The Dual-Task Condition: Intro & Assessment

An Evidence-Based Guide For
Attention-Related Fall Risk in Older Adults

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Objectives

- Highlight the problem of fall risk in older adults; explain how attentional decline is a contributor
- Explain dual-task deficits as well as their relationship to attention and fall risk in older adults
- Discuss the process of dual-task assessment
- Describe tools available for dual-task assessment
- Facilitate an understanding of the current literature behind dual-task assessment

Older Adults & Falls: The Numbers

- ~13.3% of the US population is age 65 and older (US Census Bureau)
- The Baby Boomers are aging
- Number of geriatric falls increasing (Centers for Disease Control & Prevention, National Council on Aging)
- Falls = leading cause of fatal and non-fatal injury in older adults
- 2010: $30 billion spent on fall-related healthcare expenses (Centers for Disease Control & Prevention)

Older Adults & Falls

- Consequences of falls (Centers for Disease Control & Prevention; Hiyamizu, 2012; Uemura 2012)
  - Lacerations
  - Head trauma
  - Fractures
  - Prolonged hospitalization
  - ↓ mobility, ↓ function & independence

  → depression, fear, sedentary lifestyle = ↑↑ Fall Risk!!
- Contributing factors (Hiyamizu, 2012)
  - Extrinsic factors: Environment
  - Intrinsic factors: Age-related
  - Attention (Hiyamizu, 2012; Li, 2010; Plummer-D'Amato, 2012)

Attention

- "The ability to select and attend to a specific stimulus while simultaneously suppressing extraneous stimuli" (O'Sullivan, 2007)
- Types of attention (Unsworth, 1999)
  - Sustained
  - Selective (focused)
  - Alternating
  - Divided

- Divided attention = an executive function (de Bruin, 2010)

Attention & Aging

- Attentional demand under dual-task conditions
  - Dual-Tasking: Performing 2 tasks together simultaneously
  - Simultaneous tasks compete with each other for limited cortical resources including attention (Beauchet 2010; Montero-Odasso, 2012)
- Cognitive impairment = greater difficulty dividing attention (Schwenk, 2010; Montero-Odasso, 2012)

Attention & Aging

- Attentional decline affects:
  - Balance (van Iersel, 2008; Hawkes, 2012)
  - Postural Control (Bensoussan, 2007; Zijlstra, 2008)
  - Gait (de Bruin, 2010; Holtzer, 2012; Montero-Odasso, 2012)
- Less able to shift attention between a cognitive and motor task + impaired neuromuscular system can result in (Hawkes, 2012)
  - Increased gait instability
  - Decreased ability to make quick postural adjustments
  - Less efficient allocation of motor and attention resources to respond to perturbations
  - Fall risk (Montero-Odasso, 2012)

Dual-Task Deficits

Dual-Task Deficits

- What is Dual-Task Cost?
  - Performance of each task in isolation = single-task conditions
  - Performance of both tasks together = dual-task conditions
  - DTC: Decline in performance when two tasks are performed together
- How to Calculate DTC: (% reduction or benefit)

$$\frac{\text{(single-task – dual-task)}}{\text{single-task}} \times 100$$

Dual-Task Deficits

- Factors contributing to DT deficits (Hausdorff, 2008)
  - Declines in
    - Executive function (i.e. attention, memory)
    - Mobility
  - Depressive Symptoms
  - Anxiety
  - Other
- Who is at risk for DT Deficits? (Beauchet, 2009; Bensoussan, 2007; Coppin, 2006; Schwenk, 2010)
  - Older adults
  - Cognitive impairment

Dual-Task Deficits

- May be difficult to predict who will experience DT costs
  - Effects depend on a number of variables (Hausdorff, 2008)
  - Decreased gait speed could mean several things (Coppin, 2006)
  - Executive impairment can affect judgment to slow down during high-risk tasks (Coppin, 2006)
- What are the possible consequences of DT Deficits?
  - Increased postural instability during everyday activities (Bensoussan, 2007)
  - Danger of falling!
  - Hip fracture, hospitalization, death

Dual-Task Assessment

What is Dual-Task Assessment?

- Measures ability to perform more than one task at a time
- Typically motor task + cognitive task
- Could be motor task + motor task

What are the benefits of using DT Assessment with Patients?

- Predicting falls risk in older adults and people with neurologic impairments (Beauchet, 2009; Hyndman, 2006)
- Goal: Determine if attentional resources have been exceeded

Does DT Assessment Actually Predict Falls Risk?

Beauchet (2009)

- Systematic Review of 15 Studies
- Statistically significant relationship between motor DT costs and falls risk in 2/3 retrospective studies and 6/8 prospective studies reviewed
- Findings varied greatly among studies, but overall pooled odds ratio for falling was 5.3 (95% CI, 3.1-9.1) when subjects had DT motor or cognitive costs
- Highest predictive values for falls found in studies including institutionalized adults

Zijlstra (2008)

- Systematic Review of 19 Studies
- Unable to conclude with certainty whether DT assessments are more sensitive for predicting falls risk than single task (ST) assessments due to poor study methodology
- Results of two prospective studies suggest that DT assessments may be more sensitive for predicting falls
- DT assessments tend to have moderate-high specificity and predictive values but lower sensitivity for predicting falls

Better at ruling IN fall risk, than ruling it OUT …

What is the best way to use DT Assessment in the clinic?

- Good for use with older adults with postural instability under DT conditions (Zijlstra, 2008)
- Identifies some but not all fallers (Zijlstra, 2008)
- Include as part of outcome measure battery for fall risk/balance (Verghese, 2002; Zijlstra, 2008)
- Poor performance directs intervention (Verghese, 2002)

Examples of DT Assessments

1. Stops Walking While Talking (Long)
2. Stops Walking While Talking (Short)
3. Walking While Talking
4. Faster Counting While Walking
5. Timed Up & Go
   - Manual
   - Cognitive
6. Walking and Remembering Test

Stops Walking While Talking (Long)

- Lundin-Olsson, 1997; deHoon, 2003
- Frail, institutionalized older adults (mean age 80), some with dementia, depression, or post-stroke
- Psychometric Properties
  - Specificity: 95%
  - Sensitivity: 48%
  - PPV: 83%
  - NPV: 76%

Advantages
- Simple
- Fast
- No equipment needed

Disadvantages
- Requires walking >100 m
- Protocol not well defined
- Subjective observation of "complete stop"
- Does not detect subtle changes in balance under DT conditions (de Hoon, 2003)
- No cut-off scores or normative data

Stops Walking While Talking (Short)

- de Hoon, 2003
- Frail, institutionalized older adults with increased risk of falling (mean age 86)
- Psychometric Properties
  - Not established
  - Gait speed and trunk sway significantly greater in "stoppers" versus "non-stoppers"

Advantages
- Short distance
- Well-defined protocol, simple content
- Sudden question mimics unexpected situation associated with falling

Disadvantages
- More false-positives than Long version?
- Measures gait stability vs. falls
- Equipment needed to measure trunk sway (or subjective observation of "complete stop")
- No cut-off scores or normative data

Walking While Talking

- Verghese, 2002; Brandler 2012
- Community dwelling older adults without dementia or depression (age range 65-98)
- Psychometric Properties
  - **WWT-Simple (**Sensitivity: 46%; Specificity: 89%; PPV: 55%)
  - **WWT-Complex (**Sensitivity: 39%; Specificity: 96%; PPV: 71%)
  - Brandler alternative: not yet established

Advantages
- Allows measure of cognitive costs, 2 levels of cognitive difficulty
- Well-defined protocol
- No equipment needed
- Brandler alternative minimizes practice effect

Disadvantages
- Only relationship between motor costs and falls risk studied
- Directions may be too complicated for some patients
- Brandler alternative not well-studied yet

Faster Counting While Walking

- Beauchet, 2007
- Older adults (age range 75-100) living independently in senior housing facilities
- Psychometric Properties
  - Sensitivity: 87%
  - Specificity: 90%
  - PPV: 85%
  - NPV: 90%

The "Magnet Effect" (Beauchet, 2010)

Advantages
- Specifically measures cognitive costs
- No equipment needed
- Well-defined protocol

Disadvantages
- Measure not well-studied
- Explanation for relationship between higher counting performance and falls risk not well understood

Timed Up & Go (TUG)

- Shumway-Cook, 2000; Hofheinz, 2010
- TUG Manual & Cognitive
- Community-dwelling older adults (with and without history of falling; ages 60-95)
- Psychometric Properties
  - **Manual**
    - Sensitivity: 86.7%
    - Specificity: 93.3%
  - **Cognitive**
    - Sensitivity: 80%
    - Specificity: 93.3%

Advantages
- Simple, fast
- Able to test motor-motor DT or cognitive-motor DT
- Allows assistive device
- Well-established data

Disadvantages
- TUG (Manual or Cognitive) may not be better than standard TUG (Shumway-Cook, 2000)
- Some patients (assistive devices) may be unable to perform TUG Manual

Walking & Remembering Test (WART)

- McCulloch, 2009
- Community-dwelling older adults without dementia (ages 65-86)
- Psychometric Properties
  Not yet established

Advantages
- Cognitive task difficulty customized
- Digit recall controls influence of "verbal pacing" during walking
- Safe , detailed protocol
- Mirrors challenges of everyday life

Disadvantages
- Time consuming
- Practice effect may occur
- Relationship between WART and fall risk not yet investigated

Things to Consider…

- Setting for Assessment
- Learning bias from repeated trials (Brandler, 2012)
- Challenge of Cognitive Task
  - Simple vs. Complex (Brandler, 2012)
  - Tailoring to individual (McCulloch, 2009)
- The Patient!