

A Positive Technology System for the Promotion of Well-Being: From the Lab to the Hospital Setting

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Abstract. There is growing evidence of the effectiveness of Positive Psychology Interventions (PPIs) to enhance subjective and psychological well-being in different populations, and the Information and Communication Technologies (ICTs) are becoming into a key help to increase the efficiency of this type of interventions. Recently, the use of technology to foster well-being and personal growth has been named as *Positive Technology*. The aim of this paper is to describe and to present data about a positive technology example (EARTH of Well-being system) and to examine its usefulness in different populations and settings. Data of four studies are presented: two with non-clinical population (university students) and two with clinical population (cancer patients). Outcomes show that this system is capable of promoting subjective well-being in both populations. Also, its efficacy was proved in different settings (laboratory and hospital contexts). Limitations and future research are discussed.

Keywords: Positive technology · Well-being · Efficacy · Non-clinical population · Clinical population

1 Introduction

A positive psychology intervention (PPI) has been defined as a “treatment method, strategy or intentional activity that aim to cultivate positive feelings, behavior, or cognition” [1]. Currently, there is evidence that shows the effectiveness of PPIs to enhance the subjective and psychological well-being and to reduce depressive symptoms in both general and clinical populations (e.g. anxiety, depression) [1–3]. PPIs are mainly brief and simple exercises or activities that can be implemented as part of one’s daily routine, and where commitment and daily practice become essential elements of their efficacy [4].

The literature suggests that PPIs can be used in conjunction with preventive interventions and traditional treatments with the aim to strengthen personal psychological resources. In addition, the majority of PPIs is delivered in a self-help format, as evidenced in the meta-analysis conducted by Bolier et al. [2], where this format obtained

small but significant effects. From a cost-effective perspective, self-help interventions can be effective and appropriate tools in mental health field, although it is necessary to enhance their efficacy [2].

The Information and Communication Technologies (ICTs) are becoming into a key help to enhance the efficacy and efficiency of psychological interventions [5–9]. The connectivity, the speed and the availability of ICTs are redefining our daily life, and also have an impact on Psychology and other behavioral sciences [10]. ICTs are presented as effective and sustainable solutions to public health demands that allow reaching a large number of people with a high quality and low costs. All these advantages are being already used in the PPIs [e.g., 11, 12].

Taking into account the growing relationships between ICTs and PPIs, and the increasing literature of PPIs delivered through technologies, is not strange the appearance of different terms to name this intersection. For example, Ritterband et al. [13] has proposed “Online Positive Psychological Interventions” to define those interventions offered by the Internet and focused on behavioral aspects, designed to modify and establish certain behaviours and the subsequent improvement in symptomatology. Mohr et al. [14] proposed “Technological Behavioral Interventions” to refer to technological apps (e.g., smartphones, computers, virtual reality, videogames, social networks, etc.) specifically designed to intervene on behavioral, cognitive and emotional aspects, in order to improve physical and psychological health and well-being. In addition, Botella et al. [15] and Riva et al. [16] have suggested the term “Positive Technologies” to refer to the scientific and applied approach focused on the study of the use of technology to improve the quality of personal experiences. It is a perspective that seeks to promote the use of technology to foster personal growth and the development of human virtues and strengths, thus contributing to social and cultural development.

The term proposed by Botella et al. [15] and Riva et al. [16] is the only one that establishes a classification of technologies based on conceptualizations of subjective, psychological and social well-being [15, 16]. According to Botella et al. [15], each of these levels has critical variables (hedonic level: emotion regulation; eudaimonic level: flow and presence; and social level: collective intentions and social connections) that can be used to guide the design of technological applications that seek to influence different aspects of well-being. Examples of hedonic PTs would be those that induce a positive and enjoyable experience, such as a virtual reality environment of joy induction. Eudaimonic PTs include technologies that help people to achieve experiences focused on the search for a full and meaningful life. Social PTs include technologies that support and enhance communication among individuals, groups and organizations.

Until now, the efforts have been put mainly into the assessment of the efficacy of PTs to improve well-being. Given the strengths and benefits of these tools [11, 17] the issue of its transference to other settings than the Lab should be now a priority. It is possible to translate the PTs developed so far to natural settings, like schools, organizations or hospitals?, Its positive outcomes obtained with general populations in controlled environments remained significant when they are implemented with other populations and contexts?.

Taking into account the previous, this paper aims to describe and to present data about ‘EARTH of Well-being’ (Emotional Activities Related to Health) system, a technology

based on the PT approach proposed by Botella et al. [15] and Riva et al. [16] and developed as a system designed to generate hedonic and eudaimonic experiences through self-applied PPIs. Its usefulness in two different populations and two settings will be examined. Therefore, the purpose is double: to analyze its benefits and also to explore the viability of implement this type of systems in other environments than the Lab.

2 EARTH of Well-Being System

The EARTH system is a self-guided platform initially developed for the Mars-500 project [18] with the purpose of promote positive experiences in a closed and controlled environment (a simulated Mars mission). Subsequently, it was adapted for the other population with the aim of promote different aspects of positive affect and hedonic and eudaimonic well-being for a variety of people.

This system includes several strategies structured in three modules. Two of the modules are positive Mood Induction Procedures (MIPs), and the third one includes narrative exercises of reminiscence and future projection. All the strategies included in EARTH are based on theories of well-being, regarding positive emotions [e.g., 19] optimal functioning and psychological health [e.g., 20]. EARTH system offers several techniques and tasks, since some authors have suggested that the use of different positive intervention techniques could be useful for the maintenance and enlargement of their effects [17, 21].

MIPs are experimental strategies designed to produce, in a controlled manner, specific transient emotional states similar to those experienced in natural situations [22]. In EARTH system, the specific emotions targeted are joy and relaxation, because there is evidence about their undoing effects on negative emotions [23–26] and their impact on other positive emotions, by creating the appropriate conditions for experience them [23].

To promote these positive emotional states, Virtual Reality (VR) environments were used as a frame to apply several MIPs in a structured and interactive way, overcoming some of the limitations of the traditional MIPs [27, 28].

EARTH's narrative exercises include the recall of positive life event memories and also the generation of specific plans for the future. Writing activities were included given their beneficial effects on mental health [29–31], and the reminiscence activity was considered given its potential to generate positive emotions through past memories [32, 33]. Besides, several studies have shown the effectiveness of exercises focused on the development of positive future plans for well-being, for example the 'Best Possible Self', [4, 34, 35] or the 'Life Summary' of Seligman et al. [36].

To work on these narrative exercises, EARTH includes several multimedia resources (music, pictures, videos, writing) with the purpose of expand the possibilities to represent and express personal experiences and emotions in a more dynamic way [37, 38]. In this sense, to include personal material (like photos, letters, music) is also available, as a way of enriching the meaningfulness of the activity and facilitating the "positive mental time travel" [39].

2.1 Modules Description

Park of Well-Being. This module includes two virtual environments aimed to induce joy or relaxation (MIP-VR). Both simulate a park in a city, and the colors, sounds and content of the exercises were adapted to the specific target emotion. In this setting several exercises are included: self-statements, choosing pictures, listening to music while interacting with the surroundings, watching movie scenes, and recalling an autobiographical emotional experience. Before and after each exercise, users can walk throughout the park and listen a specific music depending on the target emotion. The music used was ‘EineKleineNachmusik’ for joy and ‘Heavenly Theme’ for relaxing. Both songs were validated in previous studies [28, 40]. Five self-statements (e.g. ‘I feel happy and cheerful’) [41] were included in each VR environment (5 for relaxation and 5 for joy). In the exercise, each self-statement was accompanied by four emotional pictures (IAPS) [42] and users had to choose the image that best represented each statement. Next, users were invited to watch a movie scene in an outdoor cinema. The movies included were: ‘Singing in the Rain’ for joy and ‘Out of Africa’ for relaxation [43]. Finally, users had to remember moments of their own lives that could produce a specific emotion (joy or relaxation, respectively) [44].

Well-Being Through Nature. This module includes two virtual environments where users can learn some techniques to generate positive emotions (joy and relaxation) (MIP-VR). Both environments simulate a natural landscape, and welcome narratives, colors and sounds were chosen to generate the target emotions (joy or relaxation) [45, 46]. Three psychological techniques were also included: positive reminiscence, savoring and slow breathing. Users can choose in which order to perform each exercise.

The Book of Life. This module consists of a personal diary designed to help users to recall positive and meaningful moments of their lives, and write about positive and significant future plans. This diary is composed by 16 chapters, each targeting different psychological resources. Eleven chapters are directed to recall positive past experiences (happiest moment, the best place, significant people, achievement and effort, giving to others, enjoying social relationships, beauty, enthusiasm and passion, gratitude, courage, optimism). The other five exercises involve defining objectives and significant future plans regarding different areas of their lives (oneself, work, family, friends, or general life). Each exercise contains a general statement that explains the goal of the exercise, and a series of questions to guide the writing (to avoid negative, impersonal or nonspecific contents). Users can use different multimedia resources besides writing (music, pictures and videos) to represent their memories and plans, and develop each chapter of the book. Participants can use their own multimedia elements or use the ones available in the EARTH system.

3 EARTH of Well-Being Outcomes

Some of the exercises included in this platform have been validated in different populations: people with adjustment disorders [47] or elderly [48]. Below, data about the

usefulness of the EARTH system in two samples (general population and cancer patients), will be presented.

3.1 EARTH System in General Population

Two studies have been focused on the examination of the system in non-clinical population (university students). The first one [18] assessed users' acceptance and perceived usefulness of the system, as well as preliminary data about its efficacy in the promotion of well-being. The second one explored the efficacy of the system compared to a control activity [49].

Study 1. In this first study [18], 38 university students (mean age 24.6 years, range 18–41 years old) used the application along 6 sessions distributed over 2 weeks (3 sessions per week). Each week they received one session of the MIP-VR module (sessions 1 and 4), one session of the Book of Life (sessions 2 and 5) and one free-choice session (sessions 3 and 6). After each session, participants indicated their mood change in a 7 point Likert scale (1 = much worse; 7 = much better). Participants came to the lab to complete each session on a computer.

Regarding preferences, most of participants choose MIP-VR modules in the two free-choice session (Session 3: 89.47 % vs. 10.53 %; Session 6: 78.95 % vs. 21.05 %). However, both modules (MIP-VR and Book of Life) were considered highly useful by the participants (above 92 % of coded responses) and an important proportion of agreement (above 78 %) was found regarding the possibility to have access to the system in their own homes ('If it were possible, would you like to have the system available in your home?'). Taking into account mood changes, an improvement was found after all sessions (mean scores were from 4.95 to 5.37) [18].

Study 2. In the second study [49], 95 university students (mean age 24.9 years, range 18–47 years old) were randomly assigned to two conditions: experimental (EG) and control group (CG). Participants included in the EG used the system at the lab 3 times a week along 1 month (12 sessions). Participants of the CG did not perform any guided activity during 1 month. Both groups were evaluated at the same times (Baseline, pre-intervention, post intervention, and follow up at 1 and 3 months). Besides, EG participants rated their emotional state before and after each session, using visual analog scales to assess 10 emotions (joy, surprise, relax, vigor, sadness, anger, anxiety, boredom, stress, loneliness) using a 7 point Likert scale. They also indicated their mood change after sessions, like in the previous study. Results showed that participants who used EARTH of Wellbeing system increased their mood and positive emotions and decreased negative emotions, both in a significantly way (joy: $F = 52.83, p < .001, \eta^2 = 0.50$; relax: $F = 49.35, p < .001, \eta^2 = 0.48$; sadness: $F = 12.49, p = .001, \eta^2 = 0.19$; anger: $F = 35.93, p < .001, \eta^2 = 0.40$; anxiety: $F = 61.01, p < .001, \eta^2 = 0.54$; stress: $F = 61.95, p < .001, \eta^2 = 0.54$; loneliness: $F = 9.20, p = .004, \eta^2 = 0.15$). This outcome was also observed in participants with high scores in depression and anxiety [49].

3.2 EARTH System in Cancer Population

Given that the EARTH system was initially designed as a PT for non clinical populations, the next step was to analyze the possible implementation of this system in other groups or settings, and therefore assess also its transferability.

Following this aim, two studies have been carried out to assess the feasibility of this system in cancer population, specifically in hospitalized patients, which implied to take into account new variables such as participants' physical discomfort, and also a complex setting for implementing the intervention (a hospital).

A previous adaptation of contents and functioning was made, specially on the Park of Well-being, with the purpose of simplify the interaction (e.g. self-statements words order by themselves) and adjust some contents to the vital situation of these participants (e.g. instead of the phrase: 'I feel happy and cheerful' it was included the sentence: 'There are things that make me happy').

Study 1. In a pilot study, the feasibility and benefits of the two VR modules of EARTH in oncology inpatients with metastatic cancer were assessed [50]. The sample was composed by 19 patients (mean age 60.9 years; range 29-85 years old). The most frequent diagnoses were breast (26.3 %) and lung cancer (15.8 %). Intervention was delivered in patients' room along 4 sessions and they had the possibility of interact with the 4 VR environments. The first and third sessions were oriented to joy and the second and fourth to relaxation induction. After each session, participants experienced higher positive emotions intensity as well as lower negative emotions intensity (2nd session: general mood [$t = -4.616, p < .001, \eta^2 = 0.62$], relaxation [$t = -2.110, p < .05, \eta^2 = 0.26$], sadness [$t = 3.580, p < .003, \eta^2 = 0.50$]; 4th session: joy [$t = -3.202, p < .009, \eta^2 = 0.51$]). Besides, participants commented that the main perceived benefits were distraction, entertainment, and relaxation [50]. Its brevity, low cost and easiness of use (keyboard and a mouse as interaction devices) helped to implement this system in the hospital routine with encouraging results.

Study 2. Subsequently, the entire system was tested with hospitalized cancer patients in different stages of the disease. The Book of Life module was also included. As in the first pilot study with the VR modules, some modifications were made. Specifically, work was focused on the positive reminiscence exercises, selecting 6 life moments from the 11 available in the system, and the exercises oriented to future planning were excluded. This study had two phases:

Pilot study. In a first exploratory study [51], 16 patients (mean age 62.5, range 44–75 years old) with different diagnoses (lung 33.3 %, digestive 20 %, colon-rectum 20 %) were included. They received one or more sessions (up to 4) and their response and disposition in front of the Book of Life module was assessed. Participants could choose the module to work with, in each session (Book of Life or VR environments). Outcomes shown the acceptability of reminiscence exercises (most of patients who did both modules, preferred the reminiscence one [71.4 % vs 28.6 %] as well as its positive effect on subjective well-being (it was found a higher proportion of cases with better perceived mood after sessions in the reminiscence module) [51].

Protocol Study. Taking into account the outcomes obtained in the pilot study, it was carried out a second study in which participants received two sessions of Book of Life and two sessions of the VR modules [52]. The group of participants was composed by 11 inpatients (mean age 58.7 [range 38–82 years old] with different diagnoses (27.3 % other, 18.2 % lung cancer). Most of the participants had metastatic cancer (63.6 %). Data suggest the usefulness of the system to promote higher positive emotional states after each session (there were statistically significant changes in positive mood, well-being and calmness after 1st and 3rd session (S1 = positive mood, $Z = -2.333$, $p = .020$, $d = -0.68$; well-being, $Z = -1.890$, $p = .059$, $d = -0.67$) ($n = 11$) (S3 = positive mood, $Z = -2.121$, $p = .034$, $d = -1.20$; well-being, $Z = -2.060$, $p = .039$, $d = -1.63$; calmness, $Z = -2.121$, $p = .034$, $d = -1.44$) ($n = 8$). Besides, no patient stated being “worse” of mood after the sessions, and in all of them more than 60 % of the participants commented feeling “better” of mood after the activities. In addition, participants’ response was positive in terms of acceptance and satisfaction with the procedure [52].

4 Discussion

Four studies have been done with the purpose of explore the feasibility and preliminary usefulness of EARTH of Well-being system in the promotion of positive experiences. Outcomes suggest that this system is able of promoting subjective well-being not only in nonclinical population in a controlled setting [49] but also in participants with a medical condition in natural settings (e.g. hospital) [50]. These findings are quite relevant taking into account that PTs try to improve the quality of the personal experiences, and therefore, must be accessible and easy to use in different context and daily conditions.

In this sense, it is of relevance to consider the fact that both populations included in this paper (students and cancer population) had very different age range ($x=25$ vs $x=60$ years) and educational level (superior vs basic level) which suggests the viability of this PT system for different types of population.

Beyond testing the usefulness of this system for different groups of people, is also interesting to analyze the particularities that could arise when different populations use the system. Regarding this, it seems that for both groups the use of VR environments was quite attractive, and although for all participants both modules of the system (VR and Book of Life) were useful, data suggest that for cancer patients the book of life was a relevant component of the intervention. It would be of interest to continue exploring the specific weight of each component of the system to better understand its possibilities and limits.

Another aspect to take into account when analyzing PT is the role of expertise with technologies. As this could be a serious limitation, PTs usually try to include simple interaction devices and brief instructions. However, it seems that even more important than the experience per se, is the proneness to technologies the key gap to overtake. In the case of the populations included in this paper, university students usually are prone to technologies’ use. However, this is not the case of cancer participants: they were no very familiar with technologies (some of them had no experience at all) and some were even reluctant. However, they were able of use the system and obtained psychological

benefits from it, just like the university students did. Possibly, to introduce the system as a tool designed to help them to achieve a better mood state, and as a “working together” exercise (participant plus researcher) may have been of help to approximate these technologies to this population.

It should be noted that one limitation of the studies with nonclinical population is that they were composed by University students, who are not representative of general population, and the generalizability of our findings is limited. Despite this, data obtained so far are encouraging, and invite us to continue exploring the possibilities of this system with more heterogeneous populations. Future studies with bigger and more diverse samples will allow us to identify in a better way the particular needs and benefits obtained by each type of population who use EARTH system.

Another limitation is the absence of control group in the studies with oncology patients. It will be necessary to include a comparison group to confirm the preliminary data obtained so far with this population. Besides, it is important to notice the short-term of the benefits obtained with EARTH system in the populations assessed. In the case of cancer patients there were improvements after sessions but no follow-ups were included. In the case of university students, no differences were found between EG and CG in the evaluations post intervention, and therefore, is not possible to state the maintenance of the benefits obtained post sessions. Future studies should investigate the efficacy of EARTH in protocols that includes a longer intervention time, given that previous research have indicated the hedonic adaptation as an important obstacle in the efficacy of PIs [53]. To explore this aspect in natural settings could also generate valuable information regarding the feasibility of implement these systems in daily life environments, and its capacity to maintain the benefits even in variable conditions.

Finally, another relevant line to explore is the cost-effectiveness of EARTH in particular, and PTs in general. Previous studies have suggested the importance of economic evaluations and the absence of studies which addressed this issue [54]. To continue exploring the advantages and disadvantages of these technologies in terms of efficacy, efficiency, usability and costs is vital to add more solid evidence to support the health professional’s decisions.

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