

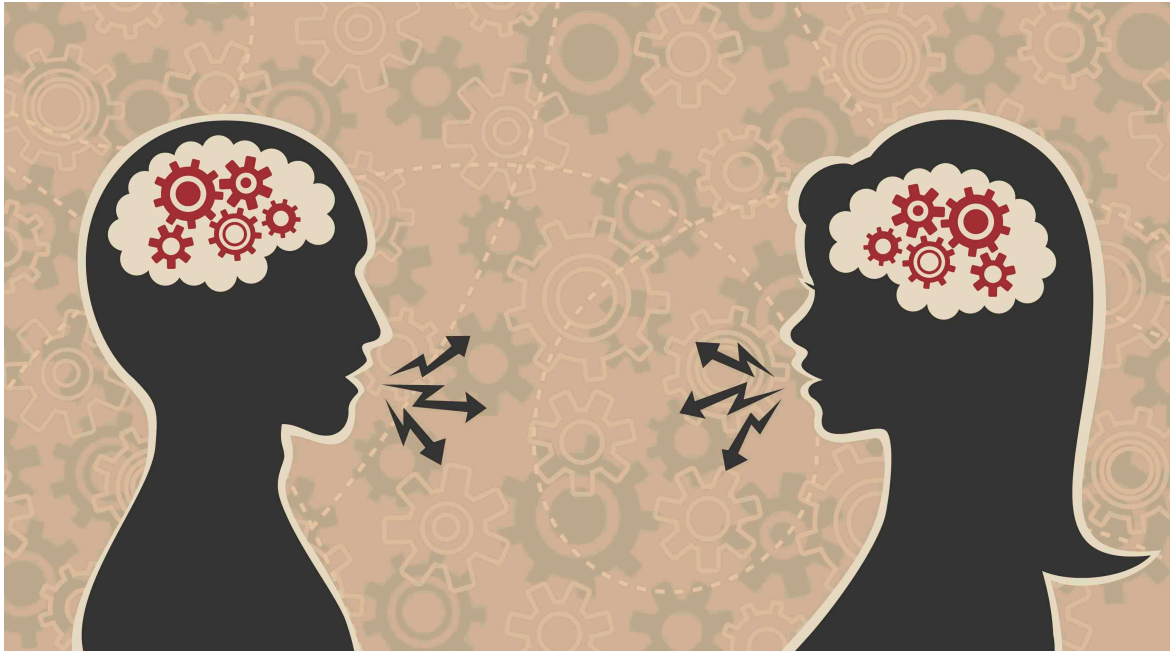
# Uncertainty and Statistical Language Learning in Adults

Riikka Möttönen

Cognitive Science

Department of Digital Humanities

University of Helsinki



Paradox: adults have advanced cognitive skills, but do not learn languages as effectively as children do – why?



Hypothesis: Late-developing prefrontal cortex that supports higher cognitive functions constrains statistical language learning mechanisms

-> Disruption of the prefrontal cortex should *enhance* statistical language learning in adults

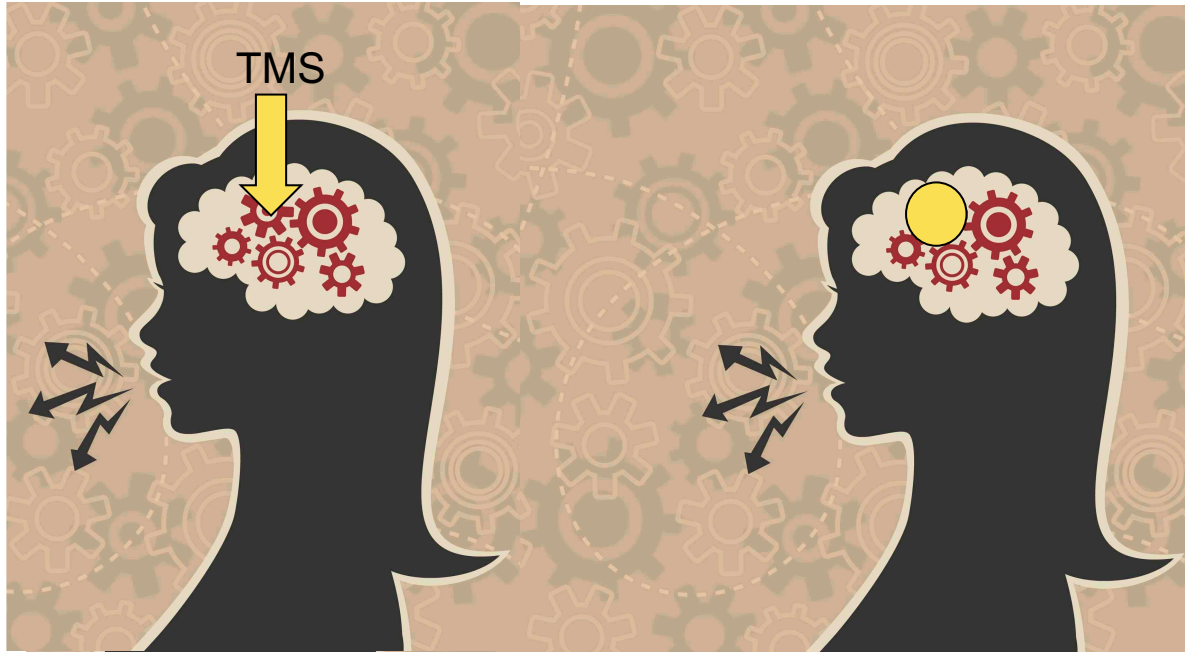


Dr. Eleonore Smalle  
Ghent University

## Transcranial Magnetic Stimulation (TMS) and electroencephalography (EEG)



TMS over dorsolateral prefrontal cortex (DLPFC),  
which matures late and supports higher cognitive functions



TMS over DLPFC or Control site

Exposure (EEG)

10-s break



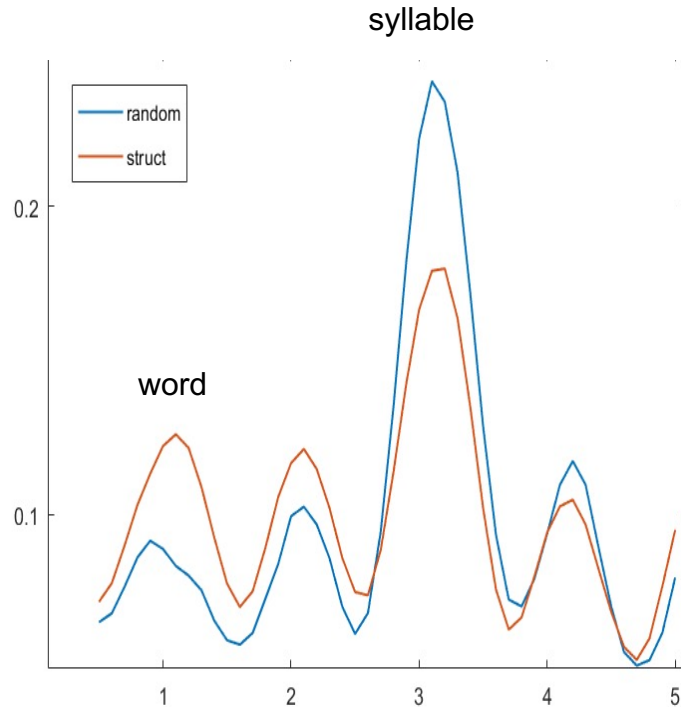
time

15-min break

Recognition task and memory judgement

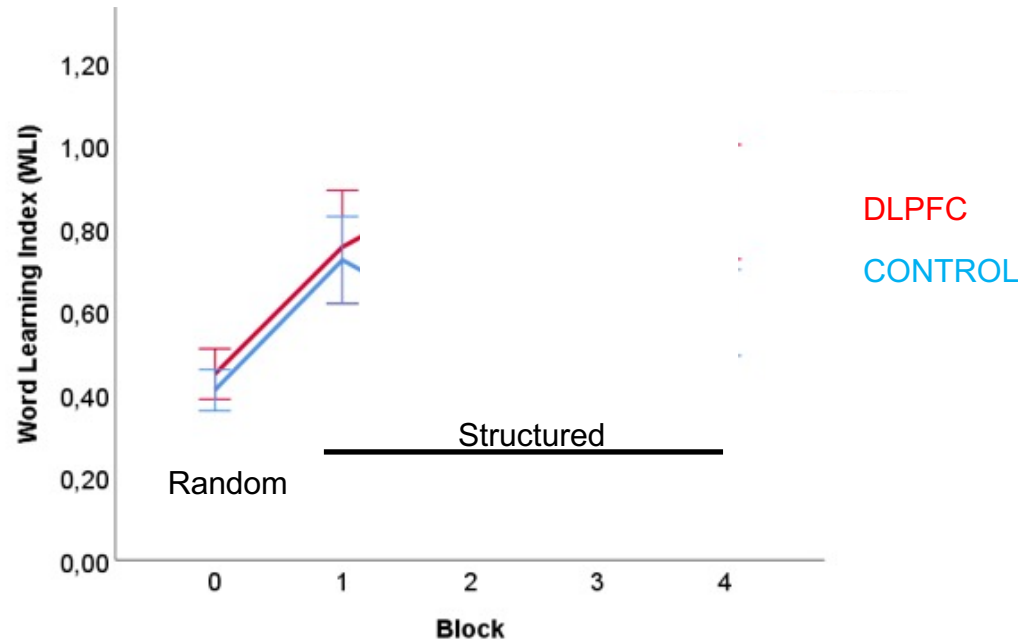
tupiro or godatu Remember/Familiar/Guess?  
(word) (non-word)

# Inter-trial coherence at word and syllable frequencies (EEG)





## TMS-induced disruption of DLPFC facilitated statistical learning during exposure (EEG)

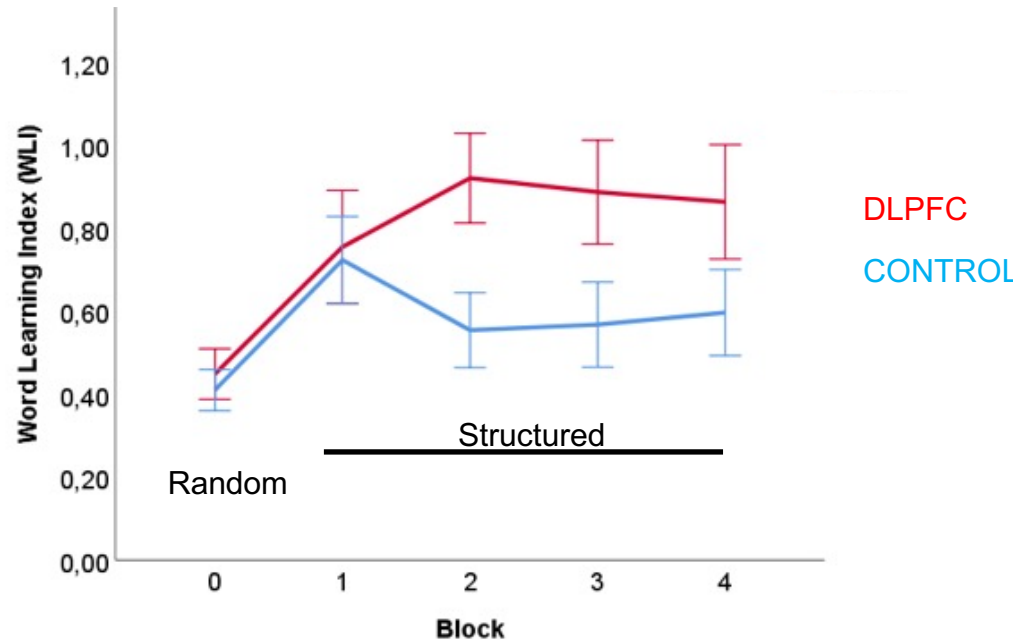


**Word Learning Index:**

$$WLI = \frac{ITC \text{ word}}{ITC \text{ syllable}}$$

(Batterink et al. 2017)

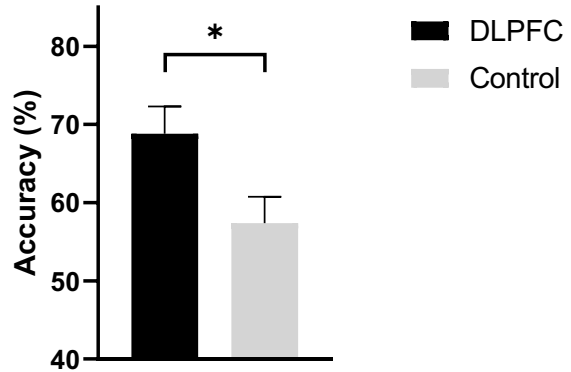
## TMS-induced disruption of DLPFC facilitated statistical learning during exposure (EEG)



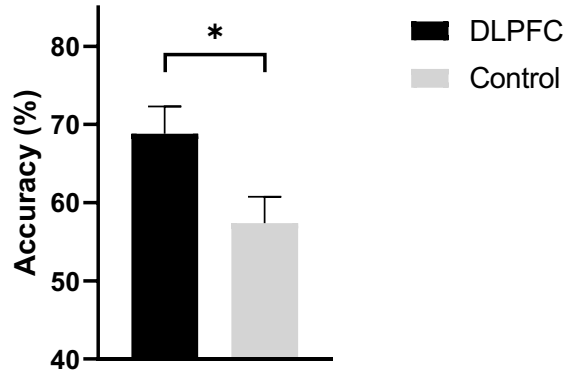
**Word Learning Index:**

$$WLI = \frac{ITC \text{ word}}{ITC \text{ syllable}}$$

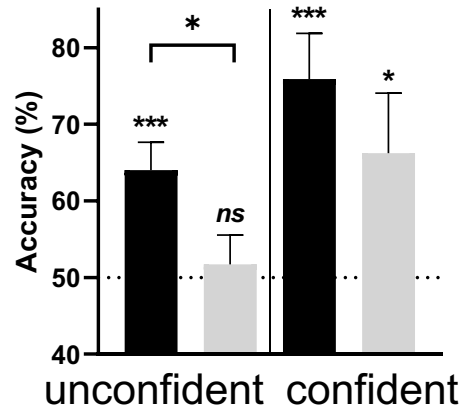
(Batterink et al. 2017)



TMS-induced disruption of DLPFC  
facilitated recognition of the  
hidden non-words

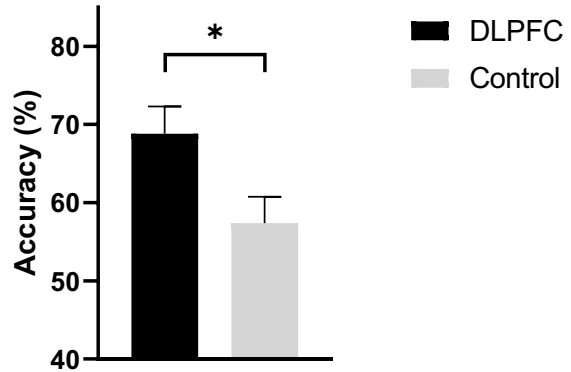


TMS-induced disruption of DLPFC facilitated recognition of the hidden non-words

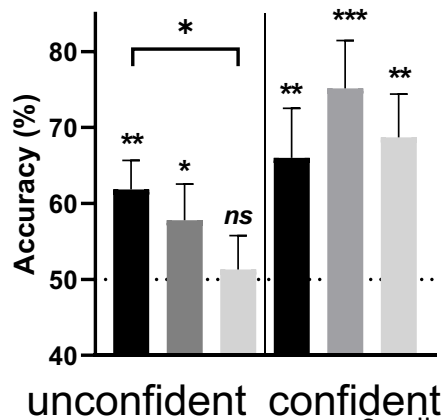
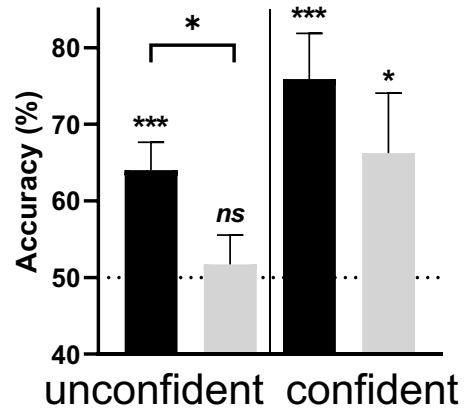
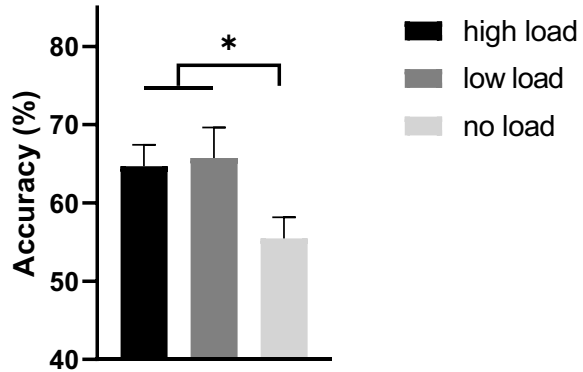


... especially when participants were unaware of remembering!

### Experiment 1



### Experiment 2



## Summary

- Results support the hypothesis that late-developing prefrontal cortex constrains implicit statistical language learning mechanisms in the adult brain
- It is possible to *unlock* adults' implicit language learning by cognitive depletion -> implications for foreign language learning in adults

## Two components of statistical language learning and uncertainty

1. Detecting the patterns and regularities in the linguistic input -> ***increases predictability and reduces uncertainty***
2. Storing the patterns in memory ***with or without awareness of (un)certainty (adults vs. infants)***

***The adult cognitive architecture suppresses uncertainty reduction during language learning without awareness (i.e., infant-like learning)***

Thank you!