

Cognitive-motor interaction and recovery from stroke

EQUAL-SPARC Workshop

Brunel University

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The University of Reading

Collaborators

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Background

- In many situations, two or more activities, e.g. walking and talking, can be carried out at the same time, without either being compromised to any noticeable extent.
 - What happens when this breaks down?
 - What circumstances attend breakdown?

Cognitive-motor interference (CMI)

- Several studies have reported that older adults have difficulty controlling posture while simultaneously attending to a cognitive task.
- Less information has been gathered on CMI following brain injury.
- However, patients may have damage to both motor and cognitive systems.
- Everyday activities may place substantial demands on overall attentional resources during recovery.

CMI in neurological rehabilitation

- When motor skills have to be relearnt after stroke they are no longer performed automatically and so use overall attentional resources.
- Responses to early rehabilitation may be affected by:
 - Distractions in the immediate environment
 - Cognitive limitations following stroke
 - Fatigue following stroke

Dual-task methodology

- A useful tool for determining the relative demands of different activities.
- Two tasks are performed separately and then together.
- Outcome (e.g. speed, accuracy) is measured for each task alone and when combined with the other.
- A dual-task decrement is assumed to represent competition for processing resources.
- The direction of the decrement may indicate resource allocation.

Our interest

- Our work developed from clinical observations of patients recovering from neurological injury.
- We were interested in:
 - Which task combinations resulted in greatest interference?
 - What other factors might influence dual-task performance?

Why is this interesting?

- Theoretical interest: Understanding and explaining allocation of attention.
- Clinical interest: Studies of competition for available resources may help in
 - Understanding course of recovery
 - Planning physical and cognitive content of therapy programmes to meet individual capabilities.

Background to this study

- During early weeks after stroke, the main focus of treatment is on motor recovery.
- Stable sitting balance is an important motor predictor of outcome after stroke.
- However, attentional demands of regaining and maintaining postural control are rarely considered.

CMI in balance recovery early after stroke

- Postural control may be affected by a cognitively demanding activity when both systems have been affected by stroke.
- There may, however, be an interference effect from any activity, even if it makes minimal cognitive demand.
- Speech is, itself, a motor act and may interfere with postural control.

Study design

- We measured cognitive performance and postural control in sitting, using a counterbalanced design, with eight one-minute trials:
 - Unsupported sitting balance single task 1
 - Unsupported oral word category generation 1
 - Unsupported sitting repetitive word 1
 - Supported sitting word category generation 1
 - Unsupported word category generation 2
 - Unsupported sitting repetitive word 2
 - Supported sitting word category generation 2
 - Unsupported sitting balance single task 2

Equipment

- Postural control in sitting was measured by a modified Balance Performance Monitor^(TM) set on an adjustable plinth.
- 4 force sensors, one in each corner of seat.
- Data acquisition card, recording movement about centre of pressure directly into computer.
- 2 measures of movement: sway area; sway path
- Speech output (no. of words) recorded via microphone into the same computer.

Supported sitting



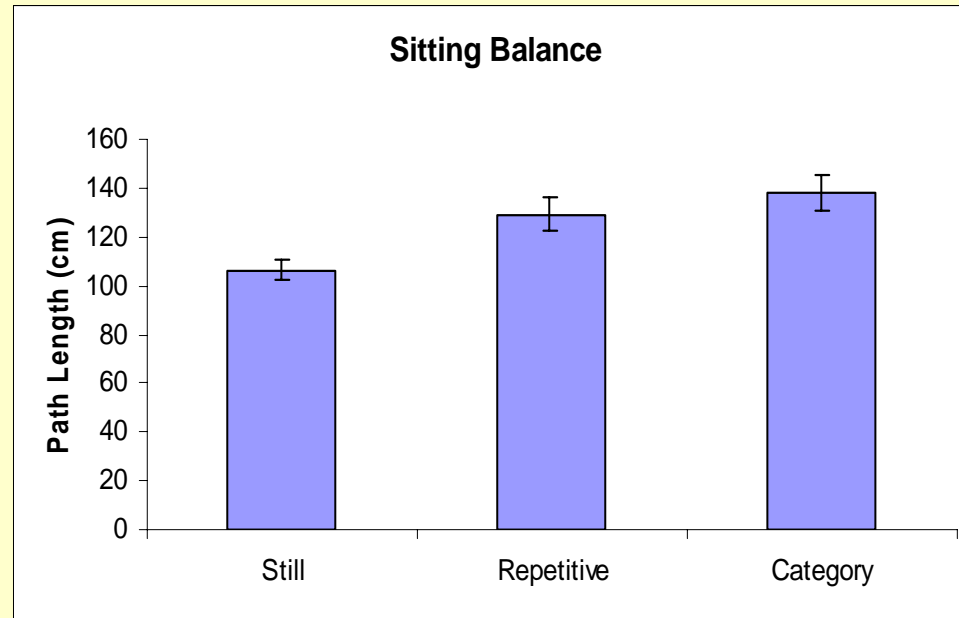
Study sample

- 36 stroke patients from hospitals in Oxfordshire and Berkshire:
 - Mean age 62 years (range 23 - 91)
 - Male = 23, Female = 13
 - Median time post-onset 46 days
 - Mean Barthel Scale score 12.86 (range 6 – 20)
 - Left hemiplegia = 25, Right hemiplegia = 11.

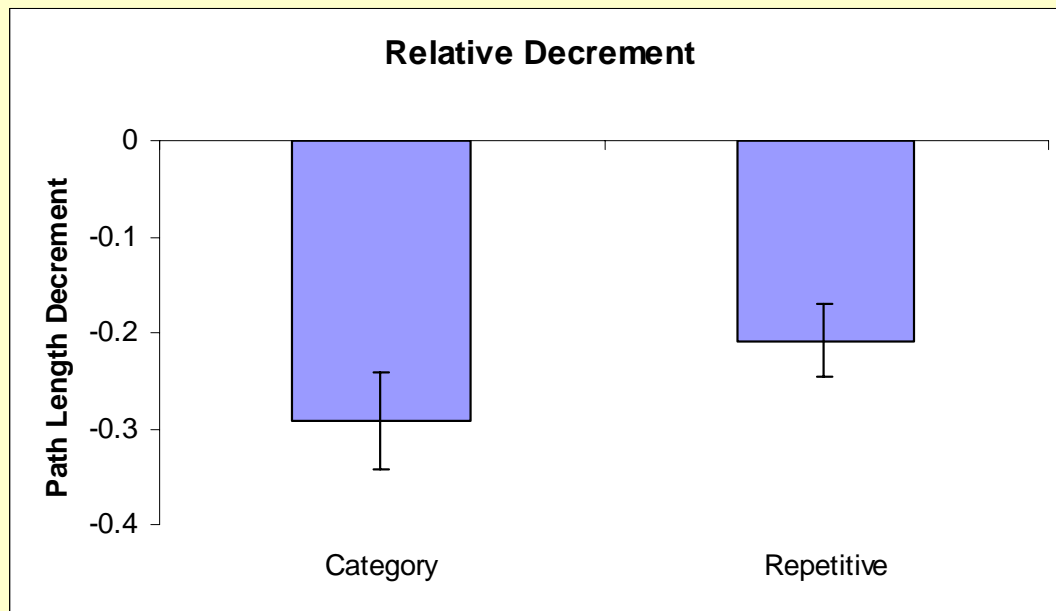
Results: Sitting balance

- Significant overall effect of postural control (difference in path length across tasks).
- Significant difference between sitting alone and sitting + word generation.
- Significant difference between sitting alone and sitting + repetitive speech.
- Significant difference between sitting + repetitive speech and sitting + word generation.

Difference in path length across sitting conditions



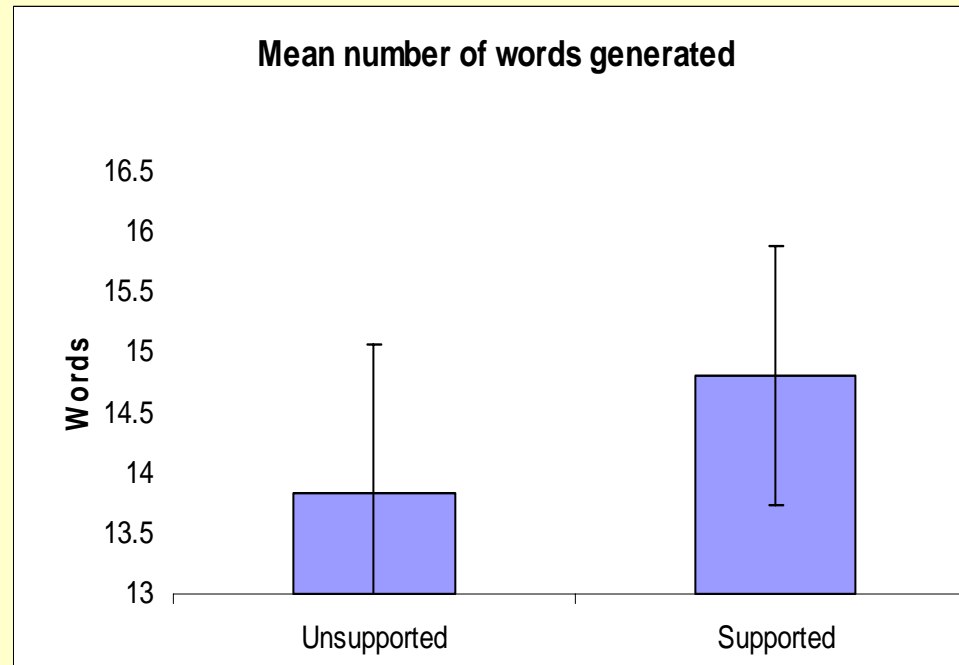
Relative effect on sway path of word generation and repetitive speech



Results: Cognitive task

- Small but significant difference in number of words generated over one minute during supported sitting and during unsupported sitting:
 - 15 words on average when supported
 - 14 words on average when unsupported.

Effect of postural control on word generation



Relationship with Age

- Significant correlation between Age and Sway path decrement during category generation.
 - Older patients move more than younger patients
- No similar significant correlation for repetitive speech.
- No significant relationship between Age and decrement in words generated.

Conclusions

- Maintaining sitting balance does make demands on attentional resources after stroke.
- Competition from a spoken activity increases extent of sway.
- Distance travelled (path length) is greater for a cognitively demanding spoken task than for repetitive speech.
- Postural disruption from cognitively demanding tasks may be more pronounced for older stroke patients.

Thank you

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