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The Effect of a Virtual Reality Intervention on Evoking Positive Emotions and the Mediating Role of Presence

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ABSTRACT

The two influential domains of *Positive Psychology* and Technology have recently been combined into the paradigm *Positive Technology*, which is concerned with the use of technology to promote positive emotions. One technical approach that could be used in this domain is *Virtual Reality* (VR). Virtual Reality Interventions (VRI) offer great advantages to researchers and have been applied successfully across many different domains, including psychotherapy. In this study, the effect of a VRI on evoking positive emotions is investigated. Furthermore, the degree in which participants felt being present in the VR was assessed, as this concept of *presence* seems to play a major role in the inducement of positive emotions through VR. In total, 80 participants took part who were randomly distributed to an experimental and a control condition. The emotional state of the experimental group, which has been exposed to a relaxing virtual beach environment, was compared to the emotional state of the control condition, which has received a guided meditation without any VR. Results showed that there was no difference in the emotional state between the experimental and the control group, indicating that the VRI was not more successful in inducing positive emotions than the Guided Meditation. Furthermore, presence could not be identified as mediating the relationship between the VR exposure and the emotional state of the participants. Based on these results it is important to further research the relation between VRI, presence and the inducement of positive emotions.

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1 INTRODUCTION

Since there is already so much suffering all over the world every day, is it not all the more important to focus on the good things in life? This is what the discipline of *Positive Psychology* does. Positive Psychology (PP) is "the scientific study of optimal human functioning and flourishing […]. Instead of drawing on a 'disease model' of human behavior, it focuses on factors that enable individuals and communities to thrive and build the best in life" (Riva, Baños, Botella, Wiederhold & Gaggioli, 2012, p.69). This view agrees with the World Health Organization's definition of health where health is seen as "a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity" (WHO, 2001, p.3). In this sense, *wellbeing* refers to the psychological, social and physical resources that an individual needs to have to master its everyday life challenges (Dodge, Daly, Huyton & Sanders, 2012). The more resources an individual has in proportion to its challenges, the higher its wellbeing can be. PP offers great opportunities and has an almost unlimited potential of applying it to enhance wellbeing (Wong, 2011). Since PP effects and underlying functioning are better explored, it has grown rapidly and has established itself as an influential domain in today's psychology.

PP concerns itself with the promotion of positive feelings and thoughts. The *Broaden–and–Build Model of Positive Emotions* (Fredrickson, 2001) gives an explanation for the usefulness of positive emotions in increasing someone's wellbeing. First, it proposes that evoking positive emotions causes the production of nonspecific action tendencies in the human body. These, in turn, can lead to the formation of adaptive behavior of an individual. Adults who are in a good mood are, for example, more likely to seek social contact to others or to help other people in need. The second proposition of the model states that "by broadening an individual's awareness and thought–action repertoire, they build upon the resultant learning to create future physical, psychological, and social resources" (Riva et al., 2012, p.72), thereby increasing the person's individual wellbeing.

The advantages of *Positive Psychology Interventions* (PPI) lie in the fact that a broad range of people can profit from these, as their focus on a good life is relevant for all types of people: the healthy and the mentally ill ones (Slade, 2010). PPI positive effects on subjective and psychological wellbeing and the reduction of depressive symptoms have already widely been tested and confirmed in many studies and meta–analyses (Bolier, Haverman, Westerhof, Riper, Smit & Bohlmeijer, 2013). Despite these identified

successes, there are also some problems concerned with applying the PP approach. First, the beneficial effects of evoking positive emotions and thoughts seem to apply more for healthy people than for mentally ill people (Aspinwall & Tedeschi, 2010). Furthermore, the positive effects caused by PPI does not seem to produce any long–lasting benefits for the individual. PPI often just create short moments of pleasantness, instead of producing long–term changes in a person's emotional state. This is especially the case for mentally ill people and can have serious consequences. According to Aspinwall and Tedeschi (2010), the "effort to promote positive thoughts and feelings not only encourages false hope for benefit, but also may take resources away from the important work of managing negative realities" (p.10). To avoid these negative outcomes, it is recommended to adapt the use of PPI. PPI need to be carried out over a long period of time and should be tailored to the individual preferences of a person (Bolier et al., 2013). To further develop the field of PP and make gainful use of its advantages, it is important to find means to oppose the possible negative consequences and for applying PPI in a way that is more effective and beneficial in the long–term.

The most obvious solution to these problems, nowadays, is probably the use of technology with its many potentials and opportunities. Although the effects of new technologies on individuals quality of life are not fully captured yet, it is generally assumed that they can help people in enhancing their general wellbeing (Riva et al., 2012). To realize this potential, it is crucial to rely on the basic principles of PP while developing new technological systems. These need to be able to advance personal development, elicit positive emotions and support human functioning and flourishing (Riva et al., 2012). This is what has been done in the paradigm of *Positive Technology* (PT), where the aims of PP have been combined with the opportunities of *Information and Communication Technologies*. PT, therefore, is "the scientific and applied approach to the use of technology for improving the quality of our personal experience through its structuring, augmentation, and/or replacement" (Riva et al., 2012, p.69). The main goal of this discipline is to create technologies that are able to change or control our personal experiencing and, through this, to enhance an individual's psychological wellbeing and resilience and to contribute to the development of the whole society. This current research will focus on the use of technology to foster positive emotions, which is dealt with in more detail in the following sections.

One technical approach to increase wellbeing could be by means of *Virtual Reality* (VR). This concept has been introduced by Jaron Lamier in 1989 (Riva, Mantovani,

Capideville, Preziosa, Morganti, Villani & Alcañiz, 2007). Since then, it is known as a computer simulated environment able to manipulate the features of an individual's experience. Through the use of devices of different modalities, such as visual, aural and haptic devices, the user's physical presence can be encouraged so that he or she gets the feeling of being part of a synthetic world (Riva et al., 2012). This effect can be increased by the use of special devices that can detect the actions of the VR device user. On basis of this, the technology can adjust the simulated environment to the actions of the user to create an illusionary world within which the user is immersed and is interacting with (Riva et al., 2007).

Based on these features, *Virtual Reality Interventions* (VRI) offer some immediate advantages to researchers, such as a great flexibility in terms of the timing and the place of carrying out an intervention, high cost–effectiveness, and a good ability to adapt interventions to users individual needs. There is an almost infinite possibility of creating and designing VR stimuli (Wilson & Soranzo, 2015), what have made them being tested and applied as a means for carrying out interventions across many different domains, including psychotherapy (Carlbring & Andersson, 2006; Clough & Casey, 2011). Especially in the domain of exposure therapy, VR is an emerging approach for the treatment of anxiety disorders and it can display its advantages over classical imaginative and in vivo exposure to the full (Pallavicini, Cipresso, Raspelli, Grassi, Serino, Vigna, Triberti, Villamira, Gaggioli & Riva, 2013).

In one early study of Rothbaum, Hodges, Kooper, Opdyke, Williford and North (1995), VR was used for graded exposure therapy to treat *acrophobia*, the fear of heights. A *Head–Mounted Display* (HMD) was used to create the *Virtual Environment* (VE) consisting out of a glass elevator in a Hotel. After the exposure therapy in the VE, the participants anxiety, avoidance and distress have been reduced significantly, highlighting the effectiveness of VR exposure therapy in treating acrophobia. In other studies, VR was used to treat *Posttraumatic Stress Disorder* (PTSD) of Vietnam combat veterans and of a survivor of the World Trade Center attack of 11th September 2001 (Difede & Hoffman, 2002; Rothbaum, Hodges, Ready & Alarcon, 2001). The participants were gradually exposed to their traumatic experience by use of a VR. The results of both studies indicated a significant decrease of the PTSD scores and a reduction of the severity of the symptoms. Next to these promising results did Turner and Casey (2014) demonstrate in a meta–analysis the large effect sizes of VRI compared to non–interventions or to active intervention control groups. In general, VRI were more effective in reducing

psychopathological symptoms than the other forms of treatment. Furthermore, they showed that these effects are not restricted to exposure therapy, but apply to a broad range of clinical disorders, such as the treatment of other specific phobias, pain management, panic disorders, social anxiety, traumatic brain injury, addiction and dementia (Turner & Casey, 2014). Taken together, VRI are nowadays seen as a promising and effective way of treating psychological disorders, next to already existing in vivo or imaginative treatment options.

Riva and colleagues (2007) used VR to investigate its usefulness in producing different emotional states, including positive emotions. In this study, every participant experienced three different VE, consisting out of a relaxing, anxious or neutral situation in a park. To create the VE, an immersive HMD was used. Navigation and movements within the environment were possible and voices and music were played during the exploration. The results showed that the VR was effective in inducing the expected emotional states associated with the environments shown: exploring the *anxious VR* environment caused anxiety and interacting within the *relaxing VR* produced feelings of relaxation in the participants (Riva et al., 2007). In a comparable study, VR parks were used to induce the emotions of joy, anger, boredom, anxiety and sadness (Felnhofer, Kothgassner, Schmidt, Heinzle, Beutl, Hlavacs & Kryspin-Exnera, 2015). The results showed that all conditions were able to elicit the desired affective state, again underlining the potential of VR to promote specific emotions in the user. In a following study, the effectiveness of VR in evoking a state of relaxation in the participants was compared with the use of less immersive technologies (DVD, audio) to do so (Villani, Riva & Riva, 2007). The results showed significant effects in the VR condition in reducing anxiety and inducing positive emotions into the participants. Among the other media conditions, there were no such effects found. These results suggest the "efficacy of VR as an affective mood induction medium, opening its possible use in different applicative areas ranging from the wellbeing industry to clinical psychology" (Riva et al., 2007, p.54).

Next to these promising results, the studies also revealed the involvement of *presence* as a critical variable in VR based mood induction, necessary for an emotion to be evoked at all in a VE (Felnhofer et al., 2015). The concept of *presence* is not defined unitary, but usually, it is described as a "sense of being there" or a "feeling of being in a world that exists outside the self" (Riva et al., 2007, p.46). As a consequence, presence is also often viewed in terms of a sort of transportation from the real world into the VE (Schuemie, Van Der Straaten & Van Der Mast, 2001). Witmer and Singer (1998) see the

following two factors being necessary to experience presence: The first is *involvement*, defined as "a psychological state experienced as a consequence of focusing one's energy and attention on a coherent set of stimuli or meaningfully related activities and events" (p. 227). It depends on the user's characteristics, such as interest, motivation, personal relevance and meaning of the activity (Baños, Botella, Garcia-Palacios, Villa, Perpiñá & Alcaniz, 2000). The second factor is *immersion*, which depends on the objective, technical characteristics of the system and its ability to produce a real–like and interactive environment (Sanchez–Vives & Slater, 2005). In this context, presence is viewed as the user's subjective response to the system and its properties.

By paying attention to factors that can promote immersion of the system, VR has the ability to evoke a high degree of presence in the user, thus, making the VRI more effective. To these factors belong characteristics of the devices used, such as the use of a HMD or trackers, display parameters, such as the extent of the field of view, and the number of different sensory systems that are addressed by the device (e.g. sound of the system) and the quality of these (da Costa & de Carvalho, 2004; Sanchez–Vives & Slater, 2005). It is important to integrate these factors into a VR experience to fully use the potential of VR. Only through this, a real–world feeling in the participants can arise so that their response to a VE correlate with how they would respond in reality (Wilson & Soranzo, 2015). Riva et al. (2007, 2012) found a significant correlation between the feeling of presence and the different emotions evoked by the participants during the VR exposure. Participants experienced stronger positive emotions when they had the feeling of being present in the VE. In another study, the effects of an immersive HMD were compared to the use of a less immersive projected video wall and a PC monitor in showing participants a neutral and negative environment (Baños, Botella, Alcañiz, Liaño, Guerrero & Rey, 2004). The results revealed that the immersive HMD condition evoked more negative effects in the participants than the other two conditions, due to the higher degree of presence felt in this condition. This implies that affective content and immersion influenced the user's sense of presence and, therefore, the overall effectiveness of the VRI (Baños et al., 2004). These research results point to the crucial role of presence in mediating the relationship between the VR experience and the induction of emotions: to achieve the intended affective response, the VR medium needs to be able to evoke a feeling of presence in the participants. Sanchez–Vives and Slater (2005) even say that the working mechanisms of VRI will not have effect in many domains of psychotherapy in the absence of presence. These facts highlight the importance of taking presence into account

as an important variable while researching the effects of VR in psychotherapy and on the induction of positive emotions.

As the usefulness of promoting positive emotions in increasing wellbeing is already widely tested and confirmed, it is now of great importance to determine the conditions under which positive emotions can be evoked (Bolier et al., 2013; Fredrickson, 2001). Due to its many advantages and great opportunities, VR could be such a tool for successfully carrying out PPI. As its effects are still somewhat controversial and are most of the time only investigated in the context of diminishing disease instead of increasing wellbeing (Felnhofer et al., 2015), the aim of this study is to investigate the usefulness of VR in inducing positive emotions. The emotional state of an experimental group, which is exposed to a relaxing virtual beach environment, is compared to the emotional state of a control condition, which receives a guided meditation without any VR or other visual illustrations. Furthermore, the degree of presence felt by the participants during the VR experience is assessed, as this concept seems to play a major role in the inducement of positive emotions through the use of VR. This leads to the following research question:

> What is the effect of the Virtual Reality Intervention on evoking a positive emotional state in the user and in which way does presence influence the effect of the Virtual Reality Intervention on evoking a positive emotional state in the user?

Resulting out of these questions and the above reviewed literature, the following two hypotheses can be formulated:

> 1) The emotional state of the participants in the experimental group after receiving the Virtual Reality Intervention will be more positive than the emotional state of the participants in the control group.
>
> 2) The effect of the Virtual Reality Intervention on evoking positive emotions is mediated through the feeling of presence in the user.

2 METHOD

2.1 Design

The design applied in this study was a between subjects pretest–posttest design. The independent variable was the media experience of the participants. In the experimental group, the media experience was a Virtual Reality beach experience together with a Guided Meditation and in the control group, it was a Guided Meditation alone. The dependent variable was the emotional state of the participants. Another variable that was investigated was the sense of presence felt by the participants during the VRI and its effect as mediating variable on the experience of emotions.

2.2 Participants

In total, 80 participants took part in the study. From them, 40 participated in the experimental group and 40 participated in the control group. The participants were recruited by the method *convenience sampling* and were, then, randomly distributed to one of the two conditions. The age of the participants ranged from 19 to 78 years, which is summarized in more detail in Table 1 together with the other demographic characteristics of the participants. The minimum age required for participation was 18 years. The mean age was 33.25 years (SD = 15.33). Of all participants, 43 were female (53.80%) and 37 were male (46.20%). The nationality of 78 participants was German (97.50%). One participant was Dutch (1.25%) and one had another unknown nationality (1.25%). In total, 70 of all participants were highly educated with a completed or current study or a high school diploma (87.50%), nine were moderately educated (11.25%) and one participant was low educated (1.25%). Most of the participants (n = 42) were students (52.50%). Another 31 participants were employed or had a job (38.75%), four were housewife or pensioner (5.00%) and three were trainee (3.75%). All participants could speak and understand German and English and had no visual or hearing impairments and no psychological symptoms. Based on the information summarized in Table 1, the participants of the experimental and control group could be compared on their demographic background. A Chi–Quadrat test and a one–way ANOVA showed that participants in the experimental and control group did not differ on their demographic background (Age: F (1,78) = .24, p = .62; Gender: X^2 (1, n = 80) = .45, p = .50;

Nationality: X^2 (2, n = 80) = 2.00, p = . 37; Highest Educational Qualification: X^2 (6, n = 80) = 7.79, p = .25; Occupation: X^2 (4, n = 80) = 2.59, p = .63) and it could be concluded that the randomization has been successful.

Table 1

Frequencies and Percentages of the Demographic Characteristics of the Respondents

		Experimental Group n = 40		Control Group n = 40		Total n = 80	
	Category	Frequency	%	Frequency	%	Frequency	%
Gender	Male	23	57.50	20	50.00	43	53.80
	Female	17	42.50	20	50.00	37	46.20
Age	18 – 28	23	57.50	23	57.50	46	57.50
	29 – 38	1	2.50	5	12.50	6	7.50
	39 – 48	4	10.00	2	50.00	6	7.50
	49 – 58	11	27.50	9	22.50	20	25.00
	59 – 68	-	-	-	-	-	-
	69 – 78	1	2.50	1	2.50	2	2.50
Nationality	German	39	97.50	39	97.50	78	97.50
	Dutch	1	2.50	-	-	1	1.25
	Other	-	-	1	2.50	1	1.25
Highest Educational Qualification	Low Education	1	2.50	-	-	1	1.25
	Moderate Education	6	15.00	3	7.50	9	11.25
	High Education	33	82.50	37	92.50	70	87.50
Occupation	Student	22	55.00	20	50.00	42	52.50
	Job	15	37.50	16	40.00	31	38.75
	Trainee	1	2.50	2	5.00	3	3.75
	Housewife	1	2.50	1	2.50	2	2.50
	Pensioner	1	2.50	1	2.50	2	2.50

2.3 Materials and Measures

2.3.1 Questionnaires

First, some general questions were asked about the demographic background of the participants, such as their age, gender, nationality and education.

Affect. For measuring the emotional state of the participants, the German Version of the *Positive And Negative Affect Schedule* (PANAS) was used. This scale was developed by Watson, Clark and Tellegen in 1988 and it was translated into the German language in 1996 by Krohne, Egloff, Kohlmann and Tausch. The PANAS consists out of a list of 20 adjectives. Ten of them describe positive emotional states, indicating the global *Positive*

Affect Score (PA), and the other half describes negative emotions, resulting in the global *Negative Affect Score* (NA). Examples of positive affect items are *'interested'* or '*enthusiastic*' and examples of negative affect items are *'upset'* and '*afraid'*. While filling in the PANAS, respondents need to indicate on a five-point scale (varying from 1 = *very slightly or not at all*, to 5 = *extremely*) to what extend they are feeling the presented mood state at this moment. Based on the rules of thumbs of George and Mallery (2003) for interpreting Cronbach's alpha coefficients, the reliability of the PA scale (pre α = .85, post α = .88) and the NA scale (pre α = .70, post α = .83) of the PANAS in the current study was good. Watson, Clark, and Tellegen (1988) also showed that the PANAS highly correlates with other measures of positive and negative emotions, indicating a high external validity.

Presence. The score of the sense of presence felt by the participants during the VR exposure was obtained by the German version of the *Igroup Presence Questionnaire* (IPQ), developed by Schubert, Friedmann, and Regenbrecht (2001). The IPQ is a self–report questionnaire composed out of 14 statements which have to be rated on a seven–point scale on to what extend they apply to oneself (varying from -3 = *fully disagree/not at all*, to +3 = *fully agree/very much*). The scale is filled in after being exposed to the VE and the 14 items are distributed into three subscales and one additional general item which assesses the general 'sense of being there' ("*In the computer generated world I had a sense of 'being there*'".). The first of the three subscales is *Spatial Presence* which consists out of five items that measure the sense of being physically and bodily present in the VE. An example item from this subscale is: *"Somehow I felt that the virtual world surrounded me"*. The second subscale, *Involvement*, comprises four items which measure the attention that the subject pays to the VE and the involvement experienced. An example item from this scale is: *"I was not aware of my real environment"*. The last of the three subscales is *Experienced Realism.* This scale consists out of four items which measure the subjective experienced sense of realism attributed to the VE. An example item is: *"The virtual world seemed more realistic than the real world"* (Igroup.org, 2016; Schuemie, Van Der Straaten, Krijn & Van Der Mast, 2001). The internal consistency of the IPQ in the current study is almost acceptable, with a Cronbach's alpha of .63 (George & Mallery, 2003). A factor analysis showed that the items of the subscales load high on each other, with scores mostly above .60 up to .85 (Igroup.org, 2016).

2.3.2 Hardware

For conducting the study, a Head–Mounted Display was used to create the Virtual Environment. In particular, it was made use of a Google Cardboard viewer, as it is shown in Picture 1. This is an inexpensive device that can easily be constructed by oneself (Davis, Nesbitt & Nalivaiko, 2015). Two optical lenses for each eye are incorporated for producing the perception of depth. The Samsung smartphone *Samsung Galaxy S4 Mini* was used with the Android Version 4.4. Further materials used included a SONY VAIO laptop with an external mouse for letting the participants filling out the questionnaires. Sennheiser headphones were used for playing the Guided Meditation and other sounds belonging to the VR.

Picture 1. Google Cardboard – Official VR Headsets

(Google Store, 2016)

2.3.3 Software

To the different software used in this study belonged the *Perfect Beach VR* app from the publisher *nDreams LTD* (see Picture 2 and 3). This app also included the Guided Meditation used in the control group. For filling in the questionnaires, the program *Qualtrics* was used.

Picture 2. Perfect Beach App

(Google Play Store, 2015)

Picture 3. Front View in the Perfect Beach App

(Google Play Store, 2015)

2.4 Procedure

Figure 1 shows a graphical representation of the structure and the conduction of the study. The current study was part of a larger study where in total four researchers were involved. The study was set up like this so that all constructs necessary for the different researchers studies were integrated and could be measured. The data collection started on the 5th of April 2016 and ended on the 31st of April 2016. Participation in the study was completely voluntary. The study took place in a silent room without any external disturbances. In the beginning, the researcher greeted the participant and gave him an oral explanation of the study. Thereafter, the participant sat down on a chair in front of a laptop on a table. On the screen of the laptop, he or she could read a further introduction and got some more written information about the study. In the next step, the participant filled in the *informed consent* in which he or she agreed with the terms of participating in the study. The study began with filling in some demographical questions. Then, the participant received the PANAS to indicate his or her emotional state at that moment. After filling in these questionnaires, the participant received some further instructions from the researcher about what he or she could expect and would have to do during the intervention. Thereafter, the participant had to put on the Google Cardboard device and the headphones. The researcher started the app with the Guided Meditation and instructed the participant to relax and to explore the virtual environment consisting out of a 'perfect beach'. After 12 minutes of exposure to the VE with the meditation, the participant had to take off the Google Cardboard device and the headphones and had to fill in again the PANAS. In addition, the participant filled in the IPQ. Participants in the control condition received 12 minutes of Guided Meditation without being exposed to the VR. The Guided Meditation was played via headphones without any visual illustrations being present. After finishing the Guided Meditation, the participant filled in the PANAS. Thereafter, the participants in the control group also were exposed to the VE by means of the Google Cardboard viewer and the *Perfect Beach VR* app. Through the headphones, they listened to beach sounds at the same time. The participants were instructed to spend at least five minutes in the VR. Next, the participants filled in the IPQ. This second treatment in the control group was added to the study design because it was necessary for another researcher of the larger study to measure the level of presence in all participants in both conditions. Additionally, as this was a research on VR, it was desired to let everybody experience the VR. At the end of the study, participants of both conditions were thanked for taking part and the aim and

background of the study were explained. Furthermore, the participants were offered the opportunity to ask questions or to give notes or advices to the researcher in form of a short debriefing.

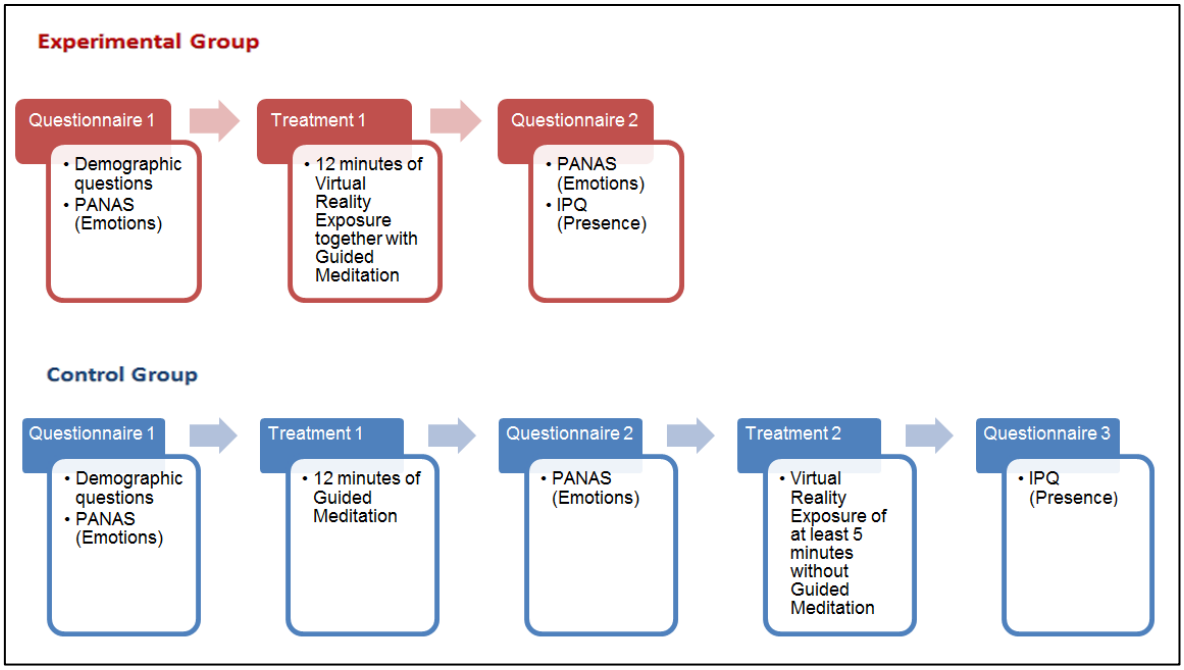

Figure 1. Graphical Representation of the Structure and Implementation of the Study

2.5 Data Analysis

First, descriptive statistics and frequencies were calculated for the demographical data of the participants. Sumscores and difference scores for the PANAS were computed which indicated the change of the participants emotional state from the pre–measurement to the post–measurement. The variable *PA sumscore pre–measurement* was substracted from *PA sumscore post–measurement* to get the new variable *Difference score PA*. Equally, the *NA sumscore pre–measurement* was substracted from *NA sumscore post–measurement* to get the new variable *Difference score NA*. With these variables, descriptive statistics were calculated to get an overview over the data. Furthermore, the appropriate statistical analyses were carried out to test the hypotheses.

An independent samples t–test with the *PA pre–measurement scores* and the *NA pre–measurement scores* was conducted to compare the baseline measures of both conditions. The first hypothesis was tested by doing two one–way repeated measures ANOVA'S. Therefore, the assumptions for conducting an ANOVA first were tested.

Although the data did not met the assumption of being normally distributed, it was still chosen for this test as it is robust against violation of normality and fits best the data. The first one–way repeated measures ANOVA was conducted with *Condition* (experimental group vs. control group) as independent variable and with the PA scores from the pre– and the post–measurement as dependent variables. In the second ANOVA, the independent variable again was the *Condition* and the dependent variables were the pre– and post–test NA scores.

The second hypothesis was tested by doing a mediator analysis according to the model of Baron and Kenny (1986). Two distinct regression analysis have to be carried out to establish a variable as a mediator. The first regression was done with the independent variable *Condition* (experimental group vs. control group) and the possible mediator *Presence sumscore* as dependent variable. The second regression had to be carried out in two blocks. In the first block, the dependent variable *PANAS score* needed to be regressed on the independent variable *Condition*. In the second block, the regression analysis had to be carried out with *Condition* and *Presence sumscore* as independent variables and with the *PANAS score* as dependent variable. To establish mediation, the following conditions must be met: the independent variable must affect to mediator in the first equation, the independent variable must affect the dependent variable in the second equation, and the mediator must affect the dependent variable in the third equation. When one of the first requirements will not be met, further analysis will not be carried out.

3 RESULTS

3.1 Descriptive Statistics and Comparison Baseline Measures

In Table 2, the means and standard deviations of the most important measures and scores are summarized. In comparison with general mean scores of the PANAS and IPQ, the scores of the participants in this study all lie on average. An independent samples t–test with the PA pre–measurement scores and the NA pre–measurement scores was conducted to compare the baseline measures of both conditions. The results showed that there were no significant differences between the experimental (M = 31.43, SD = 6.81) and the control group in their PA pre–measurement scores (M = 33.10, SD = 5.50; t (78) = 1.21, p = .23). The same non–significant results were obtained for the difference on the NA pre–measurement scores between the experimental (M = 12.23, SD = 2.40) and the control group (M = 11.43, SD = 2.25; t (78) = -1.54, p = .13). These results revealed that the participants in the two condition did not differ at their baseline measure.

Table 2

Means and Standard Deviations for the Participants Scores on the PANAS and IPQ per Condition

		Condition					
		Experimental		Control		Total	
Variable		*M*	*SD*	*M*	*SD*	*M*	*SD*
PA	Pre-test	31.42	6.81	33.10	5.50	32.26	6.21
	Post-test	29.15	6.83	29.88	7.36	29.51	7.06
NA	Pre-test	12.23	2.40	11.43	2.25	11.83	2.35
	Post-test	11.23	2.02	11.17	2.85	11.20	2.46
PANAS Difference score	PA	-2.27	6.65	-3.23	6.49	-2.75	6.55
	NA	-1.00	2.01	-.25	2.19	-.63	2.13
IPQ score		58.08	15.26	60.08	10.98	59.07	13.25

3.2 Effects of the Virtual Reality Intervention on Emotions

The outcomes of the two repeated measures ANOVA's are shown in Table 3 and 4. The results showed that there was a significant effect of time (within–subjects factor) found for both, PA and NA scores. This means that the PA and NA scores of the pre–measurement were significantly different from the PA and NA scores of the post–measurement, PA: F (1, 78) = 14.02, p = .000; NA: F (1, 78) = 7.06, p = .010 (see Table 2 for the means). The effect of condition (between–subjects factor) on the PA and NA scores of the participants at the pre– and post–test was not significant, indicating that the mean scores of both groups did not differ significantly from each other, PA: F (1, 78) = .86, p = .36; NA: F (1, 78) = .78, p = .38. There was no significant effect of interaction found for both, the PA scores (F (1, 78) = .42, p = .52) and the NA scores (F (1, 78) = 2.54, p = .12). This implies that the effect of time did not differ between the two conditions. These results indicate that the first hypothesis, which stated that the emotional state of the participants in the experimental group after receiving the Virtual Reality Intervention will be more positive than the emotional state of the participants in the control group, has to be rejected, as there was no significant difference in the emotional state between the two conditions.

Table 3

Results of the One–Way Repeated Measures ANOVA with PA

Source	Sum of Squares	*df*	Mean Square	*F*	Partial Eta Squared
Time	302.50	1	302.50	14.02**	.15
Condition	57.60	1	57.60	.86	.01
Interaction	9.03	1	9.03	.42	.01
Error	5229.38	78	67.04		

**p < 0.01

Table 4

Results of the One–Way Repeated Measures ANOVA with NA

Source	Sum of Squares	*df*	Mean Square	*F*	Partial Eta Squared
Time	15.63	1	15.63	7.06**	.08
Condition	7.23	1	7.23	.78	.01
Interaction	5.63	1	5.63	2.54	.03
Error	726.75	78	9.32		

**p < 0.01

3.3 Mediating Effect of Presence

The outcome of the regression analysis indicated that in the first equation, *Condition* was no significant predictor of presence, b = -2.00 , SE = 2.97, p = .50. As this first regression is required to be significant for a mediation to occur at all, it can be said that presence did not mediate the effect of the VRI on promoting positive emotions. The second hypothesis, that the effect of the VRI on evoking positive emotions is mediated through the feeling of presence in the user, therefore, has to be rejected.

4 DISCUSSION

The aim of this study was to examine the usefulness of a Virtual Reality Intervention on evoking positive emotions. The emotional state of an experimental group, which has been exposed to a relaxing virtual beach environment, was compared to the emotional state of a control condition, which has received a guided meditation without any VR or other visual illustrations. In addition, the degree of presence felt in the participants during the VRI was assessed to investigate its role in mediating the inducement of positive emotions. Through this, it was tried to answer the following research question: What is the effect of the Virtual Reality Intervention on evoking a positive emotional state in the user and in which way does presence influence the effect of the Virtual Reality Intervention on evoking a positive emotional state in the user? Based on this research question, two hypotheses have been formulated and investigated, whose results and implications will be discussed in the following sections.

4.1 Effects of the Virtual Reality Intervention on Emotions

The first hypothesis stated that the emotional state of the participants in the experimental group after receiving the VRI will be more positive than the emotional state of the participants in the control group. On basis of the reviewed literature and the already conducted studies in this area, it was assumed that the relaxing VR beach used in this study would have been able to induce positive emotions into the user (Villani, Riva & Riva, 2007; Riva et al., 2007). However, the results revealed that there was no effect of the VRI on emotions found. The absent interaction–effect indicated that the emotional state of the participants in the experimental group was not more positive than the emotional state of the participants in the control group. This leads to the conclusion that the VRI was not better or more successful in producing a positive emotional state in the user than the Guided Meditation alone.

The question that now arises is why the effects in this study were that insignificant and even opposed to what was expected on basis of the results of earlier research where VRI were found to be successful mood-induction mediums (Villani, Riva & Riva, 2007; Riva et al., 2007). First of all, the devices used to create the Virtual Environment in the different studies can be compared. In other studies, it was made use of a high resolution Head–Mounted Display with head tracking resulting in a high amount of immersion

(Felnhofer et al., 2015; Riva et al., 2007; Villani, Riva & Riva, 2007). Furthermore, the devices used were able to let the user navigate and move around within the VE. In the current study, a Google Cardboard was used to create the VR. This technology is a cheap self–constructed device that enables any smartphone to be used to create a VR in combination with a HMD (Davis, Nesbitt & Nalivaiko, 2015; Hussein & Nätterdal, 2015). However, several studies have revealed that users valued their VR experience more positive when using a more optimized HMD (for example Samsung Gear VR or Oculus Rift) than when using the inexpensive and less optimized VR HMD Google Cardboard (Hussein & Nätterdal, 2015). This finding is supported by the current study through the notion of many participants that the Google Cardboard was very uncomfortable to wear. These factors could have led to the effect that the participants could eventually not relax as much as it was intended to and they probably could not leave their everyday life and the current situation behind them and fully immerse into the VE.

Another possible explanation for the effect of the overall decrease in emotionality can be found in the use of the PANAS. Boniwell and Henry (2007) already noted that in this scale, positive affect is conceptualized as very active through terms such as *'interested'*, *'excited'*, *'attentive'* , *'enthusiastic'* and *'alert'*. This conceptualization could lead to a bias in activation and excitement, simultaneously covering the possible effects of a relaxing intervention on evoking positive emotions. Applied to the current study, the mostly actively described adjectives of the PANAS are partly in opposite to the calm and relaxing state that was intended to be achieved through being exposed to the Virtual Beach Environment and attending the Guided Meditation. This can offer an explanation for the absent effects and decrease in positive affect in this study and is in line with earlier research of Collard, Avny and Boniwell in 2008 and Westbrook in 2013. They also found no change or even a decrease in positive affect in the participants of their studies who followed a relaxing and meditative Mindfulness Based Intervention. They also attributed these results to the active manner of description of the adjectives that are used in the PANAS.

4.2 Mediating Effects of Presence

The second hypothesis stated that the effect of the Virtual Reality Intervention on evoking positive emotions was explained through the feeling of presence in the user. This

hypothesis was grounded in the assumption that a feeling of presence is a prerequisite for positive emotions to be achieved through a VRI at all (Riva et al., 2007). Opposite to the expectations, the results of this study revealed that the feeling of presence did not mediate the effect of the VRI on the inducement of positive emotions. With respect to this hypothesis, it can therefore be concluded that, if there had been a feeling of presence in the participants at all, it had no influence on the results of this study.

One conceivable explanation for the absence of any mediating effects of presence found in this study can lie in the degree of presence felt by the participants. This could possibly have been low or at least not sufficient to produce a positive emotional state. IPQ scores are never interpreted alone but always in terms of interaction effects and there do not exist any norm– or cut–off scores for the IPQ. Therefore, it is difficult to make a definite statement about the degree of presence felt by the users during the VR experience based on the IPQ mean scores alone. A possible argument for stating that the degree of presence felt in this study was low can nevertheless be putted forward. This concerns the device used in this study to create the VE, the Google Cardboard, and the degree of immersion which it produced. As the Google Cardboard is constructed very simple, it does not contain many technical features that do promote immersion of the system. However, immersion is something that is actually required to make the user interact real–like with the system and to produce a feeling of presence in the user (Witmer & Singer, 1998). Next to that, Witmer and Singer (1998) saw involvement as a second factor being necessary to experience presence. Involvement has nothing to do with form, but depends on content and on the user's characteristics, such as interest, motivation, personal relevance and meaning of the activity (Baños, Botella, Garcia-Palacios, Villa, Perpiñá & Alcaniz, 2000; Slater, 2003). About the degree of involvement of the participants in this study nothing was known. Nevertheless, one conceivable possibility is that the participants involvement was low too, so that the absence of immersion and involvement together could have contributed to the fact that there was no effect of presence found in this study. As it is even said that the working mechanisms of VRI will not take effect in many domains of psychotherapy in the absence of presence, this could also be an explanation for why the intervention did not achieve the goal of inducing positive emotions into the participants at all (Riva et al., 2007; Sanchez–Vives & Slater, 2005).

4.3 Strengths and Limitations

First of all, it can be said that the set–up of the study and the whole conduction were planned carefully and properly. The research method cannot be criticized as it was almost what is called the *'gold standard'* in research: a randomized controlled trail (RCT) (Kaptchuk, 2001). In the study set–up, two conditions were included: An experimental group and an active control group. Through relying on the use of an active control group, it was made sure that purely the effect of the VR experience additionally to the Guided Meditation was measured. Through this, the influence of factors such as immersion, involvement and presence elicited through the VRI could be assessed. In addition, a pre– and a post–measurement were carried out. Furthermore, random distribution of the participants to the two conditions was made sure.

Another strength of the study could have lied in the fact that it was not conducted in one completely standardized environment but across many different locations. Due to the easily transportable materials used, it was possible to carry out the study at any place and time. The conduction under different circumstances and influences and by different researchers could have increased the ecological validity of the study, making the results more generalizable to different natural settings (Schmuckler, 2001). To still obtain a certain amount of standardization, all researchers followed a beforehand drawn up research protocol to assure that it was worked according to the same procedures. In this protocol, it was determined that the study needed to be carried out in a calm, unexciting and not–stimulating environment to make sure that the participants were not influenced too much from the outside while being exposed to the treatment.

One limitation of this study could have lied in the *Perfect Beach VR* app used in this study. The app did not always work well so that the picture sometimes was jerky. Pallavicini, Cipresso, Raspelli, Grassi, Serino, Vigna, Triberti, Villamira, Gaggioli, and Riva (2013) demonstrated in an earlier study that technical problems while using VR can lead to a decrease in the system's ability to evoke emotional reactions in the user. Furthermore, many participants noted that the VE displayed in the app was too animated and, therefore, not close to reality. This could have had a detrimental impact on the users feeling of presence and the whole VR experience.

4.4 Implications and Future Research

With respect to the possible shortcomings of the Google Cardboard, it is proposed to use another, more comfortable and immersive device in a following VR study. To keep up the use of a Head–Mounted Display, the Oculus Rift can be considered as a good alternative. It "provides an extended field of view of 110 degrees, stereoscopic vision, and fast head tracking" (Boas, 2013, p.3). Furthermore, it makes fast image updates so that the picture and the whole VR should not be delayed. Through these characteristics, it can be counted among the fully–immersive systems, which make use of high quality images, cut out unrelated, distracting stimuli and, therefore, allow the user to experience the VR as real as possible (Boas, 2013). By the use of this, the chance to evoke a feeling in the user of being present in the VR increases and, therefore, the possibility of the intervention to be more successful in inducing positive emotions into the user. Additionally, it is proposed to obtain explicit and separate measures of the level of immersion and involvement next to assessing the general level of presence. This is necessary to find out more about the relation between these concepts and about which particular factors constitute a high feeling of presence.

Furthermore, it should be tried to make the VR to appear more real to the user and to try to incorporate strategies that prolong and increase the participants emotional experience. One known strategy of regulating positive affect is the ability of *savoring* positive outcomes (Bryant, 1989, 2003). Earlier studies have shown that utilizing savoring can have a beneficial impact on wellbeing (Bryant, 1989, 2003; Tugade & Fredrickson, 2007). The in the beginning introduced *Broaden-and-Build Theory* explains this by stating that the development and maintenance of positive emotions can increase an individual's resources. These, in turn, can help an individual to experience more positive emotions and to cope appropriately with negative ones to enhance one's satisfaction of life and wellbeing (Fredrickson, 2001; Tugade & Fredrickson, 2004). One specific strategy of savoring that seems to be relevant for this study is the attempt to *Be Present* (Quoidbach, Berry, Hansenne & Mikolajczak, 2010). This is to consciously perceive or pay attention to the present moment and to enjoy that specific experience. It seems to be closely related to the concept of presence attended to in this study and has been proven to strengthen one's positive emotional experiences (Bryant, 2003). A second savoring strategy that seems to be able to increase wellbeing is the engagement in *Positive Mental Time Travel (Positive MTT)* "by vividly remembering or anticipating positive events" (Quoidbach, Berry,

Hansenne & Mikolajczak, 2010, p.2). Based on these considerations, it is proposed to use a photo of a more real location as VE in a future study. It may even be possible to use a photo of the favorite beach holiday of the participants. This increases the chance of the user to engage in mindful Positive MTT while using the VR device. It could make the user feel more comfortable in the VR and, in turn, could lead to the user really getting into the spirit of the VR. This could enhance the user's emotional wellbeing, making him profiting in the long–term from the positive outcomes of the intervention.

There do exist individual differences in the way people make use of savoring strategies and in the way they regulate their emotional state (Gross & John, 2003). People with high self-esteem seem, for example, more likely to savor and maintain their positive experiences in contrast to low self-esteem individuals (Wood, Heimpel & Michela, 2003). Related to this, there seem to exist individual differences in the way in which people can profit from a Guided Mediation or a VR (Westbrook, 2013). These individual differences may have an important influence on the effect of a VRI on the users positive emotions and their wellbeing (Quoidbach, Berry, Hansenne & Mikolajczak, 2010). Therefore, it is proposed as another point of improvement to measure other factors that can be thought of influencing the effect of a VR experience or Guided Meditation in a follow–up study prior to the intervention. Next to the above mentioned factor *self-esteem*, some personality characteristics, such as empathy, may have an influence on people's degree in which they can enter a Guided Mediation or a VR (Westbrook, 2013). Another possible influencing factor could be the participants previous experience with Guided Meditations or VRI (Westbrook, 2013). Earlier research showed that people having prior experience in this area profited more from those kinds of interventions and showed a greater increase in positive affect and a greater decrease in negative affect. Measuring all these potentially relevant constructs was beyond the scope of the current project. However, in a follow–up study, it can be considered to examine factors such as participants personality, empathy and their previous experience with Guided Meditation or VRI prior to the intervention. Through this, participants can be compared on these factor and their possible influence on the effect of an intervention can be better explored.

Another consideration for future research should be the use of another scale for measuring positive emotions, instead of the PANAS. As the active formulation of the positive affect items could have led to biased results, it is proposed to use a more neutral measure with more passively described items. One scale better suitable for future research in this area could be the modified Differential Emotions Scale (mDES). It is based on

Izard's (1977) Differential Emotions Scale (DES) and has been modified by Fredrickson to make it more widely applicable by incorporating more positive emotions. By this, the mDES should have become a reliable measure for positive emotions. It comprises 20 items which cover positive affect in a more extensive way "than the more commonly used PANAS […], which exclusively targets high activation positive affective states" (Fredrickson, 2013, p.7; Galanakis, Stalikas, Pezirkianidis & Karakasidou, 2016, p.102). The English version of the mDES can be found in Appendix A.

It quickly gets clear that the list of improvements could be infinite due to the almost infinite possibilities of designing and arranging a Virtual Reality Intervention. This simultaneously makes clear that one VR is not like another. The success of a VRI depends on a lot of different factors, ranging from the planning and design of the study to the materials used. Little differences in the study set–up or the materials used can already lead to one study finding an effect where another one does not. To achieve the intended effects, it is necessary to have expert knowledge of the working mechanisms of the different possible VR equipment and to plan and conduct the study carefully. The wide extent of possible VRI simultaneously offers a lot of possibilities for doing future research in this area. With respect to today's domain of psychology, VRI have already proven their effectiveness: they have been successfully applied in treating different types of phobias, PTSD and a broad range of other clinical disorders, such as panic disorders, social anxiety, traumatic brain injury, addiction and dementia (Turner & Casey, 2014). Also in the domain of Positive Psychology, VRI efficacy in inducing positive emotions and increasing wellbeing has already widely been tested and confirmed (Felnhofer et al., 2015; Riva et al., 2007; Villani, Riva & Riva, 2007). Therefore, it is important not to rest on the opposing research results of the current study, but to take the above discussed limitations and considerations into account and to try to replicate and build upon the promising research results of earlier studies. By making use of the almost infinite possibilities of VR, it should be possible to continue with the successful application of VR. The goal should be to optimize the use of VR to make progress in establishing it as a beneficial everyday medium to be used in the wellbeing industry and clinical psychology.

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APPENDIX

Appendix A: Questionnaires

Positive and Negative Affect Schedule (PANAS) - English Version

PANAS

This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way generally, that is, how you feel most of the time. Use the following scale to record your answers.

1	**2**	**3**	**4**	**5**
very slightly or not at all	a little	moderately	quite a bit	extremely

_____ interested	_____ irritable
_____ distressed	_____ alert
_____ excited	_____ ashamed
_____ upset	_____ inspired
_____ strong	_____ nervous
_____ guilty	_____ determined
_____ scared	_____ attentive
_____ hostile	_____ jittery
_____ enthusiastic	_____ active
_____ proud	_____ afraid

Positive and Negative Affect Schedule (PANAS) - German Version

PANAS

Dieser Fragebogen enthält eine Reihe von Wörtern, die unterschiedliche Gefühle und Empfindungen beschreiben. Lesen Sie jedes Wort und tragen dann in die Skala neben jedem Wort die Intensität ein. Sie haben die Möglichkeit, zwischen fünf Abstufungen zu wählen.

Geben Sie bitte an, wie Sie sich **im Verlauf der letzten 12 Monate** gefühlt haben.

	ganz wenig oder gar nicht	**ein bisschen**	**einigermassen**	**erheblich**	**äusserst**
aktiv	☐	☐	☐	☐	☐
bekümmert	☐	☐	☐	☐	☐
interessiert	☐	☐	☐	☐	☐
freudig erregt	☐	☐	☐	☐	☐
verärgert	☐	☐	☐	☐	☐
stark	☐	☐	☐	☐	☐
schuldig	☐	☐	☐	☐	☐
erschrocken	☐	☐	☐	☐	☐
feindselig	☐	☐	☐	☐	☐
angeregt	☐	☐	☐	☐	☐
stolz	☐	☐	☐	☐	☐
gereizt	☐	☐	☐	☐	☐
begeistert	☐	☐	☐	☐	☐
beschämt	☐	☐	☐	☐	☐
wach	☐	☐	☐	☐	☐
nervös	☐	☐	☐	☐	☐
entschlossen	☐	☐	☐	☐	☐
aufmerksam	☐	☐	☐	☐	☐
durcheinander	☐	☐	☐	☐	☐
ängstlich	☐	☐	☐	☐	☐

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Igroup Presence Questionnaire (IPQ) – English Version

English IPQ Items

Number	PQI/II Nr. (internal)	IPQ item name	shortcut	loading on ...	English question	English anchors
1	s62	G1	sense of being there	PRES	In the computer generated world I had a sense of "being there"	not at all--very much
2	s44	SP1	sense of VE behind	SP	Somehow I felt that the virtual world surrounded me.	fully disagree--fully agree
3	s30	SP2	only pictures	SP	I felt like I was just perceiving pictures.	fully disagree--fully agree
4	s28	SP3	not sense of being in v. space	SP	I did not feel present in the virtual space.	did not feel--felt present
5	s31	SP4	sense of acting in VE	SP	I had a sense of acting in the virtual space, rather than operating something from outside.	fully disagree--fully agree
6	s33	SP5	sense of being present in VE	SP	I felt present in the virtual space.	fully disagree--fully agree
7	s64	INV1	awareness of real env.	INV	How aware were you of the real world surrounding while navigating in the virtual world? (i.e. sounds, room temperature, other people, etc.)?	extremely aware-moderately aware-not aware at all
8	s37	INV2	not aware of real env.	INV	I was not aware of my real environment.	fully disagree--fully agree
9	s40	INV3	no attention to real env.	INV	I still paid attention to the real environment.	fully disagree--fully agree
10	s38	INV4	attention captivated by VE	INV	I was completely captivated by the virtual world.	fully disagree--fully agree
11	s48	REAL1	VE real (real/not real)	REAL	How real did the virtual world seem to you?	completely real--not real at all
12	s7	REAL2	experience similar to real env.	REAL	How much did your experience in the virtual environment seem consistent with your real world experience ?	not consistent-moderately consistent-very consistent
13	s59	REAL3	VE real (imagined/real)	REAL	How real did the virtual world seem to you?	about as real as an imagined world--indistinguishable from the real world
14	s47	REAL4	VE wirklich	REAL	The virtual world seemed more realistic than the real world.	fully disagree--fully agree

Igroup Presence Questionnaire (IPQ) – German Version

Number	IPQ item name	German question	German anchors
1	G1	In der computererzeugten Welt hatte ich den Eindruck, dort gewesen zu sein...	überhaupt nicht--sehr stark
2	SP1	Ich hatte das Gefühl, daß die virtuelle Umgebung hinter mir weitergeht.	trifft gar nicht zu- -trifft völlig zu
3	SP2	Ich hatte das Gefühl, nur Bilder zu sehen.	trifft gar nicht zu- -trifft völlig zu
4	SP3	Ich hatte nicht das Gefühl, in dem virtuellen Raum zu sein.	hatte nicht das Gefühl--hatte das Gefühl
5	SP4	Ich hatte das Gefühl, in dem virtuellen Raum zu handeln statt etwas von außen zu bedienen.	trifft gar nicht zu- -trifft völlig zu
6	SP5	Ich fühlte mich im virtuellen Raum anwesend.	trifft gar nicht zu- -trifft völlig zu
7	INV1	Wie bewußt war Ihnen die reale Welt, während Sie sich durch die virtuelle Welt bewegten (z.B. Geräusche, Raumtemperatur, andere Personen etc.)?	extrem bewußt-mittelmäßig bewußt-unbewußt
8	INV2	Meine reale Umgebung war mir nicht mehr bewußt.	trifft gar nicht zu- -trifft völlig zu
9	INV3	Ich achtete noch auf die reale Umgebung.	trifft gar nicht zu- -trifft völlig zu
10	INV4	Meine Aufmerksamkeit war von der virtuellen Welt völlig in Bann gezogen.	trifft gar nicht zu- -trifft völlig zu
11	REAL1	Wie real erschien Ihnen die virtuelle Umgebung?	vollkommen real-weder noch-gar nicht real
12	REAL2	Wie sehr glich Ihr Erleben der virtuellen Umgebung dem Erleben einer realen Umgebung?	überhaupt nicht-etwas-vollständig
13	REAL3	Wie real erschien Ihnen die virtuelle Welt?	wie eine vorgestellte Welt- -nicht zu unterscheiden von der realen Welt
14	REAL4	Die virtuelle Welt erschien mir wirklicher als die reale Welt.	trifft gar nicht zu- -trifft völlig zu

Igroup Presence Questionnaire (IPQ) – Dutch Version

Number	IPQ item name	Dutch question	Dutch anchors
1	G1	Ik had het gevoel aanwezig te zijn in de computerwereld	Helemaal niet--Heel erg
2	SP1	Ik had het gevoel omgeven te zijn door de virtuele wereld	Helemaal mee oneens -- Helemaal mee eens
3	SP2	Ik had het gevoel slechts plaatjes te aanschouwen	Helemaal mee oneens-- Helemaal mee eens
4	SP3	Ik had niet het gevoel in de virtuele ruimte aanwezig te zijn	helemaal mee oneens-- helemaal mee eens
5	SP4	Ik had meer het gevoel bezig te zijn in de virtuele ruimte, dan dat ik het gevoel had iets van buitenaf te bedienen	Helemaal mee oneens-- Helemaal mee eens
6	SP5	Ik voelde me aanwezig in de virtuele ruimte	Helemaal mee oneens-- Helemaal mee eens
7	INV1	Hoe bewust was u zich van de echte omgeving (bv. geluiden van buiten, kamertemperatuur), terwijl u zich bevond in de virtuele ruimte	Zeer bewust--Helemaal niet bewust
8	INV2	Ik was me niet bewust van mijn echte omgeving	Helemaal mee oneens-- Helemaal mee eens
9	INV3	Ik lette nog op de echte omgeving	Helemaal mee oneens-- Helemaal mee eens
10	INV4	Ik ging volledig op in de virtuele wereld	Helemaal mee oneens-- Helemaal mee eens
11	REAL1	Hoe echt kwam de virtuele omgeving op u over	Heel echt--Helemaal niet echt
12	REAL2	In hoeverre kwam uw ervaring in de virtuele omgeving overeen met uw ervaringen in de echte wereld?	Geen overeenstemming-- Volledige overeenstemming
13	REAL3	Hoe werkelijk kwam de virtuele wereld op u over	Zoals een denkbeeldige wereld--Niet te onderscheiden v. d. echte wereld
14	REAL4	De virtuele wereld kwam echter op mij over dan de werkelijke wereld	Helemaal mee oneens-- Helemaal mee eens

modified Differential Emotions Scale (mDES) – English Version

Instructions: Please think back to how you have felt during the past 24 h. Using the 0–4 scale below, indicate the greatest amount that you have experienced each of the following feelings.

Not at all	A little bit	Moderately	Quite a bit	Extremely
0	1	2	3	4

___ 1. What is the most **amused**, **fun-loving**, or **silly** you felt?
___ 2. What is the most **angry**, **irritated**, or **annoyed** you felt?
___ 3. What is the most **ashamed**, **humiliated**, or **disgraced** you felt?
___ 4. What is the most **awe**, **wonder**, or **amazement** you felt?
___ 5. What is the most **contemptuous**, **scornful**, or **disdainful** you felt?
___ 6. What is the most **disgust**, **distaste**, or **revulsion** you felt?
___ 7. What is the most **embarrassed**, **self-conscious**, or **blushing** you felt?
___ 8. What is the most **grateful**, **appreciative**, or **thankful** you felt?
___ 9. What is the most **guilty**, **repentant**, or **blameworthy** you felt?
___ 10. What is the most **hate**, **distrust**, or **suspicion** you felt?
___ 11. What is the most **hopeful**, **optimistic**, or **encouraged** you felt?
___ 12. What is the most **inspired**, **uplifted**, or **elevated** you felt?
___ 13. What is the most **interested**, **alert**, or **curious** you felt?
___ 14. What is the most **joyful**, **glad**, or **happy** you felt?
___ 15. What is the most **love**, **closeness**, or **trust** you felt?
___ 16. What is the most **proud**, **confident**, or **self-assured** you felt?
___ 17. What is the most **sad**, **downhearted**, or **unhappy** you felt?
___ 18. What is the most **scared**, **fearful**, or **afraid** you felt?
___ 19. What is the most **serene**, **content**, or **peaceful** you felt?
___ 20. What is the most **stressed**, **nervous**, or **overwhelmed** you felt?

Appendix B: Informed Consent

German Version

Einverständniserklärung zur Teilnahme

Titel der Studie: “Die Effekte und der psychologische Hintergrund von Virtual Reality”
Verantwortlicher Untersucher: Jelka Deiters (j.deiters@student.utwente.nl)

Auszufüllen durch den Teilnehmer

Hiermit erkläre ich deutlich und ausreichend informiert worden zu sein über die Art, die Methode und das Ziel dieser Studie. Ich weiß, dass meine Daten und die Ergebnisse der Studie ausschließlich anonym und vertraulich behandelt und an Dritte weitergegeben werden. Meine Fragen wurden zu meiner Zufriedenheit beantwortet.

Ich stimme der Teilnahme an dieser Studie vollkommen freiwillig zu. Dabei behalte ich mir das Recht vor, jederzeit meine Teilnahme an dieser Studie unterbrechen oder beenden zu können, ohne dafür einen Grund angeben zu müssen.

Name Teilnehmer:
……

Datum: …….. Unterschrift Teilnehmer:
……...…….

Auszufüllen durch den ausführenden Untersucher

Ich habe den Teilnehmer mündlich und schriftlich über die Studie aufgeklärt. Weitere Fragen über die Studie werde ich so gut es geht beantworten. Der Teilnehmer wird von einer eventuellen frühzeitigen Beendung seiner Teilnahme an dieser Studie keine nachteiligen Folgen erfahren.

Unterschrift Untersucher:
……..……..

Dutch Version

Titel onderzoek: “Virtual Reality and its Psychological Background and Effects”
Verantwoordelijke onderzoeker:

In te vullen door de deelnemer

Ik verklaar op een voor mij duidelijke wijze te zijn ingelicht over de aard, methode, doel en [indien aanwezig] de risico’s en belasting van het onderzoek. Ik weet dat de gegevens en resultaten van het onderzoek alleen anoniem en vertrouwelijk aan derden bekend gemaakt zullen worden. Mijn vragen zijn naar tevredenheid beantwoord.

Ik stem geheel vrijwillig in met deelname aan dit onderzoek. Ik behoud me daarbij het recht voor om op elk moment zonder opgaaf van redenen mijn deelname aan dit onderzoek te beëindigen.

Naam deelnemer: ……..
Datum: …… Handtekening deelnemer: …...…….

In te vullen door de uitvoerende onderzoeker

Ik heb een mondelinge en schriftelijke toelichting gegeven op het onderzoek. Ik zal resterende vragen over het onderzoek naar vermogen beantwoorden. De deelnemer zal van een eventuele voortijdige beëindiging van deelname aan dit onderzoek geen nadelige gevolgen ondervinden.

Naam onderzoeker:
……..……..