Cognitive Rehabilitation In Multiple Sclerosis Using Xbox® Kinect™ Gaming: A Pilot Study

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Abstract

BACKGROUND: The prevalence of cognitive deficits in multiple sclerosis (MS) necessitates effective rehabilitation paradigms; however, relatively few studies have investigated cognitive training in this population, and evidence of its effectiveness is equivocal. Recent evidence has suggested that physical activity may have a positive effect on cognition. Furthermore, increased technology associated with commercially available gaming devices has enabled videogame play to stimulate both cognitive and motor function. The recently released Xbox 360® Kinect™ sensor allows full body movement during gameplay to be monitored. **OBJECTIVES:** This pilot study examined the effect of 10 weeks of gameplay using the Xbox 360® Kinect™ game Body & Brain Connection™ on cognitive function in people with MS. Since the game requires arm, leg and full body movement to respond to various cognitive tasks, successful play thus combines motor response with cognitive stimuli. **METHODS**: Nine female and 2 male participants (51.8±10.8 years) with MS and cognitive deficits underwent the Paced Auditory Serial Addition Test (PASAT) and Symbol Digit Modalities Test (SDMT) prior to treatment. The experimental group (n=7) followed the initial assessment with 10 weeks of Body & Brain Connection™ videogame play (3 sessions/week, 30-45 min/session; 2 weeks supervised, 8 weeks home-based training) while the control group (n=4) followed with 10 weeks of habitual activity. Both groups then participated in a follow-up cognitive assessment. **RESULTS**: Four of the initial participants in the training group dropped out of training for various reasons; therefore, only 3 participants completed 10 weeks of training. Nevertheless, training was associated with a greater effect size for SDMT scores (n=3, *d*'=0.93) compared to dropouts (n=4, *d*'=-0.06) and controls (n=3, *d*'=-0.02). A similar trend was observed for PASAT scores (*d*'= 0.22, -0.22, -0.13; training, dropouts, and controls, respectively). **CONCLUSION**: Recruiting difficulties and participant drop-out resulted in poor study completion rates. Those who did complete the study found the training to be helpful (n=3) and each decided to invest in the Xbox® gaming system and the Body and Brain Connection™ game to allow continued training. Results suggest that training with this system may improve cognition in MS, but further study is necessary.

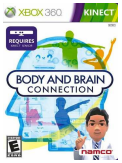
Methods

Participants
N=11, 9 females, 2 males with MS, 51.8±10.8 years
Drop-outs:
- 1 male due to back pain (not associated with study)
- 1 female due to eye pain (associated with game)
- 1 female due to frustration with game
- 1 female (less than 3 weeks of training-noncompliant)

Control participants
- 1 male, 3 female

Completed treatment
- 3 females

Training
- 3 days per week
- 30-45 minutes per day
- 2 weeks supervised training, 8 weeks at home (10 weeks total)



Study Design

Cognitive Assessment 1 • SDMT • PASAT	Cognitive Training or Control Phase (10 weeks)	Cognitive Assessment 2 • SDMT • PASAT

Purpose

The novel Body & Brain Connection™ game combines cognitive challenge with motor function. The purpose of this study was to determine whether regular video game play would increase cognitive assessment scores compared to control.

Training Games

Table 1. Body and Brain Connection™ Game (Namco®)

Category	Games
Reflexes	Balloon Buster
	Flag Frenzy
	Pop Till You Drop
	Follow The Arrows
Logic	What Time Is It
	Off the Radar
	Time Bomb
	Match Maker
Memory	Strike A Pose
	Flip 'N Find
	Pizza Catch
	Step Mania

Results

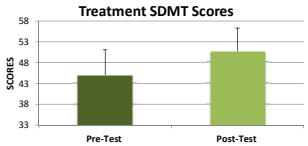


Figure 1. Symbol Digit Modalities Test scores for Experimental Group prior to and following 10 weeks of training. N=3, *d'*=0.93.

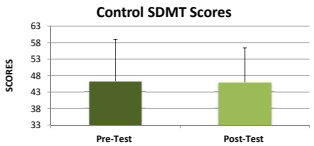


Figure 3. Symbol Digit Modalities Test scores for Control Group prior to and after 10 weeks of habitual activity N= 3, *d'*=-0.02.

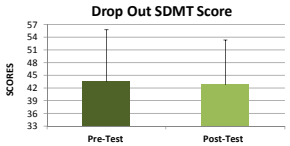


Figure 5. Symbol Digit Modalities Test for Drop outs. N=4, *d'*=-0.06.

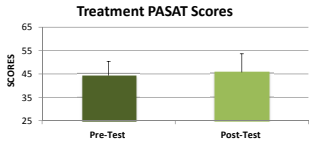


Figure 2. Paced Auditory Serial Addition Test for Treatment Group prior to and following 10 weeks of training N=3, *d'*=0.22.

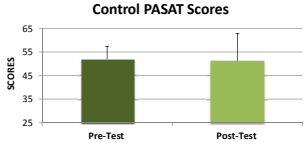


Figure 4. Paced Auditory Serial Addition Test scores for Control Group prior to and after 10 weeks of habitual activity. Group. N=3, *d'*=-0.125

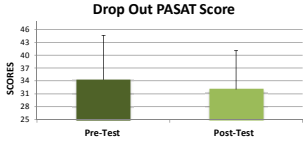


Figure 6. Scores for Paced Auditory Serial Addition Test for Drop outs. N= 4, *d'*= -0.22 .

Limitations

- High drop out rate
- Recruiting difficulties: few neurologists in Holland, MI
- Many folks did not want to know about cognitive deficits
- Xbox® Kinect® sensor problems were frustrating

Discussion

- Recruiting difficulties and poor retention did not allow statistical analysis to be performed on the data.
- Only 11 participants expressed interest in the study despite advertisement to local MS support groups and flyers in physicians and neurologists offices.
- 3 of the 11 dropped out due to various reasons and 1 was non-compliant. Kinect™ sensor sensitivity and inconsistency proved frustrating for most of the participants.
- Only 3 participants completed the 10 weeks of training.
  - SDMT and PASAT scores increased with training, with a greater effect size for SDMT (*d'*=0.93) compared to PASAT (*d'*=0.22) following treatment. The 3 participants felt the training was beneficial and each planned to continue using the Xbox® Kinect™ system and Body and Brain Connection™ game following study completion.

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