

TrainBrain: A Serious Game for Attention Training

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ABSTRACT

Attention deficits can be caused by many factors and can arise from infancy to aging. An alternative to treatment is attention training with the use of electronic games. The emergence of new mobile applications for the training of attention aims to enhance the motivation of participants and, thus, increase adherence in treatment. This work aims to present the development of the serious TrainBrain game for attention training. The game aims to minimize the effects of the decline of attention, through training that can be applied to any individual. HTML5, CSS3 style sheets, JavaScript, jQuery library and framework PhoneGap were used for the development. An evaluation of the usability of the game was conducted with 30 users and the results pointed out that the usability aspects of the game were satisfactory.

General Terms

Serious game for attention training

Keywords

Mobile applications; serious games; attention deficit; health informatics

1. INTRODUCTION

The warning, one of the main cognitive functions, is characterized as an active process, but not necessarily conscious. She refers to the ability to select and focus on mental activity [1], with an important role in the daily lives of people, since these activities occur in environments full of stimuli, which occur continuously [2].

For Lima [3], the attention can be classified as: focused, selective, sustained and divided alternately. The concentrated attention indicates the ability that an individual has to select an incentive in front of others and able to keep the attention on this stimulus for the longest period of time, to achieve the quality of the task performed and income [4]. Selective attention is the ability to select certain stimuli at the expense of other [5]. Support is the ability to remain focused on a stimulus for a certain time to fulfill a task [6]. Alternating attention is related to the ability to change the focus to use attention between a stimulus and another during the execution of a same task [7]. Finally, the divided attention is the possibility of the outbreak of different stimuli for performing different tasks simultaneously [8].

According to Garcia et al. [9], selective attention also is related to learning. In addition, is the ability to focus mental resources on the information that is most relevant at a given moment, for example, the ability to distinguish a figure of a specific context through the removal of stimuli [10].

Different factors influence changes in attention, which can manifest itself since childhood or during the aging process. Among them we highlight the attention deficit hyperactivity disorder (ADHD), present in some children and responsible for a set of Sociomedical losses, especially school difficulties [11]; and the aging brain, leading to cognitive deficits commonly observed as natural in aging as forgetfulness of recent events, calculating and attention [12].

There are several ways to treat attention deficits involving since pharmacological methods to training through video games [13][14] computer [15][16] or mobile device (tablet or smartphone) [17][18].

Regardless of the type of game, all have features that trigger the interest of users, either through the interaction, touch gestures on the screen, the constant innovation that avoids the routine or the use of attractive graphics. Yet, because they have specific purposes and purposes for a particular area of knowledge that go beyond entertainment, are classified as serious games [19].

There are various initiatives to apply serious games in the everyday life of people, using any type of technology [20]. However, for Carvalho and Ishitani [21] the use of serious gaming on mobile devices provides motivation and convenience to its users. Serious gaming on mobile devices have some advantages in front of the other, as, for example, the ease of interaction in any place, enabling a more routine access.

Research findings indicate that the intervention of serious games, mobile technology, for the training of attention offers numerous contributions to the improvement of atencionais skills. At present, there are several researches and projects developed or in development that address this subject [22][23].

Given this, this work aims to present the development of serious game called TrainBrain for attention training. The TrainBrain is intended to train the attention focused, selective and alternating. Finally, will be presented the results obtained

with the evaluation of the usability of the game, carried out with users in order to verify its complexity of use.

This article is organized into four sections: section 2 presents the methodology of development of the game, the section 3 presents the game TrainBrain and its features, in section 4 addresses the submission of evaluations. Finally, section 5 presents the conclusion of work.

2. METHODOLOGY

The survey was developed in two steps. It was initially performed a systematic review of the literature (RSL) to identify, evaluate and select existing mobile applications for cognitive training. The RSL sought to demonstrate experimental models and application specifications, in addition to checking the usability principles employed. The results are presented in [24].

The second step consisted in the development of the game. For both languages were used to allow cross-platform and web development. In this way, the languages chosen were: HTML5 (HyperText Markup Language 5), to the markup and the structuring of the content; CSS3 style sheets (Cascading Style Sheets 3), employed in the layout and the presentation of the document; JavaScript, responsible for implementing the features of the game and the jQuery library, which facilitates the inclusion of dynamism and interaction mechanisms to web pages.

Web languages HTML5, CSS3 and JavaScript allow the development of applications for any browser and also allows cross-platform development, including for the mobile platforms: Android, iOS and Windows Phone. To this end, we used the PhoneGap framework [25], an open source technology that turns the web code in an application that can run on various mobile platforms. With this, you can also publish in any of the official system stores: PlayStore (Android), Apple Store (iOS) and Windows Phone Store (Windows Phone).

When using web languages, the applications are prepared to run as web pages and not as a native application, which are designed specifically for a mobile platform [26][27]. However, it is necessary to build web codes for generation of a final application allowed the application run without the need for internet connection.

Upload the web codes was carried out from the PhoneGap website Build, being asked to build the name of the game, the logo and a short description. PhoneGap offers three types of formats for download: Android .apk file, the format chosen for the compilation of the TrainBrain; for Windows Phone and .xap. ipa for iOS, and for iOS is required a key pay to build the application. After uploading the codes, it only takes one click to download the completed application to your computer. Furthermore, the PhoneGap Build generates a QR CODE (Quick Response Code), which is a two-dimensional bar code that allows you to download the application directly to your phone. The operating system is identified automatically, before the download.

3. THE TRAINBRAIN

The TrainBrain is a serious game for people of any age, and can be used for elderly or for children with TDAH, in order to improve concentration and minimize the effects of its decline. The purpose is to train three types of attention: focused, selective and, unlike the games developed by Pascual et al. [22], that trains the concentrated attention and selective, and Bless et al. [17], who trains the selective attention.

The TrainBrain is designed to adjust the positions of the screen of the mobile device (tablet or smartphone) using the responsive design. Were used in its development images with great detail, in order to encourage users to pay attention and stay focused on the details [28]. Were created numbers (1, 2, 3, 4, 5, 6) in the colours: black, blue, green, purple, red and yellow; These have as their purpose the learning and interpretation of numbers [29]. Were also created circles in colors: black, green, purple, Orange, pink, yellow, gray, Brown, greenish-yellow, magenta, blue and red.

Additionally, when the player hits what is requested, a sign of "correct" in green is displayed. To make a mistake, a sign of "wrong" in blue are so there is no confusion between the other cards. All texts in the game utilize the Arial font and size of 12pt to 20 pt, with simple and easily differentiable colors, as described by Gonçalves [30].

The TrainBrain is divided into three categories of games: Game 1, Game 2 and Game 3. Each category has three difficulty levels: easy, medium and hard. Each level has five phases to be travelled. The phases differ by the number of images available in the game, and the first four images are provided, while the last has twenty images. Figure 1 illustrates the navigation map of the game.

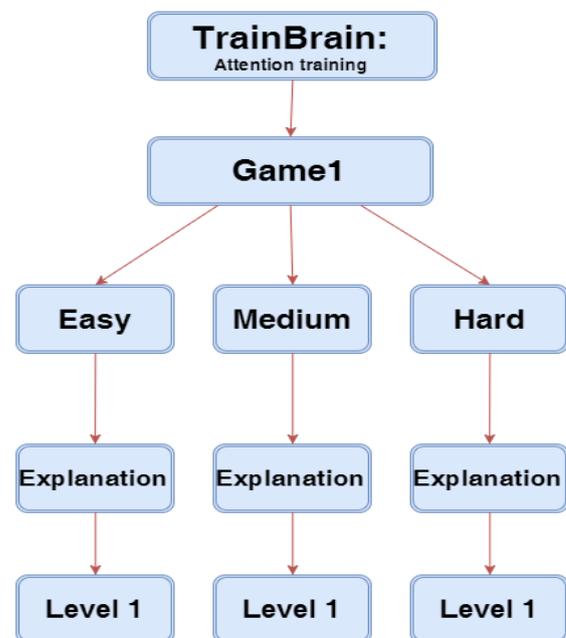


Figure 1: Seaworthiness of the game TrainBrain: attention training

According to figure 1, after being presented the splash screen (Figure 2a) the player must choose the game type (Figure 2b) and, after, must set the difficulty level (Figure 2c). When you select the game type and difficulty level, you will see a little explanation, as shown in Figure 2d. You can choose not to read the explanation, following directly for the first phase of the game selected.

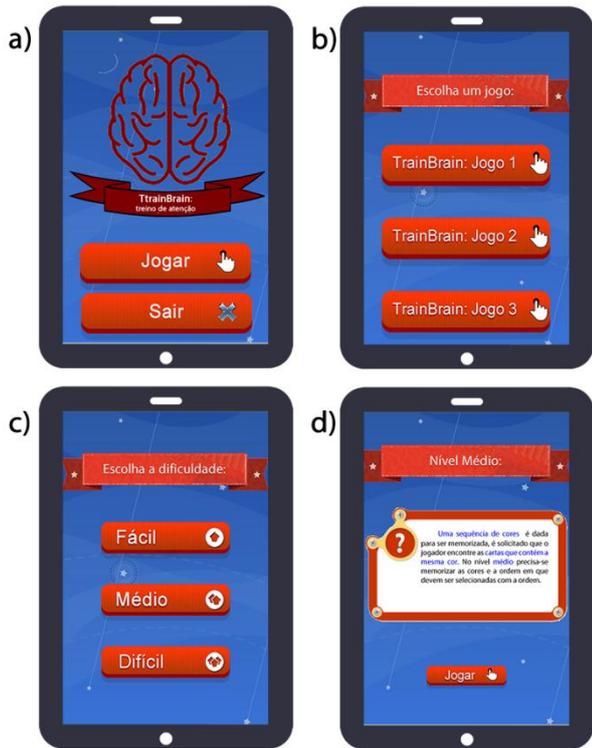


Figure 2: TrainBrain Screens

At the end of each phase, a screen allows the player to move to the next phase, choose a phase, set another level of difficulty or return to the home screen (Figure 3a). Figure 3b illustrates the screen where the user can set what stage you wish to play.



Figure 3: TrainBrain Screens

The game 1 aims the practice of concentrated attention, from the memorization of an image that is presented at the beginning of a phase. This image must be saved and select it to phase five of the game.

Levels of difficulty: easy level account with images of different figures; the middle level are colorful numbers; and the difficult level presents figures with the same color. Figure 4a shows the first screen of the game 1 and Figure 4b phase five of the same game. This last figure is possible to notice that some images were selected, which are marked with a sign of correct in green, and other images were mistakenly selected and are flagged with the wrong signal in blue.



Figure 4: Game 1 TrainBrain

The game 2 of the TrainBrain aims the practice of selective attention, which is the ID of the image that don't fit into a particular context, such as, for example, several images and an image of screw. In this case, the image out of context would be the screw (Figure 5a). Every stage of the game the images change, becoming more alike and thus increasing the level of difficulty.

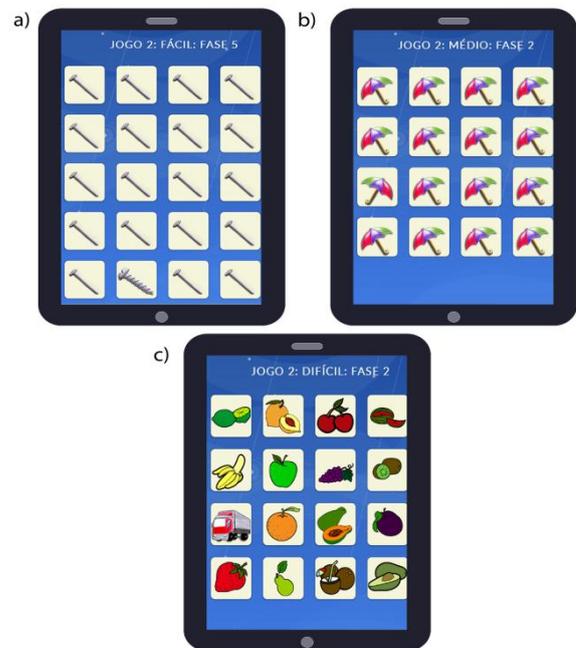


Figure 5: Game 2 TrainBrain

This game also features three difficulty levels. Easy level is displayed only one image out of context, that is, different from the other. Middle level are displayed the same images, one of them with different orientation (figure 5b). In the difficult level are several images, but all with one thing in common as, for example, pictures of fruit. The goal is to select the image totally different from the other as, for example, an image of a truck (Figure 5 c).

Finally, the game 3 of the TrainBrain aims the training of attention, consisting in the memorization of colorful circles are presented at the beginning of each phase. The first phase starts with two circles, increasing every second until you reach ten circles in phase five.

The difficulty levels of the game work as follows: easy level are presented colored circles at the beginning of each phase

and these should be selected regardless of the order in which they are displayed (Figure 6a); Middle level are displayed, in addition to the colored circles, a numerical sequence that must be respected when selecting the circles (Figure 6b); and in the difficult level images are also numbered, but not sequentially (Figure 6c) and the user needs to memorize the numerical order of the circles in time to select them.

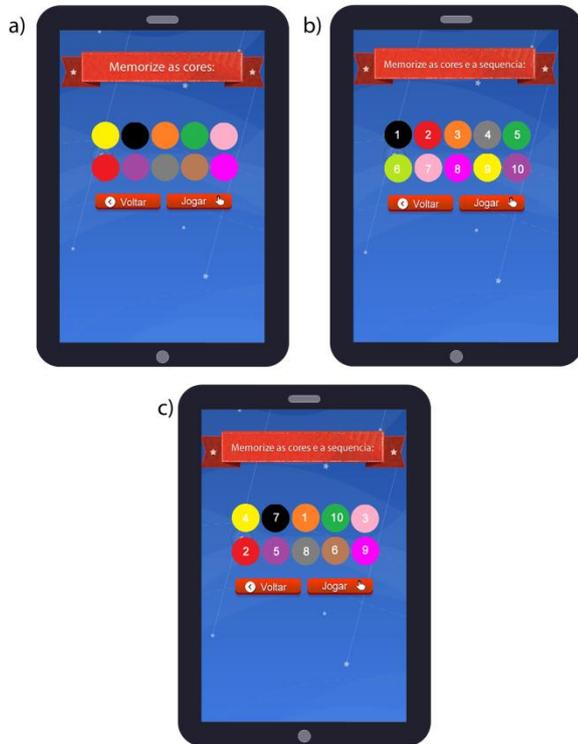


Figure 6: Game 3 TrainBrain

4. EVALUATION OF USABILITY OF TRAINBRAIN

Usability is an attribute that refers to the quality of systems interaction with users [31]. On mobile devices the application of aspects of usability, minimizes the difficulties users' interaction with the system [32]. Factors such as, for example, colors, fonts, and seaworthiness, may impair usability by using facilitated the game.

Given this, the usability of TrainBrain was evaluated from tests conducted with thirty students of higher education the courses of computer science and psychology at the University of Passo Fundo (UPF). Such courses were chosen for which encompass studies on the development and application of cognitive training, respectively. Participants had an average age of 21.77, with standard deviation of 2.66 years. The device used to perform the tests was a tablet with screen TAB 2 of 255.8mm (10.1") and Android operating system with version 4.1.2.

For data collection was used an adaptation of the Mobile Serious Game Usability Instrument (MSGUI), developed by Schmidt and De Marchi [33] to evaluate the usability of serious games for mobile devices. The instrument has thirty questions grouped into three categories: usability, gameplay and game design. For the evaluation of the TrainBrain were used fifteen issues, selected due to the relevance of the application. Multiplayer issues were excluded and designer issues that were not present in the application.

The answers were rated on a five-point Likert scale, being an equivalent to totally disagree and 5 totally agree. Participants were invited to fill the instrument after the individual interaction with the game, who understood the use of the easy level 1 Game; Game 2 in the middle level; and 3 Game on hard level.

In the category usability were performed the following issues: "I found the game easy to use", "I think I would use this play often", "I think that the functions of the game are very well integrated", "I felt confident when using the game". Figure 7 shows the averages obtained for each. The lowest average was in the question "I think I would use this play often", which gained 3.8. For Cota et al [34], young people have significant differences in choice of games, ranging from the preference given the difficulty level and the necessary skills. In this way, it is believed that the profile of the participants of the test may have negatively influenced the answers, since, being college students, have multiple stimuli of attention in their day to day and, as reported in the suggestions, found the game easy.

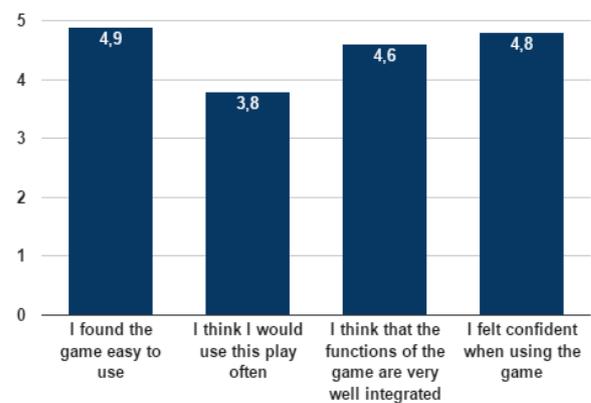


Figure 7: Usability tests

The gameplay category addressed the following questions: "The game has allowed me to track the progress of phases according to my will", "I found the rules and objectives of the game are easy to understand", "To perform tasks the game informed me about errors and successes", "The results presented were easy to be understood". The averages of these issues were between 4.6 and 4.8, as shown in Figure 8. The average obtained on the question of the game allowed me to track the progress of phases according to my will "was 4.7, reflecting on a satisfactory average for ease of navigation of the game. The lowest average in this category was the question "the results presented were easy to understand each other", with an average of 4.6. This average reflects the alert box used to display the amount of mistakes and successes, which required the click on a button to close. This result corroborates the affirmation of Carneiro and Ishitani [35] on alert boxes, which should be simple and direct, present only in times that are required.

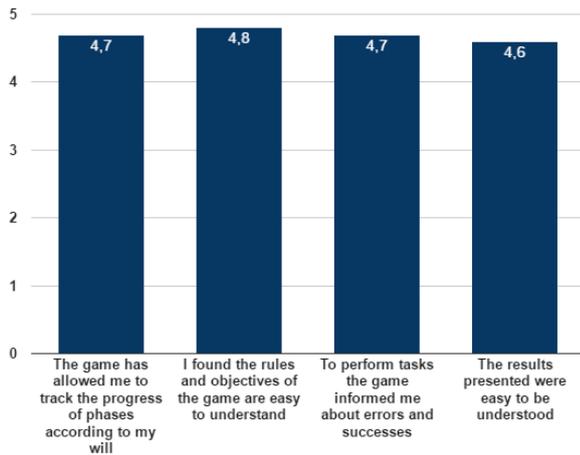


Figure 8: Gameplay tests

Lastly, the game design category has addressed the following issues: "The figures used in the game were easy to understand", "The texts used in the game easy to understand", "Were adequate the colors used in the game", "Icons of the game were easy to understand", "The screens of the game were clear and easy to understand. Figure 9 illustrates the medium-sized category. "The figures used in the game were easy to understand" has averaged 4.8, reflecting the satisfaction of users with the data used. The lowest average was 4.6 of the issue "the colors used in the game were appropriate, it is believed that this average has been undermined by the colors used in the circles used in game 3, that have already been changed. The choice of colours is one of the fundamental principles to ensure the readability in an application, and these should always be clear and contrasting with the other elements of the application such as Motti et al. [36].

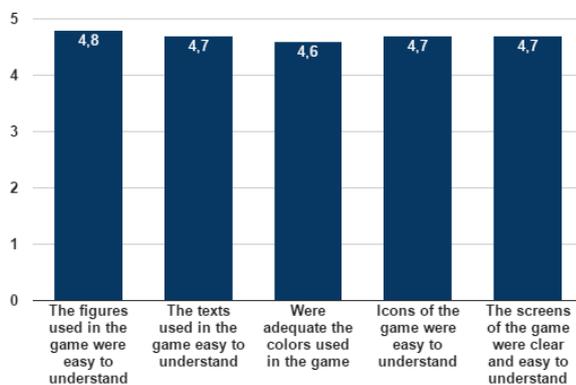


Figure 9: Design tests

After individual evaluation, participants were requested to report the problems encountered during testing and suggestions. One of the suggestions, two gained prominence: the colors used in the game 3 should be more contrasting, and which were created more difficulty levels for each category of the game.

5. CONCLUSION

The feature article reported the development of a serious game for training of attention, which can be used by any age group. Furthermore, were presented the results of usability testing conducted with users.

The game sought to work three types of attention: focused, selective and alternating. For validation tests were performed

which surrounded three categories: usability, gameplay and game design. The results obtained in the evaluation were satisfactory and some pointed suggestions have already been implemented, such as the color changes of Game 3.

As future work, new usability tests need to be carried out with a heterogeneous audience, testing on different devices, new levels with higher difficulty levels should be implemented and, finally, it would be interesting to assess the effects of an intervention with the game on the users' attention.

6. ACKNOWLEDGMENTS

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