EARTH of Well-Being System: A pilot study of an Information and Communication Technology-based positive psychology intervention

Rosa María Bañosa,*, Ernestina Etchemendyb, Luis Farfallininc, Azucena García-Palaciosb,d, Soledad Querob,d and Cristina Botellac,d

“Department of Personality, Evaluation and Psychological Treatment, University of Valencia, Av. Blasco Ibáñez 21, Valencia 46010, Valencia, Spain; Ciber, Fisiopatología Obesidad y Nutrición (CIBERObn), Instituto de Salud Carlos III, University of Jaume I, Av. Sos Baynat s/n, Castellón de la Plana 12071, Castellón, Spain; “Labpsitec (Laboratory of Psychology and Technology), University of Jaume I, Av. Sos Baynat s/n, Castellón de la Plana (Castellón) 12071, Spain; 4Department of Basic and Clinical Psychology and Psychobiology, University of Jaume I, Av. Sos Baynat s/n, Castellón de la Plana 12071, Castellón, Spain

(Received 13 September 2013; accepted 19 May 2014)

The positive technology field combines the objectives of positive psychology with enhancements from information and communication technologies. Following this approach, our team developed the ‘EARTH of Well-Being,’ a system designed to induce positive emotions and reinforce psychological resources through a self-guided positive psychology internet intervention. This paper describes the EARTH system and presents the results of a pilot study that assesses users’ acceptance and perceived usefulness of the system and provides preliminary evidence of its efficacy in providing users with positive experiences. Thirty-eight volunteers used the application in six sessions distributed over two weeks. They reported high levels of acceptability and perceived usefulness. Moreover, participants reported increased positive mood after each session. Overall, results support the future use and investigation of this system as a positive psychology intervention, and suggest that it could be useful for increasing positive mood.

Keywords: positive psychology interventions; positive technology; virtual reality; information and communication technologies; mood-induction procedures; narrative exercises

Introduction

Recently, the term ‘Positive Technology’ (PT) has been proposed to refer to the ‘scientific and applied approach that uses technology to improve the quality of our personal experience with the goal of increasing wellness and generating strengths and resilience in individuals, organizations and society’ (Botella et al., 2012, p. 1). This emerging field combines the objectives of Positive Psychology with support from Information and Communication Technologies (ICTs) by focusing on three key variables (emotional quality, engagement, and connectedness). Based on the PT approach, the ‘EARTH of Well-Being’ (Emotional Activities Related to Health) was developed as a system designed to generate positive experiences in a controlled way. The EARTH system was initially developed for the Mars-500 project (http://mars500.imbp.ru/). The Mars-500 project aimed to investigate the health and capacity for work of a crew, while simulating the conditions of an interplanetary manned flight (e.g. duration, isolation, confinement, altered communication with Earth, limited consumable resources; Kanas et al., 2009; van Baarsen, Vinokhodova, & Ferlazzo, 2012). Thus, EARTH was first developed as a self-guided system to generate positive experiences for astronauts in the simulated Mars mission. Subsequently, we adapted the EARTH system for the general population in hopes that it could increase positive emotions and promote well-being for a variety of people.

EARTH consists of several strategies structured in three modules. Two of the modules are positive Mood-Induction Procedures (MIPs), and the third includes narrative exercises of reminiscence and future projection. The EARTH strategies follow suggestions from various theories of well-being, including some that address positive emotions and subjective states (e.g. Diener, 1984) and others that address optimal functioning and psychological health (e.g. Ryff, 1989).

MIPs are experimental strategies designed to produce, in a controlled manner, specific transient emotional states similar to those experienced in natural situations (García-Palacios & Baños, 1999). MIPs can efficaciously induce a variety of mood states (Westermann, Spies, Stahl, & Hesse, 1996). Specific emotions targeted within the EARTH system were joy and relaxation. These emotions were selected because evidence supports their undoing effects on negative emotions (Fredrickson, 2000, 2002). In addition, joy and contentment facilitate cardiovascular quiescence (Fredrickson, 2013; Fredrickson & Levenson,
The EARTH system uses ICTs due to their efficacy on the target outcomes and their efficiency of delivery. As mentioned, the EARTH system was initially designed to be applied in a Mars trip simulation, and it had to be self-guided and deployed in a constrained setting. Therefore, it required exercises that users could accomplish on their own with limited outside resources. One way EARTH addresses this is through its use of virtual reality (VR) and multimedia elements. VR is an interactive immersion tool that can be used to induce different emotions. Previous findings have shown that VR can help to overcome some limitations of traditional MIPs, increasing their ecological and external validity (Baños et al., 2004, 2006). VR makes it possible to apply MIPs in a structured way, with the methodological rigor of the laboratory, but placing the person in a very similar environment to the natural one. In addition, VR allows the simultaneous use of different elements that have shown their efficaciousness in inducing emotions, such as colors (Guildford & Smith, 1959), music and sounds (Gabrielsson & Lindström, 2001, Mammearella, Fairfield, & Cornoldi, 2007), images (Lang, Bradley, & Cuthbert, 1995) or films (Gross & Levenson, 1995).

For the narrative exercises, EARTH includes several multimedia resources (music, pictures, videos, writing). These multimedia options expand the possibilities of the narrative exercises, offering elements other than words to represent and express personal experiences and emotions, and making the intervention more dynamic and engaging for the user (Abbott, Klein, & Ciechomski, 2008; Barak, Klein, & Proudfoot, 2009). The goal is to help participants capture each remembrance or anticipate the positive events with richness and vividness, facilitating ‘Positive Mental Time Travel,’ a positive emotion regulation strategy that has predicted emotional well-being (Quoidbach, Berry, Hansennea, & Mikolajczak, 2010). Fredrickson (2009) also proposed building portfolios that would include photos, letters, quotes, or objects with personal meaning, in order to work on the 10 forms of positivity.

Before carrying out a controlled study to analyze the efficacy of the EARTH system in the general population, a pilot study was designed to explore the users’ opinion and acceptance, in order to improve the system and obtain some initial data about its ability to increase positive emotions. Evidence suggests that the perceived usefulness of a system, in this case the belief that using an application will increase one’s emotions and performance, will affect an individual’s intention to use it.
contributing to its ultimate success (Davis, 1989). Thus, in this paper, we describe the EARTH system and present the results of a pilot study that assessed users’ acceptance and perceived usefulness of the system, as well as preliminary evidence of its efficacy in providing users with positive experiences.

Method
Participants
The sample consisted of 38 university students (n = 26 postgraduate students, n = 12 undergraduate students) ranging from 18 to 41 years old (M = 24.58, SD = 4.97). Participation was optional, and all participants signed an informed consent form. The ethical committee from the University of Valencia (Spain) required the exclusion of participants with high scores on depression (Beck Depression Inventory scores >13; Beck, Steer, & Brown, 1996) and/or anxiety (State and Trait Anxiety Inventory scores >15 for women and >14 for men; Spielberger, Gorsuch, & Lushene, 1970). A total of 24 participants were excluded (n = 14 for anxiety scores, n = 5 for depression scores, and n = 5 for anxiety and depression scores). They were informed of their scores and offered resources from the university’s Psychological Assistance Service.

Measures
State and trait anxiety inventory (Spielberger et al., 1970)
This is a self-administered questionnaire consisting of 40 items divided into two subscales that evaluate feelings of trait or state anxiety. Only the state subscale was used in this study.

Beck depression inventory II (Beck et al., 1996)
This is one of the most widely used self-report instruments to assess depression. It includes 21 items designed to evaluate cognitive, behavioral, affective, and somatic symptoms of depression.

Acceptance and perceived usefulness
Three questions written for this study addressed the acceptance and perceived usefulness of this system: (i) ‘If you were not a participant in this study, would you like to use the system?’ (Acceptance); (ii) ‘Do you think the system’s activities are useful? What for?’ (Perceived Usefulness); and (iii) ‘If it were possible, would you like to have the system available in your home?’ (Acceptance). Participants entered open responses to these items (space was limited to two lines for each answer). Three independent researchers who were unaware of the study procedures coded the responses as positive, negative, or neutral. Any discrepancies during categorization were resolved by agreement between researcher taking the opinion of majority as norm (Kappa index 1# = 0.91; 2# = 0.91; 3# = 0.93).

Mood scale
This scale was designed for this study. Participants were asked to assess their subjective change in mood after using EARTH (‘Compared to your mood before using the EARTH system, how do you feel now, after using it?’), on a 1 (‘much worse’) to 7 (‘much better’) Likert scale.

Program description
EARTH is a self-guided platform with three activity modules. Two of the modules are MIPs achieved through virtual environments (VEs) designed to induce the positive emotions of joy or relaxation (Park of Well-Being and Well-Being through Nature). The third, the Book of Life, includes positive narrative exercises designed to create a positive orientation toward the past and future.

Park of Well-Being
This module includes two VEs aimed to induce joy or relaxation. Both VEs simulate a park in a city, and the light, sounds, and content of the exercises were adapted to the specific target emotion (joy or relaxation). Places in the park correspond to five exercises that include self-statements, choosing pictures for self-statements, listening to music, watching scenes from movies, and recalling an autobiographical emotional experience. Self-statements draw on the Velten procedure, which involves reading, reflecting on, and trying to feel the effects of 60 self-statements related to mood (e.g. ‘I feel happy and cheerful,’ Velten, 1968). Five self-statements were included in each VE (five for relaxation and five for joy). In order to choose emotional pictures related to the self-statements, the International Affective Picture System (Lang et al., 1995) was used. Forty pictures (20 for relaxation and 20 for joy) were included in the VEs. In the exercise, each self-statement was accompanied by four pictures. Users read each statement and looked at these four pictures, and they had to choose the image that best represented the statement. Once the exercise had ended, users could walk through the Park again. Throughout the walk, specific music to induce joy or relaxation could be heard. The music used was ‘Eine Kleine Nachtmusik’ for joy and ‘Heavenly Theme’ for relaxing. These pieces were selected because they have been used successfully as MIP in previous studies,
specifically for joy and relaxation (e.g. Baños et al., 2006; Sutherland, Newman, & Rachman, 1982). Next, users were invited to watch a movie scene in a cinema located within the park. The movies included were: ‘Singing in the Rain’ for joy and ‘Out of Africa’ for relaxation. These clips had been used in a previous MIP (Gross & Levenson, 1995). Lastly, users were asked to remember moments in their own lives that could produce a specific emotion (joy or relaxation, respectively) (Brewer, Goughite, & Lubin, 1980).

**Well-Being through Nature**

This module also includes two VEs designed to teach techniques to generate positive emotions (joy and relaxation). Both VEs simulate a natural landscape, and welcome narratives, voices, colors, melodies, and sounds were chosen to generate the target emotions (joy or relaxation) (Gabrielsson & Lindstrom, 2001; Guilford & Smith, 1959). In addition, three psychological techniques were included: positive reminiscence, savoring, and slow breathing. A previous study found that both VEs induced joy and relaxation in a sample of older users (Baños et al., 2012).

**The Book of Life**

This module consists of a personal diary designed to help users recall and record positive and significant moments and past achievements, and write about positive and significant future plans. The diary consisted of 16 chapters, each targeting different psychological resources. Eleven of the 16 exercises asked the participants to write about positive past experiences related to different topics (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 asked them to write about significant future plans for different areas of life (oneself, work, family, friends, or general life). The structure of the exercises was consistent. They all began with a general statement presenting the goal, and they contained several questions to guide the answers (to help write the narrative and avoid negative, impersonal, or non-specific contents). Moreover, multimedia resources (music, pictures, and videos) could be included in each chapter. Participants could upload their own multimedia elements or use the ones available in the EARTH system.

**Procedure**

Participants were recruited from regular University courses. Postgraduate students received academic credits as an incentive. Undergraduate students did not receive any incentives. After signing an informed consent form, eligible participants (those without high depression and anxiety scores) received a username and a password. Participation consisted of six sessions distributed over two weeks (three sessions per week). The three sessions each week were: first, an MIP using a VE (Week 1 targeted joy, Week 2 targeted relaxation); second, the Book of Life; and, third, free choice. During the first week, half the sample received the Park of Well-Being VE, and the other half received the Well-Being through Nature VE. The VE was reversed for each subsample during Week 2. Each session lasted 20–30 min. Participants came to the lab to complete each session on a computer in an isolated room. After completing their session, participants completed the MS and the acceptance and perceived usefulness questions.

**Results**

**Adherence and perceived usefulness**

Table 1 shows the users’ opinions about all the activities performed. Results indicate that all the activities were assessed very positively. Although they differed in their frequency of use, they were assessed in a similar way.

Table 2 displays the selection of activities during the free-choice sessions. Participants overwhelmingly chose VEs over the Book of Life (Session 3: 89.47% vs. 10.53%; Session 6: 78.95% vs. 21.05%); however, selection of the Book of Life doubled between the third and sixth sessions. Within VEs, the selection was nearly equivalent for the two VEs (park and nature) and for the targeted emotion (joy and relaxation). Regarding the possibility of choosing a new activity or repeating one, in Session 3 only 10.5% (n = 4) of the participants chose to repeat (all them repeated the Book of Life), but in Session 6, 36.8% (n = 14) of the participants chose to repeat (eight participants repeated Book of Life, three participants selected Park of Well-Being Joy, two participants chose Park of Well-being Relaxing, and two participants repeated Well-Being through Nature).

**Mood changes after EARTH use**

Table 3 shows that most participants reported scores above 5 in all sessions (means were around 5 or higher), indicating an improvement in their mood after using EARTH in all sessions. In order to analyze possible differences among sessions, an ANOVA with one within-subject factor (‘session’) was carried out, but no significant differences were observed ($F = 1.93$, $p = 0.09$ $\eta^2_p = 0.05$). Table 4 shows descriptive data for the ‘free’ sessions (Sessions 3 and 6) where participants could choose the activity. Scores were also around 5, indicating a mood improvement after using the system.
Discussion

The EARTH system was designed as a self-guided intervention to induce positive emotions in a controlled way and reinforce psychological resources through positive psychology strategies. The present pilot study conducted with university students shows that EARTH is acceptable and perceived as useful within a general population, and it can promote positive mood in its users.

EARTH includes several positive intervention strategies. Results show that all activities were assessed positively, and no differences were found among them. When they could choose, participants preferred to experience positive moods through VEs in the two free sessions, but the selection of the Book of Life (narrative exercises) increased considerably between the first and second free sessions. In addition, participants preferred to perform a new activity rather than repeating a previous activity. When participants chose to repeat an activity, the Book of Life was preferred in both free sessions. However, it is important to highlight that participants only had two free sessions, and so these findings should be considered with caution.

The generalizability of these findings to a broader population is reduced, due to limitations in the current pilot study. The small sample included only university students. These users might be more accustomed to ICTs, and the system might be perceived differently in a less technologically savvy population. Participation took place in a small number of sessions within a short time period. All sessions were completed in a University lab. Furthermore, the sample excluded individuals with high scores on anxiety and depression measures. Thus, people

Table 1. Acceptance and perceived usefulness questions expressed as percentages of coded responses.

|                        | # used | Use | Yes | No | Neutral | Available | Yes | No | Neutral |
|------------------------|--------|-----|-----|----|---------|-----------|-----|----|---------|
| Virtual environments    | 138    | 84  | 878 | 10 | 14.0    | 5.07      | 92  | 03 | 2.90    |
| Park                   | 67     | 85  | 07  | 10 | 4.48    | 4.88      | 94  | 03 | 2.99    |
| Joy                    | 35     | 80  | 00  | 11 | 4.3    | 5.71      | 91  | 43 | 5.71    |
| Relaxation             | 32     | 90  | 63  | 9  | 3.89    | 0.00      | 96  | 88 | 3.13    |
| Nature                 | 71     | 84  | 51  | 9  | 5.63    | 0.00      | 90  | 14 | 7.04    |
| Joy                    | 33     | 87  | 88  | 9  | 3.03    | 0.00      | 90  | 91 | 0.00    |
| Relaxation             | 38     | 81  | 58  | 10 | 5.37    | 7.89      | 89  | 47 | 5.26    |
| Book of Life           | 88     | 86  | 36  | 6  | 8.22    | 6.82      | 96  | 59 | 1.14    |

Note: Use = ‘If you were not a participant in this study, would you like to use the system?'; useful = ‘Do you think the system activities are useful?'; available = ‘If it were possible, would you like to have the system available in your home?'; # used = amount of times the module was used.

Table 2. Selection of modules during free sessions.

|                        | Session 3 |   | Percentage (%) | Session 6 |   | Percentage (%) |
|------------------------|-----------|---|----------------|-----------|---|----------------|
| Virtual environments   | 34        | 89 | 47             | 30        | 78 | 95             |
| Park                   | 17        | 44 | 73             | 8         | 21 | 05             |
| Joy                    | 8         | 21 | 05             | 7         | 18 | 42             |
| Relaxation             | 9         | 23 | 68             | 10        | 26 | 32             |
| Nature                 | 17        | 44 | 73             | 15        | 39 | 47             |
| Joy                    | 7         | 18 | 42             | 9         | 23 | 68             |
| Relaxation             | 10        | 26 | 32             | 6         | 15 | 79             |
| Book of Life           | 4         | 10 | 53             | 8         | 21 | 05             |

Table 3. Descriptive statistics for mood changes.

|                        | Session 1 (x (SD)) | Session 2 (x (SD)) | Session 3 (x (SD)) | Session 4 (x (SD)) | Session 5 (x (SD)) | Session 6 (x (SD)) |
|------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Mood scale             | 5.18 (0.61)        | 5.34 (1.02)        | 4.95 (0.83)        | 5.11 (0.92)        | 5.37 (0.91)        | 5.00 (0.90)        |

Table 4. Descriptive statistics for mood changes in ‘free’ sessions.

|                        | n        | Session 3 (x (SD)) | n        | Session 6 (x (SD)) |
|------------------------|---------|--------------------|---------|--------------------|
| VEs park of Well-Being | 8       | 4.63 (0.74)        | 7       | 5.29 (0.49)        |
| VEs park of Well-Being Relaxation | 9 | 5.33 (1.00)        | 8       | 5.00 (0.54)        |
| VEs Well-Being through Nature Joy | 7 | 4.43 (0.79)        | 9       | 5.00 (1.12)        |
| VEs Well-Being through Nature Relaxation | 10 | 5.00 (0.67)        | 6       | 5.17 (0.75)        |
| Book of Life           | 4       | 5.50 (0.58)        | 8       | 4.63 (1.30)        |
experiencing current mental distress might use and benefit from the system differently from the participants in this study. The literature points out the importance of considering the baseline status of the participants’ well-being before implementing positive interventions (Layous & Lyubomirsky, 2012). Some studies have observed harmful effects in some individuals. For instance, Parks and Biswas-Diener (2013) reported studies where writing about a positive future was unpleasant for some participants (anxious and depressed), and so this task must be used with caution in clinical populations. The authors suggested that meaning-oriented activities are more appropriate for relatively high-functioning individuals and for individuals who have been in therapy for some time. Sin, Della Porta, and Lyubomirsky (2011) found that the expressing gratitude exercise (Emmons & McCullough, 2003) decreased well-being in dysphoric individuals, and Sergeant and Mongrain (2011) reported that gratitude intervention had harmful effects on needly depressive participants, but not on participants with self-criticism profiles. The authors highlighted the importance of identifying individual differences in the response to positive interventions. Lastly, Lyubomirsky, Sousa, and Dickerhoof (2006) showed that an intervention that uses positive experiences in an analytic way (analyze step by step, why, and how) may be counterproductive to well-being and health, but an intervention that promotes a repetitive and circular replay of memories will be beneficial, as it may allow the individual to savor and capitalize on experiences without judging them.

Future studies should investigate the effects of the EARTH system in different populations for longer periods of time and with a naturalistic deployment, especially because EARTH is intended to function as a self-guided Internet tool to deliver positive interventions to different populations.

Funding

This study was funded in part by the Ministry of Education, Culture and Sport Spain, Projects EARTH [grant number PSI2010-09568-E] and ‘CIBER of Physiopathology of Obesity and Nutrition, an initiative of ISCIII’.

References

Abbott, J., Klein, B., & Ciechomski, L. (2008). Best practices in online therapy. Journal of Technology in Human Services, 26, 360–375.
Ashida, S. (2000). The effect of reminiscence music therapy sessions on changes in depressive symptoms in elderly persons with dementia. Journal of Music Therapy, 37, 170–182.
Austenfeld, J. L., Paolo, A. M., & Stanton, A. L. (2006). Effects of writing about emotions versus goals on psychological and physical health among third-year medical students. Journal of Personality, 74, 267–286.
Baños, R. M., Botella, B., Alcañiz, M., Liano, V., Guerrero, B., & Rey, B. (2004). Immersion and emotion: The impact on the sense of presence. Cyberpsychology and Behaviour, 7, 734–741.
Baños, R. M., Liano, V., Botella, C., Alcañiz, M., Guerrero, B., & Rey, B. (2006). Changing induced moods via virtual reality. In W. A. Ijsselsteijn, Y. de Kort, C. Midden, B. Egggen, & E. van der Hoven (Eds.), Persuasive technology: Lecture notes in computer science (pp. 7–15). Berlin: Springer-Verlag.
Baños, R. M., Etchemendy, E., Castilla, D., Garcia-Palacios, A., Quero, S., & Botella, C. (2012). Positive mood induction procedures for virtual environments designed for elderly people. Interacting with Computers, 24, 131–138.
Barak, A., Klein, B., & Proudfoot, J. G. (2009). Defining internet-supported therapeutic interventions. Annals of Behavioral Medicine, 38, 4–17. doi:10.1007/s12160-008-9130-7
Beck, A. T., Steer, R. A., & Brown, G. K. (1996). Manual for the beck depression inventory-II. San Antonio, TX: Psychological Corporation.
Bennett, S. L., & Maas, F. (1988). The effect of music-based life review on the life satisfaction and ego integrity of elderly people. British Journal of Occupational Therapy, 51, 433–436.
Botella, C., Riva, G., Gaggioli, A., Widerhold, B. K., Alcaniz, M., & Baños, R. M. (2012). The present and future of positive technologies. Cyberpsychology, Behavior and Social Networking, 15, 78–84.
Brewer, D., & Doughtie, E. B. (1980). Induction of mood and mood shift. Journal of Clinical Psychology, 36, 215–226.
Burton, C. M., & King, L. A. (2004). The health benefits of writing about intensely positive experiences. Journal of Research in Personality, 38, 150–163.
Burton, C. M., & King, L. A. (2009). The health benefits of writing about positive experiences: The role of broadened cognition. Psychology and Health, 24, 867–879.
Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13, 319–340.
Diener, E. (1984). Subjective well-being. Psychological Bulletin, 95, 542–575.
Emmons, R. A., & McCullough, M. E. (2003). Counting blessings versus burdens: An experimental investigation of gratitude and subjective well-being in daily life. Journal of Personality and Social Psychology, 84, 377–389.
Fredrickson, B. L. (2000). Cultivating positive emotions to optimize health and well-being. Prevention and Treatment, 3, doi: 10.1037/1522-3736.3.1.31a
Fredrickson, B. L. (2002). Positive emotions. In C. R. Snyder, & Shane J. Lopez (Eds.), Handbook of positive psychology (pp. 120–134). New York, NY: Oxford University Press.
Fredrickson, B. (2009). Positivity. New York, NY: Crown Publishers.
Fredrickson, B. L. (2013). Positive emotions broaden and build. In E. Ashby Plant & P. G. Devine (Eds.), Advances on experimental social psychology (pp. 1–53). Burlington, VT: Academic Press.
Fredrickson, B. L., & Levenson, R. W. (1998). Positive emotions speed recovery from the cardiovascular sequel of negative emotions. Cognition and Emotion, 12, 191–220.
Fredrickson, B. L., Mancuso, R. A., Branigan, C., & Tugade, M. M. (2000). The undoing effect of positive emotions. Motivation and Emotion, 24, 237–258.
Gabrielsson, A., & Lindström, E. (2001). The influence of musical structure on emotional expression. In P. Justlin & J.
