Biofeedback-Based, Videogame Balance Training in Autism

Brittany G. Travers, Ph.D.
Occupational Therapy Program
Department of Kinesiology
Waisman Center

Kinesiology
UW-Madison

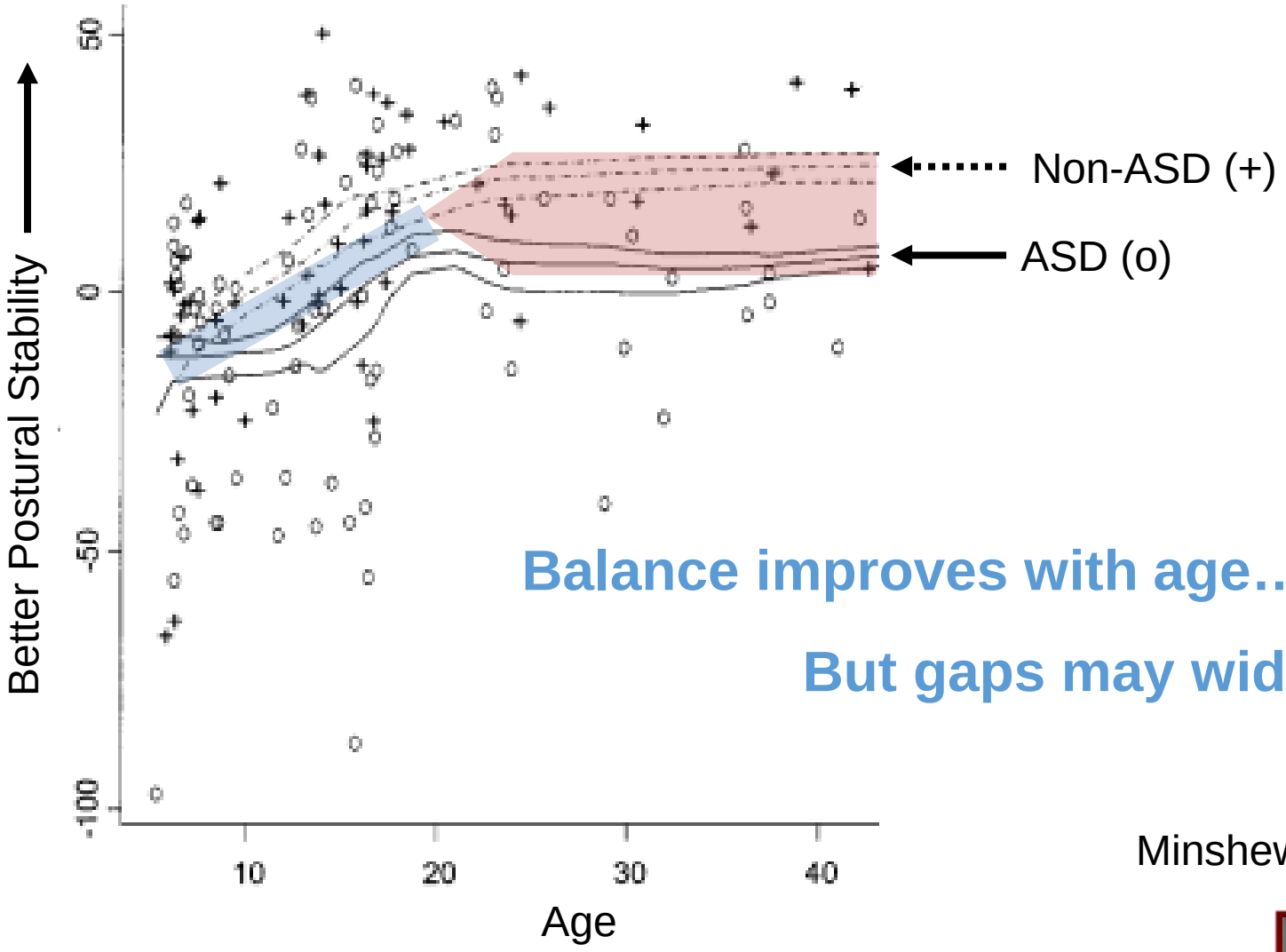
Waisman Center
University of Wisconsin-Madison

Waisman Center Motor & Brain Development Lab

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

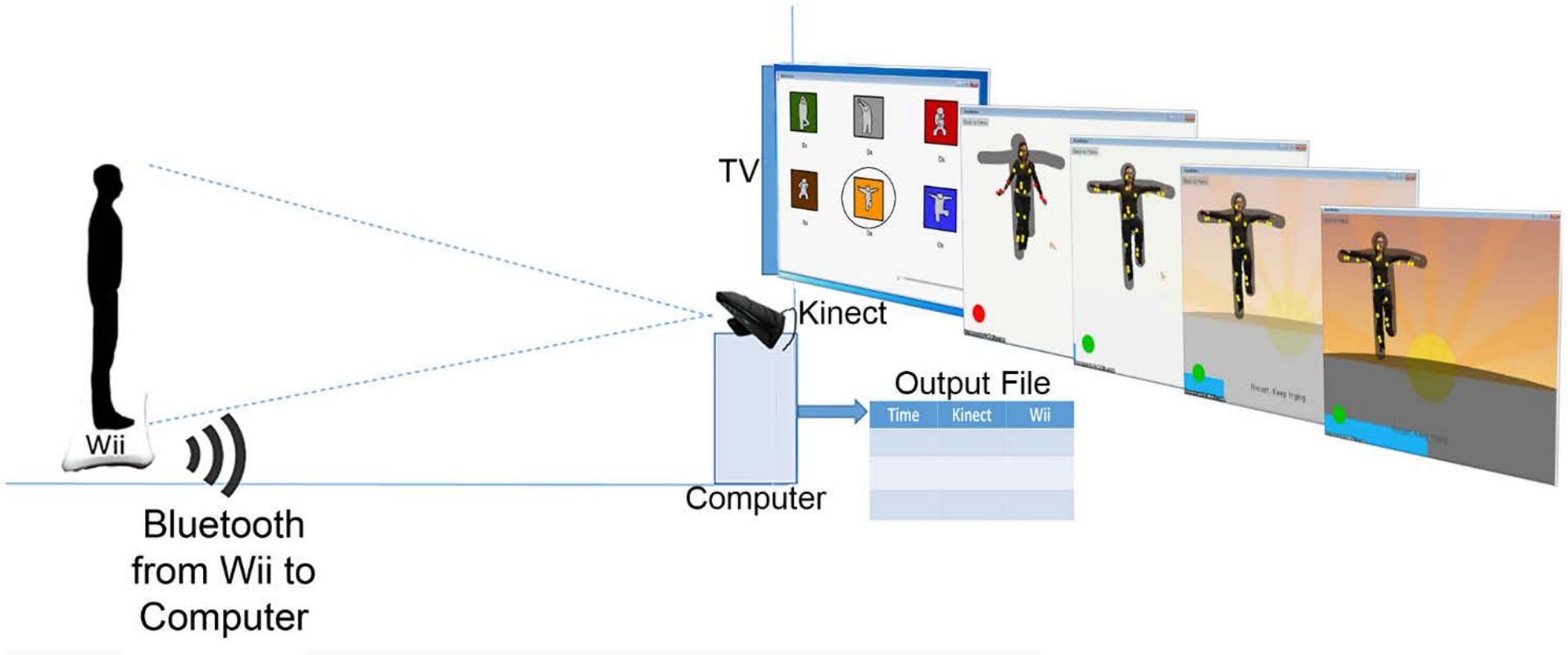
Minshew et al., 2004

Research questions:

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

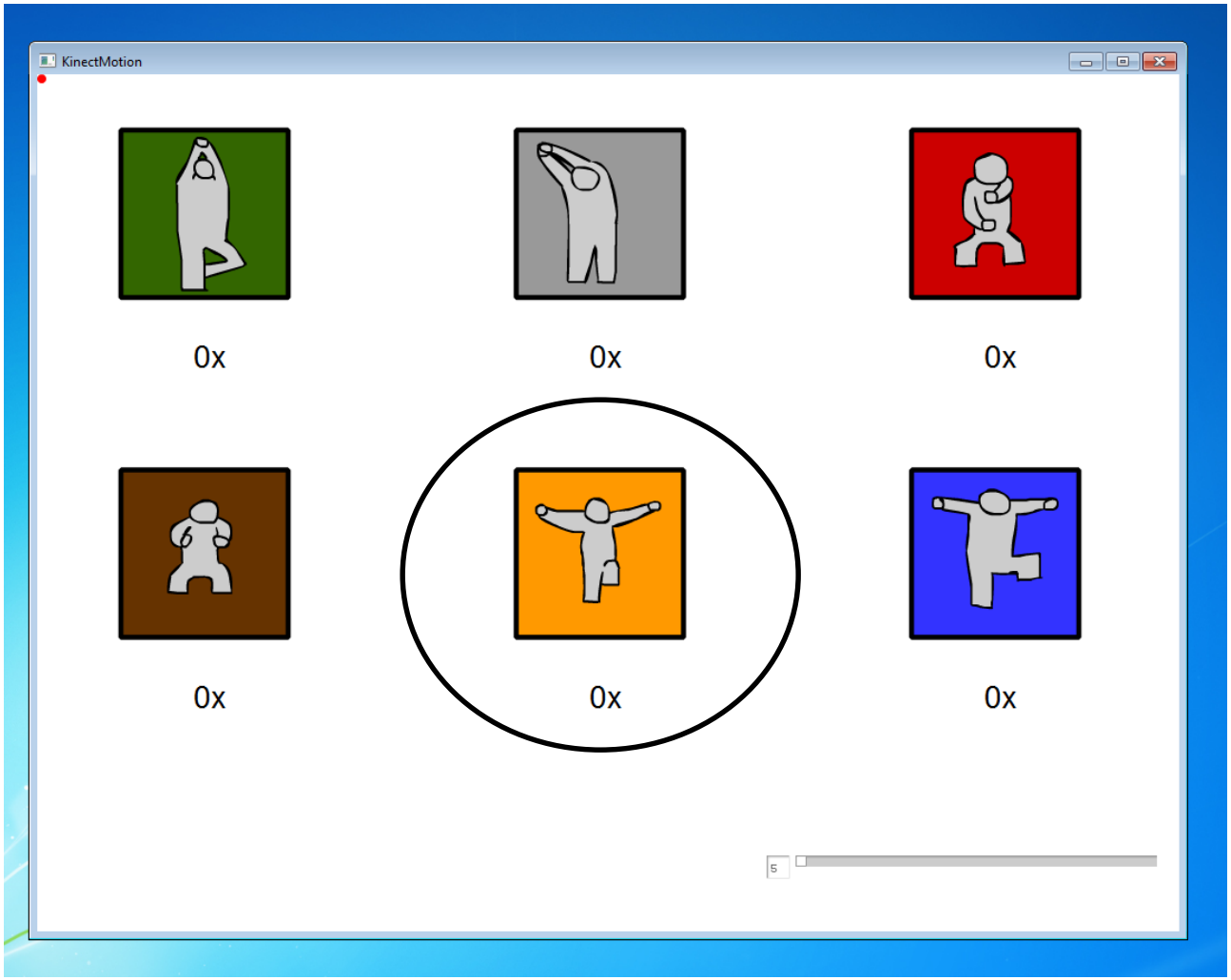
2. Can we make this training fun and motivating?

Ninja Training Video Game

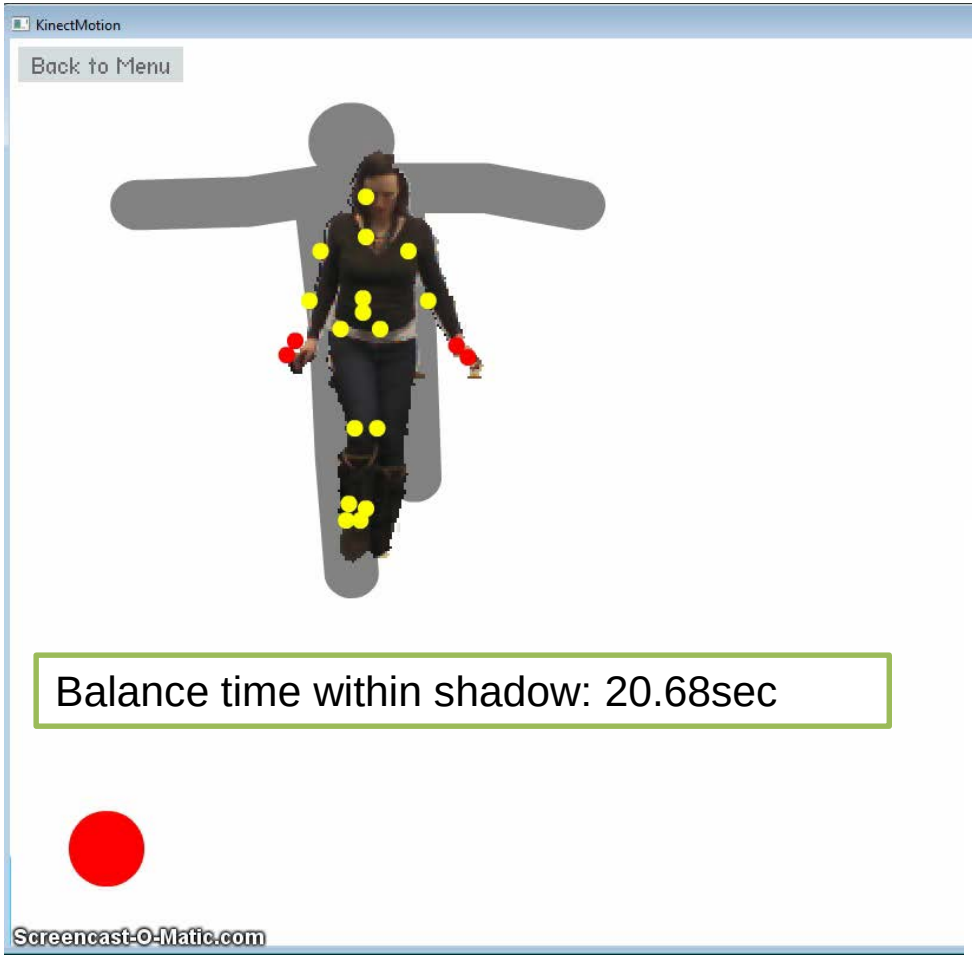


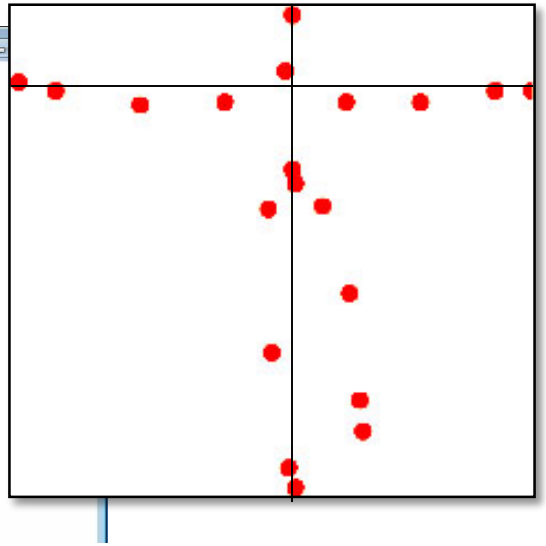
Collaborators: Anthony Ellertson (Boise State), Andrea Mason (UW-Madison), Leigh Ann Mrotek (UW-Oshkosh)

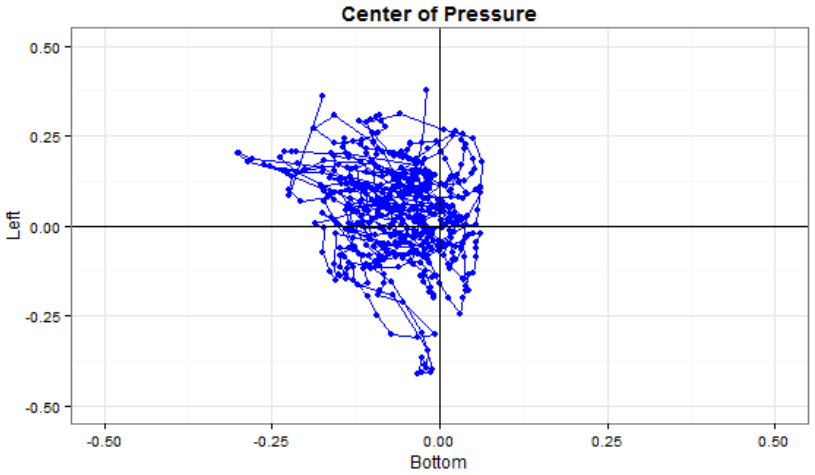
Introductory Screen



Ninja Training Video Game





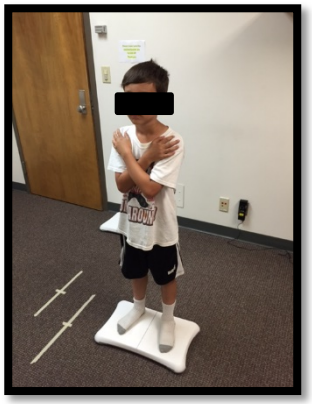


Training Schedule

6 weeks of training (18 sessions)

First Session

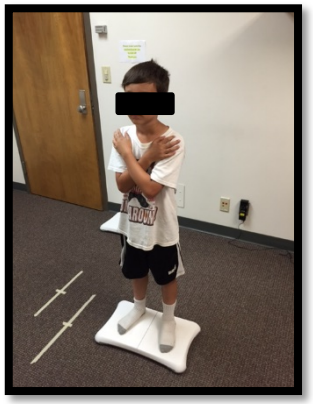
Last Session



Balance testing

Each Training Session (60 min):

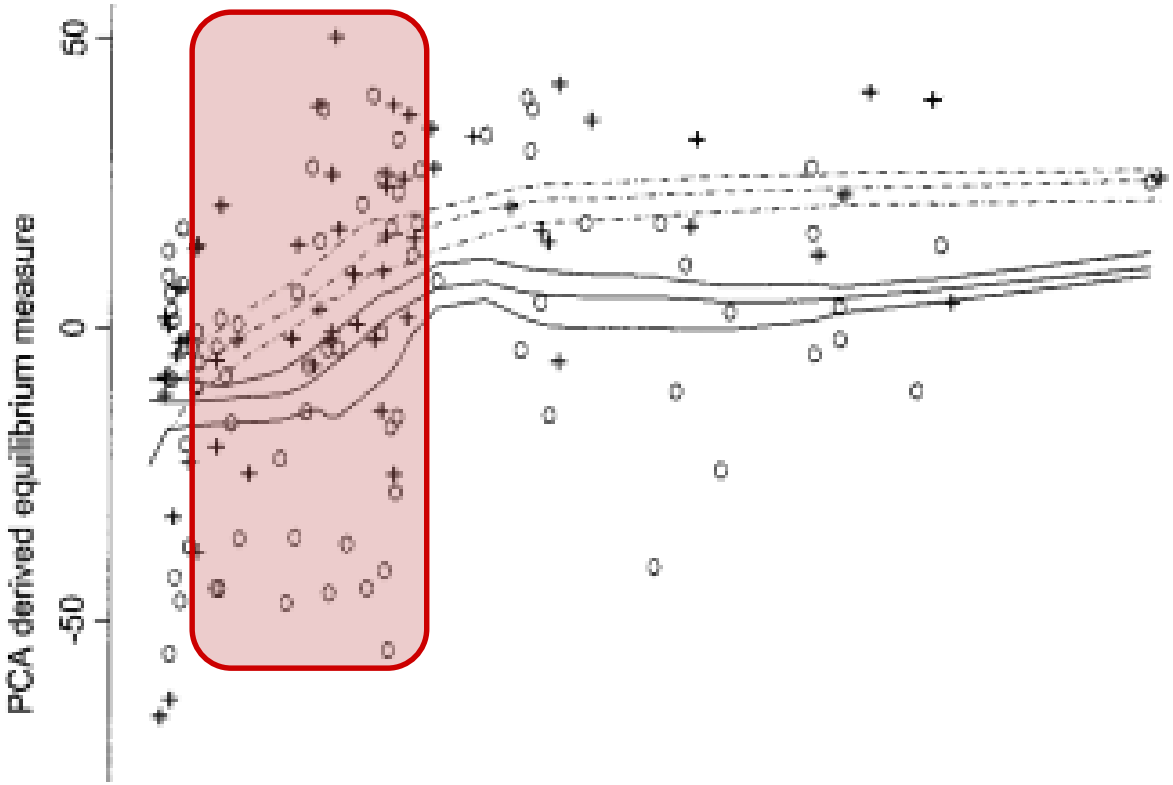
- 3-4 Ninja Poses
- 1-2 Wii Fit Games
- Break
- 1-2 Wii Fit Games
- 3-4 Ninja Poses



Balance testing

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

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

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 <u>not</u> 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.“

“Very fun, got to meet a lot of people, made me think in a different way. “

“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.“

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

1. Visual-based biofeedback balance training improves balance in youth on the autism spectrum.
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/

Collaborators:

- Andrea Mason (UW-Madison)
- Leigh Ann Mrotek (UW-OK)
- Anthony Ellertson (Boise State U)

Funding:

- Brain & Behavior Research Foundation, NARSAD Young Investigator Award
- Hartwell Foundation
- WISYS Technology Foundation
- NICHD (P30 HD003352 & U54 HD090256 to the Waisman Center)