



COGNITIVE-MOTOR INTERFERENCE DURING WALKING IN PEOPLE AFTER STROKE



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BACKGROUND

Cognitive-motor interference occurs when simultaneous performance of a cognitive task and a motor task interferes with the performance of one or both tasks.^{1,2}

It is presently unclear whether specific cognitive processes cause disruption to gait in people after stroke.

PURPOSE

To explore whether the interference effects in gait and cognition varied depending on the type of concurrent cognitive task that was presented.

METHOD

PARTICIPANT SELECTION

- 13 adults (11 male) within 5 years post stroke recruited from convenience sample at Brooks Rehabilitation, FL
- Able to walk at least 10 m without physical assistance, follow 3 step command, and hear and respond verbally to auditory stimuli
- Free of pre-existing neurological disorders or any orthopedic conditions affecting gait

PARTICIPANT CHARACTERISTICS (Table 1)

- Cognitive abilities were characterised using a battery of tests
- Gait speed assessed using 10 meter walk
- Motor function assessed using Fugl-Meyer Assessment

Table 1. Subject characteristics

Descriptive Item	Mean	SD	Range
Age (years)	60.5	15.3	33-86
Time since stroke (months)	8.7	4.8	2.5-17
Type of stroke (ischemic/hemorrhagic)	12/1		
Cognitive Assessments			
1. MMSE (max. 30)	26.7	2.7	24-30
2. Digit symbol			
Substitution (no. completed)	33.0	8.3	19-45
Copy (time, s)	139.8	45.0	83-220
Copy (errors)	0.5	0.8	0-2
3. Backward digit span (max. 14)	5.2	1.6	3-8
4. Digit ordering (max. 24)	12.2	3.9	7-19
5. WAIS-R Vocabulary (max. 70)	53.1	10.7	30-68
6. Stroop test			
Color XXX (no. completed)	50.8	17.4	21-72
Color words (no. completed)	24.7	11.1	9-39
Gait and Motor Assessments			
Gait speed (m/s)	0.78	0.38	0.15-1.11
Lower Extremity Fugl-Meyer (max. 34)	24.2	5.3	14-30

PROCEDURES

- All subjects completed all tasks:
 1. Single walking task: 3 mins continuous walking around oval track
 2. Auditory 1-back (seated, walking)
 3. Clock task³ (seated, walking)
 4. Spontaneous speech (seated walking)
 5. Single walking task

Randomised order of cognitive tasks. Single task first. (See Table 2)

Table 2. Description of cognitive tasks

Auditory 1-back	Visuospatial clock task ³	Spontaneous speech task
Listen to sequence of letters, respond 'yes' if same as previous, 'no' if different.	Listen to clock times, respond 'yes' if both hands in specified target half, 'no' if not.	Talk spontaneously in response to question, eg. Tell me what you like and don't like about...
Dependant variables: reaction time, accuracy	Dependant variables: reaction time, accuracy	Dependant variables: various dimensions of language

- Each cognitive task was approximately 3 mins in duration
- Gait data were collected using footswitches worn inside the shoes

RESULTS

DUAL TASK EFFECTS ON GAIT

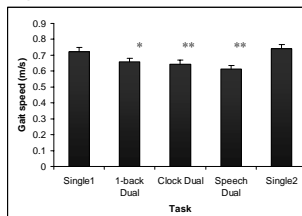
- Significant dual task effects were observed for gait speed, stride time, average stride length, and cadence (Table 3, Figure 1, Figure 2)
- No dual task effect on stride time variability (Table 3)
- There were significant differences between the 3 cognitive tasks for gait speed; speech had the greatest effect on gait speed

Table 3. Mean values (SD) for gait parameters under single and dual task conditions

GAIT PARAMETER	SINGLE TASK		DUAL TASK		
	Walk 1	Walk 2	1-back	Clock	Speech
Gait speed (m/s)	0.72 (0.40)	0.74 (0.40)	*0.66 (0.34)	*0.64 (0.38)	*0.61 (0.36)
Stride time (s)	1.44 (0.47)	1.40 (0.39)	1.46 (0.51)	*1.49 (0.49)	*1.50 (0.46)
Stride time variability (s)	0.11 (0.07)	0.08 (0.05)	0.10 (0.08)	0.08 (0.05)	0.11 (0.07)
Av. stride length (m)	1.04 (0.33)	1.07 (0.32)	*0.95 (0.34)	*0.96 (0.28)	*0.92 (0.35)
Cadence	90.16 (20.89)	91.63 (18.52)	*87.29 (21.13)	*86.18 (21.01)	*85.74 (19.41)

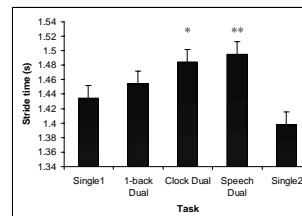
*p<0.05 relative to walk 1 and walk 2; †p<0.05 relative to walk 2 only.

Figure 1. Gait speed as a function of task



*p<0.05 relative to walk 1 and walk 2; †p<0.05 relative to walk 2 only.

Figure 2. Stride time as a function of task



*p<0.05 relative to walk 1 and walk 2; †p<0.05 relative to walk 2 only.

DUAL TASK EFFECTS ON COGNITION

- There were significant dual task effects on the speech task (Table 4)
 - Dual task: ↑ pauses per utterance, ↓ number of words and utterances per narrative, ↑ proportion of utterances with new information
- There was no dual task effect on RT or accuracy in the clock task or the 1-back task (Table 4)
- A practice effect may have occurred due to task order (single-dual)

Table 4. Mean values (SD) for cognitive tasks under single and dual task conditions

Cognitive task variable	Single task	Dual task	p
1-back			
RT (ms)	1763.65 (249.37)	1675.52 (129.13)	ns
Accuracy	98.92 (2.06)	98.77 (1.30)	ns
Clock task			
RT (ms)	2829.75 (924.49)	2486.28 (718.85)	ns
Accuracy	87.38 (10.02)	88.38 (8.94)	ns
Spontaneous speech			
Sentence length (words / utterance)	10.00 (2.17)	11.16 (3.53)	ns
Utterances / narrative	30.85 (12.19)	21.00 (6.86)	<0.02
Words / narrative	312.31 (142.26)	227.15 (78.37)	<0.05
Fillers / utterance	0.53 (0.15)	0.65 (0.18)	ns
Pauses / utterance	0.50 (0.26)	0.76 (0.43)	<0.02
Sentence complexity (clauses / utterance)	1.25 (0.23)	1.35 (0.40)	ns
Proportion of grammatical sentences	0.82 (0.09)	0.86 (0.11)	ns
Proportion of utterances with new information	0.37 (0.13)	0.54 (0.23)	<0.03

ns = not significant

SUMMARY

This study was unique because cognitive-motor interference effects during walking were examined for several minutes, not just 8-10 steps.

Cognitive-motor interference effects were observed for gait speed, stride time, average stride length, and cadence. Spontaneous speech produced more gait interference than the visuospatial and working memory tasks. There were minimal cognitive-motor interference effects on cognition; significant effects on speech production were observed, which is consistent with previous research in people with stroke.⁴

The current findings suggest that the subjects in this study may have placed a higher priority on the performance of cognitive tasks despite their gait impairments.

References & Acknowledgements

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