Does Performance on the ReadAlyzer Correlate With Performance on "Symbol Check" Activity for the Nintendo DS?

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Abstract

Background: *Computer vision therapy programs have been shown to be effective in the treatment of oculomotor disturbances across many age groups, including school aged children. Claims concerning the ability of the Flash Focus game for the Nintendo DS to improve visual function have not yet been substantiated in the literature although mass marketing has commenced. The Symbol Check module on Flash Focus was compared to a valid and reliable measure of eye movement, the ReadAlyzer. The goal was to determine if the score obtained on Symbol Check was related to eye movements.*

Methods: *Thirty-three subjects from an optometry school student population performed both the ReadAlyzer and the Symbol Check module on the Flash Focus game on the Nintendo DS.*

Results: *Regression analysis of fixations on the ReadAlyzer versus total score on the Symbol Check task demonstrated minimal correlation ($r= 0.227$, $r^2=0.051$)*

Conclusion: *As computers and video games become increasingly prevalent, it seems prudent to evaluate any possible adjunct therapy tools that may be viable. This pilot study found minimal correlation between the total score of the Symbol Check task from the Flash Focus game and the number of fixations from ReadAlyzer analysis.*

Key Words

eye movement, fixation, Flash Focus, Nintendo DS, oculomotor dysfunction, ReadAlyzer, Symbol Check, video game, vision therapy

Optometric vision therapy (OVT) requires effort outside the therapy room on the part of the patient. These activities or homework may or may not be performed for various reasons including lack of patient motivation, parental involvement, or understanding. With computers increasingly prevalent in society, the computer may be a possible way to encourage better compliance. Today's youth have a variety of interests including video games on widely distributed platforms such as the Nintendo DS. These games could have a positive impact on therapy results. The Flash Focus game for the Nintendo DS (Figure 1) has been specifically designed to improve visual function,[1] but the claims have yet to be substantiated in the literature.

A common reason to recommend OVT is oculomotor dysfunction (OMD). Symptoms include losing one's place when reading, skipping words or letters, and reading words backwards.[2] OMD can have an impact on reading ability and thus school performance, which is a concern to both parents and educators alike. Proper assessment and treatment is important for remediation.

The technological "gold standard" for clinically assessing eye movements is the Visagraph II or its contemporary, the ReadAlyzer. This infrared sensor system uses goggles and standard paragraphs of grade-level appropriate material to objectively record a person's eye movements.[3] The paragraphs vary in difficulty depending on the grade level of the material, ranging from first grade through high school. There is a purely functional test for those who are not able to read yet. Taylor et al established norms for each grade level where individual performance is analyzed and compared.[4] Ciuffreda et al discussed the use of the Visagraph II to assess eye movements and suggested baseline guidelines regarding administration.[5] This study found that at least three practice readings should be made prior to an actual recording. A similar study by Colby et al also suggested a minimum of one practice paragraph to aid in familiarizing a subject to the task. The study also demonstrated good test validity.[6] Borsting et al recently investigated the repeatability of the Visagraph II, and found good same-session repeatability and reliability for a third through eighth grade sample.[7]

Once an eye movement disorder is diagnosed, OVT should be implemented to improve oculomotor ability. Computer-based therapy programs have been designed to aid in this pursuit. A pilot study involving a proprietary, on-line, computerized eye movement training system (Taylor Reading Plus) using the Visagraph II to assess pre- and post-training abilities showed that computer training improved performance as demonstrated by the Visagraph.[8] Solan et al showed that computer-based eye movement training programs helped improve overall reading ability.[9]

Figure 1: The Nintendo DS handheld video game system and the Flash Focus game.

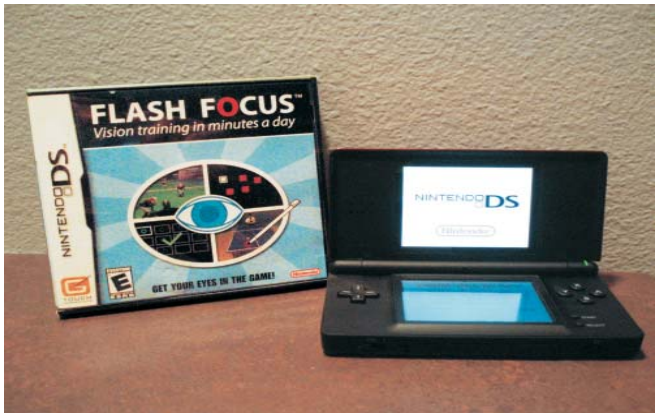
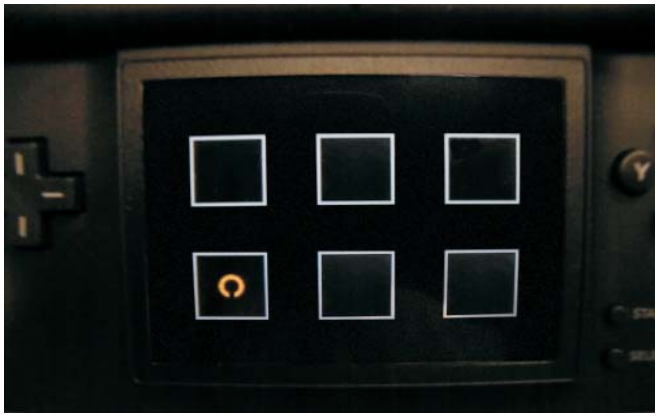


Figure 2: The patient is shown this representation and explained that the C could present in any of the four directions.



As computer technology has improved, so has video game technology. The Nintendo DS is a prime example. A "vision training" game has been designed for use with this hand-held system. The designers of Flash Focus have claimed the ability to "train your vision in minutes per day," using tasks aimed at improving visual memory, eye-hand coordination, and eye movements.[1]

Computer-based vision training programs were developed to train aspects related to vision on an individual basis. These systems have been designed to isolate and train aspects of vision with programs that are similar to traditional office-based therapy procedures. The HTS System is a widely used example. Several studies have shown the effectiveness of this program.[10,11] In contrast, the Convergence Insufficiency Treatment Trial study group compared the use of home-based pencil push-ups, home-based computer vergence/accommodative therapy and pencil push-ups, office based vergence/accommodative therapy with home reinforcement, and office-based placebo therapy with home reinforcement as treatments for symptomatic convergence insufficiency. They found that a successful outcome was obtained in 73% of patients treated with office based vergence/accommodative therapy with home reinforcement, while only 43% that were assigned to home-based computer vergence/accommodative therapy and pencil push-ups could make that claim.[12]

Other systems, including Vision Builder, function in much the same way as the HTS. Tasks working fusion, accommodation, eye movements, and various aspects of visual processing all have been designed by vision professionals to stress those isolated skills as purely as possible. Flash Focus attempts to train in a similar fashion, but it may not truly isolate aspects of vision in a manner suitable enough to improve specific function substantially, at least in training eye movements.

The purpose of this study was to determine if a correlation exists between the evaluation of eye movements using the ReadAlyzer and the Symbol Check task on the Flash Focus game for the Nintendo DS. This study was necessary before considering Symbol Check as a technique for training eye movements. The Symbol Check task involves 12 boxes, in four rows of three, presented on the screens of the Nintendo DS, with six boxes in each screen. It should be noted that there are two screens on the Nintendo DS, one on the main body and one in the lid/top. Three separate Landolt C's are then presented in any box (Figure 2), and in one of four orientations, sequentially. The screen then changes and asks the subject to tap the picture of the correct orientation of the three C's and in the correct order. This same procedure is repeated ten times. Every time the subject recalls the correct order and orientation, the next presentation of the C's is made more quickly. After ten trials, a final score is given, based on the number of correct responses and the highest level achieved (if all ten trials are correct, the highest score is 100).

Methods

Thirty-three subjects, 17 female and 16 male, ranging in age from 21 to 39, were recruited from an optometry school student population. Subjects were accepted based on a best corrected visual acuity of 20/25 or better, stereopsis of least 30 sec arc, and an examination on record within the six months prior to the date of participation to ensure eye health. A diagnosis of ocular motor dysfunction was not an exclusion factor. Subjects were asked to participate in two tasks: the ReadAlyzer and the Symbol Check task. Each task was explained, and then performed twice, to remove any learning curve from the final results. The results from the second trial of each task were then compared. To remove bias, the task order was alternated with each patient.

Each subject read the same two short ReadAlyzer passages (Peanuts, 9-76, and Edison, 9-78). Both passages were from the 9th grade level, to reduce the effect of comprehension difficulty. Each subject was fitted with goggles and the sensors adjusted to match the patient's near interpupillary distance to ensure a quality recording. The subjects were instructed that they were going to be reading a passage and would be answering ten yes/no questions when complete. They were instructed to look at the fixation dot at the top of the page of reading material, and once told to begin, to read the paragraph to themselves. Once they reached the end, they were told to close their eyes and say "done." They would then be asked the ten questions regarding what they had read. This procedure was repeated for the second paragraph. A score of 7 out of 10 on the comprehension questions was required on the second trial or another paragraph was read to obtain appropriate reliability. This was not necessary for any of the subjects in this study. The number of fixations was recorded from the second trial.

Each subject was instructed to play a game where three C's would appear sequentially in any of 12 boxes (six boxes on each screen) and that each C would be oriented up, down,

left, or right. They would have to remember in what order and orientation the C's were presented. They were told there would be 10 rounds, and a final score would be given. The entire task was then repeated. For the purpose of this study, the task was performed once to allow the subject to become acquainted with the task and to account for any learning effect. The final score was then saved for comparison to the subject's ReadAlyzer performance.

Results

Fixation results ranged from 40 to 121 fixations per 100 words, with a mean of 82.75 fixations and a standard deviation of +/-22.85 fixations. Symbol check scores ranged from 68 to 100, with a mean of 81.57 and a standard deviation of 8.52. Regression analysis of fixations on the ReadAlyzer versus total score on the Symbol Check task demonstrated minimal correlation (r=0.227, r^2=0.051) (Figure 3).

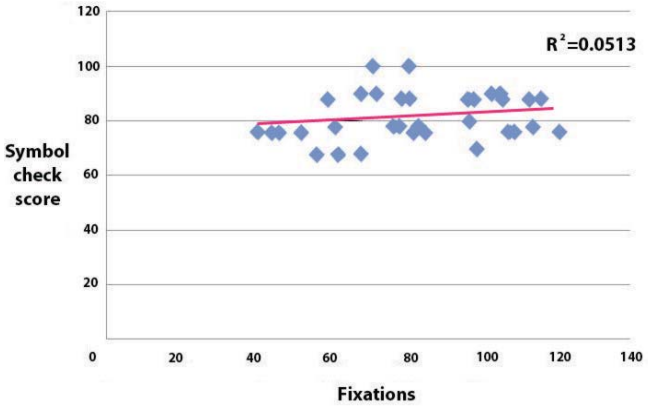
Discussion

Based on the results obtained, there is minimal correlation between performance on the Symbol Check task and fixations measured as per the ReadAlyzer. There may be several reasons for this, which include confounding factors that may be outside the realm of control. For instance, the small viewing screen and overall size of the handheld Nintendo DS system may impact just how much it can truly train large eye movements. The various activities found in the Flash Focus game, including Symbol Check, all involve extraneous elements that cannot be removed, thus making it virtually impossible to truly isolate a desired variable; in this instance, eye movement. The Symbol Check task involves more than just eye movements. Visual memory, visual sequential memory, and short-term recall are a few confounding factors that could impact performance beyond eye movement difficulties. Even if a subject had good eye movements, if their processing abilities were impaired, then their scores would be reduced.

It is possible that another issue may have confounded the findings. Hoffman and Subramaniam determined that a person cannot make an eye movement to one spot and attend to another simultaneously, demonstrating that visuospatial attention is necessary for voluntary saccadic movements.[13] Thus, visual attention, and ultimately a subject's perception of a task, could influence their performance. This could then become an issue on the Symbol Check task if one is unable to attend appropriately during the random presentation of symbols, thus impacting their saccadic movements and overall performance. In the same manner, if a subject's attention and ultimately visual attention are not focused on the given paragraph for the ReadAlyzer test, then their eye movements would be altered, and subsequently their overall performance on the task would be affected.

The data obtained truly shows how variable eye movements are between tasks. One would surmise that any further investigation into the efficacy of Flash Focus game would show similar results in other areas of vision, such as memory or hand-eye coordination. The ability of the Flash Focus to evaluate and subsequently train vision may simply be adaptation or learning to do the task better, without truly improving aspects of vision; it may become repetitious or almost habitual.

Figure 3: Total Symbol Check score versus fixations on the ReadAlyzer task.



Conclusion

OVT requires dedication and effort on the part of the patient. Thus, finding ways to aid in training that also make the patient more apt to follow through with homework activities, or just activities in general, would be beneficial. Based on this study, there seems to be little basis for comparison of ability on the Symbol Check task versus ability on the ReadAlyzer in a normal population of users. For the time being, the Flash Focus game should be used more for entertainment than true vision improvement.

References:

1. Flash Focus www.flashfocus.net/what.jsp Last accessed March 23, 2011.
2. Scheiman M, Wick B. Clinical Management of Binocular Vision. Philadelphia, PA: Lippincott Williams & Wilkins, 2002.
3. Taylor SE, Morris HF, White CE. Visagraph II Eye-Movement Recording System Test Manual. Huntington Station, NY; Taylor Associates, 1996.
4. Taylor SE, Frackenphol H, Pettee JL. Grade level norms for the components of the fundamental reading skills. EDL Information Research Bulletin 3. Huntington, NY: Educational Development Laboratories, Inc., 1960.
5. Ciuffreda KJ, Ciuffreda MA, Santos D. Visagraph: Baseline analysis and procedural guidelines. J Behav Optom 2003;14:60-64.
6. Colby D, Laukkanen HR, Yolton RL. Use of the Taylor Visagraph II system to evaluate eye movements made during reading. J Am Optom Assoc 1998;69:22-32.
7. Borsting E, Rouse M, Shin S, Dold E, et al. Repeatability of the Visagraph II in the analysis of children's eye movements during reading. Optom Vis Dev 2007;38:67-73.
8. Tran K, Yu C, Okumura T, Laukkanen H. Effectiveness of an on-line computerized eye movement training program to improve oculomotor control in adult readers. J Behav Optom 2004;15:115-21.
9. Solan HA. Deficient eye-movement patterns in achieving high school students: Three case histories. J Learn Disabil 1985;18:66-70.
10. Cooper J. Computerized vision therapy for home and office treatment of accommodative and vergence disorders, and amblyopia. J Behav Optom 2007;18:88-94.
11. Goss DA, Downing DB, Lowther AH, Horner DG, et al. The effect of HTS vision therapy conducted in a school setting on reading skills in third and fourth grade students. Optom Vis Dev 2007;38:27-32.
12. Convergence Insufficiency Treatment Trial Study Group. Randomized clinical trial of treatments for symptomatic convergence insufficiency in children. Arch Ophthalmol 2008;126:1336-49.
13. Hoffman JE, Subramaniam B. The role of visual attention in saccadic eye movements. Percept Psychophys 1995;57:787-95.

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