Inducing Anxiety through Video Material

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Abstract. For professionals in various domains, training based on Virtual Reality can be an interesting method to improve their emotion regulation skills. However, for such a training system to be effective, it is essential to trigger the desired emotional state in the trainee. Hence, an important question is to what extent virtual stimuli have the ability to induce an emotional stress response. This paper addresses this question by studying the impact of anxiety-inducing video material on skin conductance, heart rate and subjective experience of participants that watch the videos. The results indicate that the scary videos significantly increased skin conductance and subjective response, while no significant effect on heart rate was found.

Keywords: anxiety and stress, video material, virtual reality.

1 Introduction

For human beings, the ability to cope with negative emotions such as sadness, anger, and fear is important to live a pleasant life. For professionals in domains such as the police, military and public transport, the specific ability to cope with fear (or anxiety) [14] is probably even more crucial. Employees in these domains generally have a higher probability of being confronted with fear-inducing stimuli like aggressive individuals, gun fights, or human casualties. And since the extreme negative emotions experienced in such situations are known to impair cognitive processes like attention and decision making [13, 15], professionals in these domains highly benefit from effective emotion regulation skills. In addition, even if they make optimal decisions from an external perspective, inadequate emotion regulation may increase the risk of developing anxiety related disorders such as Post-Traumatic Stress Disorder (PTSD) [3].

For these reasons, much attention is dedicated to developing appropriate training methods for police officers and military personnel, to learn to cope with extreme circumstances. Such training often uses role-play, where the roles are played by co-students or professional actors. However, an important drawback of these types of training is that they are very costly, both in terms of money and time.

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As an alternative, training based on Virtual Reality (VR) currently receives much attention [2]. The main goal of the STRESS project [18] is to develop an adaptive VR-based environment to train professionals to cope with extreme negative emotions. Trainees will be placed in a virtual scenario, in which they have to make difficult decisions, while negative emotions are induced. By measuring certain physiological states, the system will be able to assess their emotional state at runtime, and to provide adequate feedback, both in terms of suggestions to improve their emotion regulation and decision making, and of runtime adaptation of the scenario.

Despite this promising prospect, the effectiveness of such a system crucially depends on its ability to evoke the desired level of anxiety in the trainee. Therefore, one of the research questions addressed in the STRESS project is to what extent computer generated stimuli trigger an emotional (stress) response in human beings that watch them. As a first step, in [1] the effect of affective pictures on emotional response was investigated. The results pointed out that a set of negatively valenced images triggered a significantly stronger emotional response than neutral or positive images. Moreover, participants that applied emotion regulation strategies (in particular reappraisal [9]) experienced the images as significantly less intense when viewing them again, an effect that persisted six months later.

Nevertheless, there is still a large gap between affective images and affective VR material. Therefore, as a second step, the current paper investigates the effect of affective videos on emotional response. To this end, an experiment has been performed in which participants were asked to watch a variety of video clips while measuring their emotional response via physiological as well as subjective data.

The remainder of this paper is structured as follows. Section 2 provides a brief overview about the relevant literature and a description of the research question. Section 3 describes the experiment performed to measure the impact of affective videos, and Section 4 presents the results. Section 5 concludes the paper with a discussion.

2 Background

Evoking an emotional (stress) response by different types of stimuli has been the focus of many research projects. Various definitions have been used to indicate more or less the same phenomenon. In our research, we use the term *stress response*, which we define as 'a physiological reaction of the autonomic nervous system to a threatening stimulus'.

In the literature, two main indicators of a stress response are reported, namely a change in heart rate and an increased skin conductance. Both these indicators are considered to be part of the physiological stress response [6, 11, 12]. However, some papers conclude that skin conductance is a more stable indicator than heart rate [8, 10, 16]. Findings regarding change in heart rate are less consistent. For example, Craig and Lowery [5] report that directly experienced stress-inducing stimuli may lead to an increased heart rate, while indirect (or vicarious) stimuli may cause a decreased heart rate. Some stimuli based on video material can be considered instances of such vicarious stimuli. Based on these considerations, we hypothesize that video clips with negative (scary) material will lead to an increment in skin conductance, but not necessarily of heart rate. These hypotheses will be tested by an experiment as described in the next section.

3 Method

Thirty participants took part in the experiment, aged between 20 and 64 years old (with an average age of 33), of which 17 people were male and 13 female. Experiments took place in a secluded room at VU University in Amsterdam. Heart rate and skin conductance were measured using Plux wireless biosensors [17].

Each participant watched five different movies in sequence. After each movie, participants were asked to report the emotion they felt and its intensity. The possible emotions were 'relaxed', 'bored', 'interested', 'excited' and 'scared', the intensity was given on a Likert-scale ranging from 0 (not at all) to 5 (very much). Thereafter, a short break of 30 seconds was added. The first movie showed an empty beach for three minutes in order to get the participants in a calm state. The second movie showed a three minute clip from a nature documentary and was used to measure a baseline for both heart rate and skin conductance. The third clip was a collection of scenes from various scary/horror movies and was intended to evoke a stress response. The fourth movie was a different three minute clip from the same nature documentary as before. The final movie was a repetition of the empty beach. These last two movies were shown to see whether heart rate and skin conductance returned to their baseline values.

4 Results

Before considering any possible effects in physiological responses due to the different nature of the clips, it is first checked whether each of the movies indeed evoked the desired emotion. A pairwise comparison of the subjectively reported emotions using a Bonferroni correction showed that each clip evoked a different emotion at the $p<0.001$ level, except for the 1st and 5th (beach) as well as 2nd and 4th movie (documentary). The beach was found to be relaxing or boring, the documentary interesting and the stressful movie exciting or scary.

To investigate whether heart rate and skin conductance of the participants during the stressful movie differed significantly from the other clips, a repeated-measures ANOVA has been performed. This method is suited to test for significant differences within participants between the two experimental groups they were part of [7].

Figure 1 shows the average heart rate during each movie. As can be seen, there are only small differences between the clips. This is confirmed by the repeated-measures ANOVA which shows no significant differences in the average heart rate ($F(4,116)=1.401$, $p=.238$).

With regard to the skin conductance, the assumption of sphericity has been violated and a Greenhouse-Geisser correction was applied. Figure 2 shows the average values and statistical testing shows the presence of significant differences between the five clips ($F(2.251, 65.285)=27,213$, $p<.001$). As can be seen, the average skin conductance is highest during the stressful movie, with the largest difference in comparison with the two preceding clips. A pairwise comparison reveals almost all differences to be significant at the .05 level. Table 1 shows for each pair the difference in skin conductance and its significance. While there is a significant decrease after the stressful movie, skin conductance remains significantly higher in comparison with the similar clips shown before. This is consistent with the fact that decay of skin conductance level is generally quite slow.

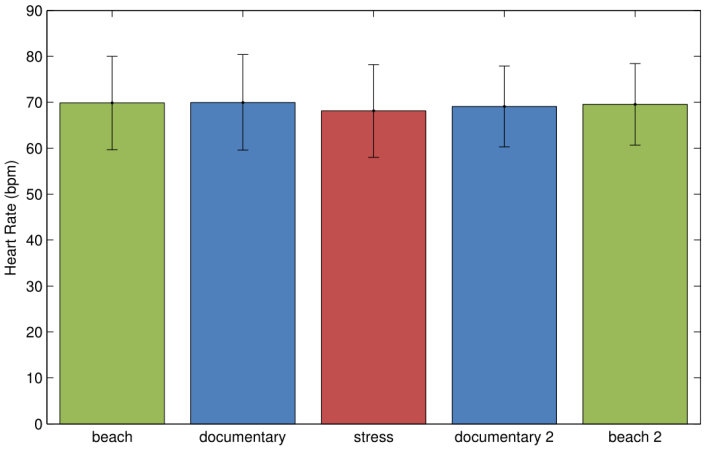

Fig. 1. Average heart rate and standard deviation for each movie

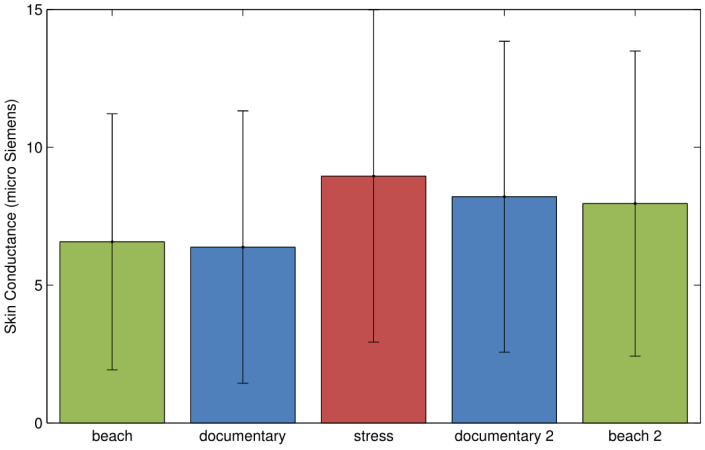

Fig. 2. Average skin conductance and standard deviation for each movie

Table 1. Pairwise comparision of skin conductance differences

	Documentary 1	**Stressful**	**Documentary 2**	**Beach 2**
Beach 1	-18,23	235,01***	161,29***	136,12**
Documentary 1		253.24***	179.53***	155.354***
Stressful			-73.71*	-97.89**
Documentary 2				-24.17
Beach 2				

*** p<0.001; ** p<0.01; * p<0.05

5 Discussion

In this paper, a preliminary exploration has been made regarding the possibilities to induce a stress response through video material. An experiment has been performed in which participants were asked to watch five different video clips while their emotional response was measured via physiological measurements as well as questionnaires. Among the five movies, the third one was composed in such a way that it could be experienced as being stressful, whereas the clip prior to this movie designed to serve as a neutral movie, to determine the baseline level of heart rate and skin conductance of the participants. The results of the measurements showed that the heart rate of the subjects did not differ significantly during the stress film compared to the other four movie clips. Instead, the skin conductance of the participants increased significantly (compared to the other four clips), and the same held for the subjective ratings. Hence, we conclude that it is possible to generate a stress response by means of video material, and that skin conductance is an effective indicator to measure this.

Although this is a promising result, it is only a first step to the accomplishment of our objectives. As mentioned earlier, our final aim is to develop a Virtual Reality-based environment for training of emotion regulation and emotional decision making skills. Hence, as a next step, we will perform similar experiments with actual video game material instead of video clips (comparable to the work of [4]), and compare the results with our current results. After that, we will investigate whether it makes a difference when the participants apply certain emotion regulation strategies while watching video (game) material. When doing this, we will study the impact on participants' emotional stress response, but also on their performance while executing certain domain-specific tasks, such as decision making or communication. This will provide further insight in the possibilities to develop intelligent VR-based training systems using physiological measurements.

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