Executive Function and Dual-Task Performance of Gait in Mexican Elders

By

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INTRODUCTION

Mexican Elders

2008  5.8 million
2050  25.9 million

Dependency index

2010  13.7%
2050  50.6%

(Consejo Nacional de Población (CONAPO), 2004; Proyecciones de población 2000-2050, CONAPO)
Cont. Introduction

- Nuevo Leon, Mexico: 21.3% of adults over age 70 years are dependent on at least one ADL/IADL
  (Instituto Nacional de Estadística, Geografía e Informática [INEGI], 2000)

- 7.1% of the Mexican population present cognitive impairment and 3.3% show also functional dependence
  (Mejía-Arango, Miguel-Jaimes, Villa, Ruiz-Arregui & Gutiérrez-Robledo, 2007)

- Prevalence of cognitive impairment in elders of Monterrey, Mexico = 10.87%

Cognitive and Functional performance are related
Walking depends largely on cognitive function; executive function allows proper performance of a concurrent task while walking, known as dual-task, especially needed when walking in public.

Ability that reflects negotiation of competing/interfering demands from the environment.
PURPOSE

Identify the relationships between executive function and gait speed using simple and complex dual-tasks in a sample of Mexican elders.

Executive function = cognitive process that regulates one’s ability to organize thoughts and activities, prioritize tasks, make decisions …
### Concepts

**Executive function**
Higher order cognitive processes necessary for planning, goal-directed problem solving behaviors including:
- attention,
- inhibitory control,
- psychomotor speed,
- mental flexibility, among others

Aspects that delineate the establishment of goals (dual-task) and allow the motor control of the proper movement (gait)


**Gait capacity**
Individual’s capacity of locomotion defined by essential requirements such as:
- progress or advance,
- postural control and
- adaptability

Distinguishes between usual walk and functional gait (dual-task)

(Craik, 1989, p. 177; Patla, citado por Shumway-Cook & Woollacott, 2007: p. 300; Lord & Rochester, 2007)

### Dual-task
- Performance of two tasks concurrently (Sevilla, 1991)

### Risks
- Interference of each one of them on the other one, thus leading to ineffective performance or accidents
Summary of Related Studies

Cognitive functions alters walking characteristics proportionately with age; reduction in speed is a compensatory mechanism to maintain stability.

Changes in gait patterns are multifactorial including genetic and environmental factors as well as interactions.

-Hausdorff, Schweiger, Herman, Yogev-Seligmann & Giladi, 2008
-Srygley, J., Mirelman, A., Herman, T., Giladi, N. & Hausdorff, J., 2009
-Fraser, S., Li, Z., DeMont, R. & Penhune, V., 2007
-Doumas, M., Rapp, M. A. & Krampe, R. T., 2009
-Sheridan, P., Solomont, J., Kowall, N. & Hausdorff, J., 2003
-Beauchet, O., Dubost, V., Aminian, K., Gonthier, R. & Kressing, R., 2005
**METHODS**

**Study design**
- Descriptive cross sectional study
  (Burns & Grove, 2004, p. 220)

**Population**
- N = 1,002 elders (60 years old and more)
- 28 Senior centers

**Sampling**
- Random by cluster (8 senior centers)
- 355 elders

**Sample**
- nQuery Advisor 4.0: SS power of 90%, 
  ES for a bilateral correlational test of 0.22, and 
  significance level of 0.05
- n = 200
  (Elashoff, Dixon, Crede & Fotheringham, 2004)
CRITERIA OF SELECTION

INCLUSION

• Be literate and able to distinguish primary colors
• Ability to walk short distances without help

EXCLUSION

• Visual impairment
# Definition of Terms

<table>
<thead>
<tr>
<th>Executive function</th>
<th>Attention, inhibitory control, psychomotor speed and mental flexibility capabilities of an older adult, measured by the Stroop Word Color Test &amp; Color Trails Test (A-B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gait capacity</td>
<td>Ability of locomotion of older adults in terms of walking speed using the metric system (4 m/s)</td>
</tr>
<tr>
<td>Dual task</td>
<td>An additional activity while walking by older adults and divided into: a) Simple dual task (walking while carrying a tray holding a glass of water) and b) Complex dual task (walking while naming objects starting with a random letter)</td>
</tr>
</tbody>
</table>
VARIABLES

- Age
- Years of School
- Living Arrangements
- # of Medicines
- # of Falls
- Cumulative Illness Rating Scale-Geriatric
- Depression symptoms (GDS)
- MMSE
- Stroop
- Color Trails Test (A-B)
- Gait speed (4m/s) on three walking conditions
## Results

**Table 1**

*Characteristics of participants and test of normality*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable</th>
<th>SD</th>
<th>Mdn</th>
<th>Range</th>
<th>K-S</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>70.28</td>
<td>6.84</td>
<td>70.0</td>
<td>60-89</td>
<td>1.20</td>
<td>.002</td>
</tr>
<tr>
<td>Years of School</td>
<td>5.44</td>
<td>3.44</td>
<td>6.00</td>
<td>0-20</td>
<td>3.08</td>
<td>.000</td>
</tr>
<tr>
<td>Medications</td>
<td>2.68</td>
<td>1.89</td>
<td>3.00</td>
<td>0-10</td>
<td>1.92</td>
<td>.000</td>
</tr>
<tr>
<td>Cumulative Illness Rating Scale</td>
<td>1.59</td>
<td>0.30</td>
<td>1.64</td>
<td>1-2</td>
<td>1.65</td>
<td>.008</td>
</tr>
<tr>
<td>Usual walk m/s</td>
<td>1.00</td>
<td>0.24</td>
<td>1.02</td>
<td>0.19-1.78</td>
<td>0.04</td>
<td>.200</td>
</tr>
<tr>
<td>Walk/Simple dual task m/s</td>
<td>0.96</td>
<td>0.25</td>
<td>0.96</td>
<td>0.18-2.17</td>
<td>0.05</td>
<td>.200</td>
</tr>
<tr>
<td>Walk/Complex dual task m/s</td>
<td>0.65</td>
<td>0.25</td>
<td>3.00</td>
<td>0.09-1.25</td>
<td>0.06</td>
<td>.071</td>
</tr>
</tbody>
</table>

*n = 202*
Demographic characteristics

- Women (70.8%)
- Live alone (53.5%)
- Falls incidence (66%)
- Depressive symptoms (26.7%)
- Cognitive impairment (12.9%)

n = 202
<table>
<thead>
<tr>
<th>Variable</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhibitory control (Stroop-interference)</td>
<td>-5.75</td>
<td>8.937</td>
<td>-6.92</td>
<td>-29.53-25.84</td>
<td>1.05</td>
<td>.211</td>
</tr>
<tr>
<td>Attention (CTT-A)</td>
<td>99.60</td>
<td>45.51</td>
<td>89.76</td>
<td>28.65-270.33</td>
<td>1.81</td>
<td>.003</td>
</tr>
<tr>
<td>Visual scanning, shift sets (CTT-B)</td>
<td>247.63</td>
<td>119.07</td>
<td>223.76</td>
<td>61.73-696.41</td>
<td>1.28</td>
<td>.074</td>
</tr>
<tr>
<td>Mental flexibility (CTTB-CTTA/ CTTA )</td>
<td>1.60</td>
<td>0.939</td>
<td>1.420</td>
<td>0.03-6.10</td>
<td>1.45</td>
<td>.030</td>
</tr>
</tbody>
</table>

\( n = 202 \)
Gait velocity in usual, simple and complex dual tasks
Table 3
Correlation Matrix

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Age (years)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Yrs. of School</td>
<td>-0.187**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Inhibitory control (stroop)</td>
<td>0.131</td>
<td>-0.112</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Attention CTT-A</td>
<td>0.171*</td>
<td>-0.467**</td>
<td>0.211**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Mental flexibility</td>
<td>0.098</td>
<td>-0.023</td>
<td>-0.115</td>
<td>-0.295**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Usual gait (m/s) †</td>
<td>-0.280**</td>
<td>0.184**</td>
<td>0.004</td>
<td>-0.328**</td>
<td>-0.045</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7. Simple DT (m/s) †</td>
<td>-0.303**</td>
<td>0.177**</td>
<td>0.019</td>
<td>-0.343**</td>
<td>-0.051</td>
<td>0.859**</td>
<td>1</td>
</tr>
<tr>
<td>8. Complex DT (m/s) †</td>
<td>-0.276**</td>
<td>0.149*</td>
<td>-0.040</td>
<td>-0.188**</td>
<td>-0.169*</td>
<td>0.616**</td>
<td>0.608**</td>
</tr>
</tbody>
</table>

(†) Pearson correlation  *p < .05    **p < .01

n = 202
Table 4
Regression Models on Gait Conditions

<table>
<thead>
<tr>
<th>Usual Gait ($F_{9,192} = 8.59, p &lt; .001, R^2 = .159$)</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.261</td>
<td>0.001</td>
</tr>
<tr>
<td>Medicines</td>
<td>-0.145</td>
<td>0.037</td>
</tr>
<tr>
<td>Yrs./school</td>
<td>0.138</td>
<td>0.036</td>
</tr>
<tr>
<td>Gender</td>
<td>0.151</td>
<td>0.027</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Simple dual task ($F_{9,192} = 5.230, p &lt; .001, R^2 = .160$)</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.286</td>
<td>0.000</td>
</tr>
<tr>
<td>Falls incidence</td>
<td>-0.177</td>
<td>0.007</td>
</tr>
<tr>
<td>Yrs./school</td>
<td>0.134</td>
<td>0.041</td>
</tr>
<tr>
<td>Gender</td>
<td>0.173</td>
<td>0.008</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Complex dual task ($F_{9,192} = 16.529, p &lt; .001, R^2 = .072$)</th>
<th>$\beta$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.276</td>
<td>0.001</td>
</tr>
</tbody>
</table>
Conclusions

Elders reduced their usual speed under both, simple and complex dual tasks, suggesting that in order to attend an extra task while walking they compensate by decreasing gait speed. Reducing their gait speed does not mean success on the cognitive task.

Executive function (measured by Stroop interference) was not related to any of the walking conditions; attention was negatively related to all walking conditions, and mental flexibility only to complex dual-tasks in a sample of Mexican elders.

Age showed a negative effect on all walking conditions. Exercise interventions including cognitive tasks may preclude declines in cognitive function and walking ability.