

Neural Fitness & Aging

Dual-Task Training Program For Older Adults
with Fall History: Blending Gait, Visuomotor
And Cognitive Training



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Mobility/Falls & Neural Fitness

Aging Effects

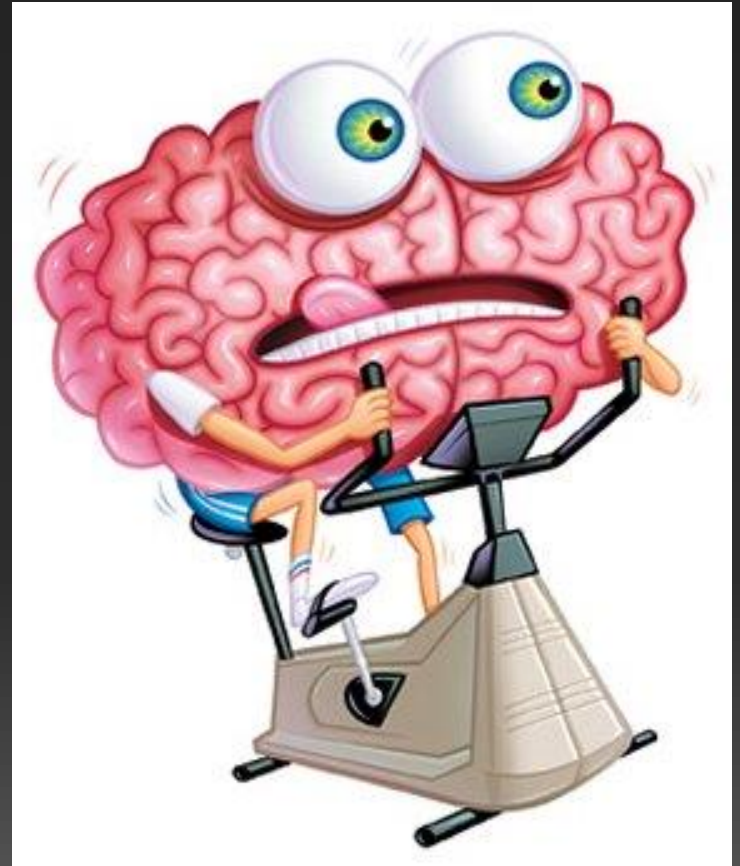
Balance Skills

Walking-Mobility Skills

Visuomotor & Gaze Stability

Cognitive Skills

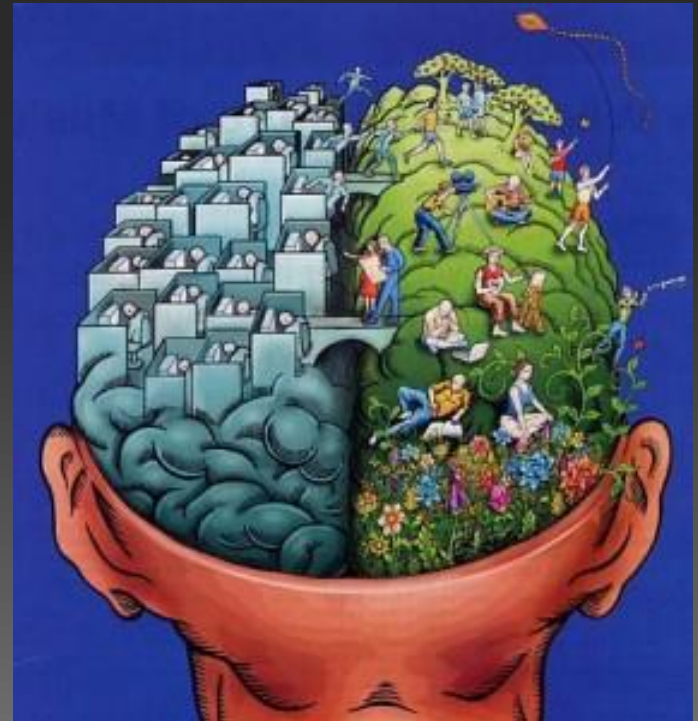
Multi-tasking Skills



Multicomponent Dual-Task Training

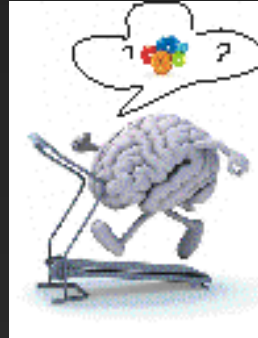
Evidence growing DT training using “digital media” playing “cognitive” computer games has beneficial effects for older adults

- Executive function
- Processing speed
- Gait function/stability
- Dual-task function

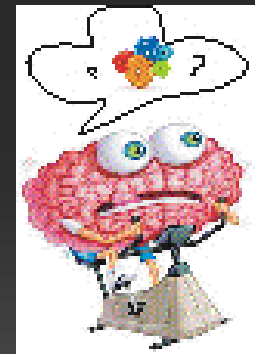


PURPOSE: Exploratory RCT To determine the feasibility & benefits of two game-based dual-task training program for older adults delivered in a community fitness centre

One group Received
Dual-Task Treadmill Walking
(Mobility skills)



Second group Received
Dual-Task recumbent cycling
(aerobic)



Both groups performed the same cognitive activities delivered through interactive “cognitive” computer games
Ten week program 2times per week

Participants 22 Older Adults (11 per group)

Inclusion criteria;-independent community living with fall history & concerns with balance; no neurological disorder; MMSE>25

	DT-Treadmill.	DT-Cycle
Age (years)	75.5±3.1	76.1±3.9
Gender ratio (Males: Females)	6:5	5:6
Mini mental status examination	28.7±1.0	29±0.44
Gait speed (m/s)	1.13±0.1	1.03±0.6
6MWT (215.16 m./lap)	484.2±41.9	512.5±33
five times sit to stand (second)	10.18±2.5	10±0.8
Number of falls in the past year	1.2±.4	1.3±0.6

Treatment

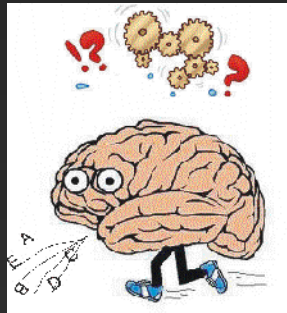
Dual-Task Treadmill Workstation

Miniature “motion mouse” on head band/cap is game controller.

Simple method for responsive hands-free interaction with any commercial “brain-fitness” computer game.

Wide range of cognitive game activities can easily be managed concurrently while performing dynamic balance activities and walking.

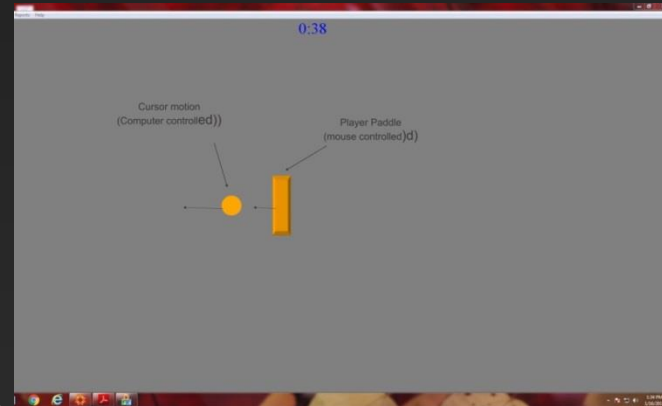




Visuomotor Tracking Task & Outcome measures



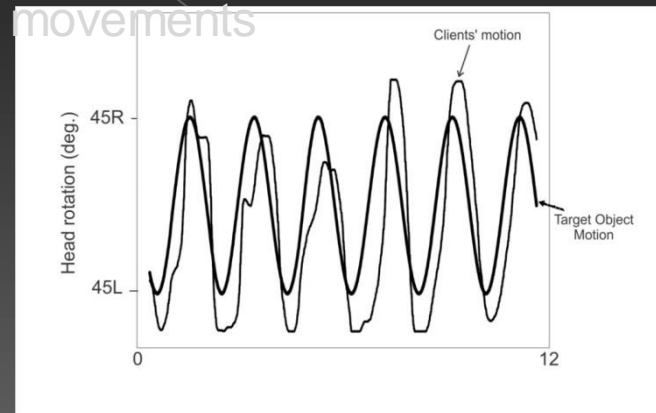
Tracking Mode Snapshot



Outcome Measures

- Total/Average Residual Error
- Amplitude Consistency

Trajectories of Target & Player movements



Cognitive” Game Tasks and Outcome Measures

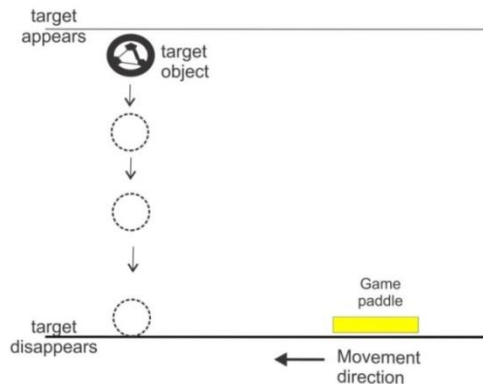


Sphere large dots is game “Target. object
Sphere small dots is “Distractor. object

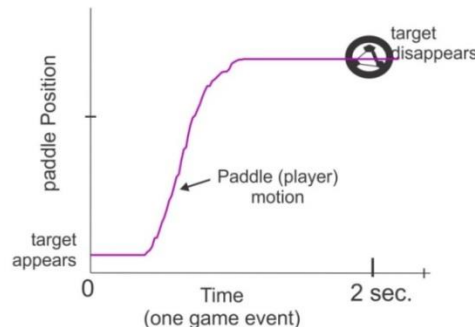
Goal = move paddle catch Target
and avoid Distractor

Duration of each game event = 2 seconds

Game Snapshot



Player movement trajectory for one game event



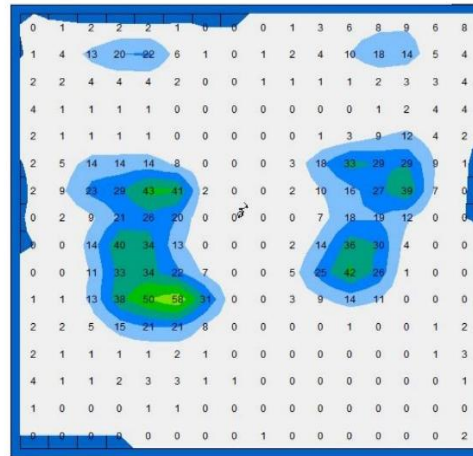
Automated Outcomes

- Success rate
- Response time
- Execution time
- Absolute error
- Response variation

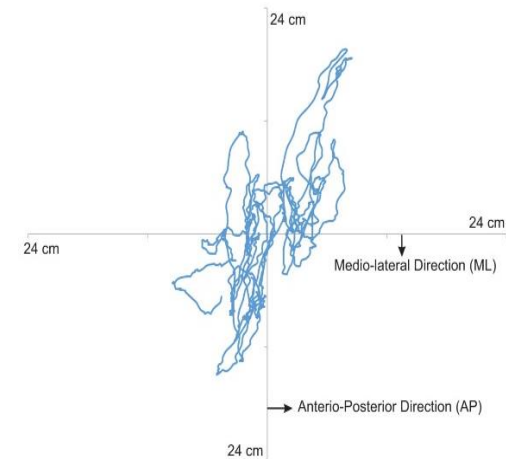
DT-Standing Balance Performance Analysis



VM task while standing on sponge surface (Balance Demand)



FSA Mat recording the Foot pressure and COP while standing



COP Excursions during Standing

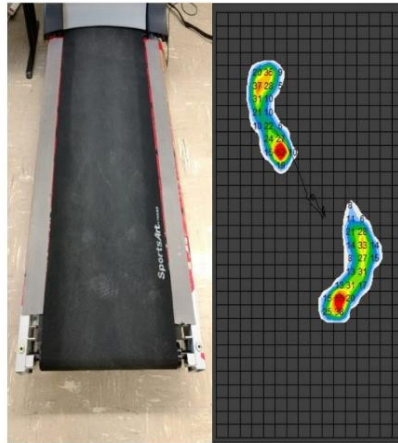
Outcome Measures

Root mean square (RMS)
and Total Path Length of COP displacement

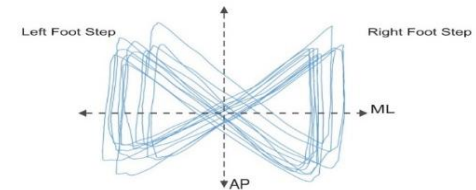
DT-Gait Performance Analysis



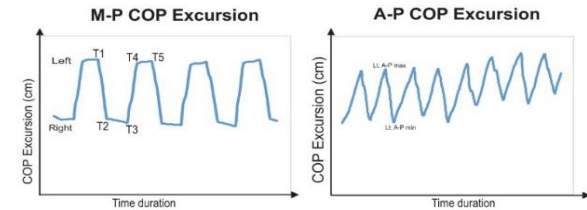
Treadmill instrumented with a pressure mapping system



Pressure Mat Recording While Walking Over Treadmill



Scatter Plot Depicting AP and ML Excursion During Treadmill Walking



Gait outcome measures from AP and ML COP data

1. T2-T3 : Rt. Single Support time (ms)
2. T4-T5: Rt. Swing time (ms)
3. T1-T5: Rt. Stride time (ms)
4. Lt. A-P max - Lt. A-P min. : Rt. step length (cm)

Outcome Measures

- Average and COV step length
- Average and COV of stride time

Qualitative Findings

3 drop-outs : 2 from DT-Treadmill group

- 2 for unrelated injuries

- one found DT treadmill program too difficult

Otherwise compliance was 100%

Participant views on program (Interviews)

- None of the participants played computer games
- Most found DT program to be quite challenging and for some it took time for them to learn how to play the games while exercising
- They found some games interesting and some they disliked. Most reported they were engaging and fun and required considerable focus /attention
- Most commented (liked) the variety of games
- Most found DT treadmill program quite difficult at first but it got easier
- A number of participants in the DT recumbent cycle group would have preferred the DT treadmill i.e. perceived a better challenge to balance /gait
- Some found head mouse difficult to get use to but with practice it did become natural
- The motion mouse did drift and this was a problem and quite annoying
- Most were willing to continue the program

Effects of Intervention on Standing Balance Performance

Within Group - Significant improvement both groups

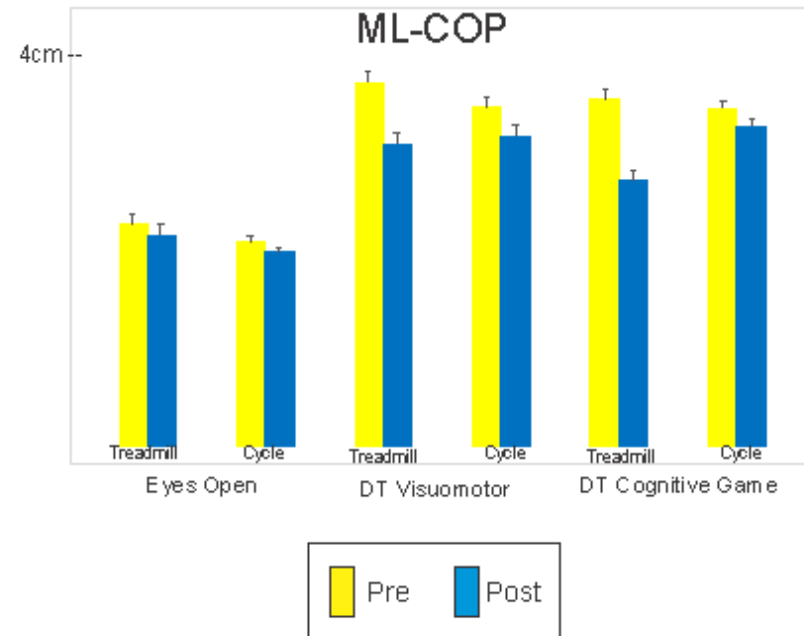
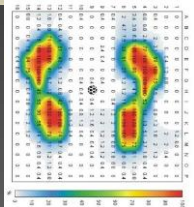
Between Group - Greater improvement seen in DT-Tread. Vs Dt-Cycle



Visuomotor



Cognitive game



Group means & SEM for RMS COP displacement

Effects of Intervention on Walking Performance

Within Group

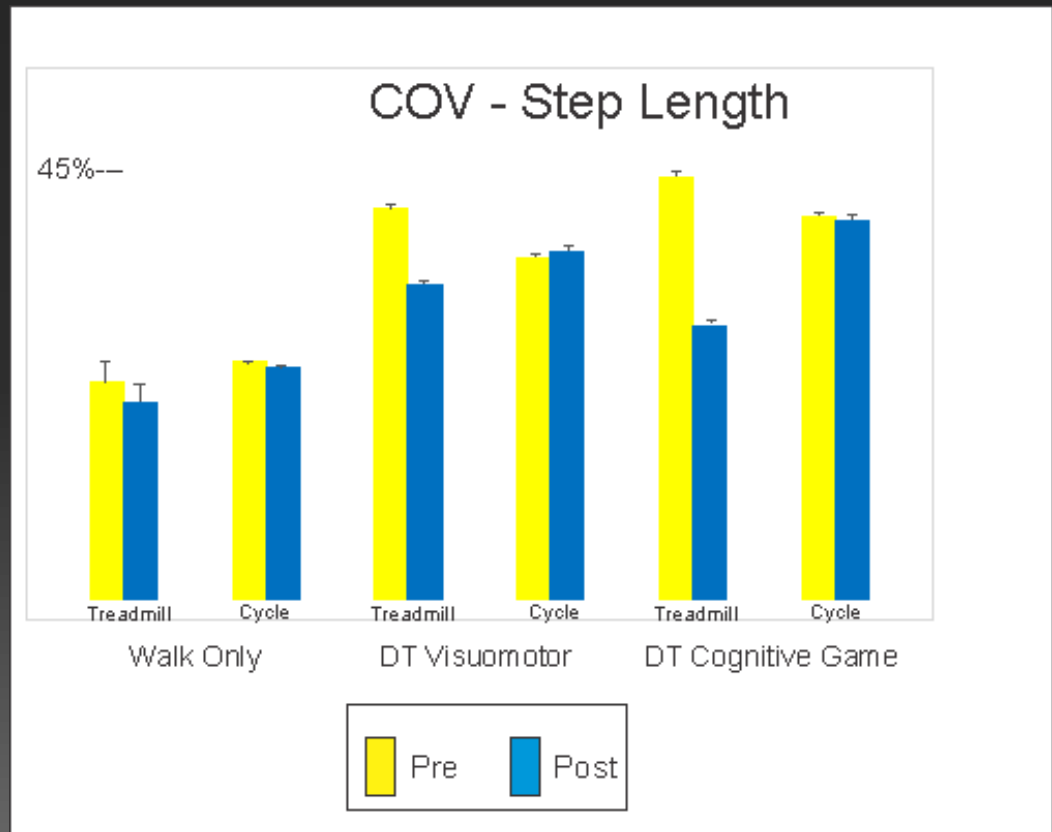
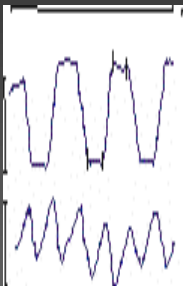
- Significant improvements DT—Treadmill group only
COV-step length & step time decreased
Average step length increased



Visuomotor



Cognitive game

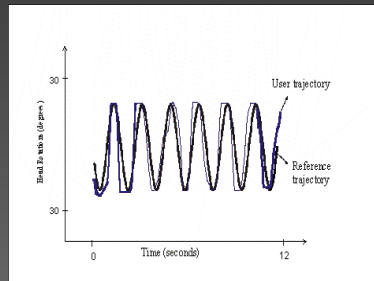


Effects of Intervention on Visuomotor/ Gaze Performance

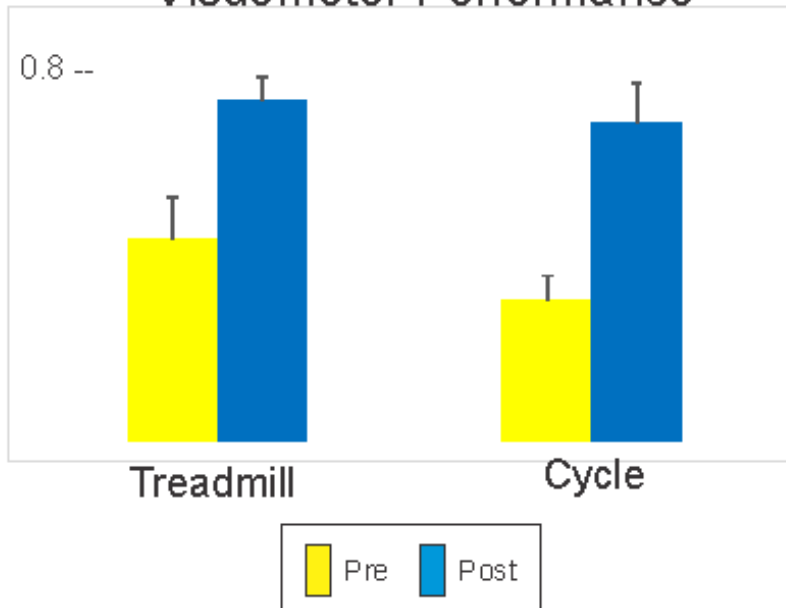
Within Group - Significant improvement both groups

Between Group – No group difference

DT Testing



Visuomotor Performance

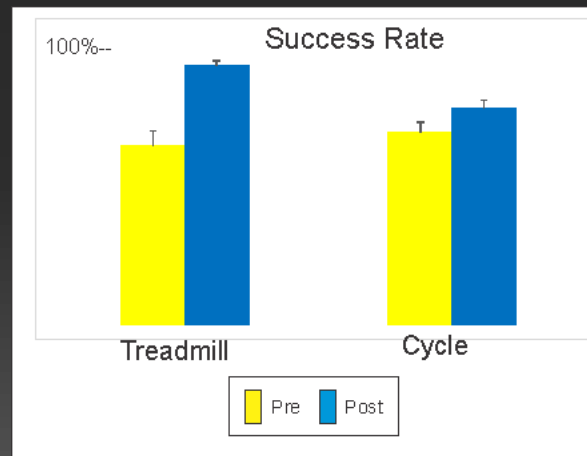
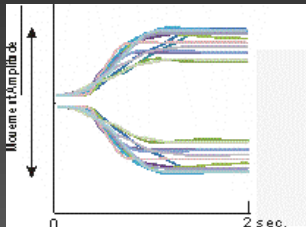


Effects of Intervention On Visuospatial Cognitive Performance

Within Group - Significant improvement both groups

Between Group – No group difference

DT Testing



Effects of Intervention on Executive Function Test Scores (sitting)

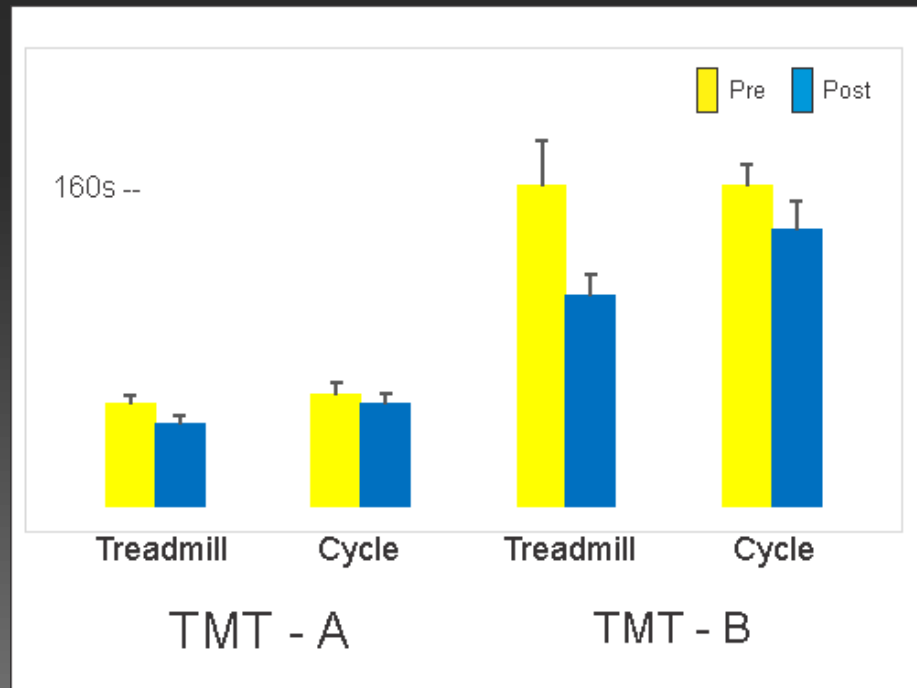
Verbal Fluency & Visual Search Test

No Within or Between Group effects improvement both groups

Trail Making Test part A & B

Within Group - Significant improvement both groups

Betw Between Group - Greater improvement seen in DT Treadmill group



Similar Study just completed on 15 Parkinson's Patients

Does Use of a Dual-task cognitive game-based treadmill platform improve gait in Parkinson Disease? A feasibility study

Bhuvan Mahana, Douglas Hobson, Ji Hyun Ko, Tony Szturm

Background: Both gait impairments and the decline in executive cognitive functions have been proven to increase fall risk and mobility limitations in individuals with Parkinson's disease (PD). As such, there is a need to develop further approaches that combine gait with executive cognitive activities.

Purpose and Objectives: To provide evidence of the feasibility of conducting a full-scale randomized controlled trial (RCT) using the GTP for dual task walking training in PD. The

Participants: Fifteen participants diagnosed with PD, stage 2-3 on Hoehn and Yahr scale.

Intervention: A 10 week, (twice per week) DT treadmill gait training program which included various visuomotor and cognitive game task

Results: - Conclusion: Although some difficulties with the technology were reported, the findings demonstrate feasible trial procedures and acceptable DT task-oriented training with a high compliance rate and positive outcomes. These findings and the theoretical evidence direct the next phase of a full-scale randomized controlled trial (RCT).

CONCLUSION

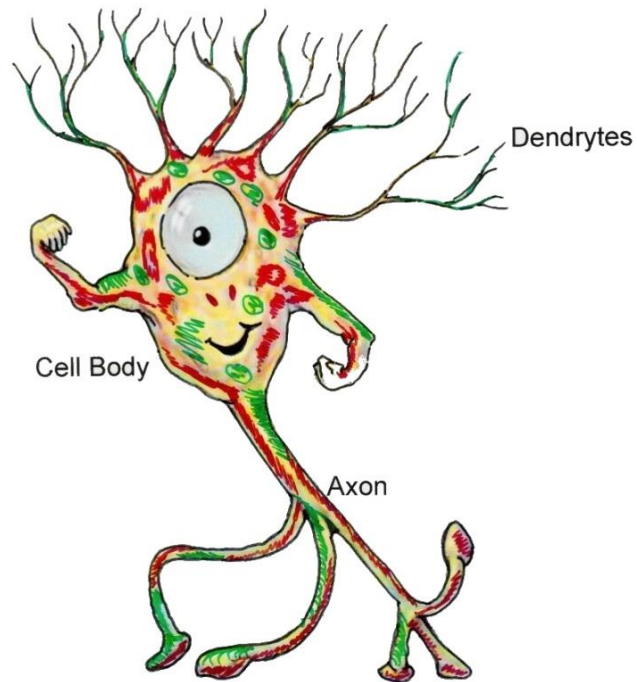
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These findings and the theoretical evidence direct the next phase of a full-scale randomized controlled trial (RCT).

BRAIN HEALTH

Keep your neurons fit & have fun doing It

Mighty Excitable Nerve Cell



Thank You