Changing Induced Moods Via Virtual Reality

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Abstract. Mood Induction Procedures (MIPs) are designed to induce emotional changes in experimental subjects in a controlled way, manipulating variables inside the laboratory. The induced mood should be an experimental analogue of the mood that would occur in a certain natural situation. Our team has developed an MIP using VR (VR-MIP) in order to induce different moods (sadness, happiness, anxiety and relaxation). The virtual environment is a park, which changes according to the mood to be induced. This work will present data about the efficacy of this procedure not only to induce a mood, but also to change after the mood is induced.

1 Introduction

This study was conducted in the framework of the EMMA project (IST-2001-39192). The main objectives of this project were to study the relationships between the sense of presence users feel in virtual environments and the emotions experienced by the users. In order to do that, EMMA's specific purpose was focused on designing Mood Induction Procedures (MIP), using Virtual Reality (VR-MIP), and to test the efficacy of these procedures.

MIPs can be defined as "strategies whose aim is to provoke in an individual a transitory emotional state in a non natural situation and in a controlled manner; the mood induced tries to be specific and pretends to be an experimental analogue of the mood that would happen in a certain natural situation" (p. 16) [1]. Mood has emerged as an important influence in conceptions of human behavior and cognition .The experimental study of the influences of mood and affect requires the induction of positive and negative mood experiences to determine their effects [2]. Studies that test the effects of MIPs offer valuable information regarding the connections between emotion, behavior and thought processes [3].

A number of methods for inducing positive and negative mood states have been proposed, and the most widely used are [2] [4]: Self-statements or Velten procedure, music, music "in crescendo", hypnotic suggestion, facial expression,

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game feedback, social feedback, autobiographical recall, social recall, imagery, empathy, experimenter behaviour, films, threat, public speaking, gift, drugs, social interaction and a combination of MIPs. We have selected four of them:

- "Self-statements or Velten procedure": This was developed by Velten [5]. The induction is achieved by means of 60 statements relative to the mood, written in first person. Subjects are asked to read the statements, and to try to feel a mood similar to the one described in the statement.
- "Music": This was first used the by Sutherland, Newman and Rachman [6]. Subjects are asked to use the music piece as a base for entering themselves into a mood. They are told that music alone can't induce the mood automatically and that they must follow their own strategies to achieve the mood.
- "Autobiographical recall": This was developed by Brewer, Doughtie and Lubin [7]. Subjects are asked to remember autobiographical events that provoke a certain mood in them, e.g. one that makes them feel alone, rejected, frustrated or hurt.
- "Films" (or fragments of films): These have been used by Gross' group [8]. Subjects are asked to feel all the emotions provoked by the film as intensely as possible, without trying to console themselves or hide their feelings.

All of these experimental procedures have been used in many research studies with different purposes, and they have shown to be effective in inducing the target mood. However, manipulating mood states in the laboratory has proven challenging. There is some criticism regarding the validity and empirical verification of some of these MIPs [4], including the possibility of demand effects, success rate, the intensity of the induced mood, the range of different moods that can be induced and the specificity of the induced mood.

Regarding demand effects, it has been suggested that participants do not truly change their mood but report as if they did, merely to satisfy the researcher's expectations. However, research on this topic has concluded that although the demand effects may inflate the induction effect size, the induction effects continue to be significant.

Regarding success rate, there is considerable variability when different MIPs are taken into account. Generally speaking, it appears to be easier to induce a sad mood than an elated one [2] [3] [4]. This may be because participants, (i.e. the general population), are usually not depressed, but rather happy to some extent; therefore, it is more difficult to enhance this positive mood than to increase negative emotions.

Regarding the intensity of the induced mood, several criteria have been used to assess it. One is how long the induction effects last. Some studies point out that 10-15 minutes is the maximum [9]. Another criterion is to compare the experimentally induced moods with people suffering from a mood disorder as depression. MIPs may provoke a negative mood equivalent to a intermediate clinical level, but only during the intensity of this very transitory mood [10] [11] [12].

Regarding the range of different moods that can be induced, there is also a great variability, as some MIPs only can be used to induce a single mood [2].

For instance, MIPs that invoke stress or anxiety often do not have variations for inducing positive or neutral moods, thereby hindering comparisons across multiple moods. Likewise, inducing a neutral mood in the laboratory has proven particularly challenging [13]. In aggregate, past studies incorporating mood induction illustrate the difficulty of finding one manipulation capable of inducing all mood states (i.e., negative, positive, and neutral), as well as robust induced moods [14].

Finally, regarding the specificity of an induced mood, it is not possible to accurately gauge, because it is not clear if "pure" moods occur even in natural situations.

Thus, there are still many unanswered questions in the MIP field; VR technology could be useful in overcoming some of them. VR has many possibilities because it is an immersive and interactive tool. Firstly, it could increase the ecological or external validity of the mood induction, since thus far these procedures have been applied only inside the laboratory. VR allows controlling the variables, without compromising the methodological rigor that the laboratory offers, while locating the person in an environment very similar to the natural one. Furthermore, this "ecological" environment can induce a broad range of moods with the same elements, not only one specific mood.

As has been mentioned, the EMMA project (IST-2001-39192) has developed an MIP using VR (VR-MIP) to induce four different moods in users (sadness, joy, anxiety and relaxation). A neutral condition was also included, where no changes in mood were expected. The efficacy of this VR-MIP has been tested previously [15], wherein data showed that this procedure was able to induce the target moods in users. Furthermore, VR-MIP was compared with a traditional MIP in which the same procedures were used (Velten sentences, movies, pictures and music) although without the mediation of the virtual environment (but rather imagination). Results [16] showed differences between subjective sense of presence in virtual and imagery environments. Participants in the imagery space (traditional MIP) informed a high sense of presence at the beginning of the procedure, but a decrease was observed. At the end of the mood induction they informed a low sense of presence. However, participants in the virtual space (VR-MIP) showed the opposite pattern: their subjective sense of presence increased throughout the virtual experience.

The present study investigates the potential of using VR not only to induce positive and negative effect, but also to change an induced mood (sadness) into the opposite one (that is, happiness). So far, there is little evidence that any MIP retains its efficacy across repeated administrations. This issue would open many potential applications for therapy.

2 Method

2.1 Participants

The sample was composed of 110 university student volunteers (40 men and 70 women). Their age range was from 18 to 49. Before the experiments, all

participants were screened using an interview and several questionnaires in order to detect any of the following exclusion criteria: history of neurological disease, head injury, learning disability or mental disorder, history of psychological disorders, use of any medication for psychological or emotional problem, or scoring 18 or higher in BDI (Beck Inventory Depression) [17].

2.2 Experimental Design

An intra-subjects design using repeated measures was used. A standard MIP was used, in which we measured the subjective mood at different moments during MIP (before and after the sadness induction and before and after the happiness induction).

2.3 Measures

- Visual Analogue Scale (VAS): A variation of the original measure [8] was used. Participants were asked to rate on a 1-7 points Likert Scale (1 = Not feeling the emotion at all, 7= Feeling the emotion extremely), how they felt at that moment in every one of the following emotions: sadness, joy, anxiety and relaxation.
- Positive Affect Negative Affect Schedule (PANAS) [18]. This is a list of 20 adjectives used to describe different feelings and emotions: 10 positive moods/emotions and 10 negative moods/emotions. Subjects must indicate if they feel these emotions in that moment with a 1-5 points scale (1= very slightly or not at all, 5 = extremely).

2.4 Virtual Environment (VR-Mood Induction Procedures)

The virtual environment consists of a neutral environment that changes depending on the mood state that we want to evoke in the user. The chosen scenery was a park, because it is an environment where natural elements are present (trees, flowers, water, etc...)By changing some light parameters (tone, direction, brightness) it is possible to modify the aspect of the environment resulting in a set of different moods in the user (see Figures 1 and 2). In order to build the different environments, variations of every one of the following elements were included: music[1], Velten self-statements, [5] plus pictures (selected from International Affective Picture System IAPS, [19]), movies [8], and autobiographical recalls [7]. A previous study [15] has proved that this MIP is able to induce different moods in users. Data from subjective mood state measurements showed that the four emotional environments (sadness, joy, anxiety and relaxation) were able to produce mood changes in the users.

The VR-MIP was as follows: Users listened to a short history according to the emotional condition (sadness, happiness, anxiety and relaxation). A woman's voice guided users through a virtual walk. From the beginning, a piece of music was heard [1]. The initial appearance of the environment was the same for all users. However, the aspect soon changed depending on the intended emotional

condition (see Figures 1 and 2). Users had two minutes to freely explore the park. Then, they were asked to go to the center of the park, where a bandstand was located. On five sides of the stand (it is an eight-faced polyhedron), a different statement of the Velten [5] technique appeared in a disordered manner; users had to order it. The content of the statements depended on the emotional condition. For each sentence, users had to choose a picture from four options which best represented the meaning of the sentence for them. All pictures were selected from IAPS [19]. Users were asked to get involved in the contents of each sentence for 45 seconds, to think about the personal meaning of each statement. After that, they could again walk around the virtual park for two more minutes. Then, users were asked to go to the cinema to watch a short film [8]. Once the cinema session was finished, users were asked to relate in a loud voice a personal recollection reminiscent of the things that happened in the park.

Fig. 1. Band stand in the sad park

Fig. 2. Band stand in the happy park

2.5 Hardware Devices

As an open immersive display we used a metacrilate retro-projected screen of 400x150 cm. The retro-projection option allowed the user to walk near the screen without blocking the image and projecting shadows on the screen. Projectors had a resolution of 1024x768 pixels and a power of 2000 lumens. However, we regulated them for a power of 1000 lumens for the comfort of the user. The interaction device was a Wireless Pad.This device has two special features; it has no wires so the user can move and stand (in front of the big screen, for example), and it has two small joysticks: one is used to navigate and the other to interact.

2.6 Procedure

The experimental session started with participants filling in some questionnaires and answering some questions in order to verify exclusion-inclusion criteria. Then, participants entered a room containing the virtual system. With the help of an experimenter, the user practised moving and interacting with virtual objects in a brief training environment. Next, participants filled in the pre-induction VAS and PANAS measures and they remained alone in the room. Then, the virtual session started. It took 30 minutes to complete the virtual walk, after which subjects filled in emotion measurements (VAS, PANAS) and other questionnaires and attentional tasks not used in the present study (lasting about 15 minutes). Then, they were invited to walk around the park again, this time with positive (happy) content. Before entering into the happy park, participants again filled out the pre-induction VAS and PANAS measures. It took 30 minutes to complete this second virtual walk. When the experience finished, users again filled out the VAS and the PANAS.

2.7 Results

Regarding VAS measure, means and standard deviations can be found in Table 1 and Figure 3. Students' t tests (paired samples t: pre-induction versus post-induction comparisons) were conducted on the mood measures and all analysis showed statistic differences, indicating that both inductions (sadness and happiness) were effective. Participants changed their moods in the expected directions, decreasing positive moods and increasing negative ones in the sad induction, with the opposite pattern for the happy induction

2.8 Discussion

Regarding the hypothesis, our results point out that VR-MIP is not only effective in inducing a target mood (sadness), but also in changing this induced mood to the opposite emotion (happiness). Data from subjective mood state measurements show that the emotional virtual environments (sad and happy) are able to produce mood changes in the users. There are still many unanswered questions

Table 1. VAS scores (before and after the two mood inductions): Means and (standard deviations) ratings

	Pre-Sad induction	Post-Sad induction	Pre-Happy induction	Post-Happy induction
VAS-hapiness	4.54 (0.937)	3.00 (1.206)	3.93 (1.091)	5.30 (0.892)
VAS-sadness	1.77 (0.908)	4.11 (1.421)	2.65 (1.316)	1.61 (0.860)
VAS-anxiety	2.45 (1.058)	2.40 (1.326)	1.76 (1.038)	1.48 (0.886)
VAS-relax	4.28 (1.155)	3.99 (1.374)	4.26 (1.237)	4.90 (1.150)

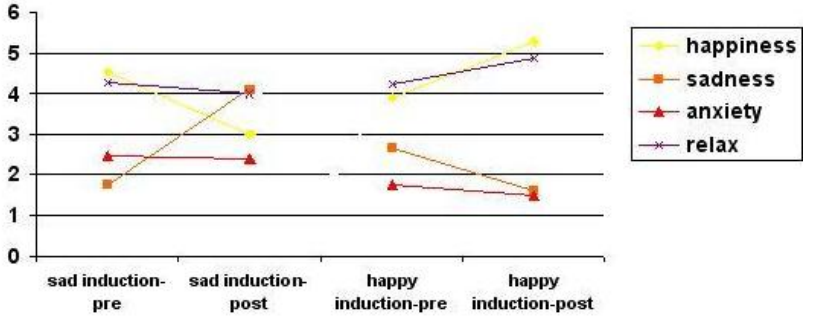

Fig. 3. VAS scores before and after the two mood inductions

Table 2. PANAS scores (before and after the two mood inductions): Means and (standard deviations) ratings

	Pre-Sad induction	Post-Sad induction	Pre-Happy induction	Post-Happy induction
Positive Mood-PANAS	30.65 (7.37)	24.96 (8.40)	24.75 (7.40)	32.05 (8.00)
Negative Mood-PANAS	13.29 (3.48)	14.73 (4.83)	15.73 (4.93)	11.61 (2.78)

that only future research could clarify. For instance, an important question is: how long do induced moods last, and to what extent are they transitory? These results are important since they reveal the utility of the VR-MIPs as mood devices and, therefore, the possibility of using them in the future from both an applied and experimental perspective.

We believe that this procedure which experimentally alters emotional states has important research and clinical applications. Regarding basic research, mood induction has been a cornerstone of research on experimental Psychopathology. Research on emotion, affect and mood is absolutely necessary to understand human behavior and, as has been mentioned, MIPs are useful procedures for experimentally studying the influence of affect and mood [4]. The results of this study contribute to the literature on MIPs, offering an alternative method for inducing mood. We have shown that VR-MIP can reliably produce desired affective states. Regarding clinical applications, this VR-MIP could also be used

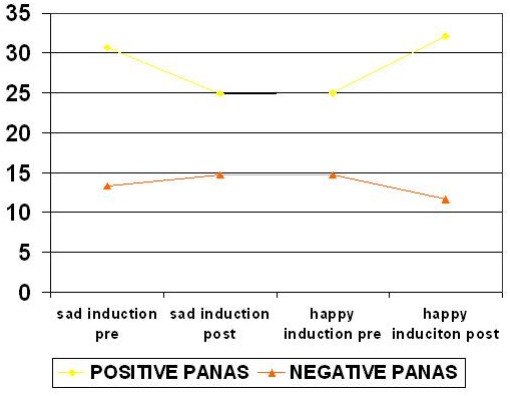

Fig. 4. PANAS scores before and after the two mood inductions

as a therapeutic tool for inducing specific moods (relaxation or happiness) in people who need mood modification. In conclusion, our results indicate that the "new technologies" are useful for creating devices that are able to induce and change emotions in the users. However, further investigation is needed, especially regarding objective measures.

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References

1. García Palacios, A., Baños, R. (1999). Eficacia de dos procedimientos de induccin del estado de nimo e influencia de variables moduladoras. Revista de Psicopatologa y Psicologa Clnica., 4 (1), 15-26.
2. Martin, M. (1990). On the induction of mood. Clinical Psychological Review., 10, 669-697.
3. Gerrards-Hesse, A., Spies, K., Hesse, F. W. (1994). Experimental inductions of emotional states and their effectiveness: A review. British Journal of Psychology, 85, 55-78.
4. Westermann, R., Spies, K., Stahl, G., Hesse, F. (1996). Relative effectiveness and validity of mood induction procedures: a meta-analysis. European Journal of Social Psychology, 26, 557-580.
5. Velten, E. (1968). A laboratory task for induction of mood states. Behaviour Research and Therapy, 6, 473-482.
6. Sutherland, G., Newman, B., Rachman, S. (1982) Experimental investigations of the relations between mood and intensive unwanted cognition. British Journal of Medical Psychology, 55, 127-138.

7. Brewer D., Doughtie E.B., Lubin B. (1980). Induction of mood and mood shift. Journal of Clinical Psychology, 36, 215-226.
8. Gross, J.J., Levenson, R.W. (1995). Emotion elicitation using films. Cognition and Emotion, 9, 87-108.
9. Frost, R.O., Green M.L. (1982). Duration and post-experimental removal of Velten mood induction procedure effects. Personality and Social Psychology Bulletin, 8, 341-347.
10. Clark, D, M., Teasdale, J.D. (1982). Diurnal variation in clinical depression and accessibility of memories of positive and negative experiences. Journal of Abnormal Psychology, 91, 87-95.
11. Clark, D, M., Teasdale, J.D. (1985). Constraints of the effects of mood on memory, Journal of Personality and Social Psychology, 48, 175-178.
12. Clark, D.M. (1983). On the induction of depressed mood in the laboratory: Evaluation and comparison of the Velten and musical procedures. Advanced Behavior Research and Therapy, 5, 27-49.
13. Hufford, M. R. (2001). An examination of mood effects on positive alcohol expectancies among undergraduate drinkers. Cognition and Emotion,15, 593-613.
14. Conklin, C.A., Perkins,K.A. (2005) Subjective and Reinforcing Effects of Smoking During Negative Mood Induction Journal of Abnormal Psychology, 114, 153-164.
15. Baños, R.M.; Botella,C.; Guerrero, B.; Liaño, V.; Rey, B.; Alcañiz, M. (2004) Sense of Presence in Emotional Virtual Environments Presented at PRESENCE 2004 - 7th Annual International Workshop on Presence 13-15 October 2004 Valencia, Spain.
16. Baños, R.M.; Botella,C.; Guerrero, B.; Liaño, V.; Alcañiz, M. Rey, B.; (2005) The third pole of the sense of presence: Comparing virutal and imagery sapces. PsychNology Journal 3 (1) 90-100.
17. Beck, A.T., Ward, C.H., Mendelson M., Hock J., Erbaugh J. (1961). An inventory for measuring depression. Archives of General Psychiatry, 4, 561-571.
18. Watson, D., Clark, L. A., Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. Journal of Personality and Social Psychology, 54, 1063-1070.
19. Lang P.J., Bradley M.M., Cuthbert B.N. (1995). International Affective Picture System (IAPS): Technical Manual and Affective Ratings. NIMH Cent. Study Emot. Atten., Univ. FL.