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Abstract

Clinical depression reportedly affected about 3.8% of the population worldwide in 2021. First-line treatments, such as medication and psychotherapy, can be ineffective for several reasons; hence, computerized solutions have been proposed as complementary aid tools. This paper presents Symphony, a mobile casual game designed to aid individuals with mild to moderate-severe depression symptoms. It exploits puzzle-solving, music-listening, and Cognitive Behavioral Therapy to provide psychoeducation for improving mental well-being and mood, and promoting cognitive stimulation. An iterative design approach was used, and was tested by a sample of university students receiving psychological support (N = 8), who completed pre-and post-intervention questionnaires to assess the impact of playing Symphony on their depressive symptomatology, mood, and also to gather their perception of the game. Additionally, therapists' informal comments and observations were also collected. Results revealed that playing Symphony generated mostly positive affective responses and mood changes. Our study supports the feasibility of using Symphony as an adjunctive treatment strategy to induce positive changes in participants. However, further research is needed to validate Symphony's effectiveness and make it customizable to each individual.

Keywords (separated by '-')

Depression - Music - Walking - Casual Games - Puzzles

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A Pilot Study to Evaluate the Feasibility of a Science-Based Game Called Symphony to Alleviate Depression Symptoms

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Abstract. Clinical depression reportedly affected about 3.8% of the population worldwide in 2021. First-line treatments, such as medication and psychotherapy, can be ineffective for several reasons; hence, computerized solutions have been proposed as complementary aid tools. This paper presents Symphony, a mobile casual game designed to aid individuals with mild to moderate-severe depression symptoms. It exploits puzzle-solving, music-listening, and Cognitive Behavioral Therapy to provide psychoeducation for improving mental well-being and mood, and promoting cognitive stimulation. An iterative design approach was used, and was tested by a sample of university students receiving psychological support (N = 8), who completed pre-and post-intervention questionnaires to assess the impact of playing Symphony on their depressive symptomatology, mood, and also to gather their perception of the game. Additionally, therapists' informal comments and observations were also collected. Results revealed that playing Symphony generated mostly positive affective responses and mood changes. Our study supports the feasibility of using Symphony as an adjunctive treatment strategy to induce positive changes in participants. However, further research is needed to validate Symphony's effectiveness and make it customizable to each individual.

Keywords: Depression · Music · Walking · Casual Games · Puzzles

1 Introduction

According to the World Health Organization (WHO), clinical depression was affecting about 3.8% of the worldwide by September 2021 [1]. Depression is a clinical condition defined as "a mental illness that causes feelings of sadness and loss of hope, changes in sleeping and eating habits, loss of interest in your usual activities, and sometimes

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physical pains" [2]. Some other common symptoms are psychomotor impariment or agitation, fatigue and loss of energy, decreased concentration and ability to think, memory difficulties, and, in some cases, suicidal ideation [3]. The most common intervention for depression consists of antidepressants, psychotherapy, or both combined, being Cognitive Behavioral Therapy (CBT) one of the most accepted psychotherapies [4, 5]. CBT considers that depression is perpetuated by depressive affect and compromised functioning due to "irrational beliefs toward the self, the environment and the future", so it is aimed at reducing depressive symptoms by reversing these attitudes and changing maladaptive behaviors for more functional and positive beliefs [6]. Obstacles to treatment, such as the lack of health professionals, and geographical limitations, have led to proposing computerized interventions to increase adherence, including computerized CBT, online interventions, and serious games [7–9].

According to the Mood Management Theory, highly absorbing media are generally used for mood regulation, aimed at either maintaining a positive mood or changing a negative mood [10]. Being video games among these absorbing media, Serrone proposed that they interrupt cognitive rehearsal of the circumstances that triggered the negative mood, providing individuals with a temporary positive relief that is important to deal with depression symptoms [11]. Most games aimed at Depression treatment in the literature have been based on CBT and designed for children, adolescents, and/or young adults [9, 12]. Among the best known in the literature we have gNAT Island [13], Journey to the Wild Divine series (Wild Divine, 2001 - now Unyte Health: https://unyte.com/), and SPARX/Rainbow SPARX [14]. gNATS island is a computer game aimed at adolescents and to work together with face-to-face therapy [13]. The players are in a world full of creatures that can sting them and cause them automatic negative thoughts, where they will find characters that give them strategies on how to deal with such thoughts [12]; Journey to the Wild Divine is a series of adventure games available for PC and Mac that use biofeedback software to reduce stress and learn to balance emotional responses [12]; SPARX is a fantasy roleplaying game aimed at teaching young people suffering from depression how to deal with their condition [8]. The players control a character whose mission is to restore balance in a fantasy world through problem-solving and shooting at negative thoughts, and it has proven to be effective as a standard treatment in reducing depression for children [8, 12].

However, these games might sometimes be challenging to find, costly, require specialized software (e.g., biofeedback software), and belong to a genre that requires certain regular commitment (e.g., roleplay). These are different from another type of video game known as Casual Video Games (CVG), which are based on familiar game concepts, played in a short time, quick to access, easy to learn, and with no regular time commitment to play [15]. Russoniello et al. [15] performed studies using three CVGs: Bejeweled 2 (a matching-sequencing game where the player string jewel-like objects together in order to get points), Bookworm Adventures (a crossword/scrabble type of puzzle game), and Peggle (pachinko/pinball type of game). Analyses in a first study revealed that these three games decreased depression scores compared to control groups [15]. A subsequent study aimed at studying whether a prescribed regime of CVG play would have the same effects also showed significant reductions in depression symptoms after playing one of these three games for at least 30 min, three times a week for a

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month [16]. Further studies by Fish et al. also showed that the same prescribed regime of CVGs using the same three games reduced anxiety symptoms in a population suffering from depression [17]. In fact, it has been suggested that playing puzzle video games improves the player's mood by promoting relaxation and reducing anxiety as they are more rewarding and less frustrating than other genres [18]. Overall, out of the three CVGs mentioned above, at least two can be clearly classified as puzzle games, supporting their use for mood regulation purposes.

Another highly absorbing media widely used for emotion and mood regulation is listening to music [19]. Research has demonstrated that young people are more likely to recur to this media and withdraw from social activities whenever they are in a negative mood. This is marked in cases of clinical depression, usually leading to an emotional dependency on music [20]. Research suggests that most young individuals who suffer from depression had, at some point, listening behaviors that showed limited awareness when it came to their music choices, with frequent negative results, until they were made aware of the consequences of their habits [20]. A study by Stewart suggests that the most common strategies used to manage negative mood can be reduced into two: 1) selecting music that differs from the negative emotion, and 2) selecting music that mirrors the negative emotion felt. The first strategy is usually aimed at distracting or hiding the undesired feeling [19, 20], providing a short-term relief that can benefit individuals with depression since it reduces the time ruminating on negative events [20]. The second strategy is reportedly the most used to deal with negative emotions, with some using it to gradually change to more positive music. According to the author, this strategy produces more long-lasting results in mood repair [20].

Physical activity also plays a role in the management of depression symptoms. Demotivation, low mood, and fatigue are common symptoms of depression that lead to a lack of exercise and can result in physical comorbidities such as cardiovascular diseases [21]. Studies suggest that the effects of exercise are similar to those of psychotherapy [21]. Another aspect to keep in mind is the type, intensity and frequency of exercise: even though it seems vigorous exercise has greater effects on depression, some evidence suggests that self-selection of exercise intensity is optimal and successful in depressed individuals [21]. Moreover, a study on the preferred activities for exercise-based depression programs showed that walking is the most preferred activity (followed by weight-lifting, yoga, and dancing), with most participants preferring sessions of 30–60 min that occurred multiple times a week, which were provided at home and individually [22]. Even though there are not any specific guidelines regarding the number of steps depressed individuals should walk a day, research by Tudor-Locke and colleagues estimates that healthy adults can take approximately 4,000 and 18,00 steps a day, being 100,000 steps/day a reasonable target [23].

Building on the existing evidence, we designed Symphony, a mobile video game aimed at supporting young adults with depression symptoms who might not have immediate access to psychological treatment. It is aimed at providing psychoeducation and symptom relief without the presence of a therapist. We opted for a CVG design as it does not require a regular commitment, can be played in short periods, and is easy to learn. Based on the fact that the CVGs that showed negative mood, depression, and anxiety levels reduction were puzzle-like, we also opted to use puzzles. Considering

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that depression is usually characterized by cognitive impairment, we have decided to include two specific puzzle games: mazes and nonograms, as they are both characterized by their cognitive stimulation potential. The evidence in the literature on the common use of music for emotional regulation, and the need to increase awareness of the strong influence our music choices can have on our mood, led us to include a mini-game we will refer to as Emotion Identification and Regulation game (EIRg), aimed at showing how our music selection can improve, or worsen, a character's mood while giving tips on how to select music appropriately based on the found literature: emphasizing the benefits of either using music that differs from or that mirrors the negative mood but in less intensity, and the drawbacks of using songs mirroring the negative mood to intensify it. Furthermore, considering that lack of activity and exercise is a common symptom in depressed individuals, we included walking as a necessary activity to gain access to the different chapters of the game. Finally, further psychoeducation on strategies for improving mental well-being is given through the game's narrative and mission. Symphony was developed through an iterative design approach involving 21 participants, whose prototype was finally tested by 8 volunteers from the target population.

2 Materials and Methods

2.1 Iterative Design Process

We developed the prototype of game called Symphony, a casual video game to aid young adults (18–30 YO) with minimal to moderately severe depression symptoms. We used an iterative design approach that included the following steps:

Input from Therapists. Aimed at gathering information on what a proposal of this nature should consider, 3 therapists (female, 30–45 YO, 12–23 years of experience) from the University of Madeira's Psychology Service (UMaPS) provided a written document with the most important aspects to consider for our design, such as encouraging the person to share healthy and pleasurable activities (e.g. do exercise), have supportive relationships, exposure to the sun and nature, minimizing stress, maximizing relaxation, and developing emotion regulation strategies.

Gathering Video Game Preferences of the Target Population. Aimed at understanding the gaming profile of young adults with depression symptoms, a sample of 9 patients of the UMaPS (3 females, 18–28 YO) volunteered and filled in a questionnaire on "The use of Video Games by Young Adults". All participants signed an Informed Consent and completed the PHQ-9 questionnaire to make sure they met the criteria for mild to moderate levels of depression symptoms (a score of 5 points or above). 78% played video games, all played at home in their free time for relaxing. 44% reported playing for up to one hour a day and 33.3% for about 1–2 h. 55.6% reportedly liked puzzle games or games played online with others, 55.5% put on some of their own music while playing, and 33.3% of participants reported listening to video game music all the time. Overall, we can conclude that a game to be played in their free time, for up to 1 h a day, with relaxation purposes would be acceptable for this population. Furthermore, puzzle games are among the most liked genres, suggesting their acceptability. Finally, a game that allowed them to use music of their own selection is likely to be well received.

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Designing Puzzles. A set of mazes and nonograms with different configurations were tested by 2 participants (1 female, 30 and 45 YO). Paper versions of 10 × 10 and 15 × 15, with and without checkpoints to reach, and nonograms 10 × 10 and 15 × 15 were tested. Based on observations and the participants' oral feedback, 15 × 15 mazes with checkpoints and 10 × 10 nonograms were selected to be implemented in Symphony.

Assessing the Emotional Content of Popular Songs. Because depressed individuals are normally unsuccessful when selecting music that helps them improve their mental state, we decided to work with a list of popular songs instead of their own selection for this pilot. Hence, we aimed at classifying these songs in terms of emotion recognition and intensity, it had two phases:

Classifying Valence. 15 participants (8 female, 18–40 YO), with each song evaluated by 6. They were asked to listen to the excerpts of about 100 songs through a set of speakers and point at a smiley that better represented the song, and classify them within the six basic emotions proposed by Paul Ekman: Joy/Happiness, Sadness, Disgust, Anger, Fear, and Surprise [24]. 82 of the tested songs showed consistent ratings among participants and were selected as follows: Joy/Happiness (34 songs), Sadness (20 songs), Anger (11 songs), and Fear (7 songs).

Classifying Intensity. Subsequently, 11 participants (7 female, 20–40 YO) were given the list of 82 songs with the classification given in the previous phase, and empty boxes corresponding to three levels of intensity: light, medium, and strong. They were asked to listen to the excerpts of each song through headphones and tick one of the three levels based on how intense they perceived the emotion each song had been classified as. 78 songs showed consistent ratings and were finally selected to be implemented in Symphony.

Observations on Uses of Music for Mood regulation. Aimed at comparing the music selection strategies used by the general population with the literature, 6 participants (2 females, 24–40 YO) participated in this study. A song of negative valence was played, and participants were asked to pick a song out of four options with positive valence for improving the negative mood. Results showed that facing sadness, looking for a boost to leave the negative state (contrasting) was preferred; facing fear, choosing something that inspired calm, no worries, and tranquility was a tendency; and when facing anger, making anger diminish without creating big contrast (gradual reduction) was a tendency.

Low-fidelity Prototype: Story and Game Mechanics. Aimed at confirming whether the psychoeducational message was perceived and story-mechanics-gameplay were balanced, we tested a low-fidelity prototype in two phases:

Therapists. 3 therapists from the UMaPS (female, 30–45 YO) enacted playing using a paper prototype of the game and existing puzzle apps. Notes from observations were taken, and the therapists gave oral feedback. Positive feedback included walking, the mini-games and the well-structured narrative. Recommendations included adding background music and a 'skip dialogue'. Based on the observations, mazes of up to 15 × 15 and 10 × 10 nonograms were considered ideal.

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General Population. 7 participants (3 female, 24–43 YO) followed the same procedure. Among positive feedback was the connection between story-mechanics-gameplay, the possibility of listening to enjoyable music, cognitive stimulation, and how walking reflects in the game. Changes recommended were reducing the narrative complexity and adding puzzle tutorials. Observations showed that a 'back dialogue' button would be a good addition.

High-fidelity Prototype: Usability Test. 5 participants from the general population (3 females, 25–27 YO) filled in an Informed Consent, and an Adapted Game Experience Questionnaire inspired by IJsselsteijn and colleagues' Game Experience Questionnaire [25]. Results showed appreciation for the game's story and aesthetics, the puzzles (especially mazes), music mirroring and contrasting songs, and the encouragement to go outside for a walk. Changes recommended were improving the game dynamics of the EIRg, the number of steps, and bringing more variety of tasks.

2.2 Implementation

Based on the participatory and iterative process outlined above, we developed Symphony using Unity Software (version 2019.4.1f1) [26]. Psychoeducation on strategies to tackle depression symptoms was implemented mainly through the story, making the goal of the game to restore four relics that represent four important principles to maintain a healthy mind: Nature, Friendship, Resilience, and Creativity (Fig. 1.a), and the environment improves as these are collected. For this, they need to rescue the Guardians (embodied healthy thoughts and emotions) (Fig. 1.c) who are trapped in a negative mood and avoid or neutralize Voids (embodied negative thoughts and emotions) (Fig. 1.d). To move throughout the world and set the Guardians free, the player has to cross mazes (Fig. 1.f) and solve nonograms (Fig. 1.e), activities that the literature suggests help with mood improvement and gradually increase in difficulty.

To provide psychoeducation on the effect of music-listening behaviors on mood, the Guardian is represented with a negative mood in the EIRg, and the players have to try to improve their mood by following tips given when selecting appropriate songs from a provided set, and avoiding songs that might negatively affect the Guardian (Fig. 1.b). To access each chapter of the game, the participant needs to select an intensity of exercise (low, medium, high), and a battery will give feedback on the steps walked (Fig. 1.g). Depending on the participant's play and walking rhythm, they were to dedicate approximately 5–30 min a day to cross the mazes, 5–10 min to solve the nonograms, and 5–10 min to complete the EIRg. Also, the number of steps and corresponding time taken per day varied according to the player's choice on exercise intensity: low (2000 steps/15 min per day), medium (4000 steps/30 min per day), and high (6000 steps/45 min per day).

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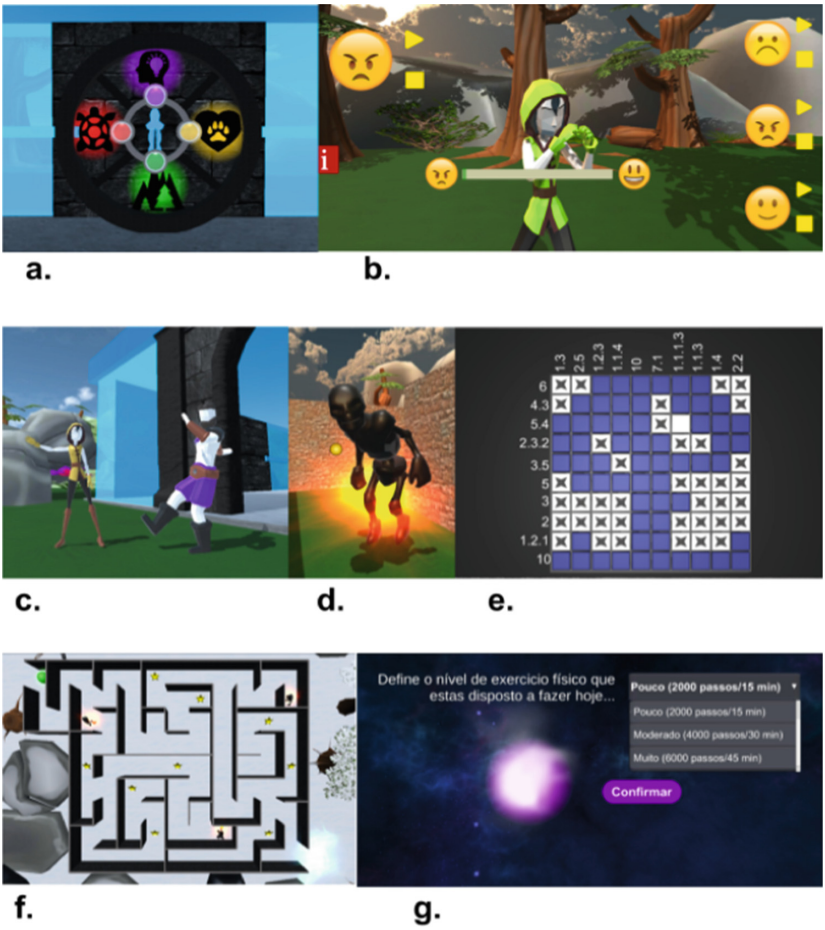

Fig. 1. Screenshots from Symphony: a. Screenshot of the Self-Knowledge Mechanisms with the collected relics; b. Screenshot of the Emotion Identification and Regulation game; c. Screenshot/Detail of two Guardians; d. Screenshot/Detail of a Void; e. Screenshot of one of the nonograms; f. Screenshot of one of the mazes; g. Screenshot of the screen to select exercise intensity.

2.3 Measures

Data was collected through a self-reporting questionnaire delivered online, developed using Google Forms, and disseminated by the UMaPS therapists amongst patients who volunteered for the study and met the inclusion criteria. The questionnaire included:

Informed Consent. They agreed to participate and to the anonymous use of the data collected. Only after this verification, participants had access to the following questionnaires.

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Demographic and Player Profile Questionnaire. It was aimed at getting basic information about the participants and characterizing this sample in terms of their video game experience, preferences, and routines. Composed of 11 items, the participants were required to give socio-demographic information, such as their age and degree, and provide information about their profile as video game players, such as how frequently they played and their favorite types of games.

The Patient Health Questionnaire (PHQ-9)'s Depression Module (Monteiro et al., 2019). It was used to determine whether the sample met the inclusion criteria of a minimum of mild depression symptoms and changes between the baseline and post-intervention levels of depressive symptomatology. The Portuguese version of this instrument is composed of 9 items and uses a 4-point Likert scale (0–3) to measure depression severity based on the 9 DSM criteria. The results are interpreted as follows: 0–4 = none; 5–9 = mild depression; 10–14 = moderate depression; 15–19 = moderately severe depression; and 20–27 = severe depression. Both the original and Portuguese versions of the PHQ-9 have shown test-retest reliability. Further, the Portuguese version has been determined to have a strong construct validity in assessing depression in university students [27].

The Positive and Negative Affect Schedule (PANAS) (Costa Galinha & Pais-Ribeiro, 2005). It was used for determining both the baseline and after-intervention levels of positive and negative affect. The Portuguese version of this instrument is composed of 20 emotions distributed in two subscales: 10 items for positive affect and 10 items for negative affect. It uses a Likert scale (1–5) to assess positive and negative affect. Ideally, the sum of all items on the positive affect subscale should be greater than 30, and all items on the negative affect subscale should sum up to less than 20. Both the original and Portuguese versions have proven to have good internal reliability [28].

Adapted Game Experience Questionnaire (GEQ). It was used to collect information on the game experience as a whole and the mini-games (mazes, nonograms, and EIRg), being most of the items inspired by IJsselsteijn and colleagues' Game Experience Questionnaire [25], marked from 0 (Not at all) to 4 (Extremely). It also included open questions aimed at collecting their opinions on what the game was about, the role of music in the game, strategies used during the game, and what they liked the most or least. Since it was primarily used to collect qualitative data not destined for systematic analysis, no scoring system was applied.

2.4 Sample

This was a within-group experiment with a convenience sample composed of university students receiving support at the UMaPS that met the following inclusion criteria: being at or over 18 years of age, and scoring a minimum of 5 points in the PHQ-9. A total of 8 people participated in this study, all students (5 women, 1 undisclosed gender; 20–28 YO, M = 22.63; SD = 2.77) from different areas of knowledge. The initial screening resulted in 2 participants with mild depression symptoms (P3 and P7), 3

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with moderate depression symptoms (P1, P2, and P5), and 3 with moderately severe depression symptoms (P4, P6, and P8). 3 participants (P1, P2, and P8) reportedly received external psychiatric support during the study for other comorbidities. One participant (P1) was reported as being through a complicated situation during the experiment and had recently started taking medication, and another participant (P4) happened to have finished his/her university evaluations when the experiment started. Baseline data revealed that 100% of the participants showed lower than average Positive Affect scores (<30) that ranged from 10 to 25; 75% (P2, P3, P4, P6, and P8) had higher than average Negative Affect scores (>20) that ranged from 22 to 34, while 25% of participants (P1, and P7) had lower than average Negative Affect scores.

2.5 Procedure

This research was conducted in accordance with the Declaration of Helsinki as revised in 2013. Due to health and safety measures demanded by the Covid-19 pandemic, all contact with the participants took place online, in Portuguese, and with the therapists from the UMaPS as intermediaries. First, the Google Forms questionnaire was sent to participants. A researcher was made available through e-mail for any difficulties they would encounter with the game and was reminded to recur to the UMaPS for any psychological and/or emotional support they needed. Once the participants gave their consent, they answered the Demographics and Player Profile, the PHQ-9, and the PANAS questionnaires. Following this, they were instructed to download the game on their mobile phones. Even though CVGs aim to be played at the individual's rhythm, participants were instructed to play 1 chapter per day (5 days in total) but were given 7 days to complete it for research control purposes. After completing the game, they completed the PHQ-9, the PANAS, and our adaptation of the GEQ.

2.6 Statistical Analyses

Data analysis was performed using IBM SPSS Statistics for Windows, version 26.023 [29]. Due to the ordinal nature of our data, we performed non-parametric analyses, more specifically the Wilcoxon signed-rank test, to evaluate pre- to post-intervention differences in depressive symptomatology, positive affect, and negative affect, with a significance level of 5%. Pearson's r was used to determine effect size.

3 Results

3.1 Game Experience Assessment

All of the participants finished the intervention within the given time frame of 5 to 7 days. The GEQ was used to assess the game experience of Symphony as a whole and for each of the mini-games (mazes, nonograms, EIRg). Regarding Symphony as a whole, they reported being interested in the story (Mdn = 2.5), while they felt it was not difficult or required much effort (M = 1). Regarding the mazes, participants did not feel challenged (Mdn = 1) and were frustrated and bored (Mdn = 1). Nonograms elicited

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positive feelings (Mdn = 3) and made them feel skillful and challenged (Mdn = 3). Regarding the EIRg, participants reported not being challenged (Mdn = 0) and being tiresome (Mdn = 3) but at the same time made them feel good (Mdn = 2). Overall ratings after playing the game were reasonably neutral for items such as satisfaction, exhaustion, or pride (Mdn = 2). Notably, Symphony scored low on bad feeling elicitation (Mdn = 1).

Information collected from the open questions indicated that most players understood the game was about music, emotions, and emotional regulation, and also mentioned self-knowledge and cognitive stimulation. The role of music was mostly perceived as a contributor to our well-being, provoker of diverse emotional reactions, and make players know how to use them for emotional regulation. The nonograms were the most liked features, regulation of emotions, and the background music from the puzzles second; 25% of participants also mentioned walking and choosing their objectives as a liked feature. Consistent with the GEQ data, what was liked the least was the Emotion Identification and regulation game, more specifically, the objective and strategies not being clear enough and the little variety of emotions. When asked, on a scale of 1 to 4, to what extent this game might influence their future daily behavior, the median value was 2. Finally, some technical issues were mentioned, such as small collision boxes, NPC's AI, slow loading, low responsiveness of some elements to touch, and device overheating.

3.2 Baseline to Post Experiment Changes

In this pilot intervention to assess the feasibility of Symphony as a tool to alleviate depression symptoms through gameplay, we compared PHQ-9 and PANAS data before and after playing the game, using both individual scores and statistical analyses (Appendix 1). The PHQ-9 scores revealed overall improvements, with a median reduction of 3 points after the intervention: 50% of the participants (P3-P6) showed reductions in depression scores that ranged from 1 to 4 points, 12.5% (P7) showed no changes, and the remaining 37.5% (P1, P2, and P8) had a mild increase in depression scores that ranged from 1 to 2 points. Overall, 50% of participants (P2, P3, P7, and P8) remained within their pre-intervention ranks of depression levels, 37.5% (P4-P5, and P6) reduced in their ranks of depression levels, while only 12.5% (P1) showed a mild increase in his/her depression level rank. Although we identified a decrease, the statistical analysis indicated that the differences in levels of depression symptoms obtained from the PHQ-9 before (Mdn = 13.00; SD = 3.82; IQR = 6.25) and after the experiment (Mdn = 10.00; SD = 4.44; IQR = 7.75) were not statistically significant. AQ4

Consistent with the PHQ-9 data, the PANAS questionnaire revealed an overall median increase of 2 points on the Positive Affect score and a reduction of 5 points on the Negative Affect score. Regarding the Positive Affect subscale, 75% of participants (P1, P3-P6, and P8) showed improvements in their scores ranging from 1 to 7 points, while 25% (P2 and P7) showed reductions of 1 point. On the other hand, on the Negative Affect subscale, 50% (P3-P6) showed a decrease in their scores ranging from 2 to 17 points, while the other 50% (P1, P2, P7 and P8) showed an increase ranging from 1 to 4 points. Overall, 100% of participants continued with lower-than-average Positive Affect scores after the intervention, but the Negative Affect scores of 62,5% (P3-P7) dropped below the average, with 35.5% (P1, P2, and P8) maintaining an above-average

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Negative Affect score. Statistical analyses of both subscales of the PANAS were also made: changes in the Positive Affect subscale showed statistically significant differences before (Mdn = 20.00; SD = 4.37; IQR = 3.50) and after the experiment (Mdn = 22.00; SD = 4.81; IQR = 6.25), with a T = 32.00, p = 0.049, and r = 0.697. There were no statistically significant changes in the Negative Affect subscale before (Mdn = 23.00; SD = 5.44; IQR = 5.00) and after the experiment (Mdn = 18.00; SD = 5.45; IQR = 9.00) (Table 1).

Table 1. Individual scores for the PHQ-9 and PANAS pre- and post.intervention.

P#	Age	Sex	PHQ-9 before	PHQ-9 after	PANAS POS before	PANAS POS after	PANAS NEG before	PANAS NEG after
1	21	N/I	13	15	21	22	19	23
2	21	F	11	12	19	18	23	27
3	25	F	8	7	21	25	23	17
4	21	M	15	8	10	13	22	11
5	24	M	13	7	18	20	24	19
6	20	F	16	14	22	29	34	17
7	21	F	5	5	25	24	15	16
8	28	F	15	17	19	22	25	26
M =	22.6	-	-	-	-	-	-	-
Mdn =	-	-	13	10	20	22	23	18

4 Discussion

The deployment of Symphony was successful in terms of adherence, with 100% of the participants finishing the intervention. No statistically significant changes were neither expected nor found in terms of depression levels reduction due to the reduced sample size (N = 8) and the length of the intervention (1 week). Regardless, median and individual scores reflected improvements in half of the sample and relative stability in others. It is worth mentioning that the 3 participants (P1, P2, and P8) who showed a slight increase in symptoms were receiving external psychiatric support for other comorbidities. P1, in particular, was reportedly going through a very difficult situation in his/her life and had started taking medication by the time of his/her participation. All of these factors may have affected the results of an experience that could have otherwise helped them improve or remain stable. Let us also consider that P4, who showed dramatic reductions in depression levels, finished his university evaluations while participating in the intervention, a factor that may have influenced such results.

The statistically significant increase in Positive Affect suggests that a multicomponent CVG like Symphony may be effective for mood improvement, providing a small but

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significant relief for depressed individuals. Further, despite not being statistically significant, individual reductions in Negative Affect in most participants may once again suggest that it has potential as a tool for mood management. Overall, these results seem to support the viability of our approach, and the need for further research and to extend the current study.

As a multicomponent tool, we cannot determine precisely which elements of Symphony worked the best or the worst, and which ones had the greatest or lowest influence on the results. However, data on their game experience may give us some helpful insight on what was appreciated about the game and what could be improved, data that we consider useful to inform future designs of mobile CVGs to aid individuals suffering from depression. For instance, feedback revealed that the participants appreciated the narrative and did not find the game required too much effort. The added exercise factor was highly appreciated, and according to the feedback from one of the therapists, it might be even more beneficial if it can be adapted to the player's daily routine. This suggests that not only adding the exercise factor to a mobile game is feasible, but it has good acceptability among depressed individuals.

Feedback also revealed that some mini-games could be improved and made more challenging, highlighting the importance of achieving ideal levels of challenge. We speculate that allowing the player to select the level of difficulty they would like to approach the mini-games in each chapter would be beneficial for a population of depressed individuals, whose fluctuations in mood and self-confidence can strongly affect their performance facing different degrees of challenge and, subsequently, their perception and enjoyability of the game.

Further, the participants' feedback regarding music's role as a contributor to our mental well-being suggests that the EIRg's psychoeducational purpose was met. However, it needs further development in mechanics and playability, as it scored the lowest in enjoyability and challenge. Improvements might include the use of music they listen to every day. A video game that teaches emotion regulation strategies and obliges the player to apply this knowledge both in the game and the real world could have much more impact because they are learning through doing. Overall, results suggest that Symphony managed to provide relief to some participants, which is meaningful in cases of depression.

This research has some limitations that need to be considered. First, our sample was quite small and not very varied, which makes these results preliminary only. Another one is the casual nature of this type of game: it is designed to be played in the player's own private space, on their own devices, without external supervision, and out of the controlled environment of a lab. This means that we rely on the participants' reports, as we could not monitor whether they followed the instructions of playing one chapter per day, or if they walked all the steps required, as a step-meter can be easily tricked. Further, as a CVG, it is supposed to be played at the participant's own pace and whenever they feel like it. Hence, the fact that they were instructed to play one chapter a day systematically and were given a time limit to complete the game may have affected the results. Another considerable limitation is the fact that we mainly used self-reporting psychometric measures, so the risk of biased answers is always present.

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Much work can be done to determine what aspects of Symphony work the best, how to improve it and explore other research methodologies to test their efficacy. As a CVG, we aimed at testing the mobile video game in its 'natural environment'; in other words, in the comfort of their homes, or while on a walk in the park rather than in a lab or wired to any instruments. However, complementing the self-reporting psychometric tests with measures such as heart rate would be helpful in strengthening the evidence. We also believe that it would be useful to carry out studies focused on each mini-game that makes up Symphony (mazes, nonograms, and EIRg), not only to determine which of them might have a greater influence on mood improvement, but also to find their flaws and make them better games. This would be especially beneficial for the EIR game; to our knowledge, there are no references to game mechanics that use popular music selection for emotional regulation. This mini-game could be improved by, not only providing psychoeducation, but also a relaxing and engaging gameplay experience, and this requires testing feasible mechanics.

Furthermore, Symphony was not used here in conjunction with therapeutic sessions, which the literature has shown to be feasible and successful at reducing symptoms of depression and anxiety. Thus, it would be interesting to compare the independent use of Symphony by affected individuals against its prescribed use as part of a therapeutic program. Moreover, even though results show short-term improvements in the participants' mood, we could not carry out long-term studies that allow us to measure whether these improvements would be sustained over time and to see whether playing the game brings, or not, any behavioral changes in the long term. Finally, this study would benefit from being extended to a larger population, and future adaptations to the personal characteristics of each participant.

5 Conclusion

The results show that Symphony is feasible and can be a valuable tool to provide psychoeducation and mood relief to individuals with mild-to-moderate symptoms of clinical depression. Results might suggest that puzzle-solving tasks can provide relaxation while cognitively stimulating users. Also, adding physical activity to a mobile game has proven feasible, positive, and can be well received by the players. However, research on how to aid clinically depressed individuals adaptively using their personal music selection through gameplay must continue, preferably with larger samples. The use of music in this game had mainly psychoeducational purposes, but the field would benefit from future studies on game mechanics that allow depressed individuals to use their own music selection to train their mood regulation skills in a motivating, challenging, and engaging environment.

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Chapter 10

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