Role of attention in experts' working memory functions - with consecutive interpreters as example

Kognitiotiede, Helsingin yliopisto

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Sinikka Hiltunen

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1. **Expertise – what is it?**
   - definition of expert
   - deliberate practise
   - attention and expertise
2. **Interpreting – what is it?**
   - simultaneous and consecutive interpreting – differences
3. **Master thesis & scientific article: Experiments**
   - Word span measures – concrete and abstract
   - Attention and foreign language expertise
   - Prose recall – concrete and abstract
4. **Conclusions - questions**

Levels of expertise
Chi, 2003, 22

- Novice – noviisi
- Initiater – aloittelija (passed initiation rituals)
- Apprentice – oppipoika
- Journeyman – ammattilainen, asiantuntija
- Expert – ekspertti, huippu-, eliitti-
- Master – mestari, opettaja

Who is an expert?

Ericsson ja Smith, 1991:

- expert performance – consistently superior performance on a specified set of representative tasks for a domain

- intensive dedication in one domain of expertise at least for 10 yrs

Expertise – not innate

Ericsson K.A. et al., 1993:

- IQ does not correlate with exceptional skills:
  - correlation visible only in beginning of career: after 5 yrs no differences
- *Talent* = practising from very early age
  - Schlaug et al., 1995: absolute pitch:
    - achieved at approx. 6 years by listening and practising

➔ learned skill – not innate - deliberate practise

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Deliberate practise

- intensive practise
  - approx. 4 hrs/day,
  - 3-5 days/week
- motivation to practise and get better
- goal
- feedback

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Deliberate practise

Experience alone not enough

➢ reorganization of knowledge
- faster accuracy
- learning from mistakes
- new alternative methods

➢ deliberate training (coaching)
- instructions help the weakest most
- high tolerance for errors, mistakes, even misfortune
- overcoming plateaus
  - unlearning may be needed
  - conscious effort to avoid automatisation (new goals)

Expertise

➢ Expert only in one's own domain, no transfer:
- WM, Chase & Simon (1973), chess: experts recall relevant positions, not random positions
- BUT: Gobet et al. 2001, meta-analysis: experts better even in memorizing random positions but not statistically significant

➢ Basic functions automatisized

➢ Selective access to knowledge

➢ Metakognitive skills (self-reflection)

➢ Understanding and integrating information from different sources:
- context, perception, experience etc.

Expertise

- ➤ Perception
  - larger units
  - profound knowledge
  - organisation of patterns, models with automatisation
- ➤ Analysis of current situation & anticipation of future
  - qualitative (not quantitative) problem solving
  - even tiny cues enough for solution
  - fast feedback – fast development
- ➤ Interruptions - no influence (Oulasvirta, 2006)
- ➤ Even fysiological adaptation (finger lengths of musicians, athletics etc.)

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Expertise and attention

- ➤ Little research available
- ➤ Direction of attention differs in experts:
  - Ericsson & Charness, 1994:
    - medical students recall details, experts global relevant information
  - Ericsson & Harris, 1990 (chess):
    - experts direct attention to board center
    - novices to board borders after 50 hrs practice

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Attention and memory

Conway et al., 2005:

- ➤ **short-term memory** - maintenance
  - • phonological coding – surface information
  - ➤ simple STM tasks: digit span, word span
- ➤ **working memory** – attention control
  - • maintenance of stimuli & goals
  - • protection from distraction, interference
  - ➤ complex WM tasks: reading span, listening span, operation span, etc.

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Attention and memory

Cowan, 2001

- ➤ Unsworth & Engle, 2007:
  - • **High** and **low** WM-spans **differ in:**
    1. Ability to **maintain** information in primary memory (WM)
    2. Ability to **search** information in secondary memory (LTM)
       - • **select relevant** information
       - • **inhibit distractions**
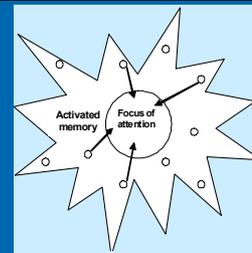
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Interpreting:
classified by time delay

Simultaneous interpreting (SI)

- Translating and speaking while listening to source language text
  - delay 3-5 s or 3-4 words
- usu. by means of technical equipment:
  - sound isolated booths
  - incoming voice through headphones
  - outgoing voice through a microphone
  - unhindered view of speaker and audiance
- working in pairs: 20 min each
- translation into mother tongue (L1)
- several languages at once (one booth per language)

Interpreting:
classified by time delay

Consecutive interpreting

- in two phases:
  - listening and note-taking
  - speaking
- a few sentences at a time = 1-3 min
- BUT: expert interpreters – 5-10 min, up to ½ h

Interpreting: where?

Simultaneous interpr.
- conferences
- congresses
- symposiums
- big scale meetings
- UN – six official languag.
- EU – 23 languages
- relaying
- bi-active: into L2
- remote interpreting

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Consecutive interpr.
- courts
- negociations, meetings
- community interpr.
  - in Finland mostly refugees
- conferences
  - usually 1-2 languages
- no techn.equipment needed

  BUT time consuming:
    +2/3 of the speaker's time

Interpreting: how is it possible?

- excellent knowledge in both languages:
  - automatisized search for equivalent words and phrases
- excellent general knowledge in:
  - politics, culture, sciences etc. of the countries where the languages are spoken
- thorough preparation beforehand:
  - background knowledge of subject in question
  - terminology and new words and their equivalents in both languages

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Interpreting: how is it possible?

Simultaneous:

- **attention divided betw. listening AND:**
  - reformulation
  - speaking
  - error monitoring
  - eventual error corrections
  - monitoring overall message
- anticipation
  - conference = supertext

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Consecutive:

- analysis of sentence **meaning** (message)
- compressing
  - chunking
- efficient reformulation
- anticipation:
  - structure in general
  - phrases, speech patterns
  - ends of sentences

Interpreting: possible problems

Simultaneous:

- fast speakers
- no materials beforehand
- no written material at all
- speaker reading written text - NO speaking freely
- extreme time pressure

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Consecutive:

- partly same problems BUT:
  - possibility to ask questions, clarifications, draw pictures, scetches
- less time pressure
- mostly conversational style, no reading written texts

Attention and memory of consecutive interpreters

Experiments, reported in:

1. Hiltunen, 2008: Pro gradu, Helsinki University, Cognitive science
2. Scientific article: coming 2009

Attention and memory of consecutive interpreters

Subjects:

➢ consecutive interpreters (12-15)
- age in average 47,5 yrs; experience 16,8 yrs

➢ foreign language teachers (12-15)
- age in average 45,3 yrs; experience 16,2 yrs

Stimuli:

➢ Finnish concrete and abstract words (frequency controlled)

➢ Finnish concrete and abstract prose

Attention and memory of consecutive interpreters

Hypotheses in pro gradu:

➢ Consecutive interpreters are experts with
- short-term memory functions no different from those of foreign language teachers
- exceptional working memory functions differing from other foreign language experts

➢ Attention explains a great deal of interpreters' exceptional WM functions
- ability to maintain information in WM
  - to direct attention to relevant material
  - to inhibit any distractions

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Experiments 1 & 2: Inhibition

1. Simple short-term memory span (no inhibition needed)
- free recall: 10 words (always at beginning of session)

2. Complex working memory span:
- 2x3 words, 2x4 words, … 2x10 words (=104 w)
- free recall after each block, spoken
- inhibition needed in order to prevent proactive interference (PI)

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Experiment 3: Prose recall

3. Prose recall, 2 prose texts:
- concrete: short story by Sinikka Nopola
  - 186 words, presented in 10 sequences
- abstract: short research article by Raimo Raitasalo in Kelan sanomat (website)
  - 197 words presented in 11 sequences
- word-based judgements of concreteness (scale: 0 – abstract; 10 – concrete):
  - concrete text - 6,39 (2,23)
  - abstract text - 4,28 (1,65)   (difference: $p < .001$)

➢ no note-taking
➢ free recall, spoken

➢ Exp. 2 and 3 counterbalanced between subjects

Results: Pro gradu
Concrete stimuli

Results: Simple STM span

- Exp.1 Simple span (no inhibition, 10 concrete words):
  - interpreters: 5,92 (1,19)
  - teachers: 6,13 (0,92)
- Exp. 2: Strict memory span (best correctly recalled word block, number of words)
  - interpreters   5,50 (0,91)
  - tearchers   5,37 (0,52)
- Hypothesis correct: No differences in simple short-term memory functions between consecutive interpreters and foreign language teachers

Results: Complex working memory span

- Complex total span (sum of all correctly recalled words)
  - Interpreters 79,77 (SD 7,60)
  - Teachers   80,40 (SD 5,87)

- Hypotheses incorrect: No differences between subject groups
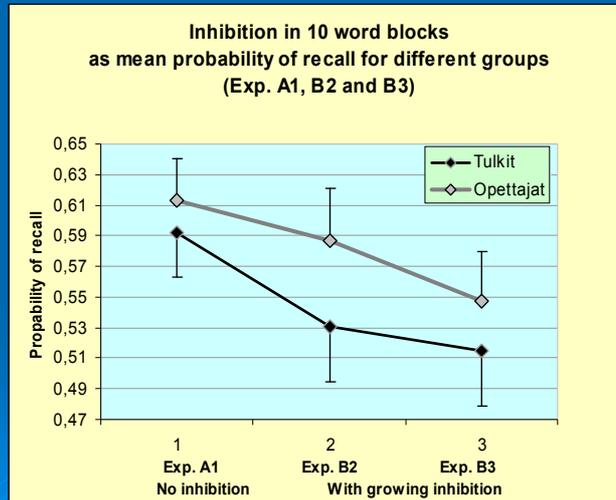
Significance of inhibition (Attention): 10 word blocks (in A1 vs. B2 ja B3)

Inhibition is significant

➢ especially B3 vs. A1 (p<.05)

➢ BUT:
  ➢ for BOTH groups

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Inhibition in 10 word blocks as mean probability of recall for different groups (Exp. A1, B2 and B3)

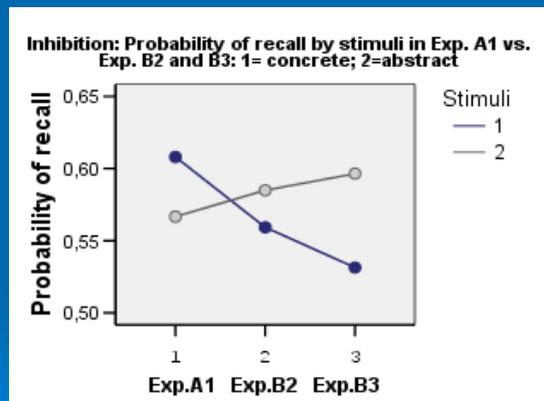# Significance of inhibition (Attention): 10 word blocks (in A1 vs. B2 ja B3)

AND: Inhibition is significant only with concrete stimuli:

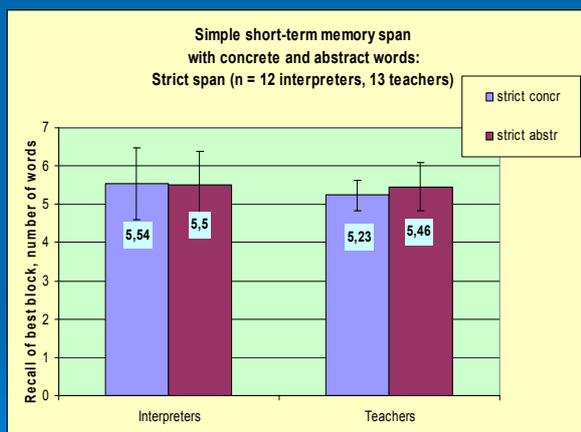➢ stimuli & inhibition interaction, p<.05

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Inhibition: Probability of recall by stimuli in Exp. A1 vs. Exp. B2 and B3: 1= concrete; 2=abstract

Results: article in 2009:

Word span tests,
concrete and abstract

Simple short-term memory span
with concrete and abstract words

NO
concreteness
effect:

➢ Both
interpreters
and teachers
recalled
concrete and
abstract
words
equally well

Simple short-term memory span
with concrete and abstract words:
Strict span (n = 12 interpreters, 13 teachers)

□ strict concr
■ strict abstr

Recall of best block, number of words

5,54   5,5   5,23   5,46

Interpreters   Teachers

Complex working memory span with concrete and abstract words

NO concreteness effect:

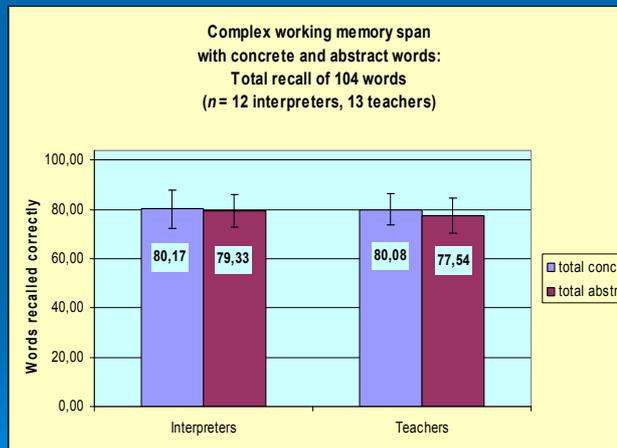➤ Interpreters and teachers recalled concrete and abstract words equally well

Complex working memory span with concrete and abstract words:
Total recall of 104 words
(*n* = 12 interpreters, 13 teachers)

Words recalled correctly

	total concr	total abstr
Interpreters	80,17	79,33
Teachers	80,08	77,54

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Concreteness effect

➤ Bourassa & Besner, 1994:
- no influence of imageability with abstract material

➤ Walker & Hulme, 1999: concreteness effect in serial recall:
- with spoken and read stimuli
- with backward recall

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Conclusions & questions

- No concreteness effect possible explanations:

1. Word spans not effective enough to measure difference??
   - Ericsson & Charness, 1994: recognition of the domain's most representative tasks and repeating these tasks in a laboratory context

2. Both consecutive interpreters and teachers are experts in foreign languages??

Conclusions & questions

3. De Beni & Moè, 2003: use of imagery with aural presentation & use of rehearsal with written presentation ➔ better recall

4. Teachers reported using more different strategies with concrete stimuli than interpreters; as to abstract stimuli not known – so far

5. Other explanations???

Conclusions & questions

Attention and expertise in foreign languages

1. Attention (inhibition) does play a role
   - BUT how?
   - why only with concrete stimuli??
2. Attention, abstractness, strategies and foreign language expertise seem to be intertwined
   - HOW?
   - and HOW to measure it?

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Results: article in 2009:

Prose recall, concrete and abstract

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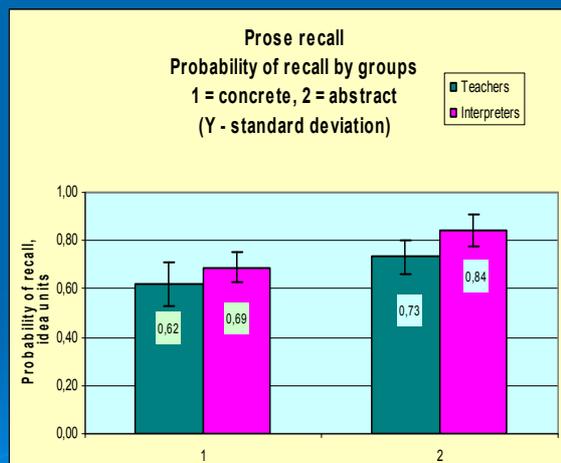
Idea unit

Mills et al., 1993, 289:

- sentence or
- part of a sentence
  - that expresses a complete idea
    - contains an actual or implied verb
    - and is usually a phrase-size unit
- practically in Finnish: clause (lause) or shortened clause (lauseenvastike)

Prose recall
with concrete and abstract texts

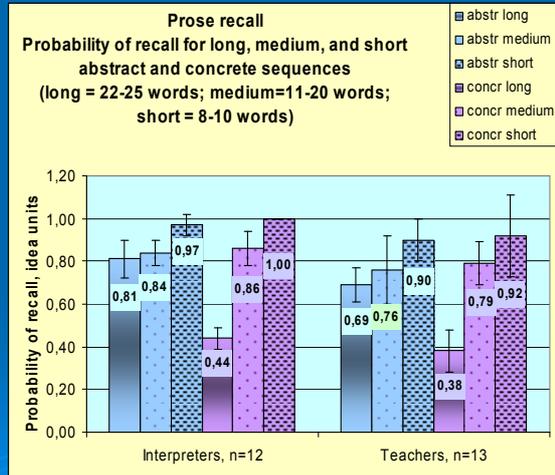- Abstract text was recalled better than concrete text
  - p < .001
- Interpreters recalled BOTH texts better than teachers
  - p < .001

Prose recall
Probability of recall by groups
1 = concrete, 2 = abstract
(Y - standard deviation)

Teachers
Interpreters

Probability of recall, idea units

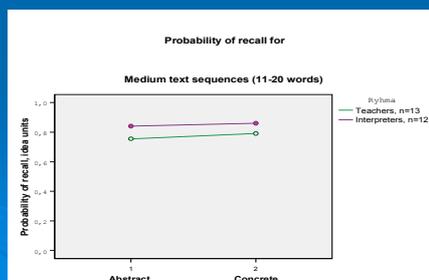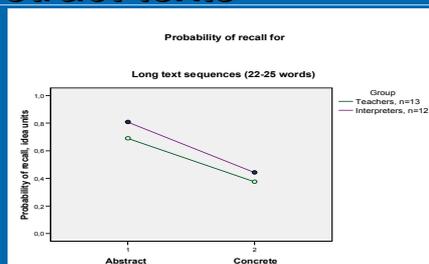| Group	Teachers	Interpreters
1	0,62	0,69
2	0,73	0,84

Prose recall: sequence length in concrete and abstract texts

> Abstract long sequences (with 22 to 25 words) were recalled better than concrete long sequences

- p < .001

Prose recall
Probability of recall for long, medium, and short abstract and concrete sequences
(long = 22-25 words; medium=11-20 words; short = 8-10 words)

Legend:
- abstr long
- abstr medium
- abstr short
- concr long
- concr medium
- concr short

Y-axis: Probability of recall, idea units

Interpreters, n=12: 0,81 0,84 0,97 0,44 0,86 1,00
Teachers, n=13: 0,69 0,76 0,90 0,38 0,79 0,92

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Prose recall: sequence length in concrete and abstract texts

> Interpreters recalled both texts and all sequences better than teachers

> Abstract long sequences best

- group & text interaction: p < .005

Probability of recall for
Long text sequences (22-25 words)
Group: Teachers, n=13; Interpreters, n=12
Abstract — Concrete

Probability of recall for
Medium text sequences (11-20 words)
Ryhmä: Teachers, n=13; Interpreters, n=12
Abstract — Concrete

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Prose recall, abstract: Mistakes

- Interpreters made fewer mistakes in:
  - understanding time descriptions
  - understanding causal relationships
- Only the best interpreter(s) recalled all details in:
  - important lists of definitions
  - the longest sequence of 25 words

Conclusions & questions

Prose recall: interpreters ARE BETTER than foreign language teachers
- as expected
- especially in recall of abstract texts

- But WHAT explains this?
- Vincent & Wang, 1998: constraint attunement hypothesis (CAH)
  - Weber & Brewer, 2003: experts attuned to domain relevant structure
  - But what is domain relevant for interpreters?

Conclusions & questions

➢ **What is** the difference between abstract and concrete texts ??

  ➢ Marschack et al., 1991:

    ▪ causality and temporal sequences in prose recall

    ▪ could explain the difference between the two texts

    ▪ BUT does not explain, why interpreters were better than teachers

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Litterature

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