

A Study of Dementia Preventions through Brain Training by Serious Games

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Abstract

Elderly population is increasing due to the rapid aging of society, and also increasing age-related diseases. In particular, dementia called disease of the 21st century is one of the diseases that receive the most attention. Globally, dementia population is growing rapidly in accordance with the aging rate. Today, over 46 million people live with dementia worldwide. This number is estimated to increase to 131.5 million by 2050 (World Alzheimer Report 2015).

Dementia is very important of early detection of symptoms because a disease that can be rapidly deteriorated when missed period. However early detection is not easy because the early symptoms of dementia in many cases it is recognized as memory deterioration of natural aging. So it is important to prevent dementia through continuous brain activity to activate cerebral functions.

The training to activate cerebral functions was effective in preventing memory deterioration of natural aging and dementia has been proven in several studies.

Keyword : dementia, memory deterioration, serious games

1. Introduction

Generally, the brain cognitive functions of the elderly deteriorate due to the rapid aging of the society. Memory deterioration and dementia among the elderly seems to be increasing as caused by natural aging as well as through inactive brain cerebral functions. The elderly may suffer from difficulties in performing their daily living activities due to these age-related diseases. Early detection and prevention of dementia among the elderly is essentially important in order to prevent the decline of the performance of the cognitive functions of their brains.

The elderly with dementia may experience short-term memory, have difficulty in remembering appointments or travel transactions, communication and language may be misunderstood, their ability to focus and pay attention may be lost, visual perception becomes poor, reasoning and judgment are

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unreasonable, etc. These symptoms start to show slowly and can be progressive and if not prevented, can get worse[1]. Early detection of symptoms that suggest dementia can result to early diagnosis as well as prevention through different brain training activities such as through playing serious games as suggested by this paper. Serious game training becomes a popular dementia prevention program as previous studies already show that it allows the improvement of brain cognitive functions of the elderly.

This paper deals with the discussion of brain training through serious games for the prevention and treatment of dementia for the elderly. Several serious games have been identified and investigated such as Brain Age, Tetris, Brain Metrix, etc. Brain training through serious games allows the continuous activities of the cerebral functions of the brain and thus improves its cognitive functions in the elderly. The Brain Age game developed by Nintendo is considered as the most popular series of brain training games. It was primarily designed and dedicated in order to train and test the user's memory and reflexes.

The rest of this paper is organized as follows: Section 2 discusses the related literatures; Section 3 identifies the different serious games that are used for brain training; Section 4 provides the discussion of the analysis of the serious games for training of the brain cerebral functions; and the concluding remarks are discussed in Section 5.

2. Related Literature

This section discusses the previous studies that show that performing brain training for dementia suffering patients through cognitive training programs such as playing video games is significantly effective. Cognitive training programs have shown that it can essentially improve the cognitive functions of the elderly[2-8]. It includes programs that provide tasks related to human's cognitive functions such as memory, communication and language, focus and attention, reasoning, and executive functions. The brain training includes working memory training wherein the memory can be tested and stimulated such as remembering faces or images[6]. The processing speed of the brain can also be measured through solving as many questions in a given short period of time[8]. This cognitive training can help improve the daily living performance.

Other types of cognitive training also include memory strategic training[6] and brain training

games[9]. Studies that include playing video games for brain training were also analyzed[9-10]. The Brain Age game is considered to be a popular brain training game for cognitive functions. Other games were also discussed that provides tasks to enhance the working memory, processing speed, multitasking activities, and concentrations.

The recent cognitive training studies were reviewed in order to ascertain that these programs are essentially helpful for the prevention and treatment of dementia and memory deterioration for the aging persons. They have been evaluated as to their effectivity in the improvement of the cognitive functions such as memory, executive functions, focus and attention, processing speed, etc.

3. Serious Games for Training the Brain Cerebral Functions

In this section, several serious games were considered for the prevention and treatment of dementia through the activation of brain cerebral functions. The performance of serious games provides a continuous brain activity and thus prevents memory deterioration of natural aging.

3.1 Brain Age Game

The Brain Age game[11] is considered as a video game series which is best known for concentration training and working memory. It is developed by Nintendo and is also known as Dr. Kawashima's Brain Training. The video game series contains educational puzzles that include mathematics, word games, memorization games, and the like. Through playing the game, the cerebral functions of the user's brain are always activated, thus keeps it young.



[Fig. 1] Brain Age game[12]

This serious game comes with different versions but with similar gameplay concepts. The ideal brain age for people which is 20 can be achieved through continuous training by using several training puzzles in order to test the brain. Most versions comes with some of these training puzzles:

- Arts and Letters

The Arts & Letters comes with words and memory puzzles. It also includes photo memory puzzles, connect maze, word memory, symbol matching, word scramble and other puzzles that deals with art and letters.

- Math

The Math puzzle game is comprised of mathematical and number puzzles. It goes with speed counting, serial subtraction, math recall, number memory, and other number manipulation trainings. It helps out the brain to sharpen calculations and counting.

- Sudoku

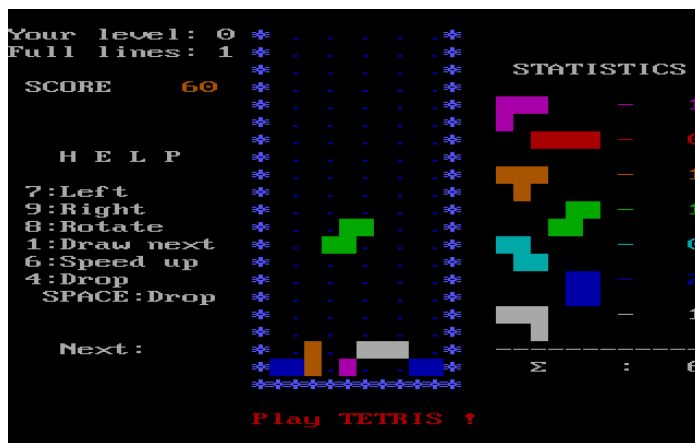
Sudoku is a logic-based serious game that allows users to place digits inside blocks. It is also known as a “Number place” which is a combinatorial number placement puzzle. The users are allowed to place digits in order to fill the 9x9 grid of blocks such that each column, each row, and each of the nine 3x3 subgrids will contain all of the digits from 1 to 9. The same integer must not appear twice for each column, each row, and in any of the 9 3x3 subgrids of the 9x9 grid of blocks.

5	3			7					5	3	4	6	7	8	9	1	2
6			1	9	5				6	7	2	1	9	5	3	4	8
	9	8					6		1	9	8	3	4	2	5	6	7
8				6				3	8	5	9	7	6	1	4	2	3
4			8		3			1	4	2	6	8	5	3	7	9	1
7				2				6	7	1	3	9	2	4	8	5	6
	6					2	8		9	6	1	5	3	7	2	8	4
			4	1	9			5	2	8	7	4	1	9	6	3	5
				8			7	9	3	4	5	2	8	6	1	7	9

[Fig. 2] Sudoku game

3.2 Tetris

Tetris is also considered a serious video game that is used for training the user's brain to prevent memory losses and dementia. It was first released in Russia and the gameworld is a tall, rectangular 2D box wherein the shaped blocks appear from the top of the box. The shaped blocks contain 4 squares that are arranged in every possible pattern where all the squares share at least one side with another square. The gameplay starts as the blocks are slowly falling from the top of the box and the users can be able to move these falling blocks either to the left or right, or rotate it in 90 degree increments. The block stops moving down as soon as it hits an obstruction or the bottom of the box and another block will then start to fall down appearing at the top of the box. If the blocks at the bottom of the screen form a horizontal line across the rectangle, that line of squares disappears, and any squares above that line move down one row. However, if the incomplete rows of the blocks fill the rectangular box game world, the game will be over since the subsequent blocks will be prevented from falling down.



[Fig. 3] Tetris game

Tetris is a good brain training puzzle game as the users will be allowed to find how they will fit together to prevent incomplete rows. The user's brain will also be tested for speed and accuracy, as on how to react for falling blocks.

3.3 Brain Metrix

Brain training programs have been implemented in an educational website known as Brain Metrix[3] which can allow the elderly to test and train their brain, test their memory or reflexes or even their

brain creativity and improve its cognitive functions. This brain training portal allows the users to improve concentration and increase brain reflection speed through effective brain training games and exercises like solving math problems, brainteasers, and puzzles.

Some of the brain exercises include the following[13]:

- Brain Reflection Test.
- Brain Creativity. Brain creativity will be stimulated by this brain training activity.
- Memory Test. The areas of the brain that is responsible for storing and retrieving information will be stimulated through remembering faces and images.
- Brain Stretching. The objective of this brain training game is moving a number of disks from one pole to another and arranging them in a right way.
- Sudoku Brain Stimulation. The users will solve the existing Sudoku puzzle and is a good brain stimulation and training.
- Spatial Intelligence. This brain training puzzle game stimulates many parts of the brain including the visual memory and spatial intelligence.
- Math Problems. This brain training activity includes solving not very complicated Math problems. The main objective is that to solve as many questions as possible given a short period of time.
- Brain Concentration. This concentration game allows users to gain the ability of better concentration. The harder the game, the more concentration of the brain.
- Arrange Game. The objective of this training activity is being able to arrange numbers in the right order in a very short period of time.

3.4 Mind Games

The following are the list of some of the brain training games that are also helpful for dementia prevention and improve the cognitive functions of the brain of the elderly[14].

- Brain Trainer
- The Brain Game 1 & 2
- Brain Waves

- Mental Training
- Daily Calcudoku
- Light It 1, 2, & 3
- Flash Your Brain
- Etc.

4. Discussions

One of the cognitive training that is becoming popular is through playing a serious game. Brain Age, developed by Dr. Kawashima is a popular dedicated brain training game that includes brain training elements such as puzzles, arts and letters, reading aloud, solving simple arithmetic problems. For example, in arts and letters, the users need to unscramble the different letters in order to form a single word. In Math puzzles, the users may be required to answer a series of simple arithmetic questions as fast as they can. They will be allowed to perform a number of mathematical calculations in a given short period of time to in order to test their brain's processing speed. The calculations will include addition, subtraction and multiplications.

The Tetris puzzle game is very helpful for training users for attention and control. The users as indicated in Section 3.2 are allowed to rotate and move the falling blocks left and right that appears on top of the game world box in order to form horizontal lines at the bottom of the box. As soon as it hits an obstruction or bottom of the box, it stops moving. The completed horizontal line with no gaps that is formed disappears and the users can gain award points. The blocks keep on piling up if there is no complete horizontal line that is formed. Thus, the user's game is over as soon as the block pile reaches the top of the box and no subsequent block can enter the game world box. The user's attention and focus is being trained by Tetris puzzle game as well as its reflexes and control. The user's reaction can also be tested as the blocks are keeping on piling and getting higher. The executive functions of the elderly has also improved as on how he reacts with the galling blocks, the processing speed through symbol identification and puzzle solving.

Each user may be provided with provided with a daily training program (e.g., 15 minutes per day) and comprised of a set of cognitive training for memory enhancement, processing speed, focus and

attention training, etc. As this daily training program progresses, the user's brain cerebral functions are activated and demonstrates that it is a significant prevention and treatment for dementia.

5. Conclusion

This paper deals with discussion of the implementation of serious game brain training for the prevention of dementia and memory deterioration among the elderly. Different serious games have been identified that are used for brain training and thus improves the brain cognitive functions for the elderly. The brain training helps activate the cerebral functions of the brain and thus sharpens the user's memory; improve its logical, spatial and lateral thinking resulting to the prevention of memory deterioration and dementia.

Calculating simple arithmetic problems activates the brain activities. The previous studies for measuring brain waves and fMRI when doing serious games showed activation of parietal lobe area as well as overall brain parts. Thus, calculating simple arithmetic problems as quickly 4 or 5 times a week will be helpful for the elderly and early dementia patients to prevent dementia and memory deterioration.

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