Biofeedback-Based, Videogame Balance Training in Autism

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Motor Challenges in Autism

• **Highly prevalent** (Fournier et al., 2010; Hilton et al., 2012; Ming et al., 2007)

• **Challenges frequently reported in**
  
  – **Hand speed** (Rinehart et al., 2001, 2006)

  – **Complex motor actions** (Dewey, 1991; Dziuk et al., 2007; Minshew, Goldstein & Siegel, 1997; Mostofsky et al., 2006; Rogers, Bennetto, McEvoy, & Pennington, 1996)

  – **Balance & postural stability** (Ghaziuddin et al., 1994; Green et al., 2002, 2009; Jansiewicz et al., 2006; Kohen-Raz et al., 1992; Memari et al., 2014; Minshew et al., 2004; Molloy et al., 2003; Radonovich et al., 2013; Travers et al., 2013; Weimer et al., 2001)
Development of Balance

Balance improves with age…
But gaps may widen

Minshew et al., 2004
Research questions:

1. Can balance be improved in children and adolescents on the autism spectrum to prevent this early plateau in balance skills?

2. Can we make this training fun and motivating?
Ninja Training Video Game

Collaborators: Anthony Ellertson (Boise State), Andrea Mason (UW-Madison), Leigh Ann Mrotek (UW-Oshkosh)
Ninja Training Video Game

Balance time within shadow: 20.68sec
Training Schedule

6 weeks of training (18 sessions)

Each Training Session (60 min):
- 3-4 Ninja Poses
- 1-2 Wii Fit Games
- Break
- 1-2 Wii Fit Games
- 3-4 Ninja Poses
Participants

29 children and adolescents on the autism spectrum (ages 7-17 years)
Did participants show improvements in balance during the Ninja Game?
Significant improvements during training

- 2.13-second increase per session.
- 1.72-fold increase in overall balance times. ($p < .001$)
- 2.41-second increase/session.
- 1.77-fold increase in overall balance times. ($p < .001$)
Did participants show improvements in balance outside of the game?
Game versus real life

They get better at the training game, but does this actually lead to balance improvements outside of the gaming context?

Eyes Opened

Eyes Closed

Feedback (see your balance on screen)
Outside of Game: Pre-post changes in balance

Ninja Pose Training Progress

Post-Training Balance

Wii Fit Training Progress

Ninja Pose

Post-Training Balance
Who benefited most from the training?
Characteristics related to better training

- Better balance at start of training ($r = +.50$)
- Fewer/less severe stereotyped behaviors ($r = -.50$)
- Fewer/less severe ritualistic behaviors ($r = -.51$)

Characteristics not related to better training

- Verbal IQ ($r = -.04$)
Was the training perceived as beneficial and fun?
Do you think you/your child benefited from the games?

9 of 11 participants and 11 of 11 family members thought participants benefited

“I became so tired and painful but it helped me to balance more, I mastered all of them. Can't wait to try it in sports, like tennis or soccer.“

“He hadn’t played video games before. Now he operates a TV remote with increased dexterity. There is also less hesitation in trying new physical activities.“

“Very fun, got to meet a lot of people, made me think in a different way. “
Did you enjoy playing these games? Overall, how much do you think your child enjoyed playing these games?

10 of 11 participants said they enjoyed the games

“I liked energy ball and hug the tree (two Ninja Training games)”

“He enjoyed the games he played, however, he frequently complained about the graphics on the Wii.”

“The Wii games were fun but the ninja games could have been more enticing.”
Do you think you/your child would play these games outside of this study?

8 of 11 participants and 11 of 11 family members said they would play the games outside the study.

“Play them anywhere!”

“It will be a good activity over the winter.”

“Would not play ninja games but would play Wii games.”
Summary of findings


2. Those with better balance at the start of the game and fewer ritualistic and stereotyped behaviors benefited the most.

3. Participants and their families generally felt the games were beneficial and enjoyable.
Implications

• Balance improvements are possible in children with ASD
• Ninja training game could be used to target balance challenges for individuals on the autism spectrum
  – Likely “guided” trainings rather than solo, as participants valued having research staff facilitate these games
Current & Future Directions

1. Investigating whether playing this game impacts the brain and behavior of adolescents with and without ASD.

2. Examining whether minimally verbal children on the autism spectrum benefit from this training game.

3. Looking for strategic partnerships to improve the training game’s graphics and interactive engagement.
Thank you!

Sincerest gratitude to the participants and their families!!!

Motor and Brain Development Lab
https://motor.waisman.wisc.edu/

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