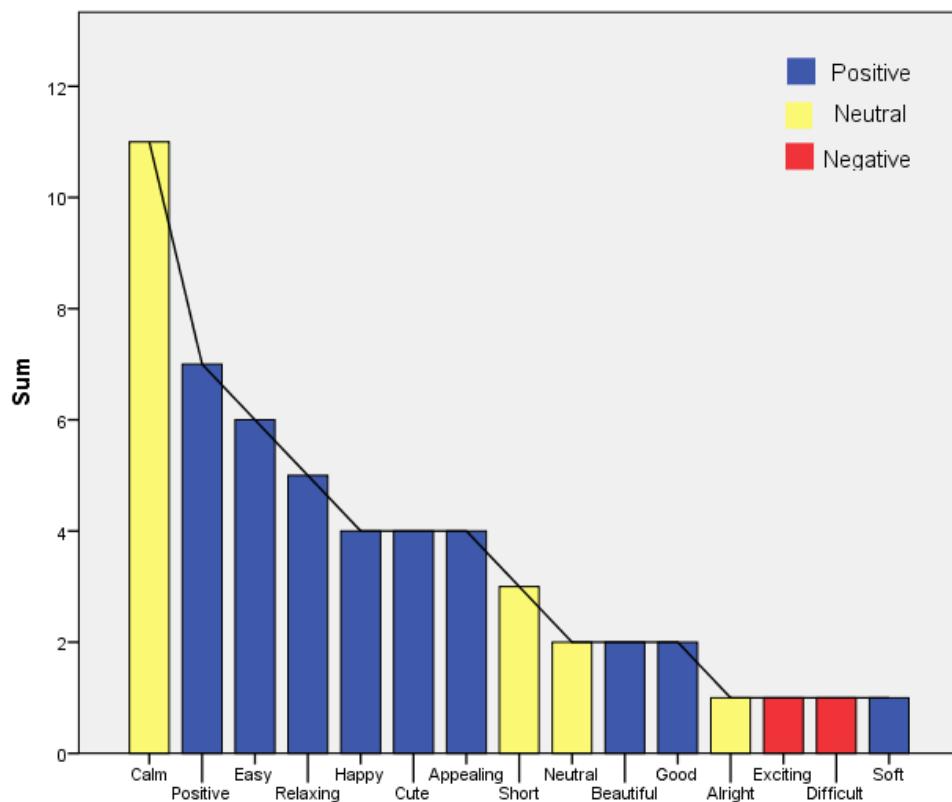
**Hypothesis Test Summary**

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Awake is the same across categories of Period.	Independent-Samples Mann-Whitney U Test	.461 <sup>1</sup>	Retain the null hypothesis.
2	The distribution of Nervous is the same across categories of Period.	Independent-Samples Mann-Whitney U Test	.539 <sup>1</sup>	Retain the null hypothesis.
3	The distribution of Stressed is the same across categories of Period.	Independent-Samples Mann-Whitney U Test	.775 <sup>1</sup>	Retain the null hypothesis.
4	The distribution of Sad is the same across categories of Period.	Independent-Samples Mann-Whitney U Test	.345 <sup>1</sup>	Retain the null hypothesis.
5	The distribution of Enthusiastic is the same across categories of Period.	Independent-Samples Mann-Whitney U Test	.512 <sup>1</sup>	Retain the null hypothesis.
6	The distribution of Irritated is the same across categories of Period.	Independent-Samples Mann-Whitney U Test	.713 <sup>1</sup>	Retain the null hypothesis.
7	The distribution of Relaxed is the same across categories of Period.	Independent-Samples Mann-Whitney U Test	.029 <sup>1</sup>	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

<sup>1</sup>Exact significance is displayed for this test.

*Table 3 – Hypothesis Test Summary*



Bar Chart 1 – Responses from desirability testing

	Cases					
	Picked		No Pick		Total	
	N	Percent	N	Percent	N	Percent
Calm	11	73.3%	4	26.7%	15	100.0%
Positive	7	46.7%	8	53.3%	15	100.0%
Easy	6	40.0%	9	60.0%	15	100.0%
Relaxing	5	33.3%	10	66.7%	15	100.0%
Appealing	4	26.7%	11	73.3%	15	100.0%
Cute	4	26.7%	11	73.3%	15	100.0%
Happy	4	26.7%	11	73.3%	15	100.0%
Short	3	20.0%	12	80.0%	15	100.0%
Beautiful	2	13.3%	13	86.7%	15	100.0%
Good	2	13.3%	13	86.7%	15	100.0%
Neutral	2	13.3%	13	86.7%	15	100.0%
Alright	1	6.7%	14	93.3%	15	100.0%
Difficult	1	6.7%	14	93.3%	15	100.0%
Exciting	1	6.7%	14	93.3%	15	100.0%
Soft	1	6.7%	14	93.3%	15	100.0%

Table 4 – Desirability testing summary

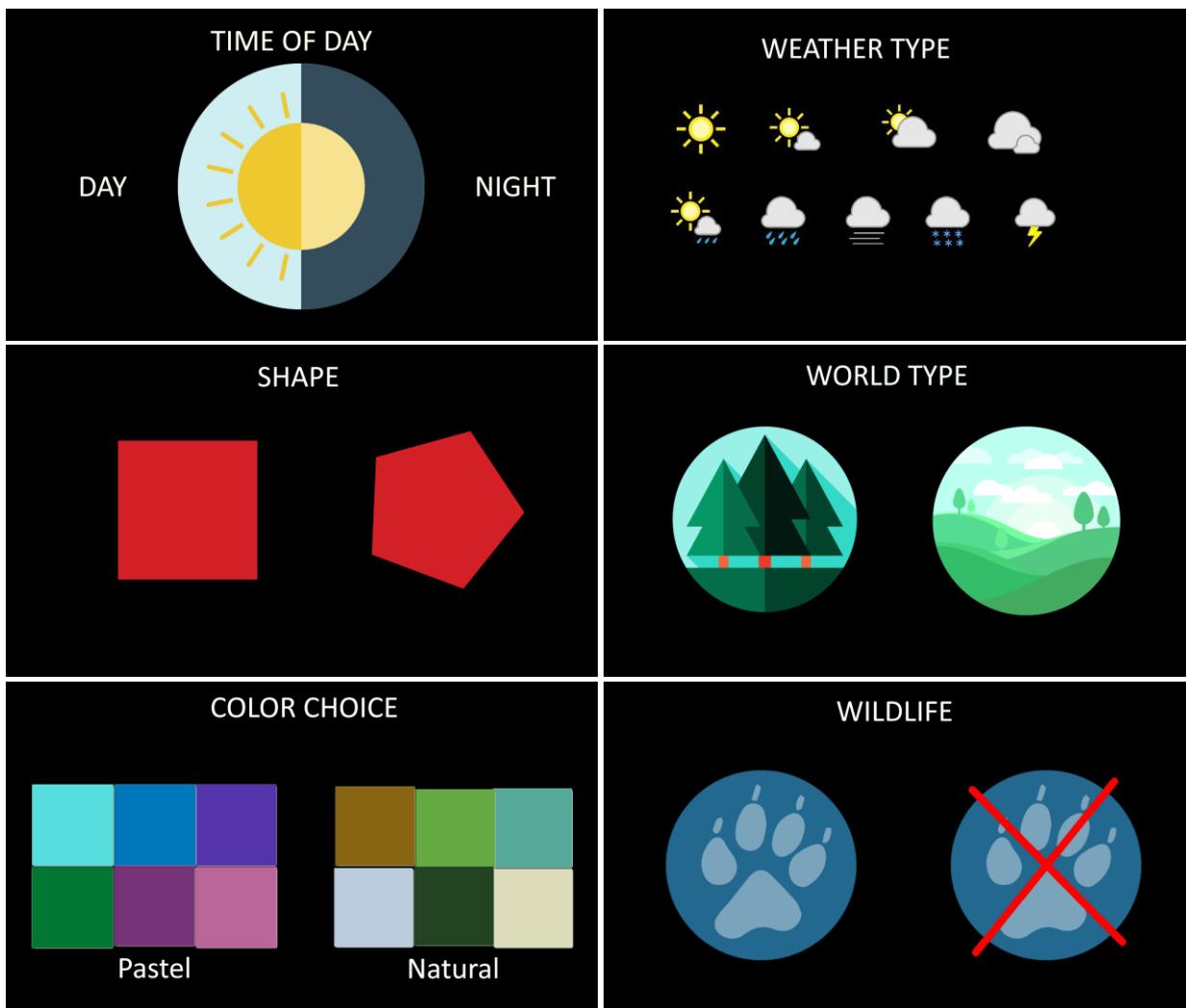
The chart and table on the previous page represent the answers given by participants during the desirability test. The most common adjective that was chosen to describe their experiences and their feeling towards the overall design of the prototype was calm, with positive in second place. Generally, the chosen adjectives for desirability testing fell within the positive or neutral category, with only a very few selections from the negative category. This result could be interpreted as follows;

- The design invokes the desired attitude for its users.
- The users of the prototype are likely to have a pleasant experience.

## Recommendations

After having evaluated the prototype with the target audience and experts, a few things had been identified which can still be improved in the future to make the product better for the target audience and stakeholders. Recommendations have been gathered from not only from the evaluation results, but also from expert discussions of the prototype.

First and foremost, the target audience needs control. Not everybody experiences the same things the same way, and not everybody uses the application for the same reasons. The user should be able to make decisions regarding what the world would look like before they are put in it. This could be done in a relatively simple way, like posing a series of choices to the user before the application generates the world.



Furthermore, the stakeholders would all like to see the current version of the prototype merged into VRelax. Having the freedom to access 360° videos, while also retaining the freedom and interaction that is offered by procedural generation would be the ultimate goal for everyone involved. It all boils down to wanting to give the user control over as much as possible to cater to their specific needs.

## Phase Five

*Critical Reflection*

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## Reflection

This is the final phase of the project, looking back and reflecting upon the process and research that took place for the duration of the project.

### Design Conditions & Specifications

Starting out with this project I was very enthusiastic. The idea of this project formed over the months before the official starting date. I was working here at Viemr, porting an application to the Oculus Go for them. We have had discussions about where it could possibly go in the future, and that the state it was in now was at its technical limits. I suggested that they could look down the venue of procedural generation. It would allow them to expand their application substantially, while also allowing for a lot more interaction to take place, and on top of that, I had prior experience with procedural generation and emergent game design. There were a few things that definitely needed to be in the application according to Viemr. Firstly, it would have to be able to run on the Oculus Go, and the second that it would have to be made in Unity. But I was given creative freedom on how it would be achieved. After this, we both decided that this could be a very fitting project for me to do my graduation thesis on, and that was the start of a long and tough road to graduation.

When I first started the preliminary research phase, I started with about five (5) key concepts. I cannot remember all of them, but I had to change some of them because they were either too broad or not relevant enough. Furthermore, it was also difficult to determine how much I would have to dive into each key concept. Personally, I think how much research I show in the document is sufficient, but in reality I did a lot more research. The preliminary research phase of the project probably took the most time. The most useful insights that came forward from the research phase had been the procedural generation concept. It is funny though, because when I was first writing this thesis I did not have that concept defined until my first green light session. My research up to that point was only really about proving that building an application like I did would be suitable for the client, but I had not shown how something like this could be built.

All of the results that stemmed from the research phase proved extremely useful during the rest of the project. It acted as a guide to how the application should be built. I feel like had I not done this correctly, my project would not have turned out the way it did.

### Concepting

Actually concepting for my project was a little difficult. After all of this research and defining all of these design requirements and specifications it did not allow for much freedom during concepting. The core application needed to let its users explore, with a large emphasis on relaxation, and within my skill set and time available there is only so much I can make possible in a procedurally generated world. I needed to keep the available time in mind, while also not sacrificing too much freedom for the user. Ultimately, I had come up with two different concepts on paper. Procedural generation absolutely needed to be in them. In that light, I developed two concepts that I felt I could realize in the short timeframe I had available. Each concept made use of procedural generation. One concept took place on an island, and the other look place on an infinite landscape. Each had their own set of things that would be available

for the user to do. The concept on the island was more focused around collecting, and the concept based on infinite landscape was focused on relaxation through distraction. The client was leaning more towards the prospect of an infinite terrain, rather than have the user confined on an island. I too felt that it would be more appropriate, and this then also shows off the capabilities of procedural generation more as well serving as a technical demo for stakeholders.

## Prototyping

Making the prototype was definitely the most fun part of the project for me. Since procedural generation was at the core of the project I needed to make something that was ultimately able to run on the Oculus Go and be able to test and evaluate it. The first thing that needed to be made was the terrain for generating the world, followed by contents for the world. It was very important to the client and stakeholders to retain the possibility of changing what the world looks like, and having control over the contents of the world. According to the research I had done in the previous stage, I chose two different color pallets to implement into the prototype, one color pallet that resembled natural colors, and another that was very un-natural; bright neon and pastel colors. Another thing that was very important is whether the Oculus Go would even be able to run a procedurally generated world. It is not a powerful device by any means, and most phones are more powerful. Yet, I did not let the prospect of it not being able to run on the Oculus Go stop me. I needed to try. I started on the core engine of the world before having the concepts set in stone. I knew that I would need to allow control over how the world looks and was structured, and as such, the engine has a settings file for nearly every aspect of it. If I want different clouds, all I have to do is change the settings file. If I want different colors, all I have to do is change a settings file. If I want to generate an island, all I have to do is tell it to do that. Having such amount of control allowed me to cater to the needs and wants of client and stakeholders.

After having implemented the first iteration of the world it turned out that it did not run very well on the Oculus Go. Not well at all. This was a huge problem for the prototype and the project. For someone in VR they need to experience it at 60 frames per second to not become motion sick. My prototype was running at 24 frames per second, and at some points in time would run at an even lower fps. The prototype was looking dead in the water, but Unity had just released something that revitalized my project; the Low Weight Render Pipeline (LWRP). To summarize what LWRP does, it removes a lot of unnecessary rendering features so lower end devices can run at a higher fps. It was almost perfect, but implementing the LWRP took time, time that I then could not spend on implementing more interaction and conceiving. That was a tradeoff I needed to make. It was either not have a working digital prototype, or have one, and I chose the latter. Getting the prototype to work with LWRP was interesting as well as challenging and I am glad that I decided to. Of course with implementing new things others will break, and sadly some things could not be fixed in time; like the terrain color. However having the prototype run smoothly was top priority, and through implementing the LWRP in Unity I was able to make the prototype run at an acceptable frame rate.

After having built the first version of the prototype I reviewed it with my client to see where I might be able to add some little things to improve immersion and presence. After some consideration I added a few sounds and color changes for user feedback and was now ready to test the prototype and gather data.

## Evaluation & Research Outcomes

When I was starting out my graduation project I was not sure what I would want to test and evaluate, or even how I would do that. Instead of determining what I wanted to test before I built the project and let that goal define what will be built, I instead inverted that design choice. I built the prototype first to determine what I could evaluate with it. I knew that one thing I would most likely want to test is how effective the procedurally generated world is at making someone feel more relaxed.

A good question that was posed at the start was how to determine if someone is relaxed or not. And there are several answers for this question. The first is through self-report, and the other is physical measurements. I wanted to get the best measurement as possible to show that the prototype is effective; therefore I chose to incorporate multiple levels of measurements. Not only would I have participants fill out a pre- and post-test questionnaire to gauge their state of mind, but I would also measure their heartrates as a supportive physical measurement. There is another physical measurement that can be done to determine someone's stress levels, through measuring skin conductivity, but I did not have access to that kind of equipment. To make the experience pleasing for participants I decided that I would do relative heartrate monitoring. Instead of measuring their heartrate over the whole duration of their playtest, I would measure it once before they used the prototype, and once after, just like the self-report evaluation. A feeling is also very hard to gauge and so through desirability testing I wanted to be able to point out what the consensus would be about the design of the prototype.

Getting access to the target audience was a little challenging. My client was able to facilitate a network connection to someone at the UMCG so I could then coordinate with them to get a testing group together. It took a little over two weeks to get everything set up and approved, sending the test protocol back and forth and the questionnaire.

Personally, back when I started I already suspected that this project would score very well when testing for its effectiveness when it comes to relaxation. I did not know how it would look at the time, but I knew that if I did my research and concepting correctly that it would be effective. Moreover, when I finally started testing my prototype it was showing results that I had hoped would occur.

A problem that I encountered when testing with a large group was keeping track of whose data belonged to whom. I had pre- and post-questionnaires stapled together and each had their own number, and I had each participant keep track of their own papers. This helped keep track of this data, but I was also measuring heartrates and after each participant was done playing, I needed to perform a desirability testing measurement on them. This ended up getting hectic and one participant actually did not have the opportunity to participate in desirability testing. I also missed someone's heartrate measurements, so it is not as if the evaluation process was flawless. I also wish that the UMCG could have provided me with more participants, but I am already grateful for the amount they did provide.

If you made it to this page, I'd like to thank you for reading my thesis in its entirety. I hope that you, the reader, have appreciated my work. It was one heck of a roller coaster.

## Appendix

### Transcript Interview Prof. Dr. Wim Veling, Stefan & Alan

00:00:01

*Alan:* Ik wou deze gesprek ook even opnemen als de en mag ik van jou.

00:00:04

*Prof. Dr. Wim Veling:* Ja

00:00:07

*Alan:* Zou jij je misschien even voor kunnen stellen?

00:00:09

*Prof. Dr. Wim Veling:* Want? Dan moet je wel even uitleggen wat je doet.

00:00:12

*Alan:* Sorry, namelijk ik ben onderzoek aan het doen voor mijn project wat ik dus aan het doen ben voor Viemr.

00:00:20

*Prof. Dr. Wim Veling:* Ja.

00:00:21

*Alan:* Dus dat zeg maar en een onderzoek naar procedural generation en hoe. Uh je ontspanning kan veroorzaken door gebruik van beeld en vormgeving. En daar wou ik graag jouw mening over een aantal vragen en gewoon even een dialoog even openen zodat ik misschien daar wat bruikbare informatie uit kan halen vanwege ook hoe hoog u bent opgeleid.

00:00:49

*Prof. Dr. Wim Veling:* Ja, want jij wil dan quotejes in een verslag ofzo?

00:00:51

*Alan:* Ja, bijvoorbeeld of ja als u nou ja... Uiteraard heeft ook heel veel ervaring al al met VRelaxed zelf maar ook met een aantal andere VR applicaties.

00:01:03

*Prof. Dr. Wim Veling:* Ja.

00:01:03

*Alan:* Dus ik wou gewoon graag uw mening over een aantal aspecten.

00:01:07

*Prof. Dr. Wim Veling:* Dan snap ik het.

00:01:14

*Alan:* OK.

00:01:14

*Prof. Dr. Wim Veling:* Mijn achtergrond toch?

00:01:15

*Alan:* Ja, over uw achtergrond uw titel.

00:01:18

*Prof. Dr. Wim Veling:* Nou ik werk als psychiater hier in UCP en dan afdeling psychose. En ik heb als psychiater, ja 10 jaar geregistreerd. Er is veel behandelaars ervaring heel veel patiënten gezien met allerlei verschillende diagnose waar het meeste is met, psychotische stoornissen. Daarnaast ook heel veel onderzoek. Ben ik hier nu als hoogleraar verbonden aan het UCP en het UMCG, en dat, en ik doe onderzoek naar veel naar psychose ook en en vooral allerlei nieuwe behandelmethodes. Virtual reality is 1 van de grootste onderzoekslijnen die ik hier op de afdeling heb. Wij zijn op allerlei manieren steeds aan het kijken of je technologie kan inzetten. Enerzijds om beter te begrijpen hoe psychiatrische problemen in elkaar zitten. En tweede van kun je daardoor ook nieuwe behandel manieren maken waardoor mensen die nog beter kunnen opknappen.

00:02:16

*Alan:* OK. Dank je wel. Duidelijk. Nou dan begin ik gelijk heeft met mijn hoofd graag. Wat zijn voor jou de sleutel attributen wat in een VR omgeving zou moeten zijn om iemand te laten ontspannen?

00:02:35

*Prof. Dr. Wim Veling:* Om iemand te laten ontspannen denk ik. Dat is heel veel variatie nodig omdat we gemerkt hebben dat het in hoge mate het persoonlijk is. Dus wat voor de 1 werkt, werkt voor de andere niet. Dus dus dus je moet iets maken waar heel veel verschillende maat dingen voor per persoon zijn samen te stellen. Tweede stuk is dat het dat de inhoud iets moet zijn wat je echt meeneemt dat je enorm wordt afgeleid zeg maar. Want heel veel mensen die last hebben van psychiatrische problemen die, die zit heel vast in hun hoofd. Doordat ze heel somber zijn en heel erg aan het negatieve gedachten hebben aan het piekeren zijn. Wat ze niet los kunnen laten. Ja heel angstig zijn. Want wat enorm ja wat je eigenlijk ook niet los kan laten.

00:03:30

*Alan:* En dan is afleiding is al een hele grote component van iemand te kunnen laten ontspannen?

00:03:35

*Prof. Dr. Wim Veling:* Ja want je merkt dat tussen de gewone dingen die we altijd hebben om de mensen te laten ontspannen de ontspanningsoefeningen die je aanbiedt. Dat mensen dat dan niet zo goed kunnen. Omdat het ja omdat ze gewoon in orde in hun hoofd daar niet toe kunnen zetten. Of dat ze het niet volhouden. En dus je hebt iets nodig wat eigenlijk sterker is dan. Dan het piekeren.

00:03:56

*Alan:* Ja precies.

00:03:57

*Prof. Dr. Wim Veling:* Verklaart het ook waarom die dolfijnen videos zo goed werkt omdat je daar elementen hebt in hebt die jou eigenlijk meeneemen?

00:04:03

*Prof. Dr. Wim Veling:* Ja ik denk dat dat wel een belangrijke is dat je zeg maar, zonder dat je daar verder zelf heel veel voor hoeft te doen wel wel inderdaad wordt meegenomen naar een heel andere plek en dus dat is een volgende ding. Beetje afhankelijk van de probleematiek maar als mensen echt vrij veel last hebben denk ik dat er voldoende moet gebeuren d'r moet d'r moet voldoende te doen zijn te zien zijn.

00:04:28

*Alan:* Ja precies dat stimulatie moet er zijn.

00:04:30

*Prof. Dr. Wim Veling:* Ja en dat is dat is in de app zoals we nu hebben. Mmm net iets te weinig nog voor de dat hoor ik van van Bart ook de interviews met mensen die Relatief ernstig depressie hebben. Zeggen ja 'k heb ik werk voor mij niet zo goed.

00:04:46

*Stefan:* Te statisch.

00:04:47

*Prof. Dr. Wim Veling:* Ja dan dan kijk als je op het strand zit en je ziet alleen maar die behandeling zo heen en weer gaan. Ja dat leent zich enorm voor gaan toch weer gaan nadenken.

00:04:58

*Alan:* Ja precies.

00:04:58

*Prof. Dr. Wim Veling:* Kijk als je milde problematiek hebt dan is het juist net misschien juist lekker want dan ja dan ben je op een andere plek en dan zie je af en toe een meeuw en kun je juist die branding wel focusen hè maar als het te slecht met je gaat dan is dat toch wel onvoldoende.

00:05:12

*Alan:* En stel dat dat je iemand wel zeg maar in in zo'n. uh, uh, ja in in bijvoorbeeld op het strand zetten en zo maar dan in plaats van dat het een hele realistische omgeving is dat het juist heel erg styleized is dat het een beetje op een cartoon of een tekening lijkt. Zou dat een heel ander effect hebben denk je?

00:05:37

*Prof. Dr. Wim Veling:* Uhm.

00:05:37

*Alan:* Of heb je daar ervaring mee laat ik het anders zo vragen?

00:05:41

*Stefan:* Ja die cleVR stijl versus photorealistisch.

00:05:42

*Alan:* Ja precies.

00:05:44

*Prof. Dr. Wim Veling:* Ja kijk die die animatie stijl die hebben natuurlijk wel bij relaxatie nooit geprobeerd. Dus dus daar heb ik geen antwoord op die vraag

00:05:52

*Alan:* OK.

00:05:53

*Prof. Dr. Wim Veling:* Maar. Ik denk voortbordurend op wat we net zeiden als het dan als het aan de omgeving is waar. Waar je makkelijk aanhaken met je aandacht en blijft hangen. Kan ook een voordeel zijn.

00:06:07

*Alan:* OK.

00:06:07

*Prof. Dr. Wim Veling:* Maar ik denk ook hiervoor geldt dat je misschien wel dat het ook weer een variatie zo zal zijn dan bij een heel aantal ineens die zegt er is niks voor mij want de animatie heb ik niks mee, ik geniet enorm van echte dolfijnen in beeld. En andersom. Dus dus de dus dat zal ook wel weer verschillend zijn. Kijk en en. En een element als interactie.

00:06:34

*Alan:* Mhm.

00:06:34

*Prof. Dr. Wim Veling:* We hebben ook geleerd in de pilot onderzoek dat dat belangrijk is je moet iets te doen hebben maar dat heeft weer met hetzelfde maken dat je, je moet je werkgeheugen en je moet je vast haken ergens aan. Je moet je moet dat belasten. Je moet zorgen dat er iets gebeurt daar ik je kop. Want anders schiet je toch weer je, die groeven in van angst en piekeren en achterdocht weet ik veel wat. Dus je moet zorgen dat je jezelf bezighoudt. En uh, je ziet ook in VRelaxed app zoals we nu hebben heel veel mensen toch wel weer die ontspanningsoefeningen die in audio erin zitten te activeren.

00:07:09

*Stefan:* Ja.

00:07:10

*Alan:* Mhm, OK.

00:07:10

*Prof. Dr. Wim Veling:* En dus dan zijn ze wel ergens op een op het strand maar dan gaan ze toch iets doen.

00:07:17

*Stefan:* Ja.

00:07:17

*Prof. Dr. Wim Veling:* Je hoort wel die bubbeltjes ook wel dat veel mensen zeggen van oh ja dan kun je net even weer. Omdat je dan bezig bent.

00:07:25

*Alan:* Ja precies dus 't gaat in principe niet echt per se om om echt een hele belastende interactie.

00:07:32

*Prof. Dr. Wim Veling:* Nee.

00:07:32

*Alan:* Maar het kan an heel iets simpels zijn.

00:07:34

*Prof. Dr. Wim Veling:* Naar mijn overtuiging maar dan moet het moet het dus iets zijn wat. Wat niet heel activerend is.

00:07:42

*Alan:* Mhm.

00:07:42

*Prof. Dr. Wim Veling:* Het klinkt een beetje als een tegenspraak hè dat het activeerend moet maar het moet niet iets activeerend zijn dus het is.

00:07:46

*Alan:* Ja ja ja precies.

00:07:48

*Prof. Dr. Wim Veling:* Je moet je moet zorgen dat je bezig bent. Maar niet op een manier dat je eigenlijk helemaal druk wordt.

00:07:53

*Prof. Dr. Wim Veling:* Ja precies ja precies want dan creëer je juist weer een hele omgekeerde effect.

00:07:58

*Prof. Dr. Wim Veling:* Ja. Je hebt dus dus bijvoorbeeld wat we dus nu met die luchtbellen hebben gemaakt dat vind ik eigenlijk wel een geslaagd voorbeeld. Dat je eigenlijk nu ook al gebeurt wel iets zodat je net even je aandacht kan vasthouden. Maar je blijft wel lekker relaxed stand staan.

00:08:17

*Stefan:* Ik moet 1 keer denken aan die brainstorm die we hebben gehad, weet je nog wel? Op die whiteboard, allerlei ideeën ook.

00:08:21

*Alan:* Ja ja ja ja precies.

00:08:22

*Stefan:* Ja en daar zaten ook een paar van dit soort dingen tussen.

00:08:24

*Alan:* Ja, klopt klopt.

00:08:25

*Prof. Dr. Wim Veling:* Maar goed dat is mijn mening eigenlijk moet je natuurlijk ook aan mensen vragen die het gebruiken of die het nodig hebben wat wat waar voor hun geld maar dat zou voor mij persoonlijk in ieder geval gelden en dat is vanuit de kennis die ik erover heb. Nu wat ik zou aanbevelen.

00:08:42

*Alan:* Ja. En even kijken. Ik had net een hele mooie vraag in mijn gedachten. Hoe lang duurt het voordat jij als behandelaar merkt dat niemand zich aan het ontspannen is terwijl ze VRelaxed aan het gebruiken zijn?

00:09:01

*Prof. Dr. Wim Veling:* Ik ben er nooit bij dus dat weet ik niet.

00:09:09

*Alan:* Oh OK, dat is jammer. Heb je enig idee hoe lang zo'n sessie zou kunnen duren. Of dat je een een inbreng zou kunnen hebben over. A dat het niet langer dan x aantal minuten zou moeten duren?

00:09:24

*Prof. Dr. Wim Veling:* Nou. Ik vind eigenlijk dat je daar als behandelaar geen mening over moet hebben want. Kijk ik vind het mooie hiervan is dat juist mensen zichzelf laat behandelen.

00:09:34

*Alan:* Ja dat is echt dat dat zelf management.

00:09:37

*Prof. Dr. Wim Veling:* Ja kijk en wij hebben nu al een tussenvorm gemaakt hè want in dat onderzoek van Saskia Neijman gebruiken we met als controle conditie VRelax. Dus dat doen we dat cleVR dingen hebben interventie gemaakt en VRelax gebruiken als controle behandeling. En die wordt door verpleegkundige gegeven. Dus dan komen mensen hier elke week. Leren ze ontspanningsoefeningen aan en dan krijgen ze de helft van de sessie de VRelax er te doen. Dus als je wil weten hoelang. Wat kun je zien wanneer ontspannt iemand die echt lekker kletsen. Want zij ziet hoe dat gaat. Mijn eigen \*onverstaanbaar\* ik heb natuurlijk wel mensen zien doen. Het is het is mijn indruk is dat het echt. Heel snel gebeurt.

00:10:28

*Alan:* OK.

00:10:28

*Prof. Dr. Wim Veling:* En wij zien nu in die pilot onderzoek moeten al die daar nog echt lekker gaan uitpluizen met elkaar maar, je ziet dat de gemiddelde behandelsessie 16 minuten of zo dat mensen kiezen hebben dat wel zelf gekozen en de blijven die doen dan gemiddeld 16 minuten zijn ze in VRelaxed bezig. Maar er zit ook een hele korte sessies van een paar minuutjes in. Dus dus ik denk dat dat vrij snel kan en dat is mijn eigen persoonlijke ervaring ook als je die bril op hebt ben je vrij vrij rap je bent vrij rap.

00:11:00

*Alan:* Zet je inderdaad wel heel rap wel even echt in een andere plek ja dat klopt.

00:11:05

*Prof. Dr. Wim Veling:* Voelt ook gelijk lekker vind ik dat gaat wel snel.

00:11:09

*Alan:* Mhm.

00:11:09

*Prof. Dr. Wim Veling:* En ik kan me voorstellen als je heel depressief vooral burnout voor angstig of zo psychotisch bent dat dat niet zo snel gaat of misschien wel helemaal niet. Of veel minder. Hè zodat je dan liever wat langer doet zodat je toch een klein beetje het effect hebt. Als je wat mildere klachten hebt denk ik dat het vrij snel gaat. Ja. Nou ja en ik heb ook dus ook wel mensen gesproken. Vorige week sprak ik iemand die, die heeft nu zelf die bril van ons dan gekocht omdat ie dan heb ik een pilot onderzoek had meegedaan daarna graag mee door wilde. Ja die heb ik gewoon heel veel last van klachten. Want die zegt ja dit is voor mij het enige tot nu toe wat echt wat echt werkt. Nou dat vind ik best bijzonder

00:11:52

*Stefan:* Ja.

00:11:53

*Prof. Dr. Wim Veling:* He dus dat is iemand die juist veel klachten heeft. En die, die merkt dat dit eigenlijk als enige tot nu toe echt een beetje helpt.

00:12:01

*Stefan:* \*Onverstaanbaar\*

00:12:05

*Prof. Dr. Wim Veling:* Ja. Ja want hij heeft veel stemmen in zijn hoofd die allemaal vervelende dingen tegen hem zeggen. En, dit is zijn manier om daar even van los te komen. Dus dat vind ik ook wel weer het leuke van VRelaxed dat je echt verrast wordt zelf. Door wat mensen daaraan hebben. Een via Marieke ook. Oh. Ja oké dat kan dus ook.

00:12:32

*Alan:* Ja.

00:12:32

*Prof. Dr. Wim Veling:* Dat helpt daar helpt het ook die dus ook blij mee, wel grappig. Wist ik

niet, had ik nooit bedacht. Je wordt ook een beetje verrast soms door. Maar goed de de leidende principes zijn afleiding en ontspanning eigenlijk steeds die 2 die 2 dingen.

00:12:48

*Alan:* Oké. En aan zijn d'r ook, ja, oefeningen die je ook aan aan patienten meegeeft om zeg maar na de tijd ook te doen?

00:13:00

*Prof. Dr. Wim Veling:* Ja. Nou dat zijn de de wat klassiekere ontspanningsoefeningen. Maar ik vind het wel een goede vraag want eigenlijk zou je nou nou nee dat wat wel leuk is, is dat mensen kijk VR heeft een heel heel sterk visueel karakter. Dus ik hoor nog wel eens terug dat mensen als ze dan daarna bijvoorbeeld dan ontspanningsoefeningen doen want ze hebben die bril niet meer. Hè dat dat de de VRelax beelden nog wel door hun hoofd gaan.

00:13:30

*Alan:* Oh echt waar?

00:13:31

*Prof. Dr. Wim Veling:* Ja die blijft nog een tijdje hangen.

00:13:35

*Stefan:* Beklijft op de een of andere manier.

00:13:39

*Prof. Dr. Wim Veling:* Ja. Ik denk niet dat je daar nog een jaar plezier van hebt maar het blijft wel even hangen en zeker als je als in VRelaxed die ontspanningsoefeningen geluisterd hebt. En je gaat daarna zonder VRelaxed diezelfde ontspanningsoefeningen weer luisteren hè die associatie heb je dan wel.

00:13:54

*Alan:* Ja.

00:13:54

*Prof. Dr. Wim Veling:* Dat hangt dan nog wel een tijdje blijft nog wel een tijdje na werken.

00:14:11

*Alan:* Ik ben hier eigenlijk zo'n beetje door mijn vraag want ik heb opgeschreven ben ik in ieder geval een beetje heen.

00:14:18

*Prof. Dr. Wim Veling:* Veel te snel.

00:14:21

*Alan:* Ja het is wel blij om. Blij dat ik er zoveel antwoorden van hebt.

00:14:27

*Prof. Dr. Wim Veling:* Nou ja ik kijk gezien waar jij nu mee bezig bent 1 van de dingen waar we

nu tegenaan lopen is dat mensen gewoon in gesprek begon even over die variatie die nodig hebt dat dat natuurlijk altijd een beperkende factor is.

00:14:43

*Alan:* Ja klopt.

00:14:43

*Prof. Dr. Wim Veling:* En anders vergeleken met de eerste pilot hebben wel meer dingen toegevoegd. En nu zegt ie ja hartstikke leuk maar kun je er nog meer toevoegen en ik denk dat dat blijft. Al voegen we nog 3 dingen toe.

00:14:56

*Alan:* Uiteindelijk zal het wel gebruikt worden inderdaad.

00:14:58

*Prof. Dr. Wim Veling:* Ja dus dat blijft gewoon een issue.

00:15:02

*Stefan:* De behoefte aan meer.

00:15:03

*Prof. Dr. Wim Veling:* Er is altijd behoefte meer ja. Kijk en dan kun je oplossen door te zeggen nou op het moment dat dat we meer klanten hebben. Hebben we voldoende cash flow om te zorgen dat we iedere 3 maanden een nieuwe een nieuwe content wordt toegevoegd aan de bibliotheek. En ja het zou me niet verbazen als we wel gaan doen maar dan nog blijft het. Blijft het enigszins beperkt.

00:15:25

*Alan:* Ja precies.

00:15:25

*Prof. Dr. Wim Veling:* Dus als je manieren kan bedenken dat met techniek, dat probleem op te lossen is. Doordat je zeg maar met algoritmes werkt en computer dingen laat maken. Zouden is dat interessant? Met de vraag daarbij van is dat voor mensen net zo acceptabel of net zo mooi als als film beelden.

00:15:47

*Alan:* Ja precies maar je zegt de belangrijke punten zijn dus echt vooral variatie vanwege dat wat voor de ene persoon werkt werkt niet per se voor de ander of minder effectief of juist veel meer effectief. En? Even kijken nog een ander belangrijk punt was. Variatie en interactie.

00:16:11

*Prof. Dr. Wim Veling:* En zelf controle hebben.

00:16:13

*Alan:* Ja.

00:16:14

*Prof. Dr. Wim Veling:* Zelf kunnen sturen in wat je wel en niet doen.

00:16:17

*Alan:* Ja precies.

00:16:18

*Alan:* Die 3 dingeen hebben we die is nu een beetje het principe van wat we van de 2 van probleematiek wilde nu hebben. En die zagen we in de eerste prototype allemaal niet. Dat hebben we na de eerste pilot geleerd en we hebben nu een tweede pilot toegevoegd en dat hoor je ook terug van mensen dat zij dat fijn vinden.

00:16:36

*Stefan:* In een ideale situatie heb je eigenlijk bij wat voor content je ook maar voorgesloteld. Dus ook even een statisch bos. Wil je eigenlijk binnen diezelfde content, als het wel photorealistisch is dus video content. Wil je eigenlijk een functie hebben nu wil ik hier iets doen. Wat het ook maar mag zijn.

00:16:58

*Prof. Dr. Wim Veling:* Of er moet van alles gebeuren. Maar dat heb je in een statisch bos niet. Want uit die interviews die een paar dingen die ik tot nu toe van gezien heb zei dat veel mensen als je ergens doorheen beweegt, dat vonden mensen eigenlijk wel fijn. Want dan is het weer een beetje anders en dan heb je steeds weer iets nieuws om naar te kijken.

00:17:14

*Stefan:* Ja dat is ook al is de omgeving statisch maar je hebt wel een beweging waarin je wordt meegenomen door de omgeving dat doet ook al mee.

00:17:22

*Prof. Dr. Wim Veling:* Ja dan ga je steeds kijken wat is er nu weer te zien. En ik denk dat dat ook een deel van die dolfijnen film is om daar steeds iets anders te zien.

00:17:32

*Stefan:* Ja. Omdat in wezen word je ook meegenomen.

00:17:35

*Prof. Dr. Wim Veling:* Ja en dat is dan wel \*onbegrijpelijk\* die dolfijnen zwemmen. Dus dat is wel denk ik een hele belangrijke.

00:17:47

*Alan:* Daar word je inderdaad ook wel erg afgeleid door het het ontdekken in principe.

00:17:51

*Prof. Dr. Wim Veling:* Ja. Op een gegeven moment verandert het omgeving steeds. Hè dus dat als belangrijk of je moet iets kunnen doen zelf een van de twee. Moet iets moet iets gebeuren.

00:18:01

*Alan:* Ja. En dus ook vooral dat dat controle is ook heel erg belangrijk dan om zoiets te starten en stoppen.

00:18:08

*Prof. Dr. Wim Veling:* Ja.

00:18:08

*Stefan:* Oke want dat is denk ik dat we in de schil die daarboven hangt dus dat is het zelf management van oké stel je voor ik kom in die app. En stel je voor je hebt wel bak aan content ja waar begint iemand dan weet je wel? En hoe filter ik zo snel mijn zo snel mijn behoeftes dat ik direct tot de juiste content kom.

00:18:25

*Prof. Dr. Wim Veling:* Ja en dat is een heel lastig hoor want op het moment dat jij gestrest ben nu wil ik VRelaxed dan wil je niet eerst 5 minuten klik klik klik weet ik veel ik wil nu startem. En dat is nog best lastig hè.

00:18:39

*Stefan:* Ik denk dus als je in de doorontwikkeling van de app hè ik heb 't eerder gezegd we hebben eigenlijk nog nooit sessies gehad. Van hé. Hoe en wat gaan we nou echt inhoudelijk doen in die app los van procedural generation \*onbegrijpelijk\* moeten onderzoeken? Ik denk dat ook in die sessies een voorstel moet komen dat, beschouw het als een soort dashboard. Iemand die komt in die app. Welke keuzes heeft ie dan allemaal? Misschien moet je al direct recht voor je pontificaal direct ontspannen staan? Weet je wel en als ze dat niet willen dan staat daar onder een tegeltje hè net zoals in de Oculus Menu. Maar die die keuzevrijheid moet er altijd in blijven liggen.

00:19:19

*Prof. Dr. Wim Veling:* Ja dus is ook de keuze van bepaal jij het maar, want ik wil nu gewoon doe maar wat.

00:19:23

*Stefan:* Doe jij maar wat want ik moet nu ontspannen.

00:19:28

*Prof. Dr. Wim Veling:* Precies. En het leuke is om om dan met een patient dit soort dingen sessies te hebben hartstikke leuk. Hè dus. wat mij betreft gaan we gewoon dingen plannen hoor.

00:19:39

*Stefan:* Ja ja.

00:19:40

*Prof. Dr. Wim Veling:* Of een serie of weet ik veel. Volgens mij is het leuke en zit natuurlijk ook een paar patiënten ook best wel te wachten al. Die die zin hebben om mee te doen.

00:19:48

*Stefan:* Ja.

00:19:49

*Prof. Dr. Wim Veling:* Dus ik denk dat we dat gewoon moeten doen. Ik had zelf nog fantasie. Stel je voor dat jouw techniek nog steeds op de naam kwijt.

00:20:00

*Alan:* Procedural generation, procedurale generatie in het Nederlands.

00:20:06

*Stefan:* Ja, inprenciepe wel.

00:20:07

*Prof. Dr. Wim Veling:* Ja wordt er niet makkelijker van.

00:20:12

*Alan:* Nee, hahaha.

00:20:12

*Prof. Dr. Wim Veling:* Ik zat zelf te denken. Want jij hebt ook wel roept de regelmaat van we zouden iets met fysiologische op neurofeedback dat zou mooi zijn als je dat t.z.t. ook kan kopellen eraan. Ik zeg ik had een beetje de fantasie er bij zitten van die neurofeedback dingen en heeft stressjam dat ook, en dat is vaak gebaseerd op EEG, hersengolven.

00:20:36

*Stefan:* Zij hebben zo'n band om de middel.

00:20:37

*Prof. Dr. Wim Veling:* Oké. Dan is dat ook niet met hersengolven.

00:20:43

*Stefan:* Ja. Er is alweer gedoe weet je wel.

00:20:49

*Alan:* Ja dus dan zal dat waarschijnlijk ook met huid conductie weken.

00:20:53

*Prof. Dr. Wim Veling:* Ja en dat is ja daar geloof ik dan weer zelf niet in maar. Kijk in de weet dat de hersengolven... Daar kan je ontspanning vrij goed op zien want dan heb je een bepaalde type hersengolven. Er zijn wel van die spelletjes die met ADHD kinderen hè. Dat dat is een spelletje. Hoe horen zeg maar hoe meer gefocust je bent. Hoe meer power je als speler meer punten je haalt dus. Daarmee leer je eigenlijk kinderen, van hoe hoe hoe hoe beter jij functioneert, kwa brein. Hoe hoe beter je spel verloopt. Dus dat principe is al. En toen dacht ik. Dat zou je met VRelaxed natuurlijk eigenlijk ook kunnen bedenken want we weten welke hersengolven voor ontspanning zijn. Als je dat nou. Hè dus je zou kunnen meten van werkt VRelaxed ook op brein niveau. Was 1 ding nou hartstikke leuk maar eigenlijk. Als je dan nou koppelt aan de procedural generation dan zou je een soort automatisch systeem kunnen maken. Dat de computer eigenlijk het zo steeds aanpassen dat jij maximaal \*onbegrijpelijk\* hersengolven zit. Daar hoef je niks te doen je begin gewoon. Je hoeft niks instellen je gewoon en de computer bepaalt uiteindelijk, die ontdekt wat bij jou, op dit moment.

00:22:12

*Stefan:* Hij gaat veel naar links dus genereer ik wat meer naar rechts, en gaat ie te veel naar links dan genereer ik wat meer naar links.

00:22:18

*Prof. Dr. Wim Veling:* Volgens mij moet dat kunnen.

00:22:20

*Stefan:* In theorie wel. Ja want ik weet dat er is nog een partij die ook met.

00:22:28

*Prof. Dr. Wim Veling:* Ja die dan dat het een vrij eenvoudig simpel.

00:22:32

*Stefan:* Je hebt hier op je voorhoofd. Het is ook gekoppeld aan hè. Het kan.

00:22:39

*Prof. Dr. Wim Veling:* Dus. En toen dacht dan is 't hartstikke leuk want dan dan maak de content van de beelden eigenlijk niks meer uit. Want dan zeg je ja hebt je computer bepaald gewoon wat bij jouw werkt en en misschien wel gewoon, een rood knipperlicht wat voortdurend zo is dat bij jou de beste he ja. Misschien kan dan zijn dat je stelt dat dat goed werkt hè. Dan dan zet jij die bril op en binnen 5 minuten val je in slaap.

00:23:07

*Alan:* Dat zou wel echt ervaring zal dat niet zijn.

00:23:12

*Prof. Dr. Wim Veling:* Theoretisch. Vind ik dat in ieder geval interessante gedachte om te kijken. Stel in die krant op. Zou je dat haalbaar zijn?

00:23:22

*Alan:* Ja dat je in principe gewoon een hele dynamische wereld creëert, wat gebaseerd wordt op hoe de gebruiker zich op dat moment voelt.

00:23:31

*Prof. Dr. Wim Veling:* Het leuke van dit procedural generation is dat je dus. Het gewoon laten gebeuren door de computer. Hè en nu en nu is 't algoritme beetje random volgens mij wat je

00:23:42

*Alan:* Ja min of meer daar komt het wel op neer

00:23:44

*Prof. Dr. Wim Veling:* Maar je kan het ook niet random maken door door te koppelen aan hersengolven.

00:23:49

*Alan:* Ja bijvoorbeeld.

00:23:53

*Stefan:* Ja heele interessante gedachte.

00:23:57

*Prof. Dr. Wim Veling:* Dat zou wel superspannend zijn want als dat zo is kijk en we weten al dat hij ADHD spelletjes. Werken ze daar al een beetje mee maar dan meer op andere hersengolven volgens gericht mij gaat er meer over concentratie en focus. Ja. Dan kun je dat ook, met ontspanning doen.

00:24:15

*Stefan:* Super gaaf. Ik denk dat het voor jou (Alan) ligt sowieso nog een grote taak natuurlijk in het maken van het prototype zelf.

00:24:21

*Alan:* Ja ik denk dat dat al \*onbegrijpelijk\* genoeg.

00:24:29

*Prof. Dr. Wim Veling:* Maar meer een vooruitkijken.

00:24:30

*Alan:* Iets voor de toekomst.

00:24:32

*Prof. Dr. Wim Veling:* Waar deze techniek denk ik eigenlijk mooier nog bij past dan de de filmpjes die we nu of content hebben. Want daar kan je dat eigenlijk niet mee. Ja dat kan wel maar dan is het veel meer over is dit filmpje beter voor jou brein dan.

00:24:45

*Stefan:* Dan is het meer een filtering op content van we denken dat het nu beter bij je past.

00:24:50

*Prof. Dr. Wim Veling:* Kijk eens dit zijn de EEG scores van een heleboel fijn en eh dit is van de bergen en noem het maar op kan ook hoor dat dat is natuurlijk ook dat is misschien wel een dichterbij scenario. En andersdenken dan zou je feedback kunnen geven. Aan het eind. Dat kan. Maar goed. Dat is vooral voor vooral uitproberen denk ik.

00:25:14

*Alan:* En misschien vul ik voor jou een vraag in nou ik weet waar Javier mee bezig was ten aanzien van wat doen kleuren en vormen. Weet je wel. Heb jij daar? Dan kun je daar misschien iets over zeggen. Misschien in relatie tot cleVR?

00:25:34

*Prof. Dr. Wim Veling:* cleVR eigenlijk niet omdat we daar eigenlijk nooit met ontspanning bezig zijn dus dus daar speelt het ook helemaal niet dat thema.

00:25:41

*Stefan:* We hebben daar wel een bewuste keus gemaakt voor hoe het eruit moet zien.

00:25:45

*Prof. Dr. Wim Veling:* Ja. Ja dat was eigenlijk een beetje andersom want daar zijn we vooral natuurlijk steeds bezig met wat prikkel waren een soort exposure. Hè dus dan ben je eigenlijk andersom en denken van hoe kun je je omgeving en zo maken dat je maximale variatie weer hebt. Ja in in om mensen paranoïde maken agressief te maken.

00:26:10

*Alan:* Om mensen te confronteren.

00:26:10

*Prof. Dr. Wim Veling:* En en daarvoor heb je dus een een soort toolbox gemaakt. Hè want nu hebben we een aantal standaard omgevingen. Die je dan vervolgens vullen. We hebben een straat en een bus en een supermarkt. En dan kan je kiezen wat voor avatars zetten we er dan in en hoe kijken die dan en wat zeggen die dan? Wat gebaren maken die. Alles gericht om om zeg maar wat te doen wat jij nu nodig hebt, in jouw behandeling. En dus dat geldt ook die variatie voor maar maar niet niet van welke kleuren of welke gedragingen werken nou het beste. Ja maar dan op persoon.

00:26:46

*Stefan:* Maar dus meer op abstract niveau kleur vorm kun je daar wel iets over zeggen?

00:26:51

*Prof. Dr. Wim Veling:* Ja ja als het over ontspanning gaat en en en welzijn zijn daar boekenkasten over volgeschreven hè dan heb je het over, healing environment moet je daar maar eens naar Googles op die term daar zijn heel veel dingen over. Over en daar zeker over kleuren. Ja over een Audogeluid over over de temperatuur over geuren over alle zintuigen daar daar is heel veel over.

00:27:18

*Stefan:* Ja daar had Javier ook al aardig wat over gevonden, daar had je ook nog \*onbegrijpelijk\*

00:27:21

*Alan:* Ja klopt.

00:27:23

*Stefan:* De werking van kleuren.

00:27:25

*Prof. Dr. Wim Veling:* Ja dus dus inderdaad kan worden dat is natuurlijk wel relevant voor voor hoe jij hoe jij procedural generation insteld. Jij geeft daar natuurlijk instructies aan de computer, welke kaders daarvoor zijn. En dan zijn er zeker kleuren en vormen die die dan vaker zult gebruiken.

00:27:47

*Alan:* Ja.

00:27:47

*Prof. Dr. Wim Veling:* Maar. Ja. Kijk weet je ik eh. Er zijn heel veel dingen waarvan je eigenlijk

zegt waar je zou dat moeten. Al die dingen uitproberen en dan weer 3 of 5 mensen niet per se patiënten maar. Gewoon met ons of personeel of collegas op mijn hulpjes. Maar gewoon eens studenten. Van hoe werkt dat? Want ik kan me voorstellen dat bij sommige mensen het eerder over afleiding gaat dan over dat ontspanning. En dan is afleiding misschien wel abstracte vormen dat je weet ik veel. Kan ook. Ik weet niet wie dat ook weet jij misschien wel van moet je niet ook een als enige filmpjes bij een live concert van weet ik veel wie erin staan. Over het algemeen.

00:28:36

*Alan:* Ja dat zou dat zou ook heel erg kunnen afleiden ja dat is inderdaad \*onbegrijpelijk\*

00:28:41

*Prof. Dr. Wim Veling:* Meeste mensen met die heel gespannen zijn en zo. Enorm veel veel te veel prikkels. Alleen sommige mensen die moeten vooral afleiding hebben van hun negatieve gedachten hebben. En dan werkt het misschien juist wel voor.

00:28:57

*Stefan:* Techno feestje ergens in een kelder.

00:28:59

*Alan:* Dat is wel een goeie. Allemaal lichtjes.

00:29:03

*Stefan:* Ja ik denk dat de kunst is binnen VRelax onder toch generiek te houden. En daarmee toch divers zodat je een hele brede groep kan aanspreken. Ik denk dat wij dat hebben al ervaren op opmaat vragen krijgen uit de markt. Hebben jullie dit toevallig hebben jullie dat toevallig? Hebben we dan niet.

00:29:25

*Prof. Dr. Wim Veling:* Nee dus ik denk dat dat wat heel erg bij VRelaxed past is wel dat ik dat zachte prettig. Ja. Je laten meenemen. Het is wel zo'n soort sfeer wel ja. Wil je hebben. En houden.

00:29:41

*Stefan:* Heb jij nog meer vragen?

00:29:43

*Alan:* Nee ik ben denk ik

00:29:45

*Stefan:* Genoeg informatie?

00:29:46

*Alan:* Ik heb voor nu eerst nogal. Even wat op te schrijven en te onderzoeken. Ook vooral. Die healing environment. Zal ook erg van pas komen.

## Questionnaire state of mind

PRE/POST PLAY

Identification Number: \_\_\_\_\_

Date: \_\_\_\_\_

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1 – 2 – 3 – 4 – 5
2	I feel nervous	1 – 2 – 3 – 4 – 5
3	I feel stressed	1 – 2 – 3 – 4 – 5
4	I feel sad	1 – 2 – 3 – 4 – 5
5	I feel safe	1 – 2 – 3 – 4 – 5
6	I feel fearful	1 – 2 – 3 – 4 – 5
7	I feel enthusiastic	1 – 2 – 3 – 4 – 5
8	I feel irritated	1 – 2 – 3 – 4 – 5
9	I feel content	1 – 2 – 3 – 4 – 5
10	I feel insecure	1 – 2 – 3 – 4 – 5
11	I feel relaxed	1 – 2 – 3 – 4 – 5

## Consent Form

I hereby agree that I am a willing participant in this evaluation session. I acknowledge that my data is submitted anonymously and is handled with confidentiality.

I will be informed about the purpose of the study after I have partaken in the testing session.

I do not have to give any personal information, but if requested may ask for the results of this study by including my email address at the bottom of this form.

Email:

Name:

Signature:

## Raw Data

**1**



Relaxing: Lets you lose focus.

Positive: Positive experience.

Cute: Aesthetics are pleasant.

**Consent Form**

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I do not have to give any personal information, but if requested may ask for the results of this study by including my email address at the bottom of this form.

Email: Thom-guillermo.321@lachnai.com

Name: Thom Guillermo

Signature: [Handwritten signature]

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 1  
Date: 4/28/2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1 - 2 - 3 - 4 - <u>5</u>
2	I feel nervous	1 - <u>2</u> - 3 - 4 - 5
3	I feel stressed	<u>1</u> - 2 - 3 - 4 - 5
4	I feel sad	<u>1</u> - 2 - 3 - 4 - 5
5	I feel safe	1 - 2 - 3 - 4 - <u>5</u>
6	I feel fearful	<u>1</u> - 2 - 3 - 4 - 5
7	I feel enthusiastic	1 - 2 - 3 - <u>4</u> - 5
8	I feel irritated	<u>1</u> - 2 - 3 - 4 - 5
9	I feel suspicious	<u>1</u> - 2 - 3 - 4 - 5
10	I feel content	1 - 2 - 3 - <u>4</u> - 5
11	I feel insecure	<u>1</u> - 2 - 3 - 4 - 5
12	I feel relaxed	1 - <u>2</u> - 3 - 4 - 5

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 1  
Date: 4/28/2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1 - 2 - 3 - <u>4</u> - 5
2	I feel nervous	<u>1</u> - 2 - 3 - 4 - 5
3	I feel stressed	<u>1</u> - 2 - 3 - 4 - 5
4	I feel sad	<u>1</u> - 2 - 3 - 4 - 5
5	I feel safe	<u>1</u> - 2 - 3 - 4 - 5
6	I feel fearful	<u>1</u> - 2 - 3 - 4 - 5
7	I feel enthusiastic	1 - 2 - 3 - <u>4</u> - 5
8	I feel irritated	<u>1</u> - 2 - 3 - 4 - 5
9	I feel suspicious	<u>1</u> - 2 - 3 - 4 - 5
10	I feel content	1 - 2 - 3 - <u>4</u> - 5
11	I feel insecure	<u>1</u> - 2 - 3 - 4 - 5
12	I feel relaxed	1 - 2 - 3 - <u>4</u> - 5

2



Exciting: Liked experimenting, felt immersive height.

Positive: Liked the atmosphere.

Beautiful: ^



Questionnaire state of mind PRE/POST PLAY		
Identification Number: <u>7</u>		
Date: <u>7-4-2019</u>		
The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.		
1 = strongly disagree   2 = disagree   3 = neutral   4 = agree   5 = strongly agree		
1	I feel awake	1 - 2 - 3 - 4 - 5
2	I feel nervous	(1) 2 - 3 - 4 - 5
3	I feel stressed	(1) 2 - 3 - 4 - 5
4	I feel sad	(1) 2 - 3 - 4 - 5
5	I feel safe	(1) 2 - 3 - 4 - 5
6	I feel fearful	(1) 2 - 3 - 4 - 5
7	I feel enthusiastic	1 - 2 - 3 (4) 5
8	I feel irritated	(1) 2 - 3 - 4 - 5
9	I feel suspicious	(1) 2 - 3 - 4 - 5
10	I feel content	1 - 2 (3) 4 - 5
11	I feel insecure	(1) 2 - 3 - 4 - 5
12	I feel relaxed	(1) 2 - 3 - 4 - 5

3



3

**Consent Form**

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I do not have to give any personal information, but if requested may ask for the results of this study by including my email address at the bottom of this form.

Email: RWHSM1@GMAIL.COM

Name: ROBIN WH SM1

Signature: RWH SM1

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 3  
Date: 2-4-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1 - 2 - 3 - <u>4</u> - 5
2	I feel nervous	1 - 2 - 3 - 4 - <u>5</u>
3	I feel stressed	1 - 2 - 3 - 4 - <u>5</u>
4	I feel sad	1 - 2 - <u>3</u> - 4 - 5
5	I feel safe	1 - 2 - <u>3</u> - 4 - 5
6	I feel fearful	1 - 2 - 3 - <u>4</u> - 5
7	I feel enthusiastic	1 - <u>2</u> - 3 - 4 - 5
8	I feel irritated	1 - 2 - 3 - <u>4</u> - 5
9	I feel suspicious	1 - 2 - <u>3</u> - 4 - 5
10	I feel content	1 - 2 - <u>3</u> - 4 - 5
11	I feel insecure	1 - 2 - 3 - <u>4</u> - 5
12	I feel relaxed	1 - <u>2</u> - 3 - 4 - 5

**Questionnaire state of mind**  
PRE/POST PLAY

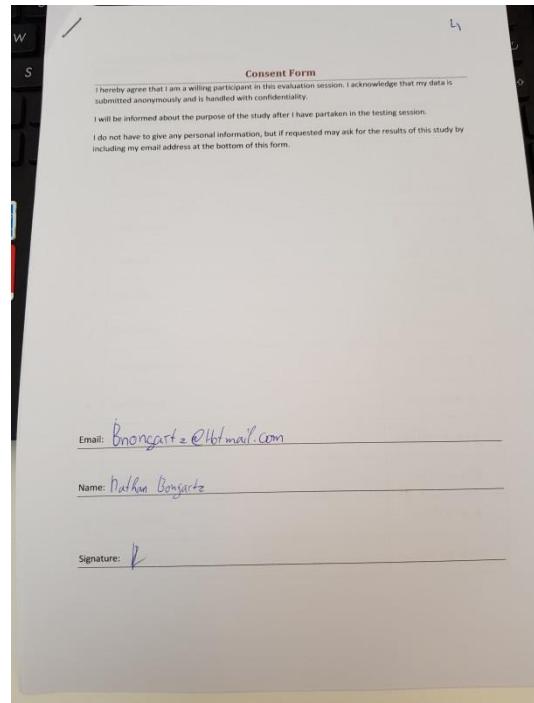
Identification Number: 4  
Date: 2-4-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1 - 2 - 3 - <u>4</u> - 5
2	I feel nervous	1 - 2 - <u>3</u> - 4 - 5
3	I feel stressed	1 - 2 - <u>3</u> - 4 - 5
4	I feel sad	1 - 2 - 3 - <u>4</u> - 5
5	I feel safe	1 - 2 - <u>3</u> - 4 - 5
6	I feel fearful	1 - 2 - 3 - <u>4</u> - 5
7	I feel enthusiastic	1 - 2 - <u>3</u> - 4 - 5
8	I feel irritated	1 - 2 - 3 - <u>4</u> - 5
9	I feel suspicious	1 - 2 - 3 - <u>4</u> - 5
10	I feel content	1 - 2 - <u>3</u> - 4 - 5
11	I feel insecure	1 - 2 - 3 - <u>4</u> - 5
12	I feel relaxed	1 - 2 - <u>3</u> - 4 - 5

4



Cute: The environment emits this.  
 Happy: The environment emits this.  
 Calm: Music and clouds feel calming.

**Questionnaire state of mind**  
 PRE/POST PLAY

Identification Number: 4  
 Date: 2-4-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1-2-3-4-5
2	I feel nervous	(1) 2-3-4-5
3	I feel stressed	(1) 2-3-4-5
4	I feel sad	(1) 2-3-4-5
5	I feel safe	1-2-3-(4) 5
6	I feel fearful	(1) 2-3-4-5
7	I feel enthusiastic	1-2-(3) 4-5
8	I feel irritated	(1) 2-3-4-5
9	I feel suspicious	(1) 2-3-4-5
10	I feel content	1-2-3-4(5)
11	I feel insecure	1-(2) 3-4-5
12	I feel relaxed	1-2-3-(4) 5

**Questionnaire state of mind**  
 PRE/POST PLAY

Identification Number: 4  
 Date: 2-4-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1-2-3-4-5
2	I feel nervous	(1) 2-3-4-5
3	I feel stressed	(1) 2-3-4-5
4	I feel sad	(1) 2-3-4-5
5	I feel safe	1-2-3-4(5)
6	I feel fearful	(1) 2-3-4-5
7	I feel enthusiastic	1-2-3-4(5)
8	I feel irritated	(1) 2-3-4-5
9	I feel suspicious	(1) 2-3-4-5
10	I feel content	1-2-3-4(5)
11	I feel insecure	(1) 2-3-4-5
12	I feel relaxed	1-2-3-4(5)

5



5

**Consent Form**

I hereby agree that I am a willing participant in this evaluation session. I acknowledge that my data is submitted anonymously and is handled with confidentiality.

I will be informed about the purpose of the study after I have partaken in the testing session.

I do not have to give any personal information, but if requested may ask for the results of this study by including my email address at the bottom of this form.

Email: PETROL LOEF @ GMAIL.COM

Name: PETROL LOEF

Signature:

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 5  
Date: 2-11-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1 - 2 - 3 - 4 - 5
2	I feel nervous	1 - 2 - 3 - 4 - 5
3	I feel stressed	1 - 2 - 3 - 4 - 5
4	I feel sad	1 - 2 - 3 - 4 - 5
5	I feel safe	1 - 2 - 3 - 4 - 5
6	I feel fearful	1 - 2 - 3 - 4 - 5
7	I feel enthusiastic	1 - 2 - 3 - 4 - 5
8	I feel irritated	1 - 2 - 3 - 4 - 5
9	I feel suspicious	1 - 2 - 3 - 4 - 5
10	I feel content	1 - 2 - 3 - 4 - 5
11	I feel insecure	1 - 2 - 3 - 4 - 5
12	I feel relaxed	1 - 2 - 3 - 4 - 5

**Questionnaire state of mind**  
PRE/POST PLAY

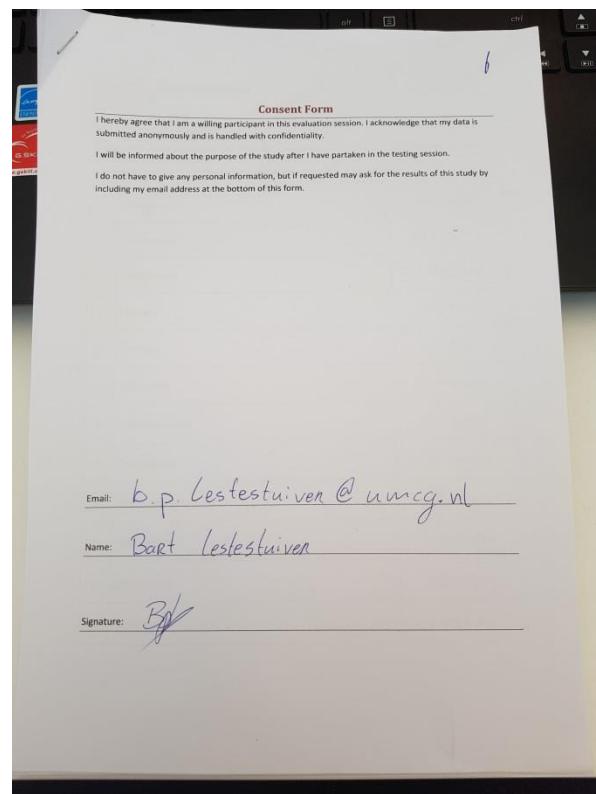
Identification Number: 5  
Date: 2-11-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1 - 2 - 3 - 4 - 5
2	I feel nervous	1 - 2 - 3 - 4 - 5
3	I feel stressed	1 - 2 - 3 - 4 - 5
4	I feel sad	1 - 2 - 3 - 4 - 5
5	I feel safe	1 - 2 - 3 - 4 - 5
6	I feel fearful	1 - 2 - 3 - 4 - 5
7	I feel enthusiastic	1 - 2 - 3 - 4 - 5
8	I feel irritated	1 - 2 - 3 - 4 - 5
9	I feel suspicious	1 - 2 - 3 - 4 - 5
10	I feel content	1 - 2 - 3 - 4 - 5
11	I feel insecure	1 - 2 - 3 - 4 - 5
12	I feel relaxed	1 - 2 - 3 - 4 - 5

6



Good: General feeling, color.

Easy: Easy to understand and use

Positive: Atmosphere

Appealing: It looks like this

Calm: Music and world

**Questionnaire state of mind**

PRE/POST PLAY

Identification Number: 6  
Date: 18-4-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1 - 2 - 3 - 4 - 5
2 I feel nervous	1 - 2 - 3 - 4 - 5
3 I feel stressed	1 - 2 - 3 - 4 - 5
4 I feel sad	1 - 2 - 3 - 4 - 5
5 I feel safe	1 - 2 - 3 - 4 - 5
6 I feel fearful	1 - 2 - 3 - 4 - 5
7 I feel enthusiastic	1 - 2 - 3 - 4 - 5
8 I feel irritated	1 - 2 - 3 - 4 - 5
9 I feel suspicious	1 - 2 - 3 - 4 - 5
10 I feel content	1 - 2 - 3 - 4 - 5
11 I feel insecure	1 - 2 - 3 - 4 - 5
12 I feel relaxed	1 - 2 - 3 - 4 - 5

**Questionnaire state of mind**

PRE/POST PLAY

Identification Number: 6  
Date: 18-4-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1 - 2 - 3 - 4 - 5
2 I feel nervous	1 - 2 - 3 - 4 - 5
3 I feel stressed	1 - 2 - 3 - 4 - 5
4 I feel sad	1 - 2 - 3 - 4 - 5
5 I feel safe	1 - 2 - 3 - 4 - 5
6 I feel fearful	1 - 2 - 3 - 4 - 5
7 I feel enthusiastic	1 - 2 - 3 - 4 - 5
8 I feel irritated	1 - 2 - 3 - 4 - 5
9 I feel suspicious	1 - 2 - 3 - 4 - 5
10 I feel content	1 - 2 - 3 - 4 - 5
11 I feel insecure	1 - 2 - 3 - 4 - 5
12 I feel relaxed	1 - 2 - 3 - 4 - 5

7



**Consent Form**

I hereby agree that I am a willing participant in this evaluation session. I acknowledge that my data is submitted anonymously and is handled with confidentiality.

I will be informed about the purpose of the study after I have participated in the testing session.

I do not have to give any personal information, but if requested may ask for the results of this study by including my email address at the bottom of this form.

Email: cmg.driel@umcg.nl

Name: Catheline van Driel

Signature:

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 7  
Date: 2019-05-18 14:20:19

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1 - 2 - 3 - 4 - 5
2	I feel nervous	1 - 2 - 3 - 4 - 5
3	I feel stressed	1 - 2 - 3 - 4 - 5
4	I feel sad	1 - 2 - 3 - 4 - 5
5	I feel safe	1 - 2 - 3 - 4 - 5
6	I feel fearful	1 - 2 - 3 - 4 - 5
7	I feel enthusiastic	1 - 2 - 3 - 4 - 5
8	I feel irritated	1 - 2 - 3 - 4 - 5
9	I feel suspicious	1 - 2 - 3 - 4 - 5
10	I feel content	1 - 2 - 3 - 4 - 5
11	I feel insecure	1 - 2 - 3 - 4 - 5
12	I feel relaxed	1 - 2 - 3 - 4 - 5

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 7  
Date: 2019-05-18 14:20:19

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

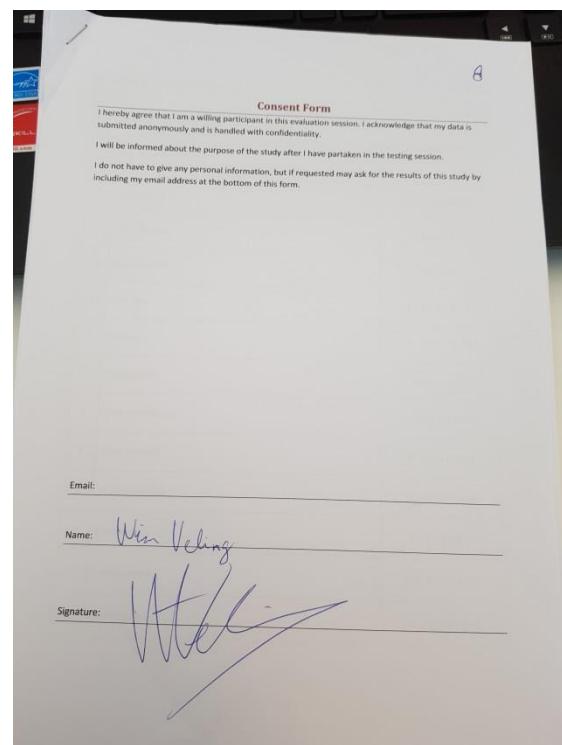
1	I feel awake	1 - 2 - 3 - 4 - 5
2	I feel nervous	1 - 2 - 3 - 4 - 5
3	I feel stressed	1 - 2 - 3 - 4 - 5
4	I feel sad	1 - 2 - 3 - 4 - 5
5	I feel safe	1 - 2 - 3 - 4 - 5
6	I feel fearful	1 - 2 - 3 - 4 - 5
7	I feel enthusiastic	1 - 2 - 3 - 4 - 5
8	I feel irritated	1 - 2 - 3 - 4 - 5
9	I feel suspicious	1 - 2 - 3 - 4 - 5
10	I feel content	1 - 2 - 3 - 4 - 5
11	I feel insecure	1 - 2 - 3 - 4 - 5
12	I feel relaxed	1 - 2 - 3 - 4 - 5

8



Missing data: -

Missing data: -



**Questionnaire state of mind**

PLAY

Identification Number: A  
Date: May 6, 2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1-2-3-4-5
2	I feel nervous	1-2-3-4-5
3	I feel stressed	1-2-3-4-5
4	I feel sad	1-2-3-4-5
5	I feel safe	1-2-3-4-5
6	I feel fearful	1-2-3-4-5
7	I feel enthusiastic	1-2-3-4-5
8	I feel irritated	1-2-3-4-5
9	I feel suspicious	1-2-3-4-5
10	I feel content	1-2-3-4-5
11	I feel insecure	1-2-3-4-5
12	I feel relaxed	1-2-3-4-5

**Questionnaire state of mind**

PLAY

Identification Number: B  
Date: May 6, 2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1-2-3-4-5
2	I feel nervous	1-2-3-4-5
3	I feel stressed	1-2-3-4-5
4	I feel sad	1-2-3-4-5
5	I feel safe	1-2-3-4-5
6	I feel fearful	1-2-3-4-5
7	I feel enthusiastic	1-2-3-4-5
8	I feel irritated	1-2-3-4-5
9	I feel suspicious	1-2-3-4-5
10	I feel content	1-2-3-4-5
11	I feel insecure	1-2-3-4-5
12	I feel relaxed	1-2-3-4-5

9



9

**Consent Form**

I hereby agree that I am a willing participant in this evaluation session. I acknowledge that my data is submitted anonymously and is handled with confidentiality.

I will be informed about the purpose of the study after I have partaken in the testing session.

I do not have to give any personal information, but if requested may ask for the results of this study by including my email address at the bottom of this form.

Email: m.berkhof@umcg.nl

Name: Flavianne Berkhof

Signature: [Handwritten signature]

Relaxing: Relaxing

Calm: Music and atmosphere

Positive: Related to the answers above

Neutral: I feel calm

**Questionnaire state of mind**

PRE/POST PLAY

Identification Number: 9  
Date: 18-4-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1 - 2 - <u>3</u> - 4 - 5
2 I feel nervous	1 - 2 - <u>3</u> - 4 - 5
3 I feel stressed	1 - <u>2</u> - 3 - 4 - 5
4 I feel sad	1 - 2 - <u>3</u> - 4 - 5
5 I feel safe	1 - 2 - 3 - <u>4</u> - 5
6 I feel fearful	1 - <u>2</u> - 3 - 4 - 5
7 I feel enthusiastic	1 - 2 - 3 - <u>4</u> - 5
8 I feel irritated	<u>1</u> - 2 - 3 - 4 - 5
9 I feel suspicious	1 - <u>2</u> - 3 - 4 - 5
10 I feel content	1 - 2 - 3 - <u>4</u> - 5
11 I feel insecure	1 - 2 - 3 - <u>4</u> - 5
12 I feel relaxed	1 - 2 - 3 - <u>4</u> - 5

**Questionnaire state of mind**

PRE/POST PLAY

Identification Number: 9  
Date: 18-4-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1 - 2 - 3 - <u>4</u> - 5
2 I feel nervous	1 - <u>2</u> - 3 - 4 - 5
3 I feel stressed	1 - <u>2</u> - 3 - 4 - 5
4 I feel sad	1 - 2 - <u>3</u> - 4 - 5
5 I feel safe	1 - 2 - 3 - <u>4</u> - 5
6 I feel fearful	<u>1</u> - 2 - 3 - 4 - 5
7 I feel enthusiastic	1 - 2 - 3 - <u>4</u> - 5
8 I feel irritated	1 - 2 - 3 - 4 - <u>5</u>
9 I feel suspicious	<u>1</u> - 2 - 3 - 4 - 5
10 I feel content	1 - 2 - 3 - <u>4</u> - 5
11 I feel insecure	1 - <u>2</u> - 3 - 4 - 5
12 I feel relaxed	1 - 2 - 3 - 4 - <u>5</u>

10

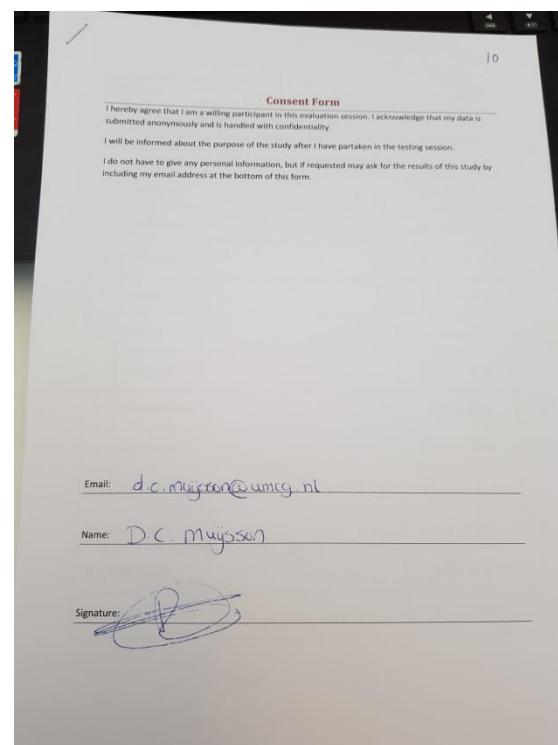


Positive: Invokes a good feeling

Beautiful: It looks beautiful

Easy: It's user friendly

Appealing: Appealing colors



**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 10  
Date: 05-05-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1-2-3-4-5
2	I feel nervous	2-3-4-5
3	I feel stressed	1-2-3-4-5
4	I feel sad	1-2-3-4-5
5	I feel safe	1-2-3-4-5
6	I feel fearful	1-2-3-4-5
7	I feel enthusiastic	1-2-3-4-5
8	I feel irritated	1-2-3-4-5
9	I feel suspicious	1-2-3-4-5
10	I feel content	1-2-3-4-5
11	I feel insecure	1-2-3-4-5
12	I feel relaxed	1-2-3-4-5

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 10  
Date: 05-05-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1-2-3-4-5
2	I feel nervous	1-2-3-4-5
3	I feel stressed	1-2-3-4-5
4	I feel sad	1-2-3-4-5
5	I feel safe	1-2-3-4-5
6	I feel fearful	1-2-3-4-5
7	I feel enthusiastic	1-2-3-4-5
8	I feel irritated	1-2-3-4-5
9	I feel suspicious	1-2-3-4-5
10	I feel content	1-2-3-4-5
11	I feel insecure	1-2-3-4-5
12	I feel relaxed	1-2-3-4-5

11



Positive: Exploration/discovery and interaction

Appealing: It looks appealing

Relaxing: Atmosphere

Difficult: Controls

Calm: Atmosphere

11

**Consent Form**

I hereby agree that I am a willing participant in this evaluation session. I acknowledge that my data is submitted anonymously and is handled with confidentiality.

I will be informed about the purpose of the study after I have participated in the testing session.

I do not have to give any personal information, but if requested may ask for the results of this study by including my email address at the bottom of this form.

Email: S.kleintuente@umcg.nl

Name: Stephanie Kleintuente

Signature: [Handwritten signature]

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 11  
Date: 18-5-19 - 20:19

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1-2-3-4-5
2 I feel nervous	1-2-3-4-5
3 I feel stressed	1-2-3-4-5
4 I feel sad	1-2-3-4-5
5 I feel safe	1-2-3-4-5
6 I feel fearful	1-2-3-4-5
7 I feel enthusiastic	1-2-3-4-5
8 I feel irritated	1-2-3-4-5
9 I feel suspicious	1-2-3-4-5
10 I feel content	1-2-3-4-5
11 I feel insecure	1-2-3-4-5
12 I feel relaxed	1-2-3-4-5

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 11  
Date: 18-5-19 - 20:19

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1-2-3-4-5
2 I feel nervous	1-2-3-4-5
3 I feel stressed	1-2-3-4-5
4 I feel sad	1-2-3-4-5
5 I feel safe	1-2-3-4-5
6 I feel fearful	1-2-3-4-5
7 I feel enthusiastic	1-2-3-4-5
8 I feel irritated	1-2-3-4-5
9 I feel suspicious	1-2-3-4-5
10 I feel content	1-2-3-4-5
11 I feel insecure	1-2-3-4-5
12 I feel relaxed	1-2-3-4-5

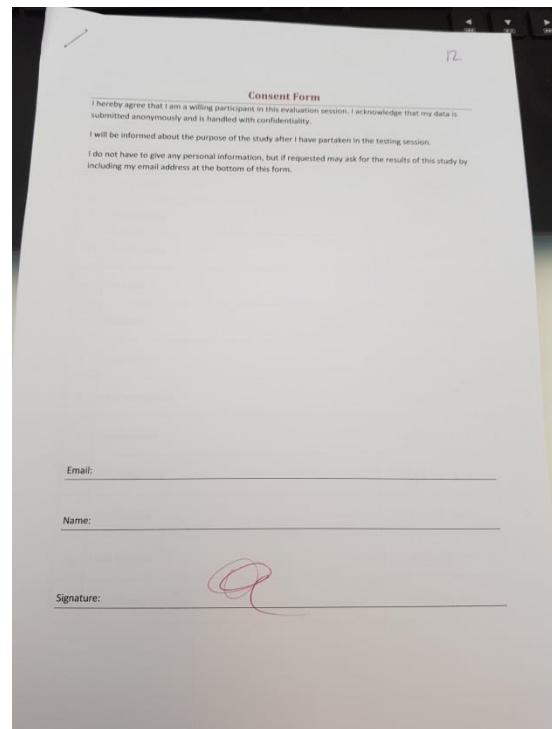
12



Cute: Because of the colors and shapes

Calm: Serene atmosphere

Easy: Easy



**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 12  
Date: 18-04-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1 - 2 - 3 - 4 - 5
2 I feel nervous	1 - 2 - <u>3</u> - 4 - 5
3 I feel stressed	1 - 2 - 3 - <u>4</u> - 5
4 I feel sad	1 - 2 - <u>3</u> - 4 - 5
5 I feel safe	1 - 2 - 3 - <u>4</u> - 5
6 I feel fearful	1 - 2 - <u>3</u> - 4 - 5
7 I feel enthusiastic	1 - 2 - <u>3</u> - 4 - 5
8 I feel irritated	1 - <u>2</u> - 3 - 4 - 5
9 I feel suspicious	1 - <u>2</u> - 3 - 4 - 5
10 I feel content	1 - 2 - <u>3</u> - 4 - 5
11 I feel insecure	1 - <u>2</u> - 3 - 4 - 5
12 I feel relaxed	1 - <u>2</u> - 3 - 4 - 5

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 12  
Date: 18-04-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1 - 2 - 3 - <u>4</u> - 5
2 I feel nervous	1 - 2 - <u>3</u> - 4 - 5
3 I feel stressed	1 - 2 - 3 - <u>4</u> - 5
4 I feel sad	1 - <u>2</u> - 3 - 4 - 5
5 I feel safe	1 - 2 - <u>3</u> - 4 - 5
6 I feel fearful	1 - 2 - <u>3</u> - 4 - 5
7 I feel enthusiastic	1 - 2 - 3 - <u>4</u> - 5
8 I feel irritated	1 - 2 - <u>3</u> - 4 - 5
9 I feel suspicious	1 - <u>2</u> - 3 - 4 - 5
10 I feel content	1 - 2 - 3 - <u>4</u> - 5
11 I feel insecure	1 - <u>2</u> - 3 - 4 - 5
12 I feel relaxed	1 - <u>2</u> - 3 - 4 - 5

**13**

Missing Data:

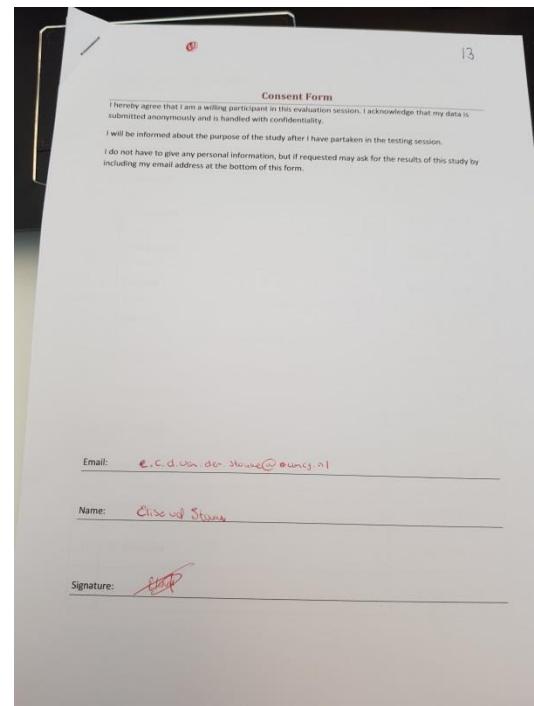
Missing Data:

Positive: Because I feel like this

Calm: Same as above

Easy: It was not difficult, not overwhelming

Happy: Atmosphere



**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 13  
Date: 18-4-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1 - 2 - 3 - 4 - 5
2 I feel nervous	1 - 2 - 3 - 4 - 5
3 I feel stressed	1 - 2 - 3 - 4 - 5
4 I feel sad	1 - 2 - 3 - 4 - 5
5 I feel safe	1 - 2 - 3 - 4 - 5
6 I feel fearful	1 - 2 - 3 - 4 - 5
7 I feel enthusiastic	1 - 2 - 3 - 4 - 5
8 I feel irritated	1 - 2 - 3 - 4 - 5
9 I feel suspicious	1 - 2 - 3 - 4 - 5
10 I feel content	1 - 2 - 3 - 4 - 5
11 I feel insecure	1 - 2 - 3 - 4 - 5
12 I feel relaxed	1 - 2 - 3 - 4 - 5

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 13  
Date: 18-4-2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1 - 2 - 3 - 4 - 5
2 I feel nervous	1 - 2 - 3 - 4 - 5
3 I feel stressed	1 - 2 - 3 - 4 - 5
4 I feel sad	1 - 2 - 3 - 4 - 5
5 I feel safe	1 - 2 - 3 - 4 - 5
6 I feel fearful	1 - 2 - 3 - 4 - 5
7 I feel enthusiastic	1 - 2 - 3 - 4 - 5
8 I feel irritated	1 - 2 - 3 - 4 - 5
9 I feel suspicious	1 - 2 - 3 - 4 - 5
10 I feel content	1 - 2 - 3 - 4 - 5
11 I feel insecure	1 - 2 - 3 - 4 - 5
12 I feel relaxed	1 - 2 - 3 - 4 - 5

14

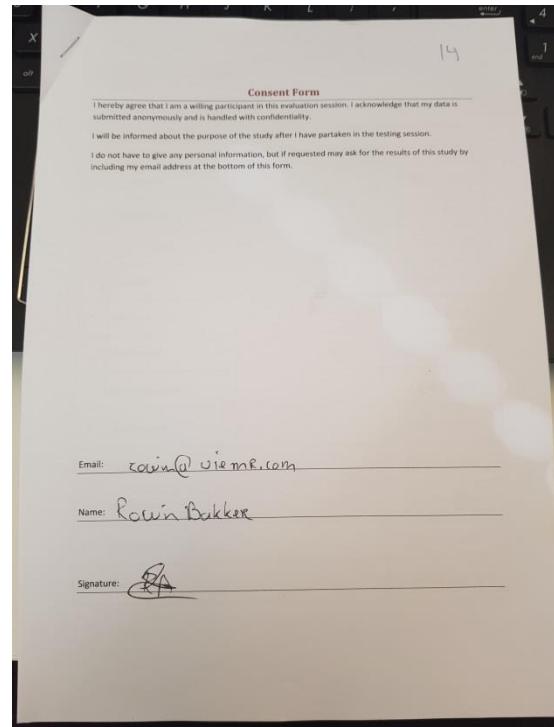


Happy: word er vrolijk van vanwege atmosphere.

Calm: atmosphere is rustgevend

Good: Het geeft een goed gevoel

Appealing: Het spreekt me aan hoe het eruit ziet.



**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 14  
Date: 21-05-19

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1 - <u>2</u> - 3 - 4 - 5
2	I feel nervous	<u>1</u> - 2 - 3 - 4 - 5
3	I feel stressed	<u>1</u> - 2 - 3 - 4 - 5
4	I feel sad	1 - <u>2</u> - 3 - 4 - 5
5	I feel safe	1 - 2 - 3 - <u>4</u> - 5
6	I feel fearful	<u>1</u> - 2 - 3 - 4 - 5
7	I feel enthusiastic	1 - <u>2</u> - 3 - 4 - 5
8	I feel irritated	1 - <u>2</u> - 3 - 4 - 5
9	I feel suspicious	<u>1</u> - 2 - 3 - 4 - 5
10	I feel content	1 - 2 - 3 - <u>4</u> - 5
11	I feel insecure	<u>1</u> - 2 - 3 - 4 - 5
12	I feel relaxed	1 - 2 - <u>3</u> - 4 - 5

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 14  
Date: 21-05-19

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1	I feel awake	1 - 2 - <u>3</u> - 4 - 5
2	I feel nervous	<u>1</u> - 2 - 3 - 4 - 5
3	I feel stressed	<u>1</u> - 2 - 3 - 4 - 5
4	I feel sad	1 - <u>2</u> - 3 - 4 - 5
5	I feel safe	1 - 2 - 3 - <u>4</u> - 5
6	I feel fearful	<u>1</u> - 2 - 3 - 4 - 5
7	I feel enthusiastic	1 - 2 - <u>3</u> - 4 - 5
8	I feel irritated	<u>1</u> - 2 - 3 - 4 - 5
9	I feel suspicious	<u>1</u> - 2 - 3 - 4 - 5
10	I feel content	1 - 2 - <u>3</u> - 4 - 5
11	I feel insecure	<u>1</u> - 2 - 3 - 4 - 5
12	I feel relaxed	1 - 2 - <u>3</u> - 4 - 5

15



Cute: The colors

Calm: Because there was no objective

Soft: The music

Short: Because I wanted to play more

Relaxing: Because I think it's relaxing.

15

**Consent Form**

I hereby agree that I am a willing participant in this evaluation session. I acknowledge that my data is submitted anonymously and is handled with confidentiality.

I will be informed about the purpose of the study after I have participated in the testing session.

I do not have to give any personal information, but if requested may ask for the results of this study by including my email address at the bottom of this form.

Email: mitsy.prada@gmail.com

Name: Mitsy

Signature:

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 15  
Date: 02/05/2019

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1 - 2 - 3 - 4 - 5
2 I feel nervous	1 - 2 - 3 - 4 - 5
3 I feel stressed	1 - 2 - 3 - 4 - 5
4 I feel sad	1 - 2 - 3 - 4 - 5
5 I feel safe	1 - 2 - 3 - 4 - 5
6 I feel fearful	1 - 2 - 3 - 4 - 5
7 I feel enthusiastic	1 - 2 - 3 - 4 - 5
8 I feel irritated	1 - 2 - 3 - 4 - 5
9 I feel suspicious	1 - 2 - 3 - 4 - 5
10 I feel content	1 - 2 - 3 - 4 - 5
11 I feel insecure	1 - 2 - 3 - 4 - 5
12 I feel relaxed	1 - 2 - 3 - 4 - 5

**Questionnaire state of mind**  
PRE/POST PLAY

Identification Number: 15  
Date: 22-5-19

The statements below relate to your current state of mind. Circle the answer that resonates with you the most at this point in time.

1 = strongly disagree | 2 = disagree | 3 = neutral | 4 = agree | 5 = strongly agree

1 I feel awake	1 - 2 - 3 - 4 - 5
2 I feel nervous	1 - 2 - 3 - 4 - 5
3 I feel stressed	1 - 2 - 3 - 4 - 5
4 I feel sad	1 - 2 - 3 - 4 - 5
5 I feel safe	1 - 2 - 3 - 4 - 5
6 I feel fearful	1 - 2 - 3 - 4 - 5
7 I feel enthusiastic	1 - 2 - 3 - 4 - 5
8 I feel irritated	1 - 2 - 3 - 4 - 5
9 I feel suspicious	1 - 2 - 3 - 4 - 5
10 I feel content	1 - 2 - 3 - 4 - 5
11 I feel insecure	1 - 2 - 3 - 4 - 5
12 I feel relaxed	1 - 2 - 3 - 4 - 5

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