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Roots and Future of Using Technologies to
Foster Physical and Mental Wellbeing

Editors:

Brenda K. Wiederhold, Ph.D., MBA, BCB, BCN

Giuseppe Riva, Ph.D., M.S., M.A.

Stéphane Bouchard, Ph.D.

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Brain and Virtual Reality:
What Do They Have in Common
and How to Exploit Their Potential

Edited by

Brenda K. Wiederhold

Interactive Media Institute, San Diego, CA, USA

Virtual Reality Medical Institute, Brussels, Belgium

Giuseppe Riva

Catholic University of Milano, Milan, Italy

Istituto Auxologico Italiano, Milan, Italy

Stéphane Bouchard

Université du Québec en Outaouais, Gatineau, Canada

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Virtual Reality environments to reduce dental anxiety.

Filippo LA PAGLIA^{a,1}, Marco DAINO^a, Danilo GUARINO^a, Salvatore ZICHICHI^a,
Giuseppe RIVA^{b, c}, Brenda K WIEDERHOLD^{d,e}, and Daniele LA BARBERA^a

^a *Department of Experimental Biomedicine and Clinical Neuroscience, University of Palermo, Italy*

^b *Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano, Milan, Italy*

^c *Department of Psychology, Università Cattolica del Sacro Cuore, Milan, Italy*

^d *Interactive Media Institute, Virtual Reality Medical Institute, San Diego, CA*

^e *Virtual Reality Medical Institute, Brussels, Belgium*

Abstract. Dental procedural pain and anxiety are issues that affect a conspicuous part of the population, leading to a decrease of dental care frequency. The problem affects the patient as well as the dentist, who often has to face a certain resistance by the patients while doing the necessary procedures. The aim of the study is to demonstrate that is possible to reduce this anxiety through the use of Virtual Reality (VR). A group of 7 patients was immersed in a VR scenario during dental treatment in order to distract them from the feared procedure. The results are encouraging and show how VR is capable of insulating the subject from the surrounding annoying stimuli.

Keywords. Dental care, dental phobia, distraction, analgesia, virtual reality.

1. Introduction

Who does not know that subtle and uncomfortable anxiety that precedes a visit to the dentist? A conspicuous amount of people admit that they are afraid of the dentist, a fear that often finds its cause in childhood traumatic experiences and can manifest itself not only with heartbeat, sweating and retching during the treatment, but also with insomnia the night before the scheduled dental visit. Often, however, odontophobia is a form of unexplained primordial anguish. A recent study outlined how dental fear affects an impressive 58.8% of a sample [1], showing that fear was not affected by age or education level and that it was higher in women. In addition, people who visited the dentist more regularly and individuals without previous traumatic dental experiences were less

¹ Corresponding author, filippo.lapaglia@unipa.it

anxious. Some odontologists use hypnosis to reduce anxiety and fear in the patients, but this process is highly complicated and, in order to achieve good results, it has to count on a very skilled professional and on a very motivated patient with high levels of hypnotizability (thus imagination). In line with previous studies carried out on the use of virtual reality (VR) as a distraction tool from anxiety and/or pain [2, 3], this study aimed to evaluate the validity and reliability of the VR intervention within this specific field by analyzing the response to the therapy by the patients who undergo dental care procedures.

2. Methods

A group of seven patients, composed of 4 males and 3 females, was recruited from a private dentist office in Palermo, Italy and they underwent dental procedures wearing a VR headset.

Table 1: Population characteristics

	Experimental group
	$n = 7$
Age (Mean \pm SD)	38.285 ± 12.697
(range)	18 ± 59
Gender (M, F)	4, 3

The treatment consisted of a single exposure to VR, lasting the whole duration of the dental procedure. The VR scenarios used were “Castle” and “Cliff”, developed by The Virtual Reality Medical Center, San Diego, CA. These worlds help evoke relaxation and deep breathing [4]. VR scenarios were run in a Microsoft Surface, and the environments were visualized in a head-mounted display (Vuzix iWear video headphones), configuring an immersive VR experience. The movements through the environments were managed with the help of a joystick and the sound was reproduced by the same HMD, which was provided with insulating headphones.

Before the treatment we administered a questionnaire to detect sociodemographic variables and some aspects of the relationship with dentist, such as familiarity, visit frequency, satisfaction rate, past odontoiatric care, type of dental procedures, and use or no use of anesthesia. Furthermore, we assessed the grade of anxiety through the State-Trait Anxiety Inventory (STAI form Y-1 and Y-2), depression state through Beck Depression Inventory-II (BDI-II), and specific dental anxiety through the Dental Anxiety Scale of Corah (DAS) [5]. Before, during and after the treatment, we established the level of subjective anxiety through the Subjective Units of Distress Scale (SUDS) [6] and monitored the heart rate (HR) as physiological measure through a fingertip pulse monitor. Moreover, after the treatment, we measured the variations of state anxiety through the STAI-Y1.

3. Results

Wilcoxon test was used to compare values pre and post treatment. All analyses were carried on using SPSS v. 21.

As it refers to HR, there was no variation between the initial (HR1) and intermediate (HR2) values because the patients were under anesthesia. The results of the tests showed a significant reduction in the scores obtained in the State-Trait Anxiety Inventory Y-1, SUDS, and HR (table 1).

Table 1. Results at Wilcoxon test

Test-retest	Mean \pm SD		Experimental	*
STAI Y-1	36.285 \pm 10.617	29.571 \pm 9.778	$z = -2.226$, $p = 0.026^*$	Significant $p < 0.05$
HR	84.147 \pm 20.489	81.000 \pm 12.583	$z = -2.028$, $p = 0.043^*$	
SUDS	4.428 \pm 2.370	3.428 \pm 3.101	$z = -2.410$, $p = 0.016^*$	

The results of the tests submitted before the treatment showed that the sample did not have excessive trait-anxiety (STAI-Y2<40) or excessive depression state (BDI-II<16). DAS scores showed a physiological anxiety for the dental context and odontoiatric procedures (7.571 \pm 4.035).

Spearman correlation coefficients were used to examine the relationship between test/retest and variables of the questionnaire. Results indicated correlation tendency between low levels of instruction and high levels of trait anxiety ($r = -.741$, $p = .057$) and a significant correlation with depression ($r = -0.808$, $p = .028$); significant correlation between pretest state anxiety and previous dental care ($r = -0.791$, $p = .034$). Furthermore, DAS correlated with both previous dental care and frequency of odontoiatric chirurgic intervention ($r = -0.798$, $p = .032$). Therefore, we found that low levels of instruction, previous dental care and frequency of odontoiatric chirurgic interventions increases the level of state anxiety and stress related to dental procedures.

4. Discussion and conclusion

Our results, in accordance with other studies [4], provide further support for the feasibility of using VR environments as tools to reduce anxiety and stress related to dental care, improve compliance with dentist and achieve non-disruptive behavior during the treatment. VR environments allow to patients relax and be distracted by navigating to another location while still physically remaining in the dental office, draining attention from the dental procedure. Therefore, it helps the patients better cope with the fear of the dentist and the odontoiatric procedures, and encourages the subject to achieve better dental health. The results obtained are encouraging even though the number of patients need to be increased, and a control group has to be added.

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