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## ORIGINAL

### ATTENTIONAL TRAINING ANALYSIS BY VIDEO CONSOLE

### ANÁLISIS DEL ENTRENAMIENTO ATENCIONAL MEDIANTE VIDEOCONSOLA

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## ABSTRACT

We performed a quasi-experimental study using an equivalent control group to analyze the effectiveness of Nintendo's "Flash Focus. Vision training in minutes a day" video game on the improvement of eye-hand coordination, time and movement anticipation, and selective attention abilities. Participants were 29 college students, they were divided in two groups, one experimental (average age 21.37,  $SD = 5.07$  years) and one control group ( $M = 22.37$ ,  $SD = 3.49$  years). Participants performed 15 training. There were significant differences on one of the assessed variables, the one related to selective attention between the training and the control group ( $p = 0.01$ ). There were no significant differences between groups related to the rest of variables; these results are in line with other researches that use this video console. Nonetheless, the results justify the interest for continue studying of this research line, and shows its potential as a beneficial training complement.

**KEY WORDS:** Attention, maintained attention, Nintendo, video games.

## RESUMEN

Se ha realizado un estudio cuasi-experimental con grupo de control equivalente, para analizar la validez del juego “*Flash Focus. Vision training in minutes a day*”, de Nintendo, sobre la posible mejora de la coordinación óculo manual, la anticipación de tiempo y movimiento y la atención selectiva. La muestra estuvo compuesta por 29 estudiantes de Ciencias de la Actividad Física y el Deporte de la Universidad Autónoma de Madrid, divididos en un grupo experimental de 21.37 años de edad ( $SD= 5.07$ ), y otro control de 22.37 años ( $SD= 3.49$ ), que realizaron un total de 15 sesiones de entrenamiento con el juego. Sólo uno de los resultados de los contrastes realizados, el referido a la atención sostenida, muestra diferencias significativas en el grupo de entrenamiento ( $p=0.01$ ); mientras que el resto de variables atencionales estudiadas muestran resultados no significativos en las comparaciones pre y post. Este resultado justifica el interés por seguir investigando en esta línea y está en concordancia con los encontrados en el empleo de esta misma consola con aplicaciones diferentes.

**PALABRAS CLAVE:** Atención, atención sostenida, Nintendo, videojuegos.

## INTRODUCTION

The development of perceptual-motor abilities has been a cornerstone for researching and intervening in the sport psychology field. Skills such as the visual-manual coordination or the dynamic visual acuity are crucial for all sorts of sports, as handball, basketball or tennis (Williams, Davids & Williams, 1999). These sport disciplines are very dynamic environments, with objects traveling in all directions and at different speeds, vision and motor coordination play a key role. Thus, the interest for training and developing these abilities is high. Sport psychologists, optometrists, and other related specialists are working in the developing of new methods for training those abilities.

Until recently, the training for these abilities was performed by using instruments designed for people with visual impairments. As Quevedo and Solé (2005) suggested, this type of instruments are not valid for training athletes, because of their type of task and its target population. First, athletes do not have visual impairments, and their abilities are normally above the average person (Williams et al., 1999). A second aspect for taking into account is that those instruments are not integrated in the sport discipline, and not adapted for sport situations (Quevedo & Solé, 1995).

The use of video games, in addition to being a normal leisure activity for adolescent and general population (Borges, De la Vega & Ruiz, 2013), also have allowed to create a wide range of programs for training motor and visual abilities. In 1995, Quevedo & Solé published the work entitled "Methodology of visual training applied in sport" they proposed a methodology for training the athletes' visual ability. Raya and Castillo (1996; 1997) propose a manual system of visual stimuli emission to improve the efficacy of throwing situations. They found that through their methodology, athletes in a formative stage improve their throwing abilities. In addition, Castillo, Raya, Oña & Martínez (1996) performed a visual training for soccer penalty kick's throwers by using a system of ball direction anticipation. They obtained positive results for supporting the need for a specific attentional training in soccer.

In parallel, it have been researched the effects of video games on the improvement of different visual and perceptual aspects, showing the presence of some differences in visual abilities, between the people who have played video games and people who have not. Green and Bavelier (2003), using an experimental approach, observed differences on selective attention between people who do not played video games and people who do. Later, those authors studied the effect of playing different types of video games (action, role game, sports, etc.) on image resolution and decision making (Green & Bavelier, 2007; Green, 2008). Those results highlighted that people who played video games showed significant differences on the detection of visual objects in space in respect of the people who do not played.

The proliferation of new forms of entertainment have support the appearance of different leisure technological platforms; some of them have aroused great interest among the scientific community. Specifically, Nintendo released the video console Nintendo DS which was used on diverse studies (Zentgyorgyl,

Terry & Lank, 2008; Wallis, Schachter & Ryan, 2008; Lee, Kim & Kim, 2009; Shirali-Shahreza & Shirali-Shahreza, 2009) showing the necessity to continue the researching with these platforms and deeply explore their possibilities. In order to train visual-motor abilities, Nintendo designed a video game called "Flash Focus. Vision training in minutes a day". The video game simulates different sport scenarios (boxing, tennis, baseball) in which the users train the abilities by performing different motor abilities, specially, following the video game user manual, they can train the eye-hand coordination, movement anticipation, peripheral vision, dynamic visual acuity, and selective attention.

Eye-hand coordination refers to the movement adjustment relation with the hand in direction with an object. In this process it is not just necessary to control the distance, but also the intensity and the speed of the movement (Schwart, 2004). Movement anticipation indicates the capacity to anticipate the trajectory and speed of a projectile moving through the space (Schwart, 2004). Peripheral vision refers to the ability to localize, recognize and respond about the information of varied visual field areas that surround an object in which somebody is gazing fixedly (Loran & MacEwen, 1995). Dynamic visual acuity is defined as the capacity for discriminating fine details in a moving object (Quevedo, 2007). Selective attention refers to the capacity to ignore environmental stimuli in order to respond to a selected one (Estévez-González, García-Sánchez & Junqué, 1997; De la Vega, Almeida, Ruiz, Miranda & Del Valle, 2011).

The purpose of the present study was to analyse the effectiveness of Nintendo's video game "Flash Focus. Vision training in minutes a day" for training the abilities of eye-hand coordination, movement anticipation and selective attention. We used the Vienna Test System as a tool for assessing the improvements.

## **METHOD**

### **PARTICIPANTS**

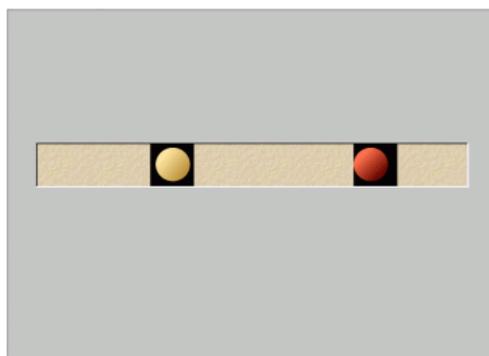
Participants were 29 students (average age 21.87,  $SD = 4.28$  years) they were enrolled on the first year of the Bachelor in Sport and Physical Activity Sciences of the Autonomous University of Madrid. Participants were assigned into two groups: the training group (13 men and 3 women, average age 21.37,  $SD = 5.07$  years) and the non-training group (8 men and 5 women, average age = 22.37,  $SD = 3.49$  years). Originally, the non-training group was formed by 16 participants, the same as the training group, however three participants did not finished the research process and were removed from the analysis.

Participants' group distribution was assigned by their personal schedules, the training group needed to train two or three times per week.

### **INSTRUMENTS**

The assessment of the different abilities was performed through the Vienna Test System. This tool is a computerized test for assessing different psychological and motor aspects (Schuhfried, 1992). In the present study we use three of the 76 six test that conform The Vienna Test System. The selected tests were: "Double Labyrinth", "Visual Pursuit Test" y "Time/Movement Anticipation".

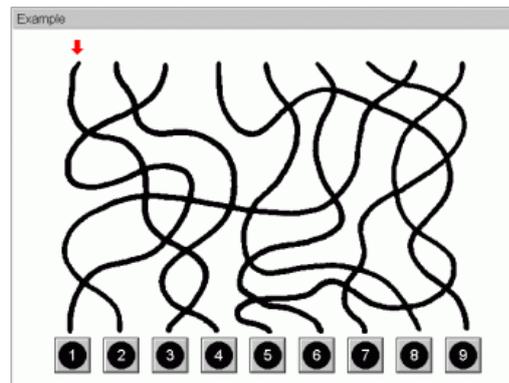
**Double Labyrinth** (Figure 1) is used for the eye-manual coordination assessment. Participant must maintain two circumferences along a lane without touching the lateral walls of the lane. Each of the circumferences left and right are controlling by one hand control device (corresponding with the side of the circumference). When one of the circumferences touches the wall is considering an error, and it turns into a red circumference. In addition, the test beeps a sharp sound until the circumference stops touching the wall. As the test progresses, lanes' difficulties increase. The test offers two results for each participant, total time on each hand error and total number of errors.



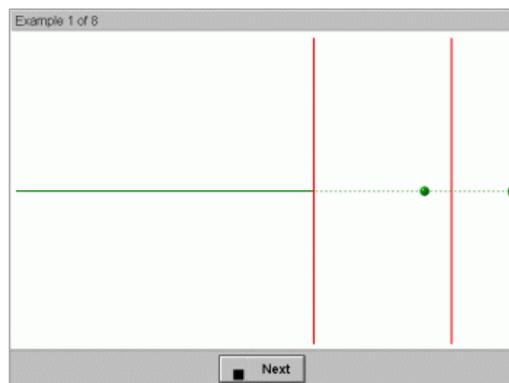
**Figure 1:** Test Double Labyrinth (B19)

The **Visual Pursuit and Time** (Figure 2) is a test for assessing selective attention. The task consists on differentiating lines, which is indicated by a red arrow, from the other lines that cross. Each way has an identify number at the end. Participants must to follow the red arrow's line by pressing two buttons, at the same time. If a participant does not push one of the buttons, the screen with the possible ways disappears and he has to select the number of the line. Participants must focus on the red arrow's lane and ignore the others, for adding pressure the task must be completed in the minimum time possible.

In the **Time/Movement Anticipation** test participants watched, on a white screen, the trajectory of a green projectile at a determined velocity and direction. In a moment the projectile disappears between two red lines, participants must calculate the moment and the exact place where the projectile will appears again. As the test progresses, trajectories become more complicate.



**Figure 2.** Visual Pursuit Test (LVT)



**Figure 3.** Time/Movement Anticipation (ZBA)

The training for the visual abilities was through five Nintendo's Dual Screen (DS) video consoles using the "Flash Focus. Vision training in minutes a day". Video consoles and the video game were donated by Nintendo for this research. Nintendo's DS is a portable video console with two touchscreens (3 in, TFT LCD, 256 x 192 pixels, size 62 x 46 mm), where is possible to watch an image from two different points of view. The touchscreens are separated by 21 mm (See Figure 4).



**Figure 4.** Nintendo DS.

The “Flash Focus. Vision training in minutes a day” video game content different exercises oriented to develop motor-perceptual abilities. Since it is sport environment video game, not all the exercise consists on sport activities. The instructions of the videogame references the purpose of the game in the developing of the following abilities a) dynamic visual acuity, b) ocular movement, which is associated to the capacity for moving the eyes rapidly and perceived a great amount of visual information in a short time. This aspect, related with the visual capacity can be training by moving the eyes fast in a long a dynamic movement. c) Immediate recognition is related with the capacity for processing a great amount of visual information during a short instant. d) Peripheral vision for viewing quickly the information that is outside the visual attention focus. e) Eye-hand coordination is related to the capacity for easily interpret visual information and transform it into precise manual movements. Figure 5 shows four examples of the videogame’s exercises, two related to sports and two neutral.

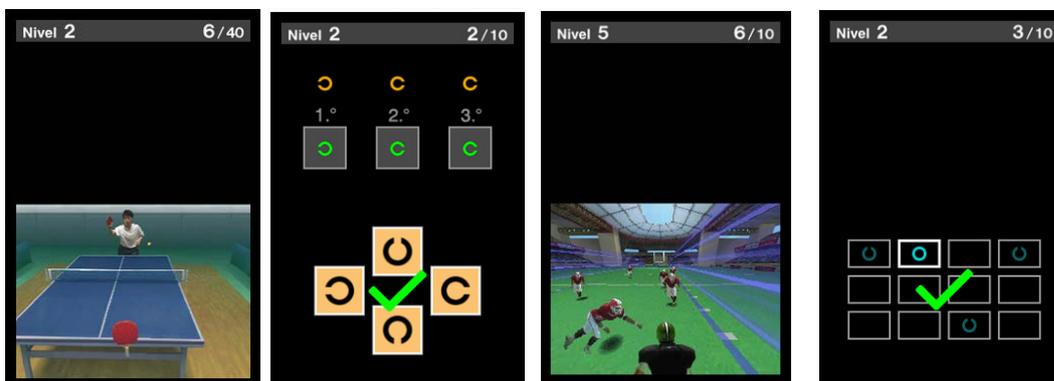


Figure 5. Screens showing the different exercises recommended for daily practicing.

## Design

We use pre-post a quasi-experimental design using an equivalent control group.

## VARIABLES

Independent variable was the training performed trough the Nintendo’s “Flash Focus. Vision training in minutes a day. This variable has two levels, corresponding to the two participants’ groups training and without training.

Dependent variables were assessed trough the Vienna Test System. From all the tests data, we selected the following seven dependent variables.

Form the **Double Labyrinth** Test, we use only two indicators: total errors and time (in seconds) of the total errors:

1. Total of errors is the sum of the times when participants touched the wall of the lane with the circumferences.

2. Time of total errors is the product of the sum of the time (in seconds) when the circumferences have been touching the lane's walls.

In the **Visual Pursuit Test** we selected three indicators:

1. Number of correct answers: the sum of all the trial in which participant has pressed the number of the red arrow's line.
2. Average time for giving the correct answer: is related to the time (in seconds) between the pressing of the two buttons for watching the lines on the screen, and the moment when participant stops pressing the buttons when the answer is correct.
3. Average time for giving the incorrect answer: the time (in seconds) between the pressing of the two buttons for watching the lines on the screen, and the moment when participant stops pressing the buttons when the answer is incorrect.

**Time/Movement Anticipation**, in this test we selected the following data:

1. Median of time of total deviation: it offers the median of the estimated time deviations regarding the real time in when the projectile arrives into the second red line.
2. Median of total direction deviation: registers the median of the estimated space deviations regarding the real space in where the projectile appears crossing the second red line.

## PROCEDURES

Participants were recruited at the Autonomous University of Madrid, all first year' student of the Bachelor of Sport and Physical Activity Sciences were invited. Volunteers were selected if they complete the following inclusion criteria: do not have visual problems or deficiencies. In addition, they committed to not using the video console outside the research sessions, and we corroborate that they do not have previous experience using the Nintendo's DS.

In order to facilitate the assessment and the training sessions the training group was subdivided into groups. Sessions were carefully scheduled.

The initial assessment (pre-test) was carried out through the three tests of The Vienna Test System. The order of the test was the same first the Double Labyrinth, then the Visual Pursuit and at last the Time/Movement Anticipation. Training group (henceforth called TG) pre-test was performed first in order to start with the training sessions, which started the day following the pre-test assessment.

While participants of the non-training group (henceforth called CG) were evaluated, participants of the TG were performing their training sessions. The training and assessment sessions were scheduled at the same time of the day from 12:30 to 15:00.

All participants completed 15 training sessions divided into five to six weeks.

Training sessions consisted on performing the Nintendo's DS recommending exercises for a daily practicing. Each participant had his own session profile, and his vide-console session guarantying the individual progress. Training sessions lasted from 10 to 15 minutes.

After the training program we perform the post-test assessment using the same Vienna Test System tests, in the same order. Participants of the GC were evaluated after the training program (five weeks) of the TG. Statistical analyses were performed by the statistical package SPSS 17.0.

### *Data analysis*

Descriptive pre and post training data were obtained from all the tests' indicators. In order to analyse the effect of the training program, we compare the results of the two groups. We use the Mann-Whitney U test. Pre-post effect was analyzed by the Wilcoxon's signed-rank test. We will present the results according to each of the Vienna Test System tests, to facilitate the comprehension.

## **RESULTS**

### *Group differences*

The Mann-Whitney U test showed no significant differences on the pre training tests scores. Results showed that both groups (TG & GC) were equivalent, and confirmed that the division between treatment and control group was correct.

### *Double Labyrinth Test (B19)*

As Table 1 shows average number of errors and their duration, for both groups, decreased on the post test in comparison with the pre-test. This decrease scores are similar between both groups.

There were significant differences between pre and post assessment on the variable duration of errors. TG ( $Z = -2.58, p = 0.01$ ) and CG ( $Z = -1.99, p = 0.04$ ).

### *Visual Pursuit Test (LVT)*

The descriptive data from the three assessed indicators are show in Table 1. The analysis showed significant pre-post differences on the number of answers of the TG ( $Z = -2.53, p = 0.01$ ). No differences were observed in the CG. In relation with the average time for giving the correct answer the analysis showed significant pre-post differences in both groups, TG ( $Z = -3.1, p = 0.002$ ) and CG ( $Z = -2.72, p = 0.02$ ).

**Table 1.** Descriptive statistics for the B19, LVT, ZBA tests

B19						
	Number of errors		Duration of errors (sec)			
	Pre	Post	Pre	Post		
TG	M = 93.19 SD = 22.09	M = 83.44 SD = 23.87	M = 33.66 SD = 11.93	M = 26.93 SD = 11.80		
CG	M = 97.08 SD = 23.35	M = 89.15 SD = 24.07	M = 45.62 SD = 28.17	M = 32.91 SD = 20.75		
LVT						
	Number of correct answers		Average time for correct answers (sec)		Average time for incorrect answers (sec)	
	Pre	Post	Pre	Post	Pre	Post
TG	M = 39.13 SD = 1.09	M = 38.63 SD = 1.31	M = 3.41 SD = 0.38	M = 3.13 SD = 0.45	M = 2.43 SD = 2.79	M = 2.27 SD = 1.96
CG	M = 38.15 SD = 1.86	M = 38.23 SD = 1.17	M = 3.27 SD = 0.21	M = 3.07 SD = 0.31	M = 2.77 SD = 2.18	M = 3.35 SD = 1.99
ZBA						
	Median deviation time (sec)		Median direction deviation			
	Pre	Post	Pre	Post		
TG	M = 1.36 SD = 0.75	M = 1.32 SD = 0.75	M = 63.94 SD = 26.38	M = 67.31 SD = 19.65		
CG	M = 0.94 SD = 0.62	M = 1.36 SD = 0.94	M = 56.23 SD = 18.67	M = 63.08 SD = 16.70		

*Time/Movement Anticipation (ZBA)*

Table 1 shows the descriptive data of median of the total deviation time and median of the total direction deviation. The results showed a minimal increase on the TG related to the median of the total deviation time of 0.04 seconds. The CG presented an increment on the median of total deviation time of 42 seconds between pre and post-tests. Standard deviations are very similar between groups. Statistical analysis showed no significant differences between the two groups.

## DISCUSSION

The present study was designed with the purpose of testing the training efficacy of Nintendo's video game Flash Focus. Vision training in minutes a day, for improving the abilities of eye-hand coordination, time and movement anticipation, and selective attention. Based on the results, it is possible to establish that training with this video game, at the present study specifications, did not offered, at least totally, an objective indicator of the supposed video game's results.

The scores of the eye-hand coordination exercise (B19), specifically, the data related with the error's duration, showed that both groups TG and CG improved in the post-training assessment. This allows us to suggest that training with the video game has not been determined on the improvement process. The results showed that this variable of eye-hand coordination is susceptible for training. Nevertheless, this ability is not effectively training trough the video game. These results should be contrasted with a similar training program but with a longer duration. In addition, it is necessary to compare the use of the video game with other activities that also allows improving the person's eye-hand coordination.

For the LVT test, the one which assessed selective attention, our results showed improvements on the time of giving correct answers. Newly, since this improvement was observed in both groups, it is not possible to establish that the improvement was caused by the training program. The only variable that showed to be related to the training program was the number of correct answers. Only the TG obtained significant differences between pre and post values. Based on this result, it is possible to considerer the video game training as a strategy for improving selective attention. A regular training will be beneficial for a better discriminating process, and consequently to improve performance. In this sense, we suggest that training programs which include the developing of the selective attention cant considerer that a well design training schedule, where participants must discriminate specific stimuli in order to give a correct answer, are necessary to significantly improve this ability. In addition, our results showed that a video game based training program was beneficial for developing specific abilities. Participants of the training group increase their scores on selective attention in comparison with the non-training group. It would be interesting that further researches consider studying the effect of Nintendo's video game training results on selective attention transferred to a real sport context, or situations.

The ZBA test showed no significant differences between groups, the training program did not increase the time and movement anticipation scores. As seen in Table 1, results showed improvement trends on the TG in all variables, except on the median of the total direction deviation of the ZBA test. We consider that these improvement trends must be taking into account, since the abilities that were trained are essential for a successful sport performance. The specific training if these abilities is necessary, especially considering the use of specific sport stimulus for comparing the video game training results with those obtained in the real sport context training.

The present study offers a first approach to explore the influence of a specific training for improving certain perceptive, attentional and motor abilities. As can be seen, the results are inconclusive, nonetheless, it is observed an improvement trends that suggest that this type of training has potential for developing future studies.

Regarding the limitations of the present study, and in order to consider for future studies, is to increase the sample size, a bigger N will allows to analyse the results through parametric statistical analysis. The specific limitations of the video game for training perceptual, attentional, and motor abilities were, first, the reduced visual field of the screen, this portable video console has not an optimal visual field range for training these abilities. Taking into account that in real life, the visual field range has an angle greater than 180 degrees, reduce it into the Nintendo's DS screen may be influencing the training process. Second, specifically the Nintendo's DS tasks for improving eye-hand coordination are limited to just one hand (the hand that manipulates the pointer) leaving the other hand with no possibility of action.

In conclusion, in spite of the mentioned limitations, we consider that it will be interesting to continue the study of training programs with the "Flash Focus. Vision training in minutes a day video game" for confirming the obtained results.

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