Complex-Arithmetic Problem Solving:
Differences among Belgians, Canadians, and Chinese

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Introduction

When solving 2-digit + 2-digit problems, do Belgians, Canadians, and Chinese

- choose the same strategies?
- execute strategies equally efficiently?
- switch adaptively between strategies?
- rely on phonological and executive working-memory (WM) resources?
- react differently on carry problems?

Method

Participants

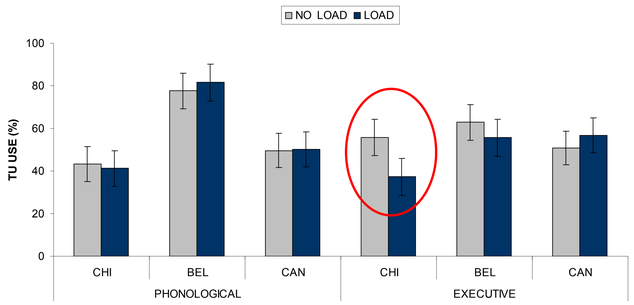
- 40 Belgians educated in Flanders
- 45 Canadians educated in Canada
- 40 Chinese educated in China

Method

- Solve 2-digit + 2-digit problems
  - without carries (e.g., 53 + 42)
  - with one carry (e.g., 58 + 37)
- One Choice condition with trial-by-trial strategy reports (Units-Tens or Tens-Units)
- Two no-choice conditions
  - Units-Tens
  - Tens-Units
- Selective interference paradigm
  - No load
  - Phonological load (retain 4 letters)
  - Executive load (CRT task)

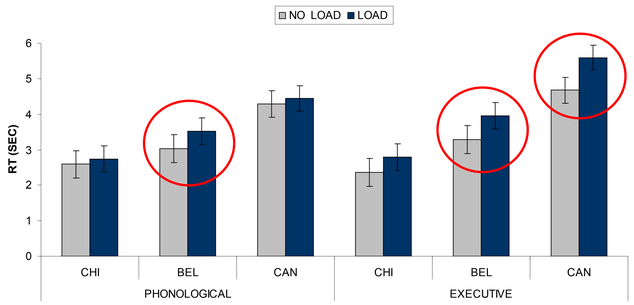
Strategy selection

- Belgians (69%) use the Tens-Units strategy more frequently than Canadians (54%) and Chinese (44%).
- Canadians use the Tens-Units strategy less frequently on one-carry problems (47%) than on no-carry problems (57%).
- Chinese use the Tens-Units strategy less frequently under executive load (37%) than under no-load (58%).



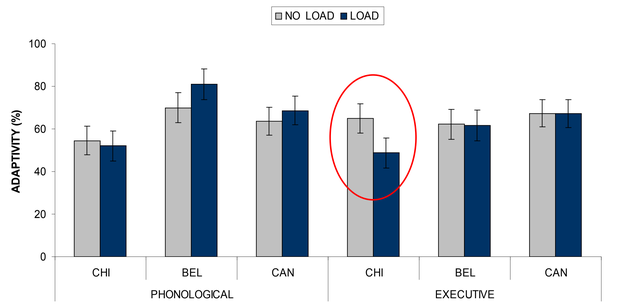
Strategy efficiency

- Chinese (2.6s; 7.1% errors) are faster but not more accurate than Belgians (3.5s; 7.6% errors). Belgians and Chinese are faster and more accurate than Canadians (4.8s, 11.4% errors).
- Canadians are less efficient on carry problems, especially under WM load.
- WM load effects on strategy efficiency are large for Canadians, somewhat smaller for Belgians, and extremely small for Chinese.



Strategy adaptivity

- Do participants in choice conditions choose the strategy that yields the best performance as evidenced by their no-choice performance?
- Chinese (55%) are less adaptive than Belgians (69%) and Canadians (67%).
- Chinese are less adaptive under executive load (49%) than under no-load (65%).



Discussion

- The cultural differences in strategy **selection** (Units-Tens vs. Tens-Units strategy use) are probably related to early educational experiences.
- The low strategy **adaptivity** in Chinese might be caused by the fact that they focus their attention on specific task properties and ignore other task properties.
- There are several possible explanations for the cultural differences in strategy **efficiency**:
  - Formal educational experiences (drill & automaticity in China vs. flexibility in Belgium and Canada)
  - Structure of the number language (Chinese is more straightforward)
  - Cultural-specific informal factors (e.g., motivation vs. avoidance)

Summary

- **Chinese are more efficient than Belgians and Canadians, they also need fewer WM resources.**
- **Chinese are less adaptive than Belgians and Canadians, especially under WM load.**
- **Education and research should emphasize both aspects of math performance; i.e., efficiency *and* adaptivity.**

Cognitive Science Conference, Washington DC, July 23-26 **www.carleton.ca/cacr** **http://expsy.ugent.be** **Ineke.Imbo@UGent.be**

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