New Technologies for Relaxation: The Role of Presence

Daniela Villani
Catholic University of Milan and Istituto Auxologico Italiano

Francesco Riva
Catholic University of Milan

Giuseppe Riva
Catholic University of Milan and Istituto Auxologico Italiano

In recent years, several publications have appeared on virtual reality (VR) therapy in the treatment of anxiety disorders. However, a limited number of these studies targeted stress management and relaxation. To evaluate the efficacy of VR as a support tool in the relaxation process, this study compared its efficacy with two other media (DVD and audiotape). The goals of the experiment were to test the efficacy of each condition in increasing relaxation and reducing anxiety, and whether the sense of presence—the feeling of being inside the media content—correlated with the efficacy of the treatment. Results suggested the importance of the sense of presence as a mediating variable between the media experience and the efficacy of the protocol.

Keywords: stress, relaxation, virtual reality, presence

Daniela Villani, Center for Communication Psychology, Catholic University of Milan and Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano; Francesco Riva, Center for Communication Psychology, Catholic University of Milan; and Giuseppe Riva, Center for Communication Psychology, Catholic University of Milan and Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano.

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Correspondence concerning this article should be addressed to Daniela Villani, Center for Communication Psychology, Catholic University of Milan, L.go Gemelli 1, Milan, Italy. E-mail: daniela.villani@unicatt.it

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A review (Ong, Linden, & Young, 2004) has recently noted that *stress management* (SM) is a term widely used with a seemingly obvious meaning, but it is not clear how many different forms of SM exist and how efficacious they are according to the target problem. Analyzing more than 100 research articles, results showed that a typical delivery format exists, but the number of techniques used is very large. It is possible to categorize the most commonly used techniques in three approaches. The first one involves imagery, relaxation, and meditation, and frequent applications are diaphragmatic breathing, directive and receptive imagery, yoga, progressive muscle relaxation, autogenic training, and massage therapy. The second one involves cognitive–behavioral approaches, where strategies include emotion-focused or problem-focused coping, self-monitoring of stress intensity, thought recordkeeping and rewriting, cognitive reappraisal, time management, assertiveness training, systematic desensitization, and various didactic and educational topics. The last category is represented by systemic approaches. They are focused on altering the external factors which contribute to create stress to the individual, such as social, environmental, or political factors. Box-score analysis of this review indicates that the most commonly employed components in a SM program involve multicomponent cognitive—behavioral therapy (CBT) or relaxation-oriented techniques.

Considering the first component we have to underline that although treatment manuals are available for specific applications of CBT like generalized anxiety disorder (GAD; Andrews, Crino, Hunt, Lampe, & Page, 1994; Greenberger & Padesky, 1995; Wells, 1997), the CBT strategies used for SM are rarely laid out in standardized treatment manuals. Some authors (Mineka & Zinbarg, 2006) suggest a link between stress and GAD, stating that people with uncontrollable and unpredictable life stress seem to be especially prone to developing GAD. In this view Barlow (2002) mentions that people with extensive experience controlling important aspects of their lives may be immunized against developing GAD.

Although a substantial body of research has investigated the impact of all approaches on arousal and symptom reduction (Lehrer, Woolfolk, Rooney, McCann, & Carrington, 1983; Lehrer, Carr, Sargunaraj, & Woolfolk,1994; Bernstein, Borkovec, & Hazlett-Stevens, 2000), today interest is focusing on their differential positive psychological effects (Ghoncheh & Smith, 2004). The profound implication of this modification of perspective is that, respecting the richness and diversity of relaxation techniques that have evolved over the centuries, it is possible to look at relaxation in a new way and examine its effective role with different individuals. Thus, the most effective way of teaching relaxation may not be to impose a single approach on all clients, but to carefully tailor a set of approaches to each individual.

Looking at the technologies used until now to induce relaxation, we can observe that some tools already exist. CDs of calming music have shown

positive effects on stress reduction, by achieving psychological benefits including distraction, sense of control over symptoms, and relaxation (Beck, 1988; Guzzetta, 1989; Zimmerman, Pozehl, Duncan, & Schmitz, 1989). Music interventions also have reported good results to reduce state and trait anxiety (Hammer, 1996), to ease stress (Hanser, 1985), and to increase relaxation (Robb, 2000). These CDs strengthened the positive effect of calm, sedative music with relaxation techniques to achieve enhanced effects. To increase effectiveness, commercial relaxation DVDs have also integrated visual stimuli. In such a delivery the visual representation of the scenario supports the process of relaxation creating an isolated context in which the subject can feel to stay.

A further advance is represented by Virtual Reality (VR), a new technology that alters the way individuals interact with computers. It has been defined as a set of computer technologies that, when combined, provide an interface to a computer-generated world. VR provides such a convincing interface that users believe they are actually present in a three-dimensional world and navigate and interact with it in real time where their actions and reactions are experienced in the present moment (Wiederhold & Wiederhold, 2005). The key feature of VR, indeed, which differentiates it from other media, is the sense of presence (Riva, Davide, & Ijsselsteijn, 2003; Ijsselteijn et al., 2001). Some authors suggest that presence is a neuropsychological phenomenon defined as the "feeling of being in a world that exists outside of the self" (Riva & Waterworth, 2003). This phenomenon does not depend only on the *hic et nunc* of virtual experience, but is related to the experienced interpretation based on past events. Thus, to allow the participant to feel the sense of presence, it is important to work on the contents to include within the mediated experience (Rettie, 2005; Baños et al., 2005; Renò, 2005). According to Ijsselsteijn (2003), although the breadth and depth of sensory experience is important to improve the media experience, the "basic appeal of media" is in the communicated content, storyline, ideas, and emotions. In agreement with Scherer's theory (Sander, Grandjean, & Scherer, 2005), we maintain that the coherence between the content of the experience and the goal of the participant is critical: the participant may feel more present in a virtual environment whether he or she considers the mediated experience relevant for his or her goals. Our proposal is to take advantage of the potential of this technological tool, by enhancing the quality of the experience through the elicitation of the sense of presence.

Considering the strong potential of VR in clinical psychology, we propose that its use in relaxation, as already studied by Freeman and colleagues (Freeman, Lessiter, Keogh, Bond, & Chapman, 2004), could offer a series of advantages. As stated before, VR has been traditionally used to deliver graded exposure, as an adjunct to cognitive–behavioral therapy (CBT) (Wiederhold et al., 2001; Moore et al., 2002) to treat pathologies such

as phobias, posttraumatic stress disorder (PTSD), and others related to anxious stimuli management (Riva, Wiederhold, & Molinari, 1998; Pull, 2005; Riva, 2005).

Usually, through VR, the therapist controls a repertoire of stimuli to structure a graded exposure of relevant arousing ones. The principal disadvantage of this approach is that it is content specific: a new virtual environment has to be developed for every particular context. So it is hardly applicable to some conditions, like stress and generalized anxiety disorder, not strongly related to a specific scenario.

Nevertheless, VR could make a strong contribution to SM research. Some authors have recently observed (Plante, Cage, Clements, & Stover, 2006; Plante et al., 2003) that individuals who interact in an environment enriched with a variety of positive visual and auditory stimulation report greater improvement in self-efficacy and mood (McAuley, Talbot, & Martinez, 1999; Turner, Rejeski, & Brawley, 1997), suggesting that it is possible to use VR for manipulating experience-related self-efficacy and mood.

Our perspective is to use VR for triggering a broad empowerment process within the optimal experience induced by a high sense of presence. Within this general approach, positive imagery represents a powerful strategy for affecting an emotional response. The visual presentation of a calm scenario can facilitate participants' practice and mastery of relaxation and acceptance techniques. Thanks to VR, the experience is more vivid and real than the one that most subjects can create through their own imagination and through their own memory (Vincelli, 1999).

We have planned some "virtual experiences" in which participants have an active role, and this should help them experience themselves as competent, efficacious, and with domain. According to Bandura's (1977) theory, once established, self-efficacy tends to generalize to other situations. Practically, the acquisition of specific skills of SM during the virtual experience promotes the sense of personal efficacy and prepares the participant to cope with real stressful situations. Indeed, once acquired, these competencies assigned to internal factors become a means to the management of stressful situations and they can be transferred and applied to other contexts.

The specific goal of the present study was to investigate with a nonclinical sample the role of variables associated with the use of different technologies together with adequate relaxation therapeutic narratives in SM. To achieve this aim we compared three different media: Immersive VR, DVD, and audiotape. We also included in the study a control group with no treatment. We were interested in evaluating whether a significant emotional modification existed within groups and whether the correlation between the sense of presence and increase of relaxation was related to the medium used. After analyzing the literature in this field we decided to use different

techniques to induce relaxation, involving Autogenic training (Schultz & Luthe, 1969), Progressive Muscular Relaxation (Jacobson, 1929/1938), and breathing techniques.

METHOD

Participants

We recruited 64 participants (34 female and 30 male students), aged 21 to 28 years ($M = 24.52$, $df = 1.75$). for the study from the Catholic University of Milan. We randomly allocated groups of 16 participants to one of the 4 experimental conditions by a true random number service (http://www.random.org). They voluntarily participated to the experiment after having subscribed the informed consent.

Experimental Design

In order to study the efficacy of different technologies on relaxation, a between subjects design was used with three experimental conditions and repeated measurements (pre and posttreatment). We compared the following conditions:

VR Condition: An immersive virtual reality environment, the Relaxation Island (experienced with a head-mounted display and head-tracking) supported by a therapeutic narrative.

DVD Condition: A commercial DVD (with relaxing tropical videos) supported by the same therapeutic narrative.

Audio Condition: An audiotape with the same therapeutic narrative (requiring imagination skills).

Control group: A group without treatment.

Measures

The dependent variables were emotional state (with special focus on relaxation) and trait dimensions. Our proposed Integrated Multimodal Assessment—combining quantitative and qualitative methodologies—was intended to provide a more robust mechanism to identify the affective state of the participants. Several questionnaires were used.

State Anxiety Inventory

The State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) is a self-report measure that assesses anxiety levels. We used both state and trait versions.

Visual Analogue Scale

The Visual Analogue Scale (VAS; Gross & Levenson, 1995) is an 8-adjective questionnaire to describe different emotions.

Positive and Negative Affect Schedule

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) measured the positive and negative affects through 10 positive and 10 negative mood/emotion adjectives.

Coping Orientation to Problems Experienced Questionnaire

The Coping Orientation to Problems Experienced (COPE) Questionnaire (Sica et al., 1997) assessed the different strategies commonly activated in daily problem solving, focusing on three categories: problem, emotive expression, and maladaptive mechanisms.

Sense of Presence Inventory

The ITC–Sense of Presence Inventory (ITC-SOPI; Lessiter, Freeman, Keogh, & Davidoff, 2001) is a subjective presence measure including two parts, after and during a media experience. It considers four dimensions: Physical space, Engagement, Ecological Validity, and Negative effects.

From a physiological point of view, we considered stress to be generally accompanied by generalized activation of the nervous central system, autonomous nervous system, and neuromuscular system. This implies an increase in muscular tension, heart rate, blood pressure, palmar sweating, peripheral vasoconstriction, and rate and irregularity of respiration. For this reason we also recorded four physiological parameters: heart-rate (Hr) and amplitude (Ham), respiration rate (Rr) and amplitude (Ram), skin conductance (Sc), and electromyographic responses (Em).

Relaxation Tools and Hardware

The virtual environment used, the Relaxation Island, was conceived and had previously been used by Freeman et al. (2004) within the "Engaging Media for Mental Health" European funded project. Exploration in the immersive VR condition involved four different zones related to different relaxation exercises: waterfall, clouds, beach1, and beach2. The DVD used was a commercial relaxation system, with the visual content similar to that of the VR condition—four beaches of tropical islands—supported by the same narrative. The audiotape included only the same narrative. For this reason this condition requires imagination skills by the participants.

The computerized and VR materials consisted of: a portable computer (Fujitsu Siemens AMILO Processor, Pentium 4); a wireless joystick (only in the VR condition; Logitech Wingman Cordless Rumblepad Gamepad); a head-mounted display (only in the VR condition; a Sony Glasstron PLM S-700 with a head-tracker, Intersense Intertrax2); and an audiotape with headphones. For physiological measurements, we used the BioGraph Infiniti Procomp.

Procedure

Participants sat in a swivel armchair in front of a computer and were tested once per session. At the beginning of the sessions, they provided their informed consent and received a set of instructions about the experiment. The experiment consisted of two sessions carried out on two different days within the same week.

Day 1 (Session 1)

Assessment before Session 1 (pretreatment). This phase consisted of:

A 3-min physiological measurement (baseline)

Administration of the Questionnaires to Assess Emotional States, Anxiety, and Coping Skills (STAI-Trait, COPE, VAS, PANAS, STAI-State).

Instructions for participants in the VR condition to use the specialized equipment and to explore the relaxation virtual environment following the narrative

Instructions in the DVD condition to watch the scenes following the narrative in order to practice the exercises.

Therapeutic Session 1. This phase of Session 1 consisted of the following relaxation activities:

Virtual Relaxation Island (different zones): Participants moved through different relaxation experiences, exploring the environment and watching waves lapping gently on a shore, or sitting near a waterfall and watching leaves float down a stream into the surrounding ocean. Each experience was supported by a therapeutic narrative.

Relaxing DVD (different scenes): Participants moved through different relaxation experiences, watching water at beach levels. Each experience was supported by the same therapeutic narrative.

Audiotape: Participants listened to a therapeutic narrative that instructed them in the different exercises of the protocol, imagining the tropical scenario.

All participants in the VR, DVD, and Audio conditions listened to the same narrative and followed the same exercises, based on PMR, Autogenic Training, and deep breathing techniques.

Assessment after Session 1 (posttreatment). During this phase of Session 1, a 3-min physiological assessment was conducted. Then participants completed the questionnaires (VAS, PANAS, STAI-State) to assess emotional states.

Day 2 (Session 2)

Day 2 followed the same procedures as Day 1, using the same questionnaires and physiological measurements. The therapeutic session was focused on different relaxation experiences. At the end of Day 2, all participants also completed the trait skills questionnaires (COPE, STAI-Trait, Self-Efficacy).

Control Condition

Participants in the control condition did not receive the treatments but were only assessed on two days within the same week. Two 3-min physiological measurements were taken, and these participants completed the questionnaires to assess their emotional states, anxiety, and coping skills.

RESULTS

The data were not normally distributed in almost all multimodal aspects evaluated. For this reason and to avoid analyses with a low statistical power, we conducted nonparametric analyses.

Before treatment we compared the participants in the four experimental conditions (VR, DVD, Audio, Control) and found no significant differences between groups. Then, we analyzed the degree of change on the dependent variables achieved with the treatment separately for each group (within groups effects). As a third analysis set, we focused on testing whether the degree of change was different among the four groups (between groups effects). A final analysis tested whether a correlation existed between sense of presence and efficacy of the treatment. We analyzed data from the following four "moments/time points" in the treatment:

T1: before Session 1 (pretreatment)
T2: after Session 1
T3: before Session 2
T4: after Session 2 (posttreatment)

Within Groups Effects

The Friedman test and several Wilcoxon's tests (paired samples) were used to compare different moments of the treatment for each condition. The principal results are shown in Table 1.

Since the time between the two sessions involved in each condition was 3–4 days, some participants started the second session with different mood and relaxation levels in comparison to that achieved at the end of the first session.

Table 1. Within Groups Self-Reports Results

Psychological dimension	Condition	T1–T4	T1–T2	T3–T4
Anxiety (measured by the STAI questionnaire)	VR	$Z = -1{,}819$, $p < .05$	$Z = -1{,}905$, $p < .05$	$Z = -2{,}923$, $p < .00$
	DVD	$Z = -2{,}815$, $p < .005$	$Z = -2{,}852$, $p < .01$	$Z = -2{,}946$, $p < .00$
	Audio	NS	$Z = -3{,}244$, $p < .00$	$Z = -1{,}889$, $p < .05$
"Anxious" state (measured by the VAS questionnaire)	VR	$Z = -2{,}679$, $p < .005$	$Z = -2{,}973$, $p < .005$	$Z = -2{,}200$, $p < .05$
	DVD	$Z = -2{,}434$, $p < .05$	NS	NS
	Audio	$Z = -2{,}965$, $p < .00$	$Z = -2{,}568$, $p < .005$	$Z = -2{,}919$, $p < .005$
"Relaxing" state (measured by the VAS questionnaire)	VR	$Z = -2{,}504$, $p < .01$	$Z = -2{,}288$, $p < .05$	$Z = -2{,}648$, $p < .005$
	DVD	NS	$Z = -1{,}904$, $p < .05$	$Z = -2{,}138$, $p < .05$
	Audio	NS	NS	NS

No significant changes were found related to trait aspects such as coping skills, self-efficacy, and trait anxiety. A probable explanation is that the length of the experiment, one week, was not a sufficient amount of time to achieve these trait changes.

Some interesting results were found with respect to the physiological parameters assessed, for which we decided to investigate only the differences within each session and not within the whole treatment. Respiration rate, heart rate, and skin conductance seem to be the main parameters involved in the significant results found (see Table 2).

Between Groups Effects

We investigated whether the degrees of change in anxiety and emotional states were different among the four groups (VR, DVD, Audio, and Control) through the Kruskall-Wallis (4 independent samples) test. No significant differences were found either the questionnaires or the physiological parameters.

Correlations With Sense of Presence

In addition we examined whether any correlations between sense of presence and efficacy of the treatment existed using several rho-Spearman nonparametric correlation tests. In general, the data showed a significant correlation between changes in anxiety and emotional state and some factors

Table 2. Within Groups Physiological Results

Physiological parameter	Condition	T1-T2	T3-T4
Respiration rate mean	VR	$Z = -1{,}939$, $p < .05$	$Z = -2{,}329$; $p < .05$
	DVD	NS	NS
	Audio	NS	NS
Heart rate mean	VR	NS	NS
	DVD	$Z = -2{,}947$, $p < .005$	$Z = -2{,}275$, $p < .05$
	Audio	$Z = -2{,}741$, $p < .005$	$Z = -2{,}120$, $p < .05$
Galvanic skin response mean	VR	NS	NS
	DVD	$Z = -2{,}844$, $p < .005$	$Z = -2{,}430$, $p < .01$
	Audio	$Z = -2{,}669$, $p < .005$	NS

of presence, considering separately the first (see Table 3) and the second session (see Table 4).

These results indicate that the sense of presence experienced by the participants enhanced the effectiveness of the treatment, considering both the whole group of participants and the four conditions separately.

DISCUSSION

Results of this study show a significant reduction in anxiety and a significant improvement in positive emotional states—in particular, relaxation—measured through self-report questionnaires. Physiological parameters showed some changes related to respiration rate, heart rate, and skin conductance parameters, but less than expected.

The appraisal theory of Scherer (Scherer, 2001; Sander, Grandjean, & Scherer, 2005) could help interpret these results. In Scherer's Component Process model, it is assumed that there are direct connections between stimulus evaluation check (SEC) units and response modalities in the neuroendocrine system, autonomic nervous system, and somatic nervous system, independently from action tendencies. Two dimensions in particular involved in this model, intrinsic pleasantness and goal conduciveness, could have modified the expected physiological results (Van Reekum et al., 2004). On one side, the goal, achieving a relaxation state, might not be strictly pertinent to the participant's interests because we did not select stressed people for the study. According with Van

Table 3. Correlations With the Sense of Presence in the First Session

Psych. dimension; presence scale	Condition	Negative effect	Ecological presence	Engagement
Anxious state (measured with VAS questionnaire)	All groups	rho = −.319; $p < .05$	NS	NS
	VR	NS	NS	NS
	DVD	NS	NS	NS
	Audio	NS	NS	NS
Anxiety (measured with STAI questionnaire)	All groups	NS	rho = −.435; $p < .005$	rho= −.391; $p < .01$
	VR	NS	NS	NS
	DVD	NS	NS	NS
	Audio	NS	NS	rho = −.501; $p < .05$
Relaxing state (measured with VAS questionnaire)	All groups	NS	NS	NS
	VR	NS	rho = .589; $p < .05$	rho = .562; $p < .05$
	DVD	NS	NS	NS
	Audio	NS	NS	NS

Table 4. Correlations With the Sense of Presence in the Second Session

Psych. dimension; presence scale	Condition	Negative effect	Ecological presence	Engagement
Anxious state (measured with VAS questionnaire)	All groups	NS	NS	NS
	VR	NS	NS	NS
	DVD	NS	NS	NS
	Audio	NS	NS	NS
Anxiety (measured with STAI questionnaire)	All groups	NS	rho = −.391; $p < .01$	rho = −.408; $p < .01$
	VR	NS	NS	NS
	DVD	rho = .542; $p < .05$	NS	rho = −.506; $p < .05$
	Audio	rho = .573; $p < .020$	rho = −.700; $p < .005$	NS
Relaxing state (measured with VAS questionnaire)	All groups	NS	NS	NS
	VR	NS	NS	NS
	DVD	NS	NS	NS
	Audio	NS	NS	NS

Reekum and colleagues (2004), nonpertinent goals can be related to an increase in heart rate and muscle tension. On the other side, the pleasantness of the virtual relaxation experience might predict a reduction of heart rate and skin conductance. We also have to consider that the novelty effect related to using these technologies could have caused physiological activation conflicting with relaxation. The absence of significant differences between groups could be also due to the intrinsic pleasantness and goal conduciveness of the experience. These factors, together with the use of the same narrative and same relaxation exercises, are indeed common to all groups.

This result is consistent with data obtained regarding the sense of presence, specifically, positive correlations between presence and changes in anxiety/emotional state. According to a study by Baños et al. (2004), presence is not a direct function of immersion alone. As stated at the beginning, in agreement with Ijsselsteijn (2003), to induce an emotionally mediated experience, it is important to focus on the content and the emotions that are being communicated. In our research, the emotional environment elicited a sense of presence independently from using an immersive (VR) or nonimmersive system (DVD). It is possible that the relaxation experienced, using different techniques in a quiet multisensorial scenario, was still effective by itself. Moreover, perhaps presence is not only influenced by the environment's graphic realism, immersion, and other technological features, but even more by other characteristics of the experience, including the emotional ones, provided by the technology.

Despite these limitations, we believe that the use of immersive VR for SM in a nontraditional way represents a promising approach, joined with the

novelty of combining different methodologies, quantitative and qualitative, for integrated multimodal assessment. It is convenient to use more advanced technology, such as VR, whether or not it is possible to use all the potentialities that such strategies could offer to therapy.

This is a preliminary study in this field. Limitations due to the rather small sample size lead us to view the obtained results with caution. Nevertheless, important clinical applications suggested by these results include the possibility that people might learn relaxation strategies within controllable mediated experiences characterized by a high level of presence. However, significant efforts would still be required to move VR into routine clinical use in relaxation strategies. In particular, building new virtual environments will be important in helping therapists investigate applications of such tools in day-to-day clinical practice. Finally, controlled clinical trials are needed in order to compare the efficacy of the proposed VR approach with competing methods.

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