

Effects of Ageing on Working Memory Capacity

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General Assumptions

- Working memory capacity is limited
 - number of chunks
 - Size of chunks

Questions

- How is working memory capacity affected by ageing?
- What impact does this have on language comprehension?

Amanda L. Gilchrist, Nelson Cowan, and Moshe Naveh-Benjamin
(2008)

**Working memory capacity for spoken sentences
decreases with adult ageing: Recall of fewer but not
smaller chunks in older adults**

Working memory and chunking

- Capacity limit approximately **three to four** unitary items or chunks (Broadbent, 1975; Cowan, 2001)
 - ➔ reliable recall (in normal young adults) without hesitation

Word
Two words
Or three words

Word
Two words
Or three words

Word
Two words
Or three words

...

➔ Number of chunks fix, but not size of chunks

Working memory and chunking

Chunking possible when...

- associations exist between items
- covert phonological rehearsal is possible
(limited to materials that can be pronounced in 2 seconds)

Possible chunk size...

- depends on strength of associations
- is limited

Effects of ageing

- Older adults have a deficit in memory for coherent linguistic materials
- Causes of age difference not entirely clear
 - working memory capacity?
 - size of chunks recalled?
 - both?

The current study

- Participants listen to lists of spoken sentences
- Asked to repeat as much as possible
 - ➔ effects of age on working memory for lists of coherent sentences
 - ➔ effects of ageing on qualitative and quantitative use of chunking

Participants

Young

- 17 females
- 7 males
- Normal vision and hearing
- **Mean age: 18.37**
- Years of education: 13.00

Old

- 17 females
- 7 males
- Normal vision and hearing
- **Mean age: 70.95**
- Years of education: 14.02

Design

Four conditions

Four short sentences

- 3 to 5 words each
- 2 words from age of acquisition norms (AoA) from 100 to 350
- *Don't scare your brother*

Four long sentences

- Two connected short sentences
- *Don't scare your brother because the screaming bothers me*

Eight short sentences

- Like for four short sentences

Four random sentences

- Like short sentences, but non-grammatical, random order
- Spoken with sentence intonation
- *Aunt jersey cooked almost*

Design

Comparable conditions

Four short & eight short

- Effects of total memory load
- Higher memory load for eight sentences

Eight short & four long

- Effects of linguistic coherence
- Can long sentences be stored as single chunk?

Four long & four short

- Twice as many clauses recalled for four long sentences?

Four short & four random

- contribution of linguistic coherence within a short sentence

Design

- Two trials in each condition
- Order of trials randomised across participants
- Participants split in two groups to counterbalance sentences in different conditions

Group 1		Group2
Four long	<i>divided among</i>	Four short, Eight short
Four random	<i>divided among</i>	Four short, Eight short
Four short	<i>divided among</i>	Four Random, Four long
Eight short	<i>divided among</i>	Four Random, Four long

Procedure

- Participants listen to trials through headphones
- 1000 ms fixation screen before each trial
- 1000 ms pause between sentences in a trial
- 1000 ms pause after each trial
- Participants say recalled parts into a microphone
- Max. duration of recall period one minute

Analyses

3 measures to examine age differences for the different conditions

Total words recalled

- number of words correctly recalled from each condition
- Each occurrence of a word is counted

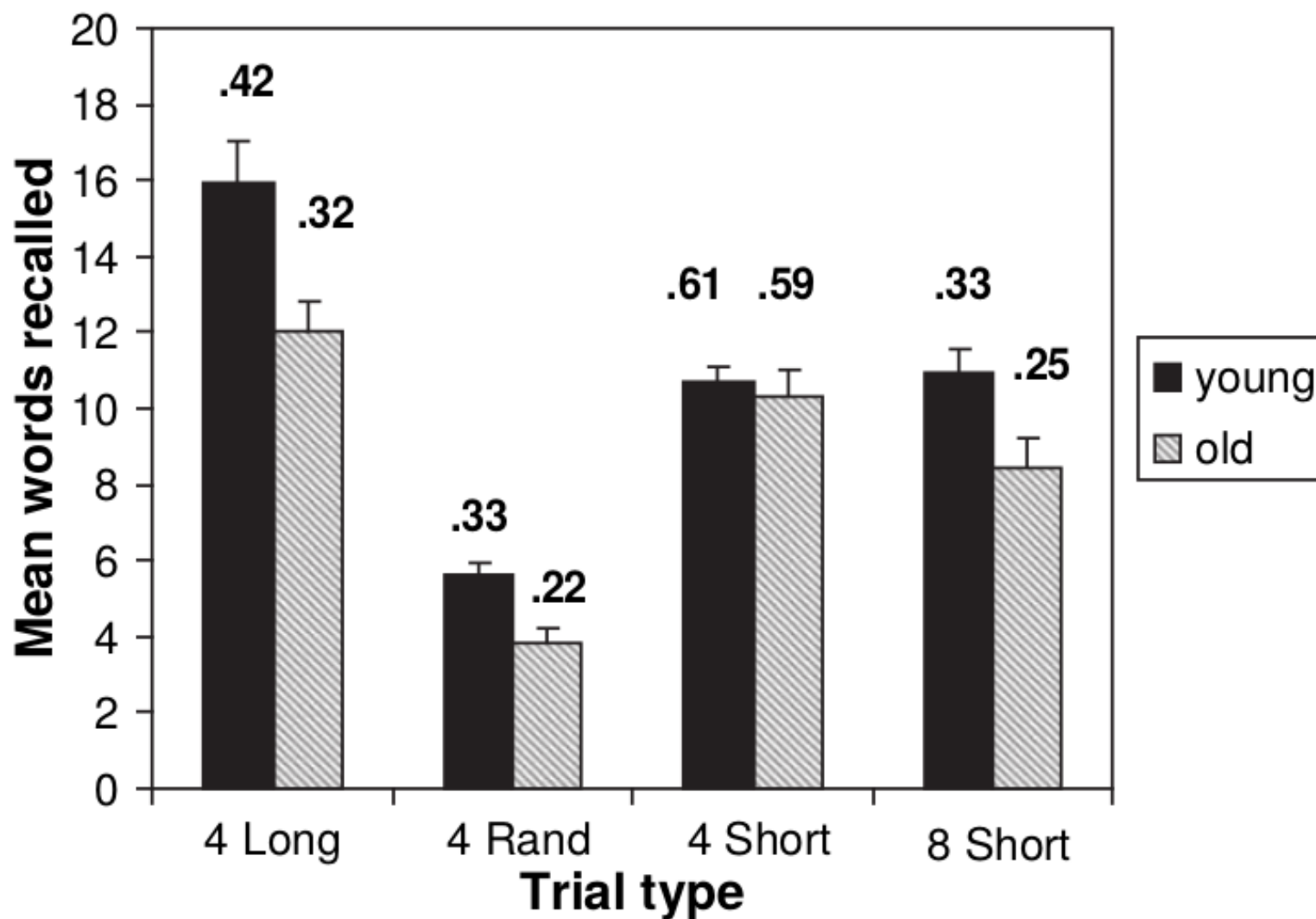
Clause access

- Number of clauses with at least one word recalled in from each condition
- Clause measured as one short sentence

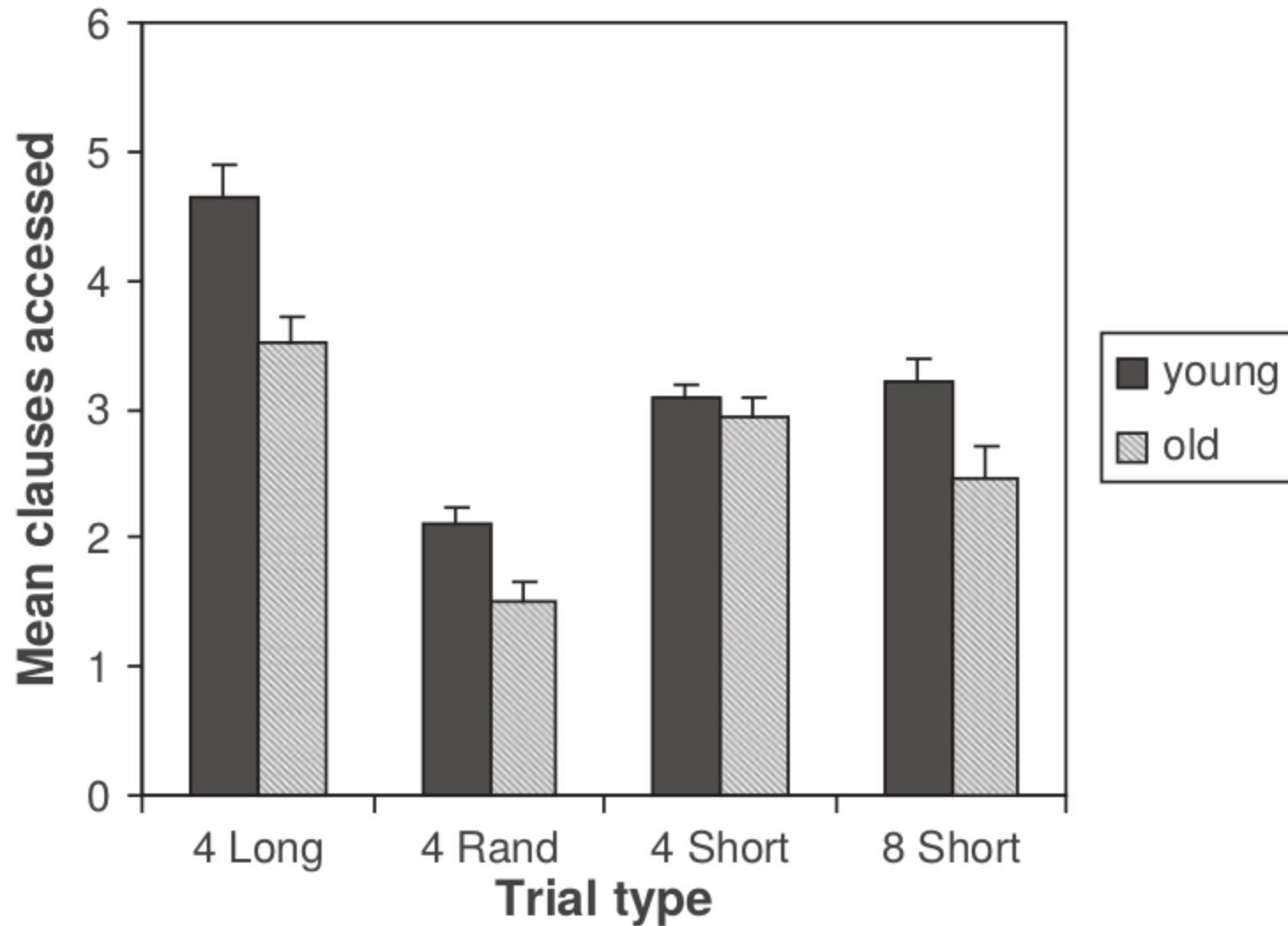
Clause completion

- proportion of words recalled from a clause, given that the clause was accessed

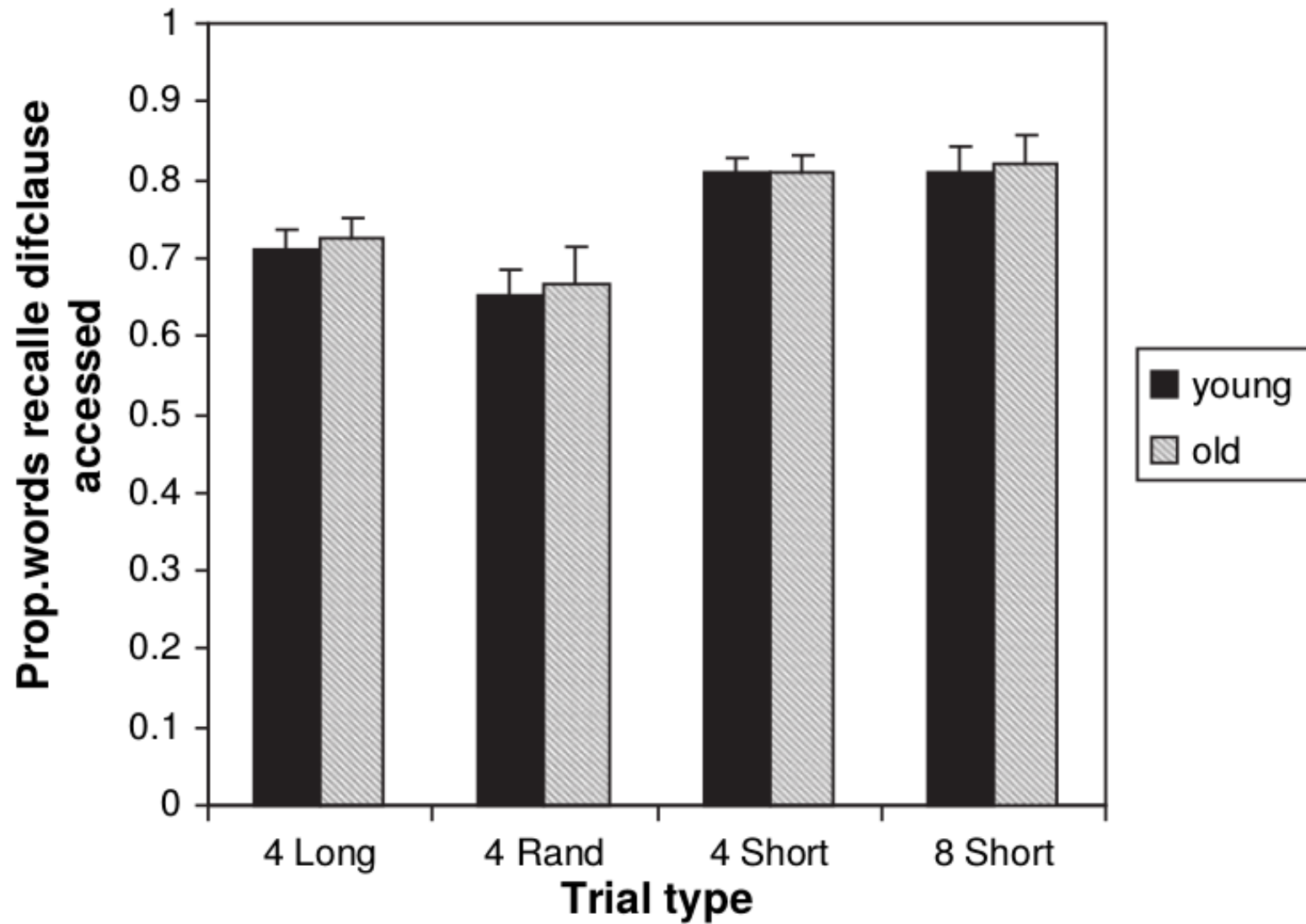
Total words recalled



Clause access



Clause completion



Conclusions

- Older adults can hold less chunks in working memory
 - At least when measured by chunks accessed
- Number of words recalled per clause very similar across age groups
 - ➔ integration of related elements into chunks appears unaffected by ageing

Specific age effects

- Biggest age difference for recalled words and accessed clauses in 4 long sentences
 - ➔ when capacity limit of working memory is exceeded, use of linguistic structure more efficient in young adults
- Younger adults accessed more long sentences
- BUT no difference in clause/sentence completion
 - ➔ ageing deficit in retaining multiple unrelated units when there is a lot of linguistic material

Discussion

1. Older adults have worse recall of words and chunks when the information load is bigger (4 long, 8 short), both relative to younger adults and absolute when comparing 8 short to 4 short. How might this affect older adults in “real life”?
2. How close is the task of the experiment to real language processing? How realistic is it?
3. Why do older adults perform slightly better in clause completion (even if insignificant)? Could it just be a matter of different priorities when the information load becomes too much?