

Language problems in relation to problems in other areas of cognition

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To start...

- Assumption: Language is a part of cognition.
- My question in this lecture is:

What is the relationship between linguistic abilities and abilities in non-verbal cognition (in the context of populations with disorders)?

NB hot topic still in psycholinguistics with respect to the issue of modularity here using disordered populations as a window

A long-standing debate

Modularity approach:

A module is a specialized, encapsulated mental organ that has evolved to handle specific information types of enormous relevance to the species.

Language is a module within cognition?

For: e.g. Fodor (1983, 1985) following Chomsky, and other generativists

Against: e.g. Bates, Tomasello and many others

A long-standing debate

Current view on modularity as a research agenda from Cognitive Neuropsychology:

‘One approach to understanding a complex process starts with an attempt to divide it into *modules*, sub-processes that are independent in some sense, and have distinct functions.

Sternberg 2011

Separate modifiability:

there are **process-specific factors** that have a **selective influence**

Functional distinctness

Past cases

Discussion points in the past

Language module within cognition?

Discussion on cases where it was claimed that :

1. Language was preserved despite problems in non-verbal cognition.

2. Non-verbal cognition was preserved despite language problems

Past cases

Christopher: the language savant.

- C. has severe cognitive impairments (IQ:40-76) but can read, speak and translate between many languages. Used as evidence that language is a separate module *Smith & Tsimpli 1993*
- Cognitive capacity of a five-year old can mean language learning is largely intact. *Bates 1997*
- *Filmclip with Neil Smith:*
<http://www.youtube.com/watch?v=jFi7BXTGqJ8>

Williams syndrome

- Cognitive impairments *Bellugi, Bihrlé, Neville, Jernigan and Doherty, 1991* but some areas not affected e.g. face recognition although visual-spatial construction is very weak.
- Language claimed to be spared
- BUT in fact differentially affected: conceptual vocabulary; grammatical ability correlates with cognitive level.
- **Conclusion:** Complex interaction between language and non-verbal cognition - see overview *Mervis & Bercerra 2007*
- Interview:
<http://video.nytimes.com/video/2007/07/06/magazine/1194817106646/my-life-with-williams.html>

Gene for past tense: KE family

- Family with a genetic disorder in UK with problems with verb morphology *Gopnik & Crago 1991*
- Claimed that the deficit was specific to grammar, verb past tense; non cognitive problems.
- BUT later research showed non-verbal deficits also found and wider language problems esp. Verbal dyspraxia e.g. Non-Word Repetition *Vargha-Khadem et al. 1995*
- Example of dyspraxic speech: <http://trittgen677s09.weebly.com/>
- **Conclusion:** more complex relationship between language, non-verbal abilities and genetics.

Past cases

Specific Language Impairment

- Classic definition: no other impairments except language *Stark & Tallal 1981* NB
- Recent studies do show group differences in various areas of cognitive functioning
e.g. non-linguistic tasks such as mental rotation,
number skills and motor skills

Johnston & Ellis Weismer 1983; Bishop, 2002; Cowan et al 2005

- In which areas are there differences?
- What do any differences imply?

Methodological issues

- **Research strategy:** Consider the different components of **Executive Functioning in SLI children**

BUT

1. different definitions of SLI due to national differences etc.
2. Different numbers tested
3. Tasks vary

Executive Functioning

‘(...) the ability to maintain an appropriate problem solving set for attainment of a future goal.’

Welsh & Pennington, 1988: 201

Components: Pennington & Ozonoff 1996

- flexibility/switching
- fluency
- planning
- inhibition
- working memory

**These all need to be
measured
in the Non-Verbal domain.**

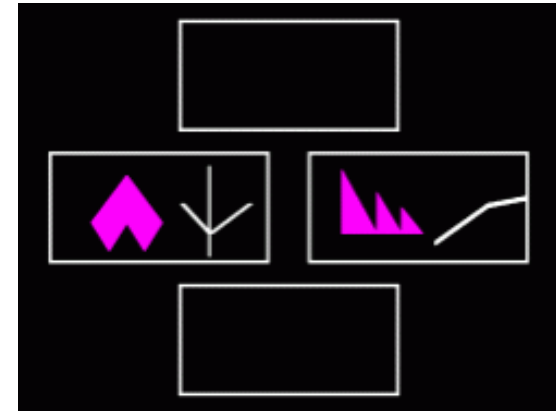
NB different tasks can test several different aspects and to a different degree *Huizinga et al 2006*₁₁

EF: NV Flexibility tasks

Intra-Extra Dimensional (IED) shift task

CANTAB

- Participants choose one of a pair of nonsense line drawings or coloured shapes, with feedback on whether the choice is “correct” or not.
- At certain points, the dimensional criteria are changed without warning and the participant must discover the new rule. At other points, two co-occurring dimensions are introduced.



EF & SLI

EF: NV Flexibility tasks

SLI children lower level than TD:

Marton 2008 (?)

No difference

Weyandt & Willis 1994

Kiernan, Snow, Swisher & Vance 1997

Dibbets, Bakker & Jolles 2006

Im-Bolter et al. 2006

Lukacs & Kemeny 2011

Henry et al 2012 NB age and non-verbal IQ factored in

Parriger 2012

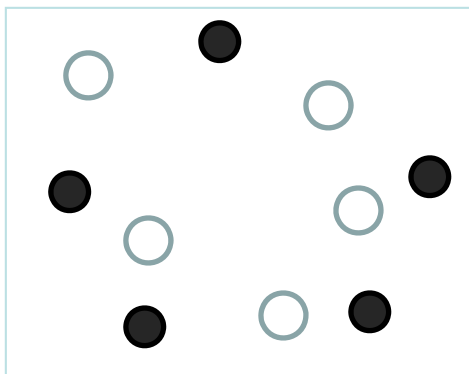
Laloi et al. 2012

EF: NV Fluency task

Design fluency

D-KEFS *Delis, Kaplan & Kramer 2001*

Make different 'four-line' designs by connecting the empty dots with straight lines



Part one: filled dots only (not shown here)
Part two: empty dots

EF: NV Fluency task results

SLI children lower level than TD

Henry et al 2012 (larger numbers tested)

No difference

Weyandt & Willis 1994

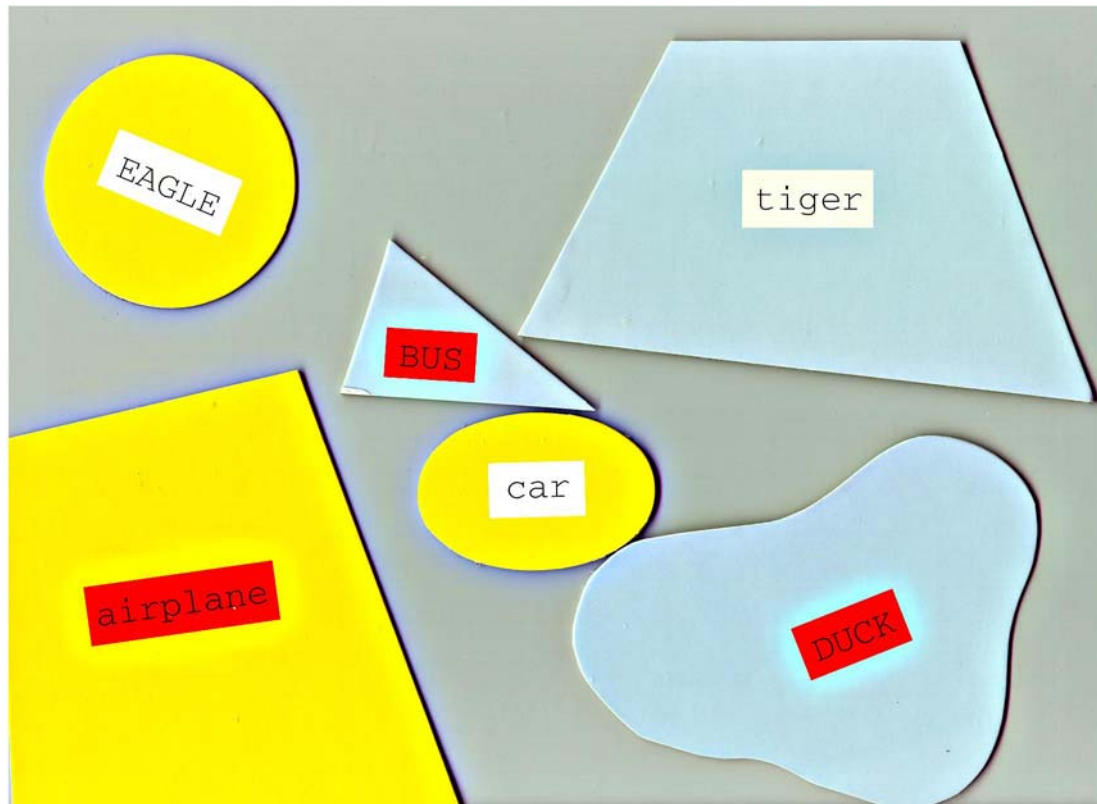
Bishop & Norbury 2005

Parigger 2012

EF: Planning task

D-KEFS Sorting Test (verbal and non-verbal)

Delis, Kaplan & Kramer, 2001



Verbal Sorts:

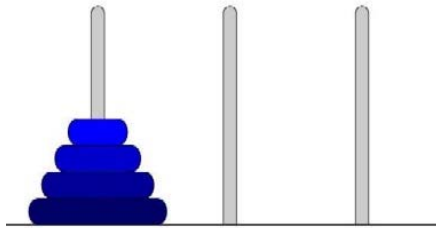
1. Animals/Transportation
2. Air/Land
3. Syllable/Syllables

Perceptual Sorts:

1. Uppercase/Lowercase
2. Large/Small
3. Curved/Straight
4. Blue/Yellow
5. Red/White

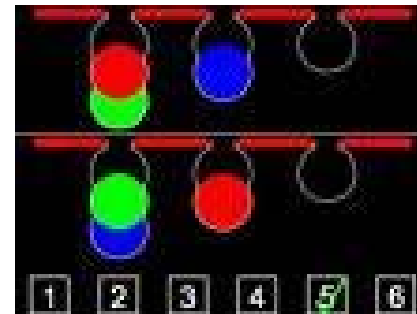
EF: NV Planning tasks

Tower of Hanoi



Transfer rings to other upright one ring at a time without putting a larger ring on top of a smaller ring

Stocking of Cambridge



CANTAB

Adult level reached at 21 years in TD children

EF: NV Planning tasks

SLI children lower level than TD:

Weyandt & Willis 1994

Marton 2008

Lukacs & Kemeny 2011

Henry et al 2012

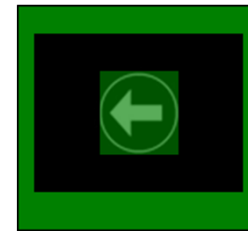
No difference

Parigger 2012

Laloi et al. 2012

EF: NV Inhibition task

Stop-Signal Task (CANTAB)



Press the left button if the arrow points left.

Press the right button if arrow points right.

DO NOT PRESS if the arrow is green

Adult level reached 15-21 years (TD)

EF: NV Inhibition task

Fist-finger game

developed by *Henry, Messer & Nash 2012*

Build up prepotent response first:

Show finger = copy finger

Show fist = copy fist

n = 20 trials



Then alter instruction: Inhibition trials:

Show finger = show fist

Show fist = show finger

n = 20 trials



EF & SLI

EF: NV Inhibition results

SLI children lower level than TD:

Imbolter, Johnston & Pascuale Leone 2006

Bishop & Frazer-Norbury 2005

Lukacs & Kemeny 2011

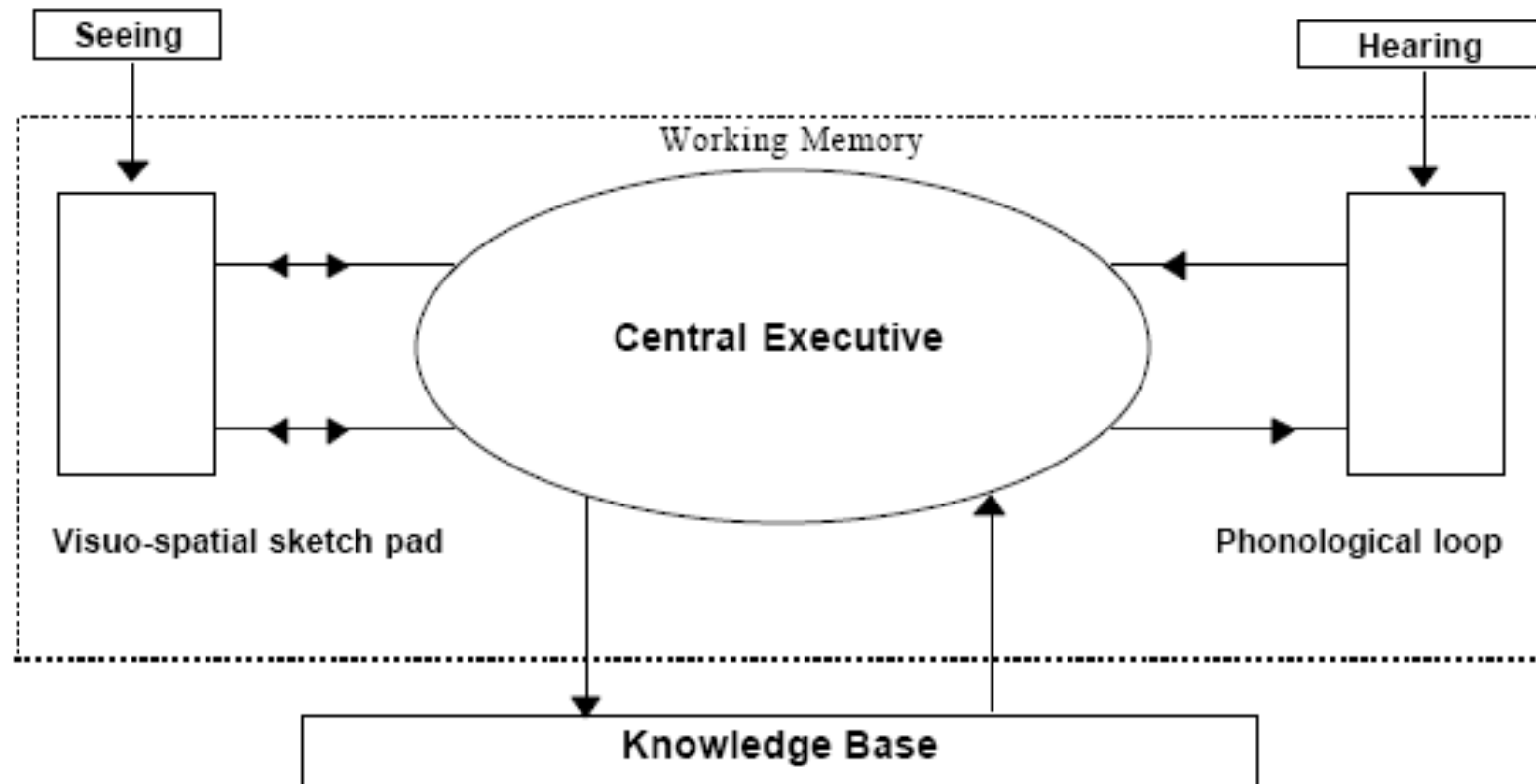
Henry et al. 2012

Laloi et al 2012

No difference

Parigger 2012

Working Memory: Baddeley model



EF: Working Memory task

Digit span – forwards and backwards

Discussion:

to what extent non-verbal?

affected by syllable length of digit names,

e.g. forward digit span of Chinese speakers longer than in speakers of other languages because of monosyllabicity; backward digit span not affected. *Chen & Stevenson 1988*

Backward digit span better task but still some verbal element

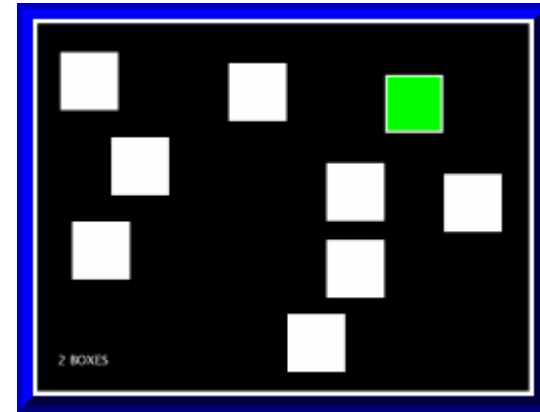
EF & SLI

EF: NV Working Memory task

Spatial span

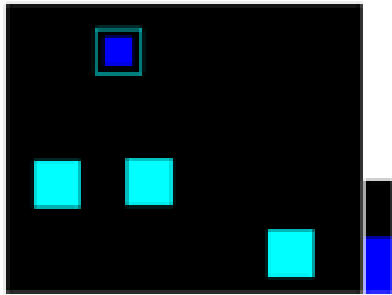
White squares change colour in a different order.

Touch screen in the same order of colour change.



EF: Working Memory tasks

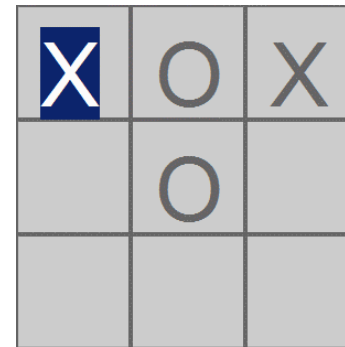
Spatial WM



CANTAB

Search for the box with a token inside it. Continue search in any box except one where a token has been found. Also child friendly version with frogs in the boxes Iluz-Cohen 2011

Noughts and Crosses

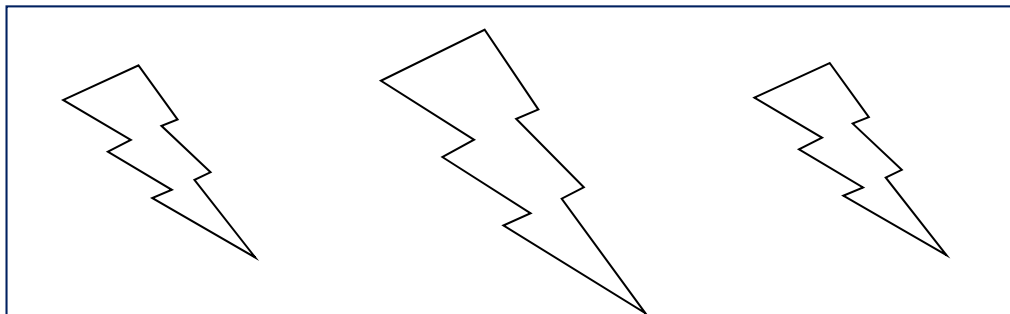
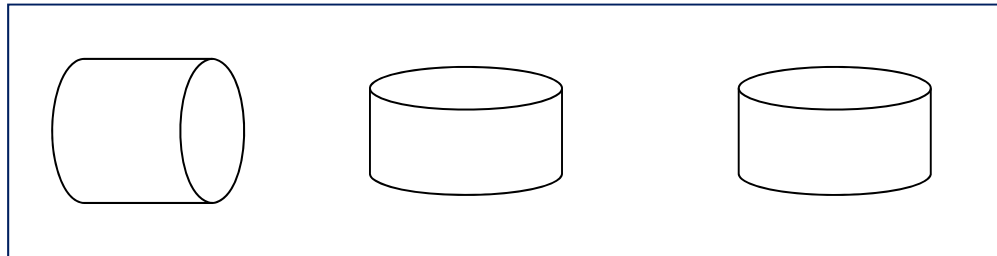


Huizinga et al 2006

Adult level WM reached at 21 years in TD children

EF: NV Working Memory task

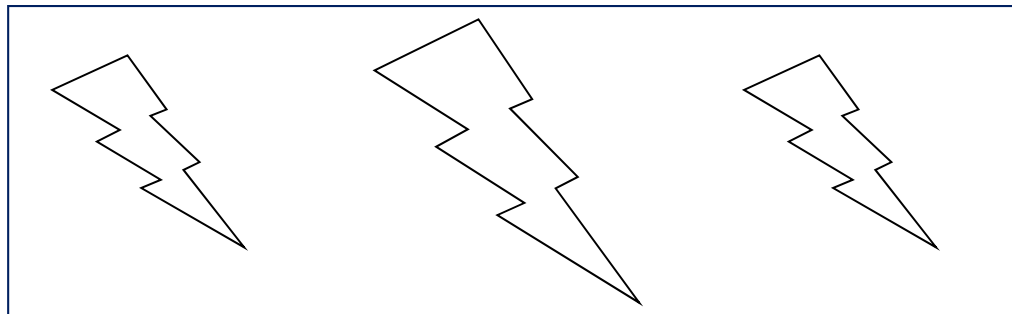
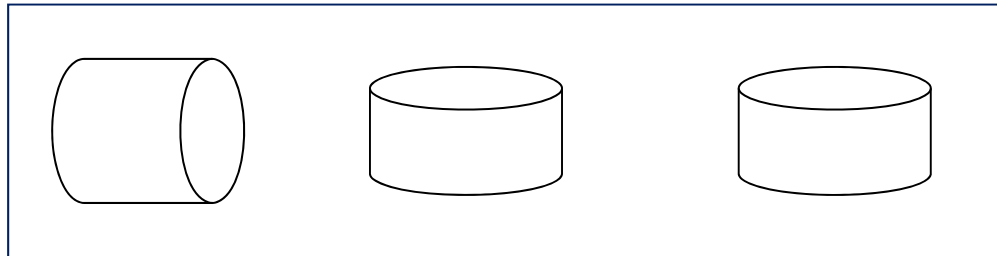
Odd-one-out *Henry 2001*



Shown two sets of three figures, then fill in on computer where the odd-one-out was.

EF: Working Memory task

Odd-one-out *Henry 2001*



Shown two sets of three figures, then fill in on computer where the odd-one-out was.

X		
	X	

EF & SLI

EF: NV Working Memory results

SLI children lower level than TD

Marion 2008

Im-Bolter, Johnson and Pascual-Leone 2006

Montgomery et al. 2010 review

Zebib & Scheidnes 2011 SLI < L2-TD children, only forward digit span

Henry et al 2012

No difference

Archibald & Gathercole 2006

Lukacs & Kemeny 2011

Parigger 2012

Rispens & Baker (in press) on digit span BUT SLI + reading impairment group was significantly worse

Summary EF in SLI

Where are there differences between groups of SLI children versus TD children on **non-verbal EF tasks**?

- | | |
|------------------------|------------|
| •flexibility/switching | NO |
| •fluency | YES/NO |
| •planning | YES |
| •inhibition | YES |
| •working memory | YES/NO |

Conclusions

- Some functions are clearly affected; others are not; others are not clear NB possibly task related.

Are general EF deficits causing language problems?

- In many studies there are correlations with language measures, but causality?
- However other groups show EF deficits without same degree of language effects e.g. in ADHD larger inhibition problems but far fewer problems in language *Parigger 2012*.

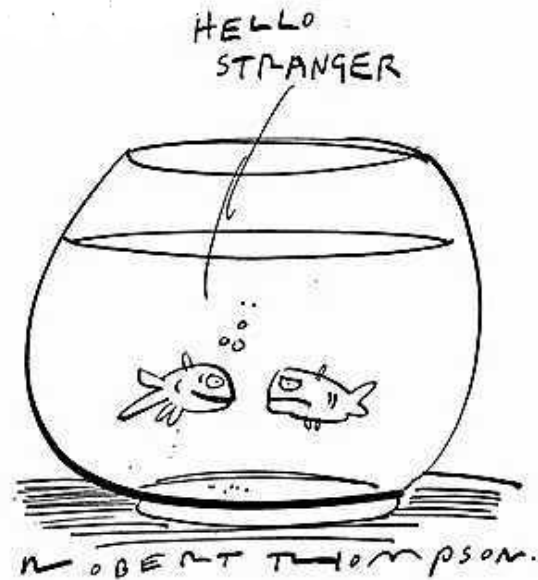
Where to go from here?

- **Large scale** studies are needed like those of *Henry et al 2012*.
- **Non-verbal** tasks must be compared to verbal tasks.
- **Statistical analysis** accounting for age and language level factors.
- Many **different populations** of children with disorders to establish further the interrelationships between non-verbal EF and verbal skills.

Forthcoming events related to this topic

- **Debate:** *Language and Cognition*, CSCA, Plantage Muidergracht 28, Amsterdam, Feb. 16th, 4pm.
- **Lecture:** Simon Fisher *A genetic perspective on language acquisition*. Netwerk 1TV, Universiteitstheater, Amsterdam. March 9th, 10am.
- **Lecture:** Ianthe Tsimpli *Signed and spoken language asymmetries in a polyglot-savant*. CSCA, Plantage Muidergracht 28, Amsterdam, March 20th, 4pm.
- **Symposium:** *Language and EF*, Anéla conference, Lunteren. May 9th, 5-7pm.
- **LOT summer school**, Utrecht. Different activities, July 9-13th.

THANK YOU FOR YOUR ATTENTION



TO HELP THE MEMORY:
Powerpoint in pdf on my homepage:
<https://home.medewerker.uva.nl/a.e.baker>

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