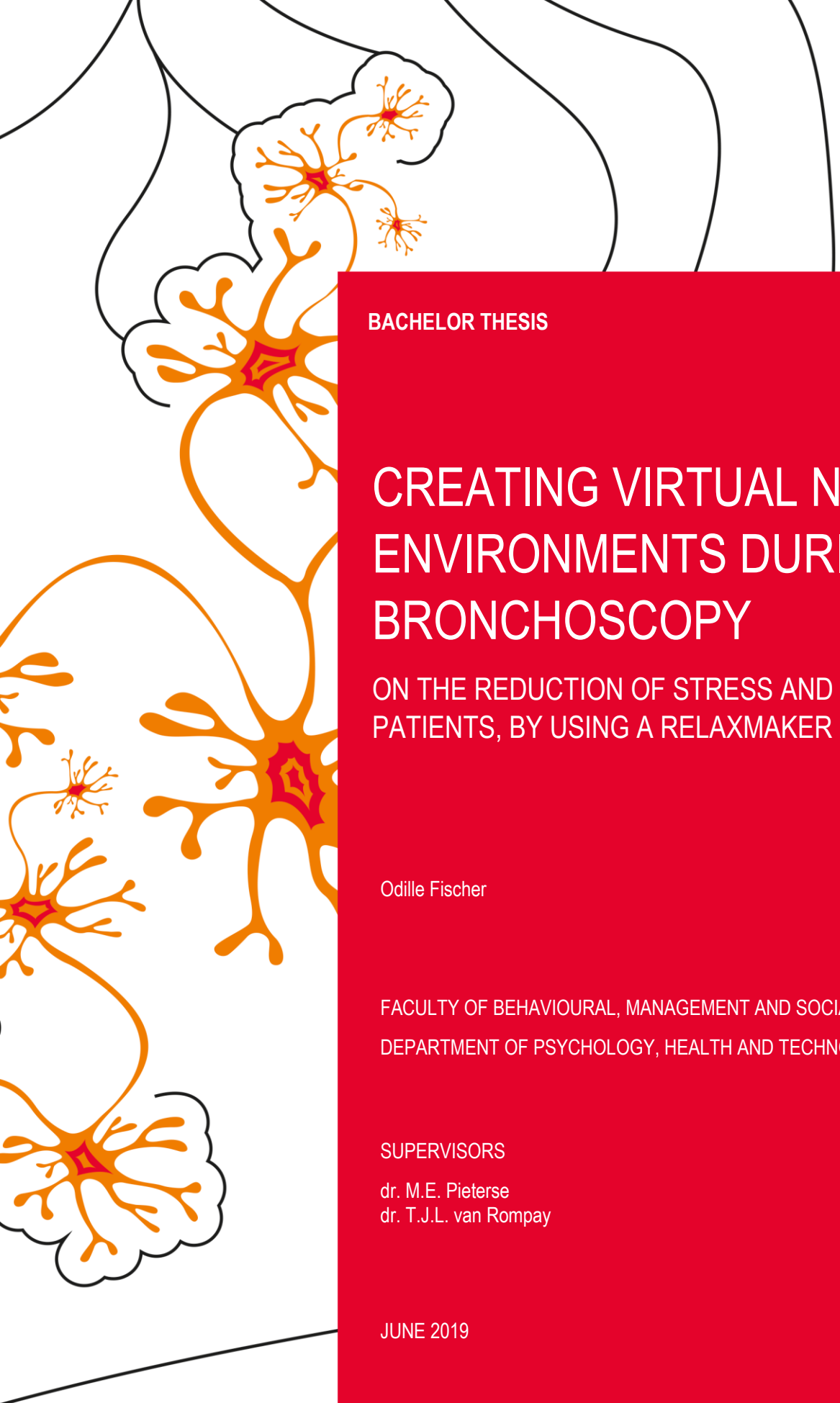

BACHELOR THESIS

CREATING VIRTUAL NATURE ENVIRONMENTS DURING BRONCHOSCOPY

ON THE REDUCTION OF STRESS AND DISCOMFORT FOR PATIENTS, BY USING A RELAXMAKER

Odille Fischer

FACULTY OF BEHAVIOURAL, MANAGEMENT AND SOCIAL SCIENCES

DEPARTMENT OF PSYCHOLOGY, HEALTH AND TECHNOLOGY

SUPERVISORS

dr. M.E. Pieterse
dr. T.J.L. van Rompay

JUNE 2019

UNIVERSITY OF TWENTE.

Abstract

Objective According to prior research, nature has a positive effect on patient experiences in hospitals. Patients would feel less stressed and more comfortable when a certain form of nature is present in their environment. One group of patients that could especially benefit from this positive effect of nature is bronchoscopy patients, because this is a highly stress inducing procedure. Nowadays, only sedation is used in order to reduce the stress and discomfort of patients undergoing bronchoscopy, but this has some serious disadvantages. Therefore, the current study aimed to investigate whether stress and discomfort can be reduced for bronchoscopy patients by using a head mounted device that showed nature videos.

Method A quasi experimental, between groups (nature and control) design was used and both self-reported and physiological data were obtained from the participants (n = 32). Participants in the nature condition were exposed to nature videos presented by a RelaxMaker during bronchoscopy. Control group participants underwent the bronchoscopy as in a usual treatment.

Results Quantitative analyses showed a possible decreasing trend in stress and discomfort experienced by participants exposed to nature videos, compared to the conventional treatment. However, more extensive research is needed in order to confirm this effect. For duration of the procedure and fear for a future bronchoscopy, no effects were found.

Conclusion The trends found in the current study pointed to a possibly less stressful and more comfortable bronchoscopy experience when participants were exposed to nature videos on a RelaxMaker. It is strongly recommended to further investigate this effect and include more variables in future studies about bronchoscopies. Also, the power score of the tests should be increased, by increasing the number of participants.

Introduction

In recent research, there is much attention for the effects of nature on patient experience in healthcare settings. Different studies investigated whether nature, in the form of plants, window views, posters, films and VR can reduce stress and discomfort experienced by patients. Often positive effects were found (Heerwagen & Orians, 1990, cited in Ulrich, 1991; Ulrich, 1991; Ulrich, Simons & Miles, 2003). The majority of patients experience stress and anxiety during their period in the hospital. A study of Bailey (2010) points out that 80% of adult patients report feelings of stress and anxiety prior to surgery. A medical intervention that is especially stressful and frightening for patients is bronchoscopy. This is an endoscopic technique that is used in order to visualise the airways and detect any abnormalities that may indicate, for example, lung cancer. One of the main factors that causes stress and anxiety in bronchoscopy patients is the anticipation of pain and breathing difficulties during the procedure (Poi, Chuah, Srinivas & Liam, 1998). Even though anxiety is a natural reaction in this situation (Bailey, 2010), it does negatively influence the experiences of the patient during bronchoscopy and significantly affects the efficiency of this procedure (Matot & Kramer, 2000; Reed, 1992).

One possible method that is often used to reduce stress, and discomfort experienced by patients undergoing bronchoscopy is sedation (Matot & Kramer, 2000). Sedation might however not be the ideal solution. Negative side-effects are associated with sedation, such as an increased risk of hypotension, bradycardia, and cardiovascular instability (Chadha, Kulshrestha & Biyani, 2015), prolonged hospital stay and increased costs because of higher demands on hospital resources (Matot & Kramer, 2000). Besides, research showed that when fears and stress are reduced, no sedation is needed for patients undergoing bronchoscopy (Colt & Morris, 1990; Johnson, Morrissey & Leventhal, 1973; Korteweg, van Mackelenbergh, Zanen & Schramel, 2004). Because of the negative side effects and the questionable need for sedation,

it is relevant to look at other possible ways in which patient comfort can be increased and stress, anxiety and pain can be minimised during bronchoscopy.

Studies about the design of healthcare environments might reveal a possible alternative for sedation. These studies indicate different environmental stimuli that influence the supportiveness of a healthcare environment and decrease stress in patients. Harris, McBride, Ross and Curtis (2002) distinguished the following three groups of environmental stimuli; ambient features, architectural design features, which are relatively permanent, and interior design features which are less permanent. Research into the interior design features, at that time, focused mainly on the effects of the presence of a television, seating arrangements and natural elements (Harris et al., 2002). Important for the current study is that studies about the effect of natural elements indicate that window views and posters of nature contribute to a supportive healthcare environment that decreases stress in patients (Honeyman, 1987, cited in Ulrich 1991; Ulrich, 1991, 2001). Furthermore, studies have shown that stress reducing effects can also be elicited by films of nature displayed on screens (Ulrich et al., 2003; van den Berg, Koole & van der Wulp, 2003; de Kort, Meijnders, Sponselee & IJsselsteijn, 2006) and by virtual reality nature (Liszio, Graf, & Masuch, 2018). As an extension to this, the current study will investigate whether nature videos and sounds, provided by a head mounted display (HMD), can reduce stress and discomfort during bronchoscopy.

Effects of Stress and Anxiety

For patients undergoing bronchoscopy, there are some specific negative consequences related to stress. Repeated periods of coughing, retching, vomiting and pain decrease the efficiency of the bronchoscopy and Reed (1992) suggests that these periods can be reduced when patients feel more comfortable and less stressed prior to and during the procedure (Reed, 1992). This is especially important, because a single bronchoscopy procedure is often not

sufficient enough to obtain proper biopsy material and a second procedure can be needed. In such cases, it is important that the patient is willing to attend this second bronchoscopy procedure and that the possibility of refusal is minimised (Mitsumune, Senoh & Adachi, 2005). Experiencing less stress and pain positively contributes to the patients' willingness to attend another bronchoscopy (Matot & Kramer, 2000). In another study, Simmons and Schleich (2002) also indicated that patients who feel comfortable and have low stress and anxiety levels cooperate more effectively during the procedure. This will ease the process and makes it more likely that the bronchoscopy succeeds (Simmons & Schleich, 2002), which is essential, because a diagnosis of possible diseases during the first bronchoscopy can save lives in certain cases.

It is thus important to reduce stress, anxiety and discomfort in patients undergoing bronchoscopy, because that eases the bronchoscopy procedure and increases the willingness of patients to attend another bronchoscopy if needed.

Nature and Stress

Exposure to nature has the capacity to reduce stress, as both shown by laboratory studies and clinical studies within different healthcare settings (Ulrich et al., 2004). From multiple laboratory studies it is concluded that visual exposure to nature for three to five minutes already reduced stress significantly, as indicated by physiological measures (Ulrich, 1991). This study also recorded brain electrical activity, which showed that people felt more relaxed during nature exposure. A clinical study of Heerwagen and Orians (1990) into the anxiety of patients in a dental fears clinic, showed the stress reducing effect of nature posters. They compared the stress levels of patients, measured by self-report and heartrate, on days when a nature poster covered a wall of the waiting room, with the stress levels on days when the wall was blank. Results showed that patients were significantly less stressed and tensed on the days when the nature poster covered the wall (Heerwagen & Orians, 1990, cited in Ulrich, 1991).

Nature recordings and stress. For the current research, it is important that stress reducing effects can be elicited by films of nature displayed on screens, as shown in previous studies (Ulrich et al., 2003; van den Berg et al., 2003; de Kort et al, 2006). In a field experiment of Ulrich et al. (2003), the effect of nature and urban videotapes on the stress levels of 942 patients who were about to donate blood (a highly stressful event for most patients) was studied. Self-reported fear, anger, sadness, positive affect and attentiveness were measured as well as the physiological measures pulse rate and blood pressure. In the waiting room and the blood donation room was a television screen which showed one of the four environmental conditions; nature, urban, daytime television (showing the program that was on tv at that moment), no television. The results of this study show that pulse-rate and blood pressure, were significantly lower in the nature video group than in the other environmental conditions, indicating that nature reduces stress when delivered in the form of a video (Ulrich et al., 2003).

Virtual reality nature and stress. In recent years, also virtual reality is used in studies into the effect of nature on stress. For example, in the laboratory study of Liszio et al., (2018), it was investigated whether simulated nature environments in virtual reality had a calming effect on participants ($N = 62$) in acute stress situations. This acute stress situation was caused by series of unpleasant tasks that participants had to perform in the virtual reality version of the Trier Social Stress Test (VR-TSST) (Liszio et al., 2018). The calming effect of a nature environment in virtual reality was compared with the effect of nature pictures on a desktop screen and a control group that did not see any form of nature. They found that stress, anxiety and negative feelings were significantly lower in the virtual reality group than in the desktop and control group. The study was however a laboratory study, so possibly these effects will be slightly different in a clinical setting. They also state that virtual nature is a helpful tool for developing therapeutic environments in scenarios where real nature cannot be integrated into the interior setting or cannot be directly accessed (Liszio et al., 2018). This is the case in

hospitals, where physical plants may bring bacteria with them. Therefore, the use of virtual reality nature might be a good solution for reducing stress in patients undergoing bronchoscopy.

Nature and Pain

Besides the effect of nature on stress, nature also influences the pain experience of patients. A study of Ulrich (1984) found that patients with a nature window view used less pain-relieving drugs than patients viewing a brick wall. This led to the assumption that patients with a nature view were better able to tolerate severe pain for a few days after major surgery (Ulrich, 1984). Two laboratory studies that used the cold pressor method to induce acute experimental pain, further investigated the ability of plants to relieve people's perceived pain or increase their pain tolerance (Lohr & Pearson-Mims, 2002; James & Hardardottir, 2002). Results of the study of Lohr and Pearson-Mims (2002) showed that participants in the room with plants tolerated short-term (5 minutes) discomfort significantly better than participants in the non-plant and control room (Lohr & Pearson-Mims, 2000). The study of James and Hardardottir (2002) indicated that pain tolerance was greater in distracted participants and participants with low trait anxiety (James & Hardardottir, 2002).

The above described studies are laboratory studies, so one should be careful with drawing conclusions based on these results. The studies suggest that acute pain might be better tolerated when patients have low levels of anxiety and are distracted and that distraction in the form of nature might have a positive effect.

Underlying Theories about the Stress Reducing Effect of Nature

There are a few theories that explain the stress reducing effect of nature. The Attention Restoration Theory (ART) (Kaplan & Kaplan, 1989) and the Stress Reduction Theory (SRT) (Ulrich, 1983) will be described in more detail. Both these theories give insight into the

‘restorative effect’ of nature, which is described as the reduction in stress, cognitive fatigue, negative affect and sympathetic nervous system activity and an increase in focus and positive affect (Ulrich, 1991). This psychological restoration is based on the suggestion, that the current complex world we live in places greater demands on our processing resources than it was originally designed for. It is expected by both the ART and the SRT that our processing resources are limited and can be depleted by complex urban environments (Kaplan & Berman, 2010). Nature is believed to distract and puts relatively little demands on our cognitive and emotional systems, therefore it helps to restore the consumed resources. The theories explain the underlying process of the stress reducing effect of nature, however, in different ways.

According to the ART, there is a distinction between top-down or directed attention and bottom-up or involuntary attention. Kaplan and Berman (2010) describe that directed attention takes effort and requires the use of cognitive resources. These resources can be depleted and need time to replenish. Involuntary attention, on the other hand, is described as an automatic process that does not take any effort or resources. Involuntary attention is brought forth when an individual encounters inherently intriguing stimuli. Examples of stimuli with this intriguing quality are strange things, moving things, bright things, words and wild animals. Directed attention can restore when involuntary attention is utilized (Kaplan & Berman, 2010). It is hypothesized that directed attention abilities are better after interaction with natural environments, because also nature captures involuntary attention (Berman, Jonides & Kaplan, 2008).

According to Kaplan and Berman (2010), nature scenes have the capacity to capture involuntary attention without interfering with other thoughts. This is called soft fascination and is important in ART. A study of Ottosson and Grahn (2006) supported the statement that nature has the capacity to restore directed attention. They tested the effect of nature on the directed attention capacities of elderly in a nursing home. Participants performed different directed

attention tests before and after one hour spent either inside the nursing home or outside in nature. All participants participated once in each condition. Results of this study show that elderly performed significantly better on directed attention tests after spending an hour in nature compared to spending an hour inside the nursing home (Ottosson & Grahn, 2006). So, according to the ART, nature might be a good method to use for decreasing stress and discomfort of bronchoscopy patients.

The SRT suggests that responses to an environment are affective and aesthetic rather than cognitive as suggested in the ART. According to this theory, viewing nature is aesthetically preferred and elicits more positive affect than urban environments. Especially natural environments that contain water, vegetation and visual properties such as mild complexity, depth and curvilinearity are aesthetically preferred. SRT is a psycho-evolutionary theory and assumes that approach and avoidance behaviour can be used optimally in an environment that contains these visual properties. This would explain why we prefer these environments. It is believed that visually pleasant surroundings elicit positive emotions, reduce stress, restrict negative thoughts and return arousal back to moderate levels, within minutes (Ulrich, 1983).

Both theories describe that attention will be captured by nature, either because of aesthetic preferences or automatic processes triggered by the direct exciting quality of nature. This is also found in the study of Diette, Lechtzin, Haponik, Devrotes and Rubin (2003). They concluded that distraction therapy based on nature sights (posters) and sounds is effective in reducing experienced pain of patients undergoing bronchoscopy. It is therefore expected that viewing nature will distract patients from discomfort and stress that is experienced during bronchoscopy.

Present Study

The current study will investigate whether stress and discomfort in patients undergoing bronchoscopy, the duration of the bronchoscopy and fear for a future bronchoscopy can be reduced by videos of natural environments displayed on a HMD. It is expected that patients who view the nature videos experience less stress and discomfort, as indicated with self-reported and physiological measures, compared to a usual treatment control condition. This leads to the first two research questions: *"Do patients in the nature condition experience less stress than patients in the control condition?"* and *"Do patients in the nature condition experience less discomfort than patients in the control condition?"*

Physiological measures are used to indicate the level of stress patients experience during the bronchoscopy procedure, while self-reported stress and discomfort is measured before, directly after and one week after the procedure. According to Ulrich (1991), viewing nature causes stress recovery that is quickly evident in physiological changes (Ulrich, 1991), and also Fechir et al. (2008) state that heart rate (beats per minute) is an appropriate indicator of stress. Furthermore, Ulrich et al. (2003) found in their (earlier described) study a difference between groups as indicated by physiological measures, but not for the self-report measure. For the self-report measure, patients from both conditions reported an improved affective state after blood donation (Ulrich et al., 2003). Because there might be a difference in physiological and self-report measure outcomes, both methods will be used in this study to get the most complete image.

Another expectation is that bronchoscopy procedures of patients in the nature condition take less time compared to the usual treatment control condition. This is expected because episodes of coughing, retching and vomiting decrease the efficiency of a bronchoscopy and according to Reed (1992), these episodes can be avoided when patients feel less stressed and more comfortable. Furthermore, Simmons and Schleich (2003) indicated that patients cooperate

more effectively with the operating physician when they experience less discomfort and stress. This leads to the third research question: *"Do bronchoscopy procedures of patients in the nature condition take less time than those of patients in the control condition?"*

The last expectation is that participants in the nature condition will feel less stressed when they anticipate having to undergo a future bronchoscopy. This is expected because a reduction in experienced stress and discomfort during the bronchoscopy will positively contribute to the willingness to attend another bronchoscopy as explained by Matot and Kramer (2000). The last research question is therefore: *"Do patients in the nature condition feel less fearful when they anticipate having to undergo a future bronchoscopy compared to patients in the control condition?"*

Method

Design

A quasi-experimental, between-group design was employed in which a nature and control condition were compared with each other. Nature was the independent variable in this study and the dependent variables were stress, comfort, duration of the bronchoscopy and fear for another bronchoscopy. In both conditions, participants had to undergo a bronchoscopy. In the nature condition a HMD that displays nature videos was worn during the bronchoscopy. The control condition was a usual treatment control condition, which means that these participants underwent the bronchoscopy as in a normal situation.

Participants

In total, 32 patients participated (N = 32), 25 of them were male and 7 were female. The age was ranging from 43 to 87 years old with a mean age of 69 years old. The experimental group consisted of 19 patients and the control group of 13 patients. All participants were recruited in the Medisch Spectrum Twente (MST) in Enschede during the period March until July in 2017 and 2018 (pilot study and experimental group) and March until July 2019 (control group). Participants were selected based on their willingness to participate. Exclusion criteria were reduced vision of more than -5 myopic, patients with an age under 16, insufficient mastery of the Dutch language and total anaesthesia during the bronchoscopy. The first nineteen participants were assigned to the experimental group and the following thirteen to the control group.

Procedure

Participants were informed about the research by the secretary of the lung function department of the MST. After scheduling the bronchoscopy appointment, the secretary shortly explained the goal of the investigation. On the day of the bronchoscopy, the researcher approached the participants in the waiting room and provided them with a letter containing more detailed information about the study. The participants had the opportunity to ask questions and signed the informed consent. The researcher followed the doctor and the participant to the treatment room. Here, a wristband, which acquires physiological data, was applied at the participants wrist and the researcher started a timer. The participant filled out the first questionnaire, the pre-test. After the doctor informed the participant about the bronchoscopy procedure, the throat of the participant was stunned, the Relaxmaker was installed (in the nature condition) and the bronchoscopy started. A bronchoscope, which is a tube with a diameter of approximately 5 mm, was inserted through the mouth or nose. At the end of the scope a camera was installed that provided imagery of the airways and the lungs of the participant on a screen in the room. Small instruments could be inserted through the scope, for example to take biopsies. The researchers timed the moment of intubation, any particularities if they occurred and the moment of extubation. After the procedure, the participants had a few minutes time to rest. Then, the wristband was removed and the second questionnaire, the post-test, was filled out. One week after the bronchoscopy, researchers called the participants and filled out the follow-up questionnaire by telephone.

Measures and Materials

The current study was a follow-up study of the pilot-study of Jansen (2017), and the studies of Rupert (2018) and Boekel (2018). They collected the data of the nature condition and in the current study, this data was compared with data of the control condition on the following

outcome measures; stress, mood and comfort during the bronchoscopy, duration of the bronchoscopy and fear for a potential next bronchoscopy. Figures 1 and 2 show two screenshots of the videos that were used in the nature condition. These are recordings taken from a static position, which give the impression of an image containing virtual immersive elements such as moving leaves, grass and water. The nature videos were provided by a special type of HMD, the Relaxmaker Cinema. The Relaxmaker has two LCD displays with 1280×720 (HD) pixels, a 98" screen, 26° sight and an aspect ratio of 16:9, 24-bit RGB colours (Beter door Beeld, 2018). Besides, nature sounds of streaming water were produced by a headphone that belonged to the Relaxmaker. The choice to use a Relaxmaker in this study was, firstly, based on the fact that it offers the opportunity to look over the glasses and communicate with staff, which is important during a bronchoscopy. Furthermore, a HMD is a successful distractor and gives a feeling of being present in the virtual environment (Rose, Nam, & Chang, 2018). Virtual reality with a 360° view also possesses these qualities, but an important disadvantage is that participants are encouraged to move their head in order to see the full movie. During a bronchoscopy, participants should not move their head and to facilitate this, the videos on the Relaxmaker do not interact with the movements of the participant.

Figure 1. Screenshot from nature condition 1. Reproduced from Rupert (2018).

Figure 2. Screenshot from nature condition 2. Reproduced from Rupert (2018).

Three questionnaires were used in this study. All questionnaires were in Dutch, since the participants were recruited in the MST, a Dutch hospital. In the questionnaires, several scales were used that measured the different outcome measures.

Stress experienced by the participant during the bronchoscopy was measured during and after the bronchoscopy by both self-report and physiological measures. During the bronchoscopy, stress level was derived from an Empatica E4 wristband which measured the heart rate of participants with a sample rate of 1 Hz (sample per second). Per phase the average heart rate was calculated in Beats Per Minute (BPM) and an increase in heart rate was considered to indicate higher stress levels. The Empatica E4 is a wearable research device that provides real time physiological data. It can measure among others skin conductance, heart rate and acceleration (Empatica, 2019), and has high stress discrimination power (Ollander, Godin, Campagne & Charbonnier, 2016). After the bronchoscopy, the participant filled out the post-test questionnaire which included the tension dimension of the *Profile of Mood States short form (POMS-SF)* (Baker, Denniston, Zabora, Polland, & Dudley, 2002). This scale measured perceived stress during the bronchoscopy (α = .892). For more information on the tension dimension of the POMS-SF see Boekel (2018) and Rupert (2018).

Discomfort experienced by the participant during the bronchoscopy was measured post-test by self-report. In the post-test questionnaire, two scales were included about procedural discomfort. Both scales consisted of one item and were answered on a scale ranging from very uncomfortable (1) to very comfortable (10). The first scale was the *Discomfort Insertion Scope* ("How comfortable or uncomfortable did you think the insertion of the scope was?"). The second was the *Discomfort After Insertion scale* ("How comfortable or uncomfortable did you think the bronchoscopy was after the insertion of the scope?") (Diette et al., 2003). More information can be found in Boekel (2018) and Rupert (2018).

Duration of the bronchoscopy is measured with a timer on a mobile phone. The timer was started at the moment of intubation and stopped when the bronchoscope was completely removed from the participant.

Fear for a future bronchoscopy was measured with one item in the follow-up questionnaire. This item was *"Suppose you have to undergo another bronchoscopy, how much would you dread that?"*. Participants indicated this on a 7-point Likert scale ranging from "I would dread that very much" (1) to "I would not dread that at all" (7).

Statistical analysis

First, some remarks about the collected data. One participant refused to fill out the follow-up questionnaire, another participant did not fill out the post-test and it happened twice that the Empatica E4 did not measure the heart rate of the participant. It was decided not to exclude these participants and to use their successfully obtained data. In total 32 patients participated (N = 32). All analyses were performed with SPSS version 24 and only two tailed tests were performed using an alpha of 0.05. Because the sampling strategy used for this study was non-random, it was possible that differences between groups in age and gender occurred. Descriptive statistics were used to get an overview of the data. In order to choose the right analyses for analysing the data, a t-test and a Pearson Chi-square were used to determine whether significant differences occurred between groups for gender and age. Also, the Cronbach's alpha of the POMS-SF was determined.

In order to analyse the first research question "do patients in the nature condition experience less stress than patients in the control condition?" two different analyses were performed. First, the average heart rate in three periods; 'before' (5 minutes before intubation), 'insertion' (start of intubation till scope passed the vocal cords) and 'during' (passing vocal cords till extubating) was compared between the control and nature group with a General Linear

Model (GLM) for repeated measures. The choice for this model was based on its ability to take into account repeated within-subject measures. The dependent variable in this analysis was the mean heart rate in the three different periods and the independent variable was condition (nature/control). Also, the interaction effect of time and condition was computed. The second analysis performed to answer the first research question was based on self-reported stress by the patient as indicated by the total score on the POMS-SF. A t-test was used to compare the total scores between the nature and the control group. The dependent variable in this analysis was the total score on the POMS-SF and the independent variable was 'condition'. For the variable POMS-SF, the assumption of normality was met.

For analysing the second research question "do patients in the nature condition experience less discomfort than patients in the control condition?", four tests were performed. Data on experienced discomfort by participants was gathered both post-test and follow-up for the moment of insertion and the period after insertion. Two analyses were performed with the dependent variable 'comfort during insertion', one with post-test data and the other with follow-up data. Two other analyses were performed with the dependent variable 'comfort after insertion', again one with post-test data and the other with follow-up data. The independent variable for all four analyses was 'condition' (nature/control). To determine the level of comfort during insertion, the score on the Discomfort Insertion scope was used. For comfort after insertion, the score on the Discomfort After Insertion scale was used. A Mann-Whitney U test was used for the analyses in case the dependent variable did not meet the assumption of normality that is needed for a t-test.

The third research question was whether bronchoscopy procedures of patients in the nature condition take less time than those of patients in the control condition. In order to analyse this, the total durations were compared between the nature and the control group with a t-test for independent groups. The dependent variable in this analysis was 'duration' and the

independent variable was ‘condition’ (nature/control). For the variable ‘duration’, the assumption of normality was met.

The last research question was “do patients in the nature condition feel less fearful when they anticipate having to undergo a future bronchoscopy compared to patients in the control condition?” This was analysed with a t-test with dependent variable ‘fear for a potential next bronchoscopy’ and independent variable ‘condition’ (nature/control). The dependent variable of this analysis met the assumption of normality.

Results

Descriptive statistics give an overview of the composition of the nature and control group, see Table 1. There were no significant differences between the nature and the control group concerning gender and age, as indicated by a Pearson Chi-square and a t-test. An overview of the self-reported group means of the different outcome measures is given in Table 2. The mean heart rate in the three periods; before insertion (before), during insertion (insertion) and during the rest of the bronchoscopy (during) can be found in Table 3.

Table 1.

Characteristics per condition and differences between conditions.

Condition[1]	**Age**		**Gender**	
	M	SD	Male	Female
C	69.77	9.49	76.9%	23.1%
N	68.16	13.45	78.9%	21.1%
T	68.81	11.86	77.4%	22.6%
p	0.712[2]		0.698[3]	

[1]C = control, N = nature, T = total.

[2]Computed from t-test [t = -0.37, d.f. = 30; p = 0.712].

[3] Computed from Pearson Chi-square (χ^2 (1) = 0.15, p = 0.698).

The first analysis performed was a General Linear Model (GLM) repeated measures. This analysis was conducted in order to test whether there was a significant difference in mean heart rate over time between the nature and the control group. The events in time that were considered were again 'before' (1), 'insertion' (2) and 'during' (3). The assumption of sphericity has not been violated, as indicated by Mauchly's test of sphericity ($\chi^2(2)$ = 1.99, p = .369). The outcome of the GLM repeated measures showed that there was a significant main effect of time (F = 5.41, p = 0.007), the main effect of condition was not significant (F = 1.77, p = 0.195) and the interaction effect of time and condition was also not significant (F(2) = 0.21, p = .808). Also, between the 'before' and the 'insertion' phase (F = 0.48, p = 0.496) and the

'insertion' and 'during' phase (F = 0.36, p = 0.612), no significant interaction effects of time and condition were found. Figure 3. provides more insight into the differences in mean heart rate over time between the groups and gives an example of the heart rate plots of one of the participants of the control group. As can be seen, the observed mean heart rate in the control group is higher during every phase of the bronchoscopy, however not statistically significant due to the wide confidence intervals. Furthermore, visual inspection suggested that in the control group, a slightly more marked increase in BPM in the phase after insertion can be observed. In the nature group, a more gradual increase in BPM was observed.

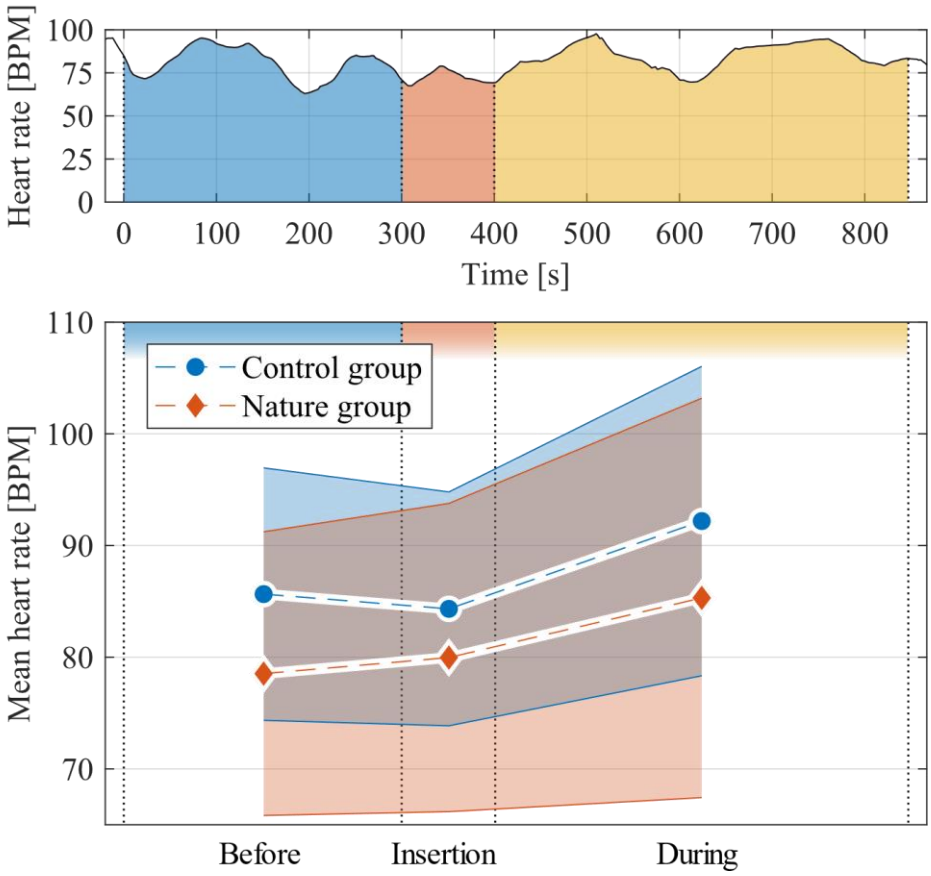

Figure 3. Top: example of a physiological measurement taken from a control group participant during bronchoscopy. Bottom: plot of the evolution of the mean heart rate over the course of the bronchoscopy. Markers show the exact values and the dashed lines depict the trend. The shaded areas visualise the standard deviation of the data.

Table 2.

Group means and variances of the self-reported outcome measures and effects computed with two tailed t-tests.

	Condition	Post-test				Follow-up			
		M	SD	*t*	*p*	M	SD	*t*	*p*
Poms-SF	C	11.42	7.56						
	N	7.95	5.54	1.47	0.151				
	T	9.29	6.51						
Discomfort insertion	C	4.50	3.09			4.92	2.68		
	N	3.63	2.09			3.95	1.87		
	T	3.97	2.51			4.05	2.65		
Discomfort after insertion	C	5.67	2.68			5.33	2.61		
	N	3.95	1.87	-2.07	0.048	3.78	2.28		
	T	4.61	2.38			4.67	2.54		
Fear future bronchoscopy	C	11.42	7.56			3.62	2.72		
	N	7.95	5.54			3.33	1.58	-0.28	0.783
	T	9.29	6.51			3.50	2.29		

[1] C = control, N = nature and T = total.

Table 3

Mean heart rates in the different periods.

Condition[1]	Before		Insertion		During	
	M	SD	M	SD	M	SD
C	85.65	11.30	84.33	10.47	92.19	13.85
N	78.53	12.70	79.97	13.80	85.32	17.88
T	81.24	12.48	81.62	12.62	87.92	16.56

[1] C = control, N = nature, T = total.

The results of the independent samples t-test of self-reported stress (POMS-SF) show that there is a non-significant difference in perceived stress between the nature and the control condition [t = -1.47, d.f. = 29; p = 0.151]. This indicates that self-reported stress in the nature condition was not significantly lower than in the control condition. However, the trend found in these scores was in the expected direction.

The second aim of this study was to determine whether experienced discomfort was lower in the nature condition compared to the control condition. The t-test with post-test data about discomfort after insertion had a marginally significant outcome [t = -1.89, d.f. = 17.35; p = 0.075]. So, the participants in the nature group reported marginally significant lower discomfort after insertion than participant in the control group did, directly after the bronchoscopy. The Mann-Whitney U test with post-test data about comfort during insertion (U = 127, p = 0.617) and the two Mann-Whitney U tests with follow-up data about comfort during (U = 74.5, p = 0.148) and after insertion (U = 73.5, p = 0.169) gave non-significant results. Even though the analyses on discomfort were non-significant, the mean scores on all four discomfort scales were higher for the control group than for the nature group (see Table 2.). This, in combination with the marginally significant effect of nature on discomfort after insertion indicates that the trend in this data is in the expected direction, namely less discomfort in the nature condition.

Furthermore, the difference in duration of a bronchoscopy procedure between the nature and the control group was analysed. This was done with an independent samples t-test which revealed that there was no significant effect of nature on the duration of the bronchoscopy [t = 0.82, d.f.=28; p = 0.417]. The average duration in the nature group seems to be even longer than in the control group, which contradicts with the expectations.

Lastly, the difference in fear for a possible future bronchoscopy was analysed with a t-test. No effect of nature on fear was found [t = 0.20, d.f. = 20; p = 0.843], indicating that the nature and control group were equally fearful when they anticipated having a future bronchoscopy.

Discussion

The current study investigated the possibility to improve the experiences of patients undergoing bronchoscopy by exposing them to nature videos on a Relaxmaker. More precisely, the study aimed to find whether these nature videos reduced stress and discomfort for patients during bronchoscopy and decreased the duration of the bronchoscopy and the fear for a possible future bronchoscopy. Clear effects of exposure to the nature videos were not found, because nature did not have a significant effect on neither of the outcome measures. However, the scores on stress and discomfort and the mean heart rate in the three periods were all lower in the nature group than in the control group, which indicates a promising trend. Effects of nature on the duration of the bronchoscopy and fear for a possible future bronchoscopy were not found.

The first finding of this study, that nature images did not significantly reduce the stress of patients during bronchoscopy, is not completely consistent with previous studies about the influence of nature on stress. For example, Ulrich et al. (2003) and Liszio et al. (2018) found in their studies that nature videos significantly lowered stress in patients who either had to donate blood or had to deal with an acute social stress situation. Based on this literature, the SRT (Ulrich, 1983) and the ART (Kaplan & Kaplan, 1989), a significant reduction in stress was expected for the nature group of the current study compared to the control group. Only a possible trend was found. There are multiple explanations for this difference in findings. First, the methods used to expose participants to nature differed. Ulrich et al. (2003) used nature videos on a large tv-screen and Liszio et al. (2018) used virtual reality glasses that created a virtual nature environment. In the current study, a Relaxmaker was used which showed videos of nature with small moving elements. It is possible that the videos on the Relaxmaker were less fascinating than the nature environments created in the other studies and therefore less immersive and effective as distractor (Wyles et al., 2019). For example, Jansen (2017) pretested

the level of fascination of the images used in the current study and found that one of the images was more fascinating than the other. So, variation in the level of fascination of nature is indeed possible.

There are also factors that indicate a more nuanced difference between the current and previous studies about the relation between nature and stress. In the current study, the stress level of participants was higher in the control group than in the nature group, as indicated by the mean scores of the heart rate and the POMS-SF. Possibly, the small population explains why the effect of nature on stress in the current study was not as strong as the effects found in for example the studies of Ulrich et al. (2003) and Liszio et al. (2018). The estimated observed power for all analyses done in the current study was only 27%, which indicates a low power to detect effects. A larger population helps to increases the power of the analyses. Also, confounders that were not taken into account (such as different physicians and different operations during the bronchoscopy) could explain the weak effect of nature on stress in the current study. Finally, the two-sided tests used for the analyses might play a role. They were used to exclude the possibility that the nature videos had any negative effects on the stress level of participants. But also one-sided tests could have been used, because a decrease in stress and heart rate was expected. A one-sided test provides more power to detect an effect in one direction. In the current study, one of the discomfort tests would have been significant if a one-sided test was used.

Furthermore, the results of the analyses of nature on discomfort found in the current study did only partly confirm prior research. As the laboratory studies of Lohr and Pearson-Mims (2000) and James and Hardardottir (2002) indicated, people would be better able to tolerate discomfort or pain when they are distracted by nature. Also, Diette et al. (2003) found a reduction in pain experienced by patients undergoing bronchoscopy, caused by distraction in the form of a nature poster and nature sounds. This effect was however only weakly found in

the current study. The main explanation for the absence of a significant effect of nature on discomfort in the present study is the low observed power of the analyses. Another possible explanation is that in the study of Diette et al. (2003), the distraction by nature started a few minutes before the bronchoscopy. In the current study, the Relaxmaker with nature videos was put on only a few seconds before insertion of the bronchoscope.

Diette et al. (2003) concluded that nature had a pain reducing effect, because it effectively distracted the patient. This idea fits to the SRT of Ulrich (1983), who stated that nature environments are aesthetically preferred and elicit a shift from negative feelings and emotions towards more positively toned feelings. A reduction in stress is one of the shifts that he described. The ART (Kaplan & Kaplan, 1989), on the other hand, describes that nature captures involuntary attention, which provides the opportunity for the directed attention resources to replenish. This theory is less relevant for the current study, because the replenishing of directed attention resources requires time. The Relaxmaker was put on just before the bronchoscopy started, and therefore the immediate effect of nature is more important than a longer process of replenishment of resources. Nevertheless, the minimal duration of exposure to nature for the optimal level of replenishment is, to the best knowledge of the author, not yet known. According to the SRT, the positive effects of nature are visible in just a few minutes (Bratman, Hamilton & Daily, 2012).

Based on the expectation that the nature videos would reduce stress and discomfort and the studies of Reed (1992) and Matot and Kramer (2000), there were also the expectations that nature would influence the duration of the bronchoscopy and the fear for a possible future bronchoscopy. These expectations were not met, but this can simply be explained by the hypothetical positive dependence of duration and fear for a future bronchoscopy on the level of stress and discomfort of the patient (Matot & Kramer, 2000; Reed, 1992; Simmons & Schleich, 2003). In the current study, no difference was found in the level of stress between the nature

group and the control group. Therefore, it would not have been logically to do find a difference between the groups for duration and fear for a possible future bronchoscopy. What however stands out is that the trend found for stress and discomfort was not found for duration and fear for a possible future bronchoscopy. The trends of stress and discomfort indicated less stress and less discomfort in the nature condition. Therefore, it was expected that duration and fear for a possible future bronchoscopy showed similar trends, with shorter duration and less fear in the nature group. This was not the case, no trend was found for these outcome measures. Possibly the low observed power of the analyses could explain this.

The duration of a bronchoscopy was also too much dependent on other factors that were not considered in the current study. For every bronchoscopy, different operations have to be performed and the duration heavily depends on that. Sometimes only a picture needs to be taken from the bronchial airways, which is a fast procedure, but operations such as taking biopsies and bronchial washing take much more time. For future research it will be good to take this into account.

Strengths and limitations

A major strength of this study is that it used both self-reported and physiological data in order to determine the stress level that patients experienced. As Ulrich et al. (2003) mentioned, physiological and self-report data do not always give the same outcomes. By combining the two methods, the most complete picture was obtained. This makes it also more likely that the lack of effects is true. Furthermore, the scales that are used in the questionnaires all have very good reliability, as indicated by the Cronbach's alpha.

There are also aspects that should be taken into consideration when interpreting the results of the current study. First of all, there are several factors that could have influenced the level of stress and comfort of the patient, that were not taken into account in the current study.

Clearly the physician who performs the bronchoscopy, as well as the medical assistants present in the treatment room, influence the level of stress and comfort of the patient. There was, for example, a difference in how much attention the physician and the medical assistant paid to the reassuring of the patient. Also, some physicians were much more experienced with bronchoscopies than others. Another factor that is not considered in the current study, is that every bronchoscopy involves slightly different procedures. Sometimes a picture of the airways is enough, but it is also possible that biopsies need to be taken or a bronchial wash needs to be performed in order to collect the information needed. What became clear during the bronchoscopies was that biopsies and bronchial washing causes much more discomfort than taking a picture only. Also, the expected diagnosis of the patient might play a role, because the consequences of one diagnosis might be less frightening than the consequences of another diagnosis. Lastly, for most patients, a bronchoscopy becomes more and more uncomfortable when the scope is in the airways for an extended period. In case these different factors were not equally divided over the groups, it is possible that they had confounding effects. In the current study it was not possible to ascertain whether these factors were equally distributed across the groups or not. It would be interesting to take these factors into consideration in future research.

Another outstanding aspect was that participants who did not fill out all questionnaires were typically the ones for whom the bronchoscopy was particularly uncomfortable. They did not feel strong enough after the bronchoscopy to fill out the questionnaire or they did not want to be called for the follow-up questionnaire. This might have influenced the outcomes of the analyses in case this occurred more often in one of the groups compared to the other. The strength of this study, namely that it takes into account both self-reported and physiological data, is also visible here because it is still possible to use the physiological data of these participants. However, also for the heart rate no effects of nature were found.

Also important is that the physiological data of the Empatica E4 might not always have been very precise. It happened a few times that the E4 lost the signal of the heart rate. The E4 was programmed in such a way that it automatically fills in those gaps with the estimated average heart rate in that period. Because of this, Empatica claims that the average heart rate for the different periods should be reliable. However, this also means that peaks and dips in heart rate might have been overlooked when the E4 lost signal exactly at the moment of such a peak or dip (Empatica, 2019).

The last limitation of this study was that the data collection of this study was spread over three years and that every year, other researchers collected the data. The same protocol was used over the years and the bronchoscopies were performed in the same treatment room, but small differences could have occurred, for example in the timing of the events during bronchoscopy or in the way participants were approached. Especially because the data of the control group was collected by other researchers than the data of the nature group, this might have influenced the outcomes of the analyses.

Future research

In the current research, several differences between the outcomes of this study and existing literature were found. Above various influence factors have been identified that may alter the outcomes of the research performed. Firstly, for future research it will be interesting to investigate whether increased power scores lead to more statistically significant findings for the effect of nature on stress and discomfort. This is mainly because the expected trends were present in the current study, but not yet proven to be significant. A larger number of participants will increase the power score. Also, it should be investigated whether variables unaccounted for influenced the outcomes. For instance, the effect of different physicians, different operations during the bronchoscopy and different researchers collecting the data should be considered.

This could be done by adding these as extra variables, and controlling for them in the analyses, for example by using an Anova.

Another factor that is important to consider when conducting a similar study is that the resting heart rate differs per person. The average resting heart rate ranges from 60 to 100 BPM for adults, which indicates that, also within groups, large differences could occur because of differences in resting heart rate. In the current study, the before phase (5 minutes before the bronchoscopy started) was intended to give an indication of the resting heart rate of participants. This might, however, not have been such a reliable indication, because participants experienced different proceedings during these 5 minutes that could have influenced the heart rate in different ways. The throat of most participants was stunned during these 5 minutes and often an explanation was given about the procedure, both proceedings can cause stress already. Sometimes these proceedings already had been carried out before these 5 minutes and the participant just had to wait for the bronchoscopy to start while the resting heart rate was measured. Because of these differences, it might be better to measure the resting heart rate for example during an earlier visit to the hospital. This will also give a more reliable resting heart rate, because the participant is not already stressed about what is going to happen to him or her in a minute.

It would also be interesting to investigate more closely the effect of the duration of exposure to nature. The current study did not find an effect of nature on stress and discomfort during bronchoscopy and exposed participants to nature only during the bronchoscopy. Diette et al. (2003) did find an effect of nature on experienced pain and exposed participants to nature already a few minutes before the bronchoscopy started. So, it would be interesting to investigate whether the difference in findings could be explained by the duration of exposure to nature. This could be done by comparing two groups, differing in duration of exposure to nature. In one of the groups, nature is presented at the moment the patient walks into the treatment room

and in the other group, the nature is only presented during the bronchoscopy itself. This will help to find the effect of duration of exposure to nature that Bratman et al. (2012) indicated would be interesting to investigate.

Lastly, it would be interesting to test the effect of different nature videos on the stress and discomfort of participants. In the current study, only two videos were used and it is very well possible that other nature environments would have had other effects. The study of Van den Berg and Koole (2006) shows for example that there is a difference in the type of nature that people prefer. Older people would prefer managed, park-like nature, while younger people prefer wilder nature. When combining this knowledge with the SRT (which states that visually pleasant surroundings elicit positive emotions, reduce stress and return arousal back to moderate levels), it is possible that looking at a personally preferred nature environment is better able to reduce stress and discomfort than less preferred nature settings. So, it will be good to test the effects of different environments on stress and discomfort. It can also be considered to take personal preferences even more into account by providing the patient the option to choose what environment is the most attractive. Offering patients a choice, generally has a positive effect on a patient's feeling of control and level of stress (Laugharne & Priebe, 2006).

Conclusion

The scores on discomfort and stress scales indicate that there is much to gain on the field of making bronchoscopy a better experience. This could be done by performing all bronchoscopies under sedation. However, the negative consequences of this ask for another solution. According to the literature, a good alternative non-pharmacological solution would be to use a form of nature as distraction therapy for patients undergoing bronchoscopy. The current study showed a decreasing trend in stress and discomfort experienced by participants exposed to nature videos on the Relaxmaker, compared to the conventional treatment. However, more extensive research is needed in order to confirm this effect. Future research ideally should focus on more variables, such as the operating physician and the operations performed during bronchoscopy, and obtaining a higher power score. The investigated method would be a very cost-effective and innovative way of making experiences of patients undergoing bronchoscopy more pleasant, without serious disadvantages. Therefore, in the light of the found trend, it can be very rewarding to further investigate this method.

References

Bailey, L. (2010). Strategies for decreasing patient anxiety in the perioperative setting. *AORN journal*, *92*(4), 445-460. doi: 10.1016/ j.aorn.2010.04.017

Baker, F., Denniston, M., Zabora, J., Polland, A., & Dudley, W. N. (2002). A poms short form for cancer patients: Psychometric and structural evaluation. *Psycho-Oncology*, *11*(4), 273-281. doi:10.1002/pon.564

Van den Berg, A. E., & Koole, S. L. (2006). New wilderness in the Netherlands: An investigation of visual preferences for nature development landscapes. *Landscape and urban planning*, *78*(4), 362-372. https://doi.org/10.1016/j.landurbplan.2005.11.006

van den Berg, A. E., Koole, S. L., & van der Wulp, N. Y. (2003). Environmental preference and restoration:(How) are they related?. *Journal of environmental psychology*, *23*(2), 135-146. https://doi.org/10.1016/S0272-4944(02)00111-1

Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological science*, *19*(12), 1207-1212. https://doi.org/10.1111/j.1467-9280.2008.02225.x

Beter door Beeld (2019). *Specificaties RelaxMaker.* Retrieved from https://relaxmaker.com/specificaties/

Boekel, I. (2018). *Psychological and physiological effects of virtual nature environments on well-being of bronchoscopy patients.*

Bratman, G. N., Hamilton, J. P., & Daily, G. C. (2012). The impacts of nature experience on human cognitive function and mental health. *Annals of the New York Academy of Sciences*, *1249*(1), 118-136. https://doi.org/10.1111/j.1749-6632.2011.06400.x

Chadha, M., Kulshrestha, M., & Biyani, A. (2015). Anaesthesia for bronchoscopy. *Indian journal of anaesthesia*, *59*(9), 565. doi: 10.4103/0019-5049.165851

Colt, H. G., & Morris, J. F. (1990). Fiberoptic bronchoscopy without premedication: a retrospective study. *Chest, 98*(6), 1327-1330. https://doi.org/10.1378/chest.98.6.1327

Diette, G. B., Lechtzin, N., Haponik, E., Devrotes, A., & Rubin, H.R. (2003). Distraction therapy with nature sights and sounds reduces pain during flexible bronchoscopy: a complementary approach to routine analgesia. *Chest, 123*(3), 941-948. doi:10.1378/chest.123.3.941

Empatica (2019). *E4 wristband from empatica.* Retrieved from https://www.empatica.com/en-eu/research/e4/

Empatica (2019). *What should I know to use the PPG/IBI data in my experiment?* Retrieved from https://support.empatica.com/hc/en-us/articles/203621335-What-should-I-know-to-use-the-PPG-IBI-data-in-my-experiment-

Fechir, M., Schlereth, T., Purat, T., Kritzmann, S., Geber, C., Eberle, T., ... & Birklein, F. (2008). Patterns of sympathetic responses induced by different stress tasks. *The open neurology journal*, *2*, 25. doi: 10.2174/1874205X00802010025

Hardy, C.H., & Rejeski, W.J. (1989). Not what, but how one feels: The measurement of affect during exercise. *Journal of Sport and Exercise Psychology, 11*(3), 304-317. doi:10.1123/jsep.11.3.304

Harris P.B., McBride G., Ross C. & Curtis L. (2002) A place to heal: environmental sources of satisfaction among hospital patients. *Journal of Applied Social Psychology* 32, 1276-1299. https://doi.org/10.1111/j.1559-1816.2002.tb01436.x

James, J. E., & Hardardottir, D. (2002). Influence of attention focus and trait anxiety on tolerance of acute pain. *British journal of health psychology, 7*(2), 149-162. https://doi.org/ 10.1348/135910702169411

Jansen, E.M.M. (2017). *Effects of nature on stress and anxiety during invasive diagnostic procedures : using virtual reality environments*

Johnson, J. E., Morrissey, J. F., & Leventhal, H. (1973). Psychological preparation for an endoscopic examination. *Gastrointestinal endoscopy*, *19*(4), 180-182. https://doi.org/10.1016/S0016-5107(73)73995-X

Kaplan, R., & Kaplan, S. (1989). *The experience of nature: A psychological perspective*. CUP Archive. Retrieved from http://www.books.google.com

Kaplan, S., & Berman, M. G. (2010). Directed attention as a common resource for executive functioning and self-regulation. *Perspectives on psychological science*, *5*(1), 43-57. https://doi.org/10.1177/1745691609356784

Kim, H. G., Cheon, E. J., Bai, D. S., Lee, Y. H., & Koo, B. H. (2018). Stress and heart rate variability: A meta-analysis and review of the literature. *Psychiatry investigation*, *15*(3), 235. doi: 10.30773/pi.2017.08.17

Korteweg, C., van Mackelenbergh, B. A., Zanen, P., & Schramel, F. M. (2004). Optimal premedication for diagnostic flexible fiberoptic bronchoscopy without sedation: a randomized phase II study. *Journal of Bronchology & Interventional Pulmonology*, *11*(1), 12-16. Retrieved from https://journals.lww.com/

de Kort, Y. A., Meijnders, A. L., Sponselee, A. A., & IJsselsteijn, W. A. (2006). What's wrong with virtual trees? Restoring from stress in a mediated environment. *Journal of environmental psychology*, *26*(4), 309-320. https://doi.org/10.1016/j.jenvp.2006.09.001

Laugharne, R., & Priebe, S. (2006). Trust, choice and power in mental health. *Social psychiatry and psychiatric epidemiology*, *41*(11), 843-852. https://doi.org/10.1007/s00127-006-0123-6

Liszio, S., Graf, L., & Masuch, M. (2018). The Relaxing Effect of Virtual Nature: Immersive Technology Provides Relief in Acute Stress Situations. *Annual Review of Cybertherapy And Telemedicine 2018*, 87. Retrieved form https://www.researchgate.net/publication/325929767_The_Relaxing_Effect_of_Virtual_Nature_-_Immersive_Technology_Provides_Relief_in_Acute_Stress_Situations

Lohr, V. I., & Pearson-Mims, C. H. (2000). Physical discomfort may be reduced in the presence of interior plants. *HortTechnology, 10*(1), 53-58. https://doi.org/10.21273/HORTTECH.10.1.53

Matot, I., & Kramer, M. R. (2000). Sedation in outpatient bronchoscopy. *Respiratory medicine, 94*(12), 1145-1153. doi:10.1053/rmed.2000.0926

Mitsumune, T., Senoh, E., & Adachi, M. (2005). Prediction of patient discomfort during fibreoptic bronchoscopy. *Respirology, 10*(1), 92-96. https://doi.org/10.1111/j.1440-1843.2005.00642.x

Ollander, S., Godin, C., Campagne, A., & Charbonnier, S. (2016). A comparison of wearable and stationary sensors for stress detection. *2016 IEEE International Conference on Systems, Man, and Cybernetics (SMC)*, 4362-4366. Retrieved from https://hal.archives-ouvertes.fr/hal-01387298

Ottosson, J., & Grahn, P. (2006). Measures of restoration in geriatric care residences: the influence of nature on elderly people's power of concentration, blood pressure and pulse rate. *Journal of Housing for the Elderly, 19*(3-4), 227-256. https://doi.org/10.1300/J081v19n03_12

Poi, P. J., Chuah, S. Y., Srinivas, P., & Liam, C. K. (1998). Common fears of patients undergoing bronchoscopy. *European Respiratory Journal, 11*(5), 1147-1149. Retrieved from https://journals.lww.com/bronchology/citation/1999/04000/common_fears_of_patients_undergoing_bronchoscopy.33.aspx

Reed, A. P. (1992). Preparation of the patient for awake flexible fiberoptic bronchoscopy. *Chest, 101*(1), 244-254. doi: 10.1378/chest.101.1.244

Rose, T., Nam, C.S., & Chen, K.B. (2018). Immersion of virtual reality for rehabilitation – a review. *Applied Ergonomics,* 69, 153-161. doi:10.1016/j.apergo.2018.01.009

Rupert, K. L. M. (2018). *The effects of nature on physiology and phenomenological experienced stress and anxiety during bronchoscopy: using an HMD*

Simmons, S. T., & Schleich, A. R. (2003). Airway regional anesthesia for awake fiberoptic intubation. *Regional Anesthesia and pain medicine*, *27*(2), 180-192. doi:10.1053/rapm.2002.30659

Svebak, S., & Murgatroyd, S. (1985). Metamotivational dominance: A multimethod validation of reversal theory constructs. *Journal of Personality and Social Psychology, 48*(1), 107-116. doi:10.1037/0022-3514.48.1.107

Ulrich, R. S. (1983, october). Aesthetic and affective response to natural environment. *Behavior and Natural Environment*, *6*, 85-125. https://doi.org/10.1007/978-1-4613-3539-9_4

Ulrich, R. S. (2001). Effects of healthcare environmental design on medical outcomes. In *Design and Health: Proceedings of the Second International Conference on Health and Design. Stockholm, Sweden: Svensk Byggtjanst*, *49*, 59. Retrieved from https://www.pdfs.semanticscholar.org

Ulrich, R. S. (1991). Effects of interior design on wellness: Theory and recent scientific research. *Journal of health care interior design*, *3*(1), 97-109. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/10123973

Ulrich, R. S., Simons, R. F., & Miles, M. A. (2003). Effects of environmental simulations and television on blood donor stress. *Journal of Architectural and Planning Research*, 38-47. Retrieved from https://www.researchgate.net/publication/273354344_ Effects_of_Healthcare_Environmental_Design_on_Medical_Outcomes

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science*, *224*(4647), 420-421. doi: 10.1126/science.6143402

Ulrich, R. S., Zimring, C., Zhu, X., DuBose, J., Seo, H. B., Choi, Y. S., Quan, X., & Joseph, A. (2008). A review of the research literature on evidence-based healthcare design. *HERD: Health Environments Research & Design Journal*, *1*(3), 61-125. https://doi.org/10.1177/193758670800100306

Wyles, K. J., White, M. P., Hattam, C., Pahl, S., King, H., & Austen, M. (2019). Are some natural environments more psychologically beneficial than others? The importance of type and quality on connectedness to nature and psychological restoration. *Environment and Behavior*, *51*(2), 111-143. doi: 10.1177/0013916517738312

Appendix A

Pre-test questionnaire

Vragenlijst

Deelnemer code: ☐

UNIVERSITEIT TWENTE.

Voorafgaand aan de bronchoscopie

Algemene vragen

1. **Wat is uw geslacht?**
   - ❑ Man
   - ❑ Vrouw
2. **Wat is uw geboortedatum?**

Dag ☐☐ - *Maand* ☐☐ - *Jaar* ☐☐☐☐

Wat is uw stemming op dit moment?
Omcirkel het cijfer dat het best weergeeft hoe uw stemming op dit moment is.

Heel slecht	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Heel goed**

De volgende stelling meet hoe ontspannen/kalm ofwel gespannen/onrustig u zich voelt. Omcirkel het cijfer dat het best weergeeft hoe u zich voelt op dit moment.

Ik voel me op dit moment:

Gespannen, onrustig	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Ontspannen, kalm**

Appendix B
Post-test questionnaire

Na de bronchoscopie

Wat is uw stemming op dit moment?
Omcirkel het cijfer dat het best weergeeft hoe uw stemming op dit moment is.

Heel slecht	1	2	3	4	5	6	7	Heel goed

De volgende stelling meet hoe ontspannen/kalm ofwel gespannen/onrustig u zich voelt. Omcirkel het cijfer dat het best weergeeft hoe u zich voelt op dit moment.
Ik voel me op dit moment:

Gespannen, onrustig	1	2	3	4	5	6	7	Ontspannen, kalm

Hoe prettig of onprettig vond u het inbrengen van de bronchoscoop?
Omcirkel het cijfer dat het beste bij uw ervaring past.

Zeer onprettig	1	2	3	4	5	6	7	8	9	10	Zeer prettig

Hoe prettig of onprettig vond u het verloop van de bronchoscopie na het inbrengen van de bronchoscoop?
Omcirkel het cijfer dat het beste bij uw ervaring past.

Zeer onprettig	1	2	3	4	5	6	7	8	9	10	Zeer prettig

Hoe goed of slecht werkte de verdoving die u heeft gekregen tegen pijn tijdens de bronchoscopie?
Omcirkel het cijfer wat het meest van toepassing is voor u.

Zeer slecht, ik vond de procedure erg pijnlijk	1	2	3	4	5	6	7	8	9	10	Zeer goed, ik vond de procedure niet pijnlijk.

Hieronder staat een aantal woorden die verschillende emoties en gevoelens beschrijven.

Geef bij elk woord aan in hoeverre het beschrijft hoe u zich voelde tijdens de bronchoscopie.

Gebruik de volgende schaal en zet het kruisje in het vakje dat van toepassing is.

---

[0] = absoluut niet [1] = zwak [2] = matig [3] = sterk [4] = heel sterk

1. ZENUWACHTIG

[0] [2] [3] [4] [4]

2. PANIEKERIG

[1] [2] [3] [3] [4]

3. GESPANNEN

[1] [2] [3] [4] [4]

4. RUSTELOOS

[0] [2] [3] [4] [4]

5. ANGSTIG

[1] [2] [3] [3] [4]

6. ONZEKER

[1] [2] [2] [4] [4]

Appendix C

Follow-up questionnaire

Vragenlijst: een week na de bronchoscopie

Als u nu terugdenkt aan de bronchoscopie, kunt u dan aangeven hoe uw stemming was op dat moment?
Omcirkel het cijfer dat het best weergeeft hoe uw stemming tijdens de bronchoscopie was.

Mijn stemming tijdens de bronchoscopie was:

Heel slecht	1	2	3	4	5	6	7	Heel goed

De volgende stelling meet hoe ontspannen/kalm ofwel gespannen/onrustig u zich voelde. Omcirkel het cijfer dat het best weergeeft hoe u zich tijdens de bronchoscopie voelde.

Ik voelde me tijdens de bronchoscopie:

Gespannen, onrustig	1	2	3	4	5	6	7	Ontspannen, kalm

Stel dat u nogmaals een bronchoscopie zou moeten ondergaan, hoe erg ziet u daar dan tegenop?
Omcirkel het cijfer dat het beste bij uw gevoel past.

Ik zie er heel erg tegenop	1	2	3	4	5	6	7	Ik zie er helemaal niet tegenop

Hoe prettig of onprettig vond u het inbrengen van de bronchoscoop?
Omcirkel het cijfer dat het beste bij uw ervaring past.

Zeer onprettig	1	2	3	4	5	6	7	8	9	10	Zeer prettig

Hoe prettig of onprettig vond u het verloop van de bronchoscopie na het inbrengen van de bronchoscoop?
Omcirkel het cijfer dat het beste bij uw ervaring past.

Zeer onprettig	1	2	3	4	5	6	7	8	9	10	Zeer prettig

Hoe goed of slecht werkte de verdoving die u heeft gekregen tegen pijn tijdens de bronchoscopie?
Omcirkel het cijfer wat het meest van toepassing is voor u.

Zeer slecht, ik vond de procedure erg pijnlijk	1	2	3	4	5	6	7	8	9	10	Zeer goed, ik vond de procedure niet pijnlijk.