

Maintaining Mobility and Independence

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the Life Course



Outline

- The impact of falls
- Falls in females
- Multi-task control of balance
- Improving balance and mobility



Falls are Pervasive and Debilitating

Leading cause of fatal and non-fatal injuries in older adults

Third leading cause of injury-related death for all ages

Quality of life is compromised following a fall

Medical costs predicted to exceed:

\$54 billion in 2020

\$100 billion in 2030

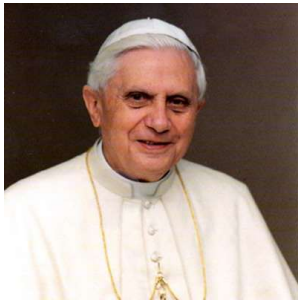
Falls are Common



Ann B. Davis

2014 – fell in bathtub (died)

Fell at 88 years old



Pope Benedict XVI

2009 – fell walking indoors (broke wrist)

Fell at 82 years old

Falls are Common



John Glenn

1966 – fell in bathtub (concussion and injured inner ear)

Left him unable to campaign

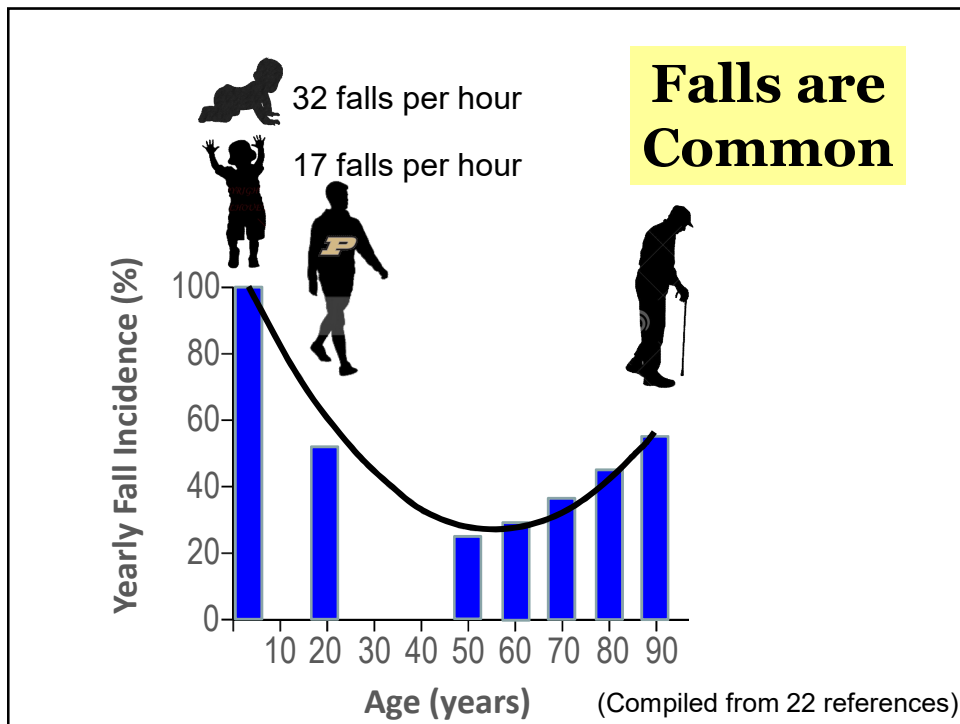
Fell at 45 years old



Jennifer Lawrence

2013, 2014, 2015

Fell at 23, 24, and 25 years old

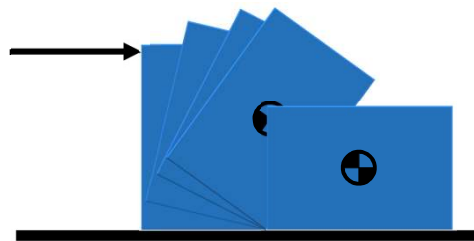


The Balance Control System

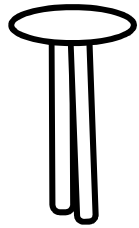
The mechanical aspect

Center of Mass

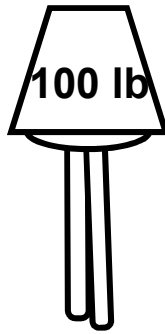
Base of support



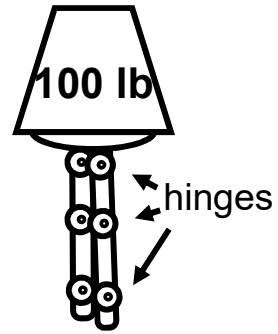
The Mechanical Aspect of Balance



2-legged stool?

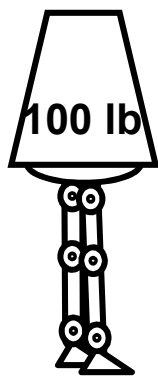


Add a weight

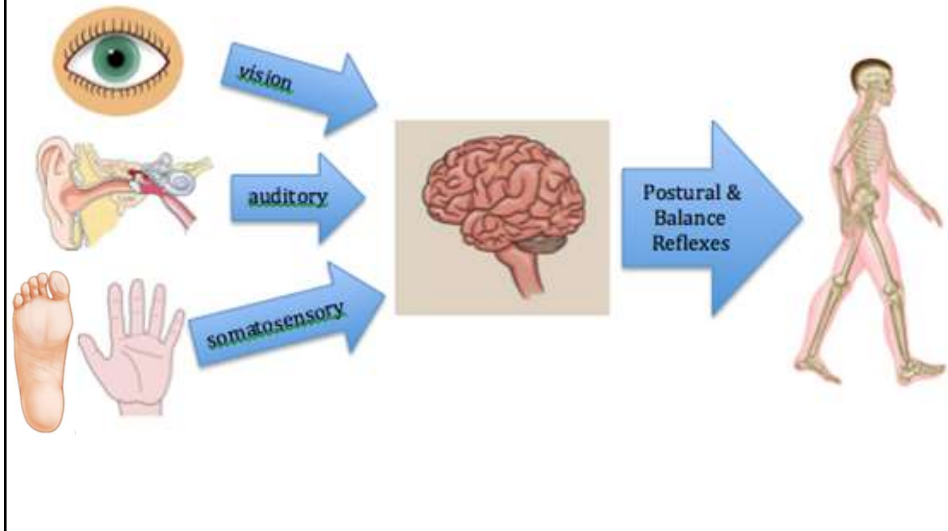


and hinges

Bipeds are Inherently Unstable



Control of balance and gait



Factors that Lead to a Fall

Personal Factors

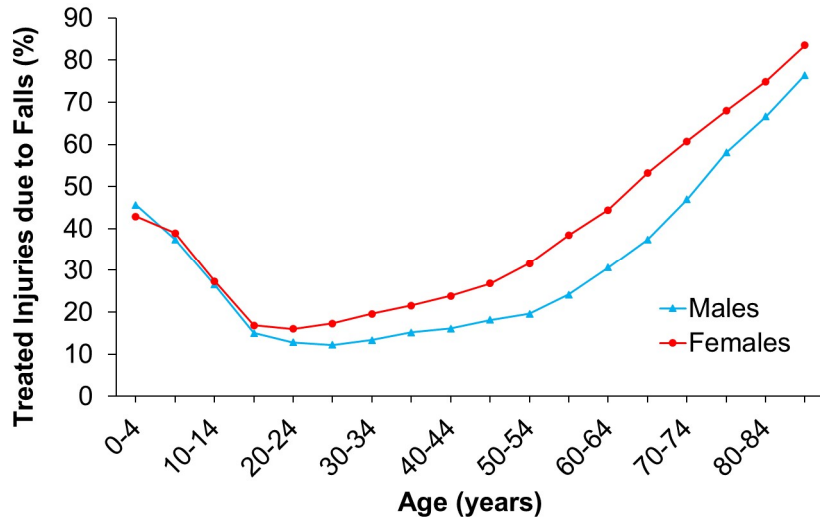
Age
Sex
Weight
Disease/disorder
Weakness
Pain
Sensory Changes
– Especially Vision & Vestibular
Previous Falls
Risk-taking Behavior
Alcohol
Medications
Etc.

Environmental Factors

Slippery Surfaces
Stairs
Ramps
Trip Hazards
Lighting



Injuries due to Falls



Compiled from CDC website for 2015

Young Adult Falls: Males vs Females

Young adult males and females fell at the same rate

Females were more likely to fall on stairs (trend)

Females were more likely to be talking to a friend when they fell

Females were more likely to trip

Only females sustained serious injuries that required medical attention

Cho et al., in review

Gait Speed and Mortality

Health Risk Assessment:

1. Age
2. Sex
3. Chronic conditions
4. Smoking history
5. Blood pressure
6. Body mass index
7. Hospitalization

Similar accuracy:

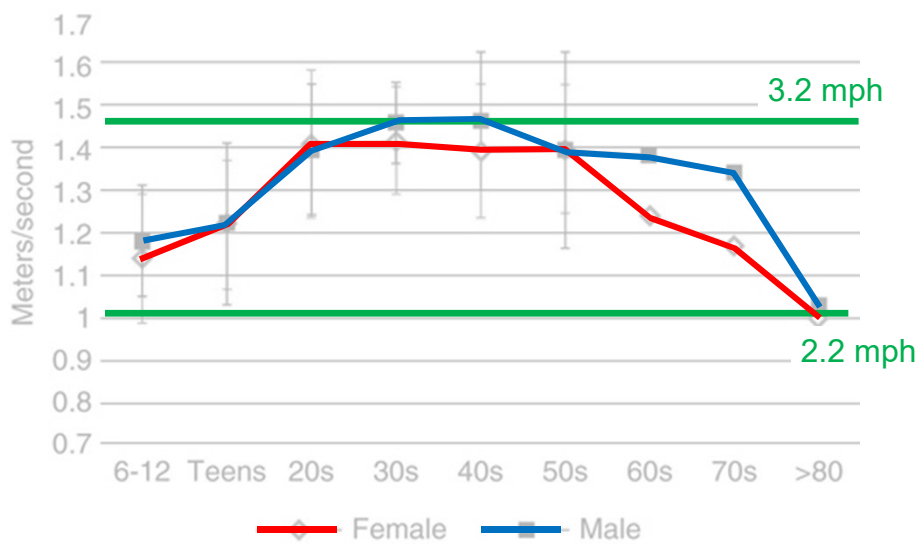
1. Age
2. Sex
3. Gait speed

Gait puts demands on multiple systems:

- Cardiovascular
- Respiratory
- Musculoskeletal
- Nervous
- Cognitive

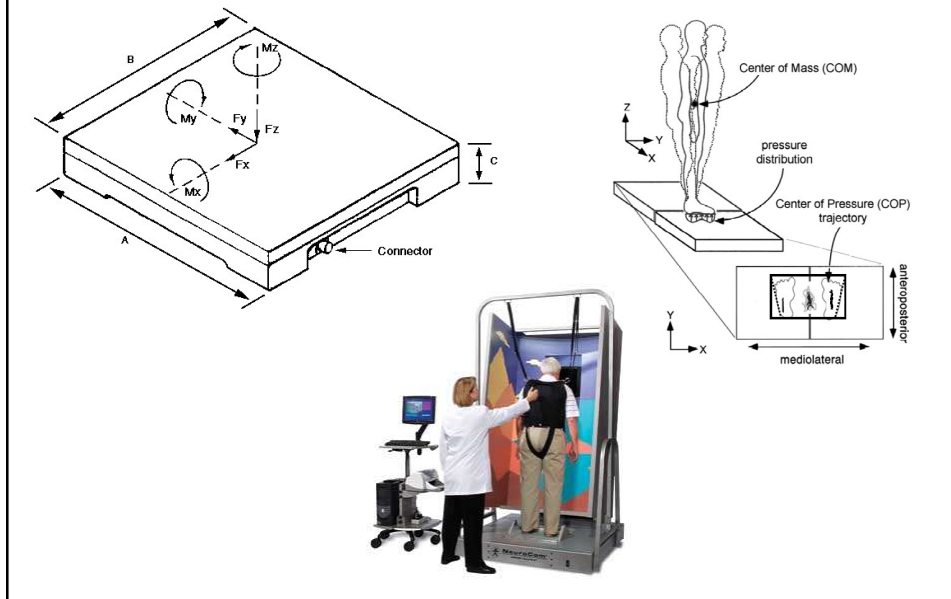
Studenski et al., 2011

Gait Speed



Fritz & Lusardi, 2009

Assessing Balance



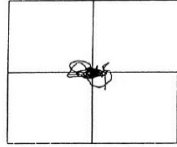
Balance, Mobility, & Communication

- Communicating is a cognitively demanding task which is done while performing a variety of other tasks.
- Can the simple act of communication compromise balance, and mobility and increase the likelihood of suffering a fall?

Balance, Mobility, & Communication

Older Non-Faller

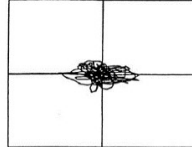
Firm Surface - No Task



Sway

Older Non-Faller

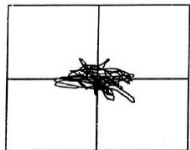
Firm Surface - Sentence Completion



Sway

Older Faller

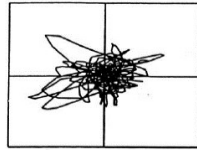
Firm Surface - No Cognitive Task



Sway

Older Faller

Firm Surface - Sentence Completion

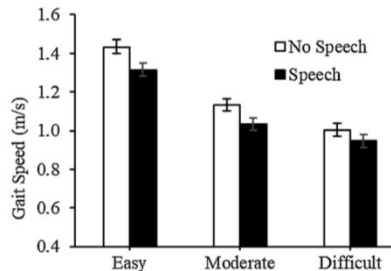
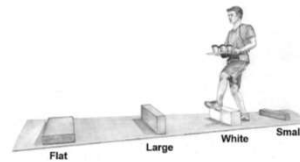


Sway

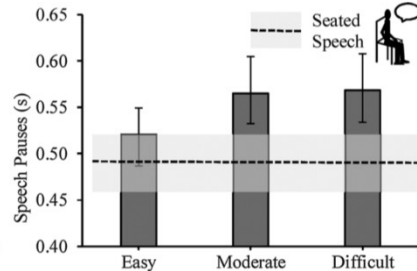
Woollacott et al. 2002

Walking while talking: Young adults flexibly allocate resources between speech and gait

Tiphonie E. Raffegaue^{a,b}, Jeffrey M. Haddad^a, Jessica E. Huber^c, Shirley Rietdyk^{a,*}



(A)

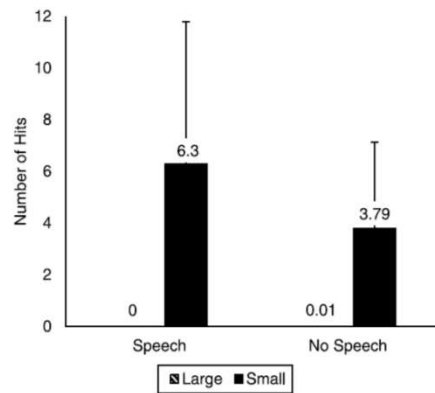


(B)



Multi-task prioritization during the performance of a postural–manual and communication task

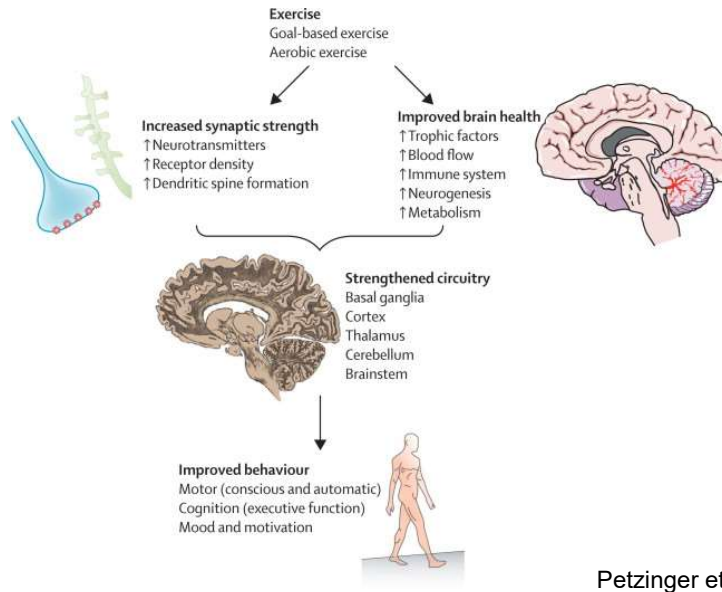
Kara L. Simon-Kuhn¹ · Jeffrey M. Haddad² · Jessica E. Huber¹



What we have learned

- Speech, mobility, and fall risk are related.
- Individuals prioritize task performance based on perceived consequences of failure or falling.

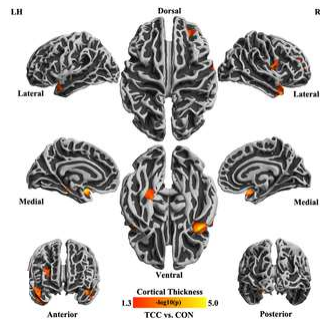
Exercise and Cognition



Improving Balance and Mobility



Can Tai Chi reshape the brain
Wei et al. (2013)?



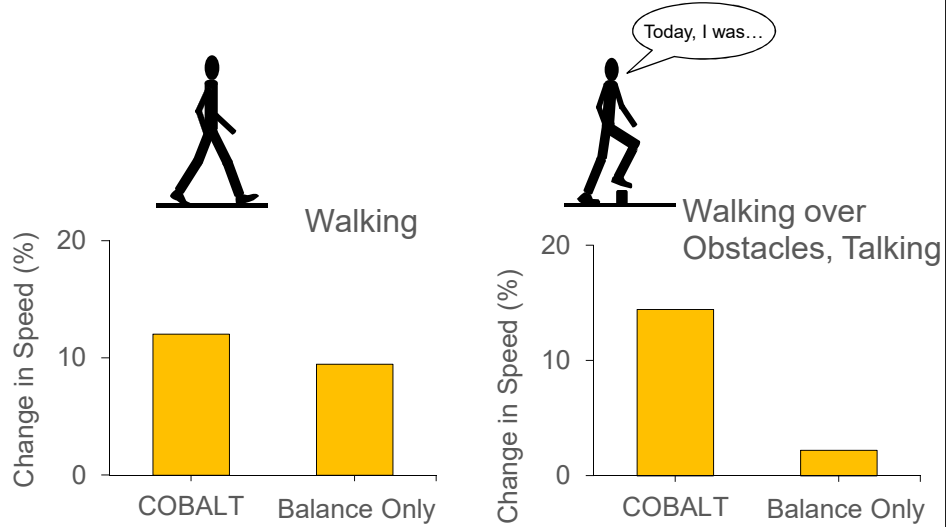
Cognitive Balance Training (COBALT)

- Balance games that simultaneously challenge aspects of cognition
 - Inhibition using a modified Stroop task
 - Memory using a game similar to the Simon handheld game
 - Set switching using an A-B paradigm
- Games are played using repurposed gaming technology such as the Microsoft Kinect and Wii balance board.

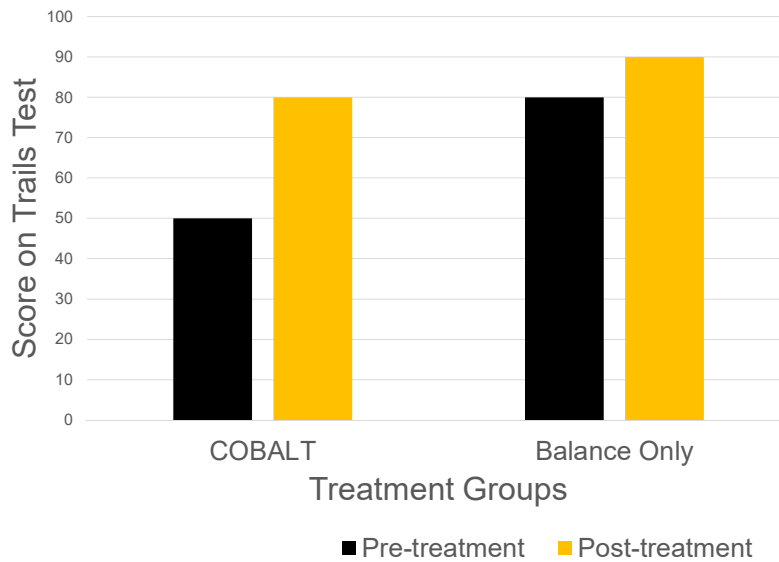
COBALT – *Memory*



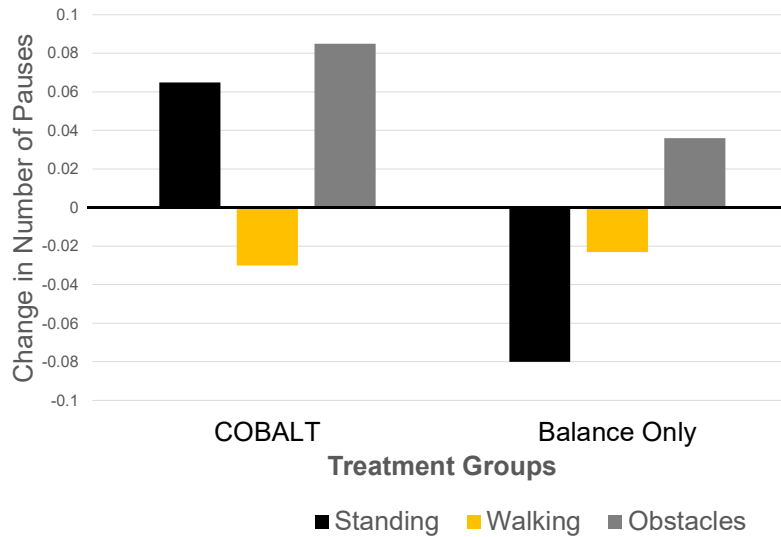
Gains in Gait Speed Post-COBALT



Gains in Cognition Post-COBALT



Gains in Speech Production Post-COBALT



Summary

- Evidence that balance training does improve functional gait and precision manual control.
- Implication: this type of training can improve the ability of older adults to safely engage in typical ADLs without compromising balance.
- Does this type of training help individuals with PD?

Questions?

- Acknowledgements:
 - Sandy Snyder
 - Our many graduate and undergraduate research assistants
 - Our research participants
 - Funding



- Presenter Brief Biographies
 - **Jeffrey M. Haddad**; Associate Professor, HK
 - Ph.D. 2006 from the University of Massachusetts at Amherst
 - **Jessica E. Huber**, Professor, SLHS
 - Ph.D. 2001 from the University of Buffalo
 - **Shirley Rietdyk**, Professor, HK
 - Ph.D. 1999 from the University of Waterloo

CEREBBRAL

- Center for Research on Brain, Behavior, and NeuroRehabilitation (CEREBBRAL)
- Goals:
 - Characterize risk factors and mechanisms related to loss of quality of life with aging and neurological diseases
 - To develop and assess interventions and devices to improve function, independence, and quality of life
 - To understand cognition and behavior in complex biological systems
- Website: <http://www.purdue.edu/hhs/cerebbral/>
- Email: cerebbralcenter@purdue.edu
- Co-directors: Jessica Huber and Sebastien Helie