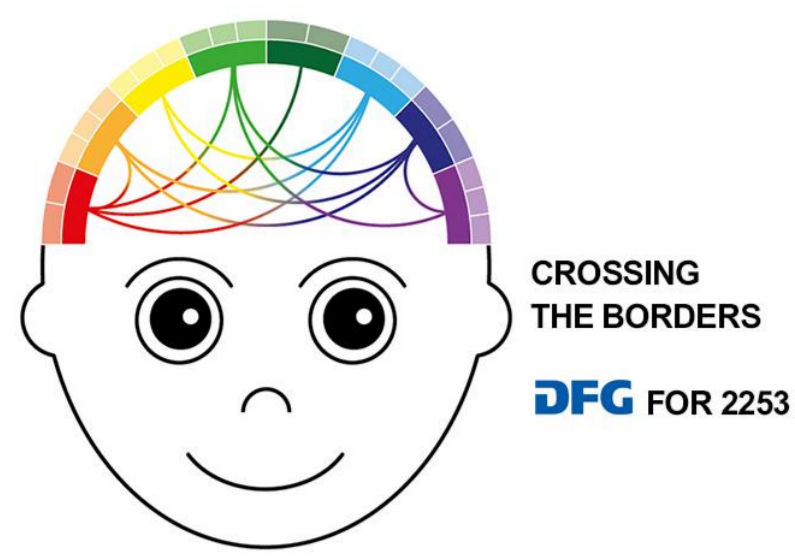


Adult processing of non-adjacent dependencies in the linguistic and non-linguistic domain



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Introduction

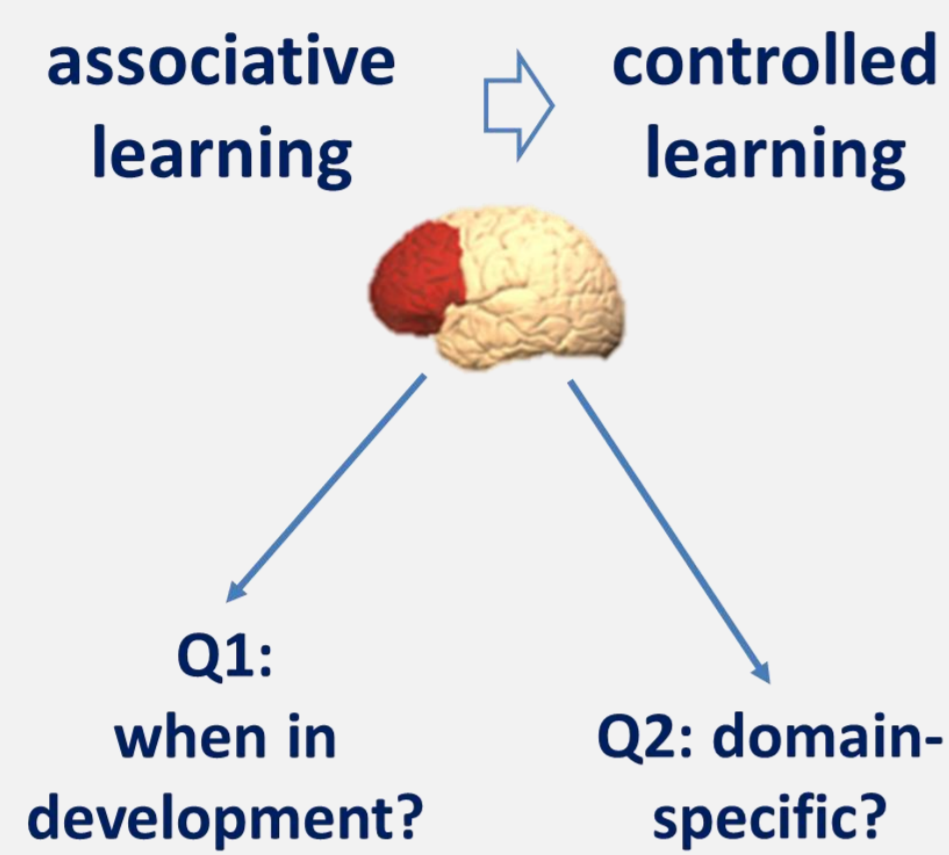
Adults were previously shown to need an explicit task or additional cues to learn non-adjacent dependencies (NADs)^[1,2].

1. Which brain regions underlie adult NAD learning? Do these change over age / domain?

Downregulation of PFC shown to elicit infant-like ERP patterns^[3] → controlled learning in adults is expected to engage prefrontal brain regions

2. Is adult non-adjacent dependency (NAD) learning domain-specific?

Similar brain regions while learning linguistic and non-linguistic NADs → general learning mechanism.



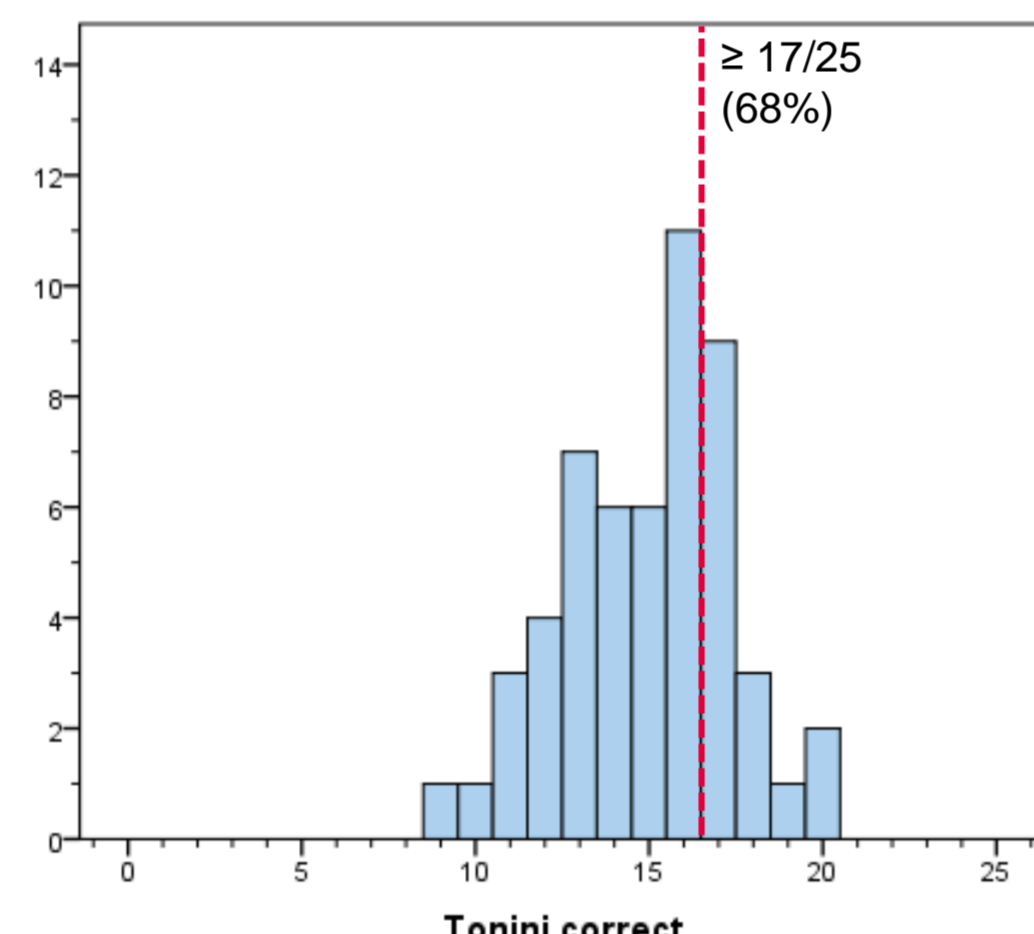
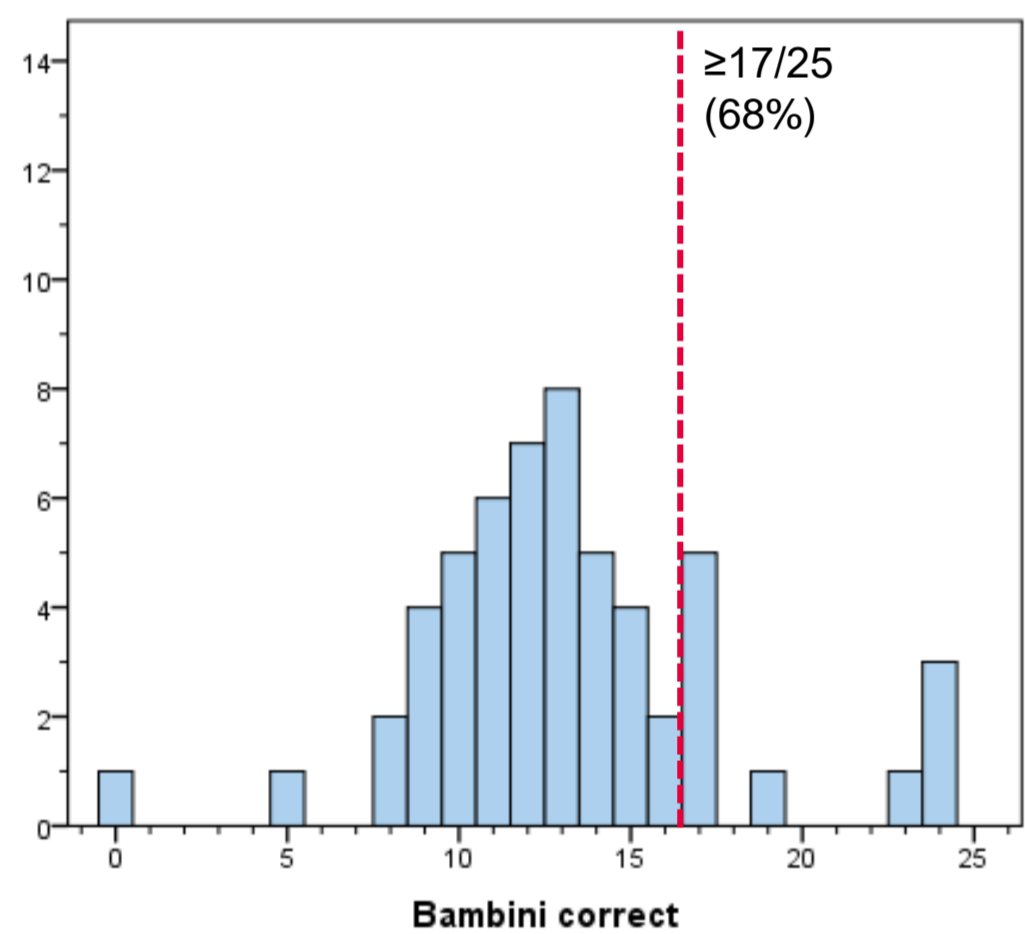
Behavioral data

Linguistic stimuli:

- 10/56 adults learned
- 2 excluded due to Spanish proficiency

Non-linguistic stimuli:

- 15/56 adults learned
- correlation with years of musical experience



Methods

Participants

- 56 healthy German-speaking adults (21 M), ages 19-37 (Mean: 24,6)
- fNIRS data included for channels/participants where ALL vs Rest showed hemodynamic response

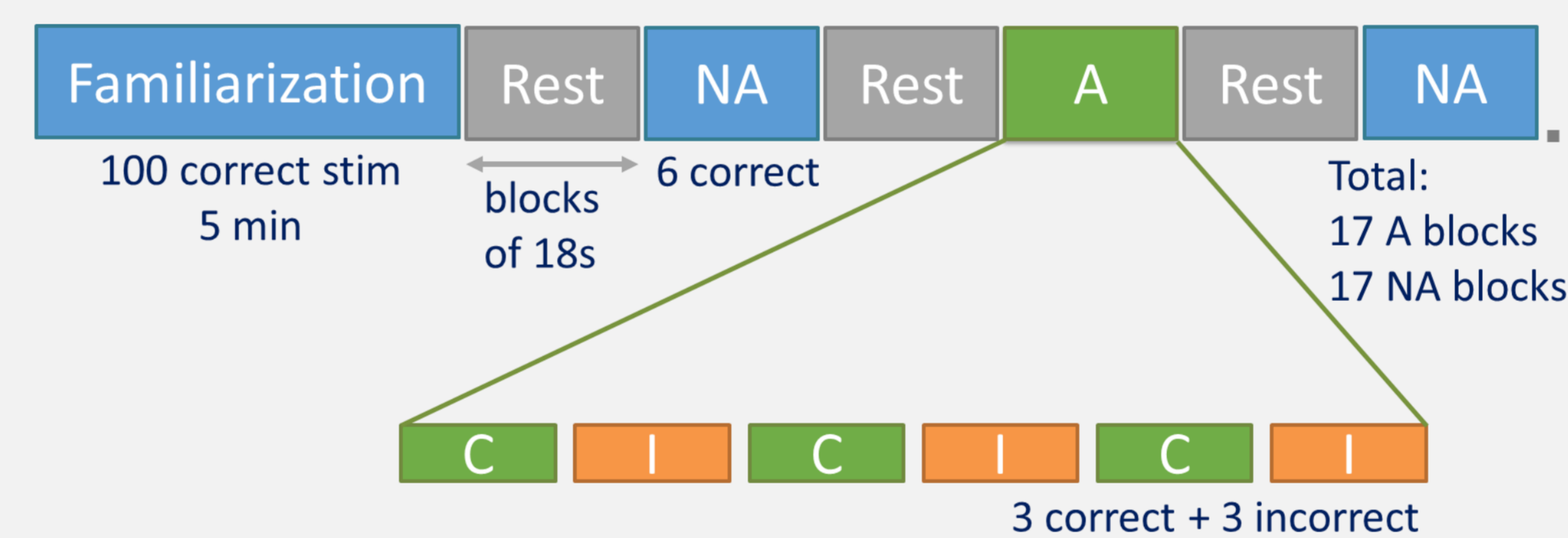
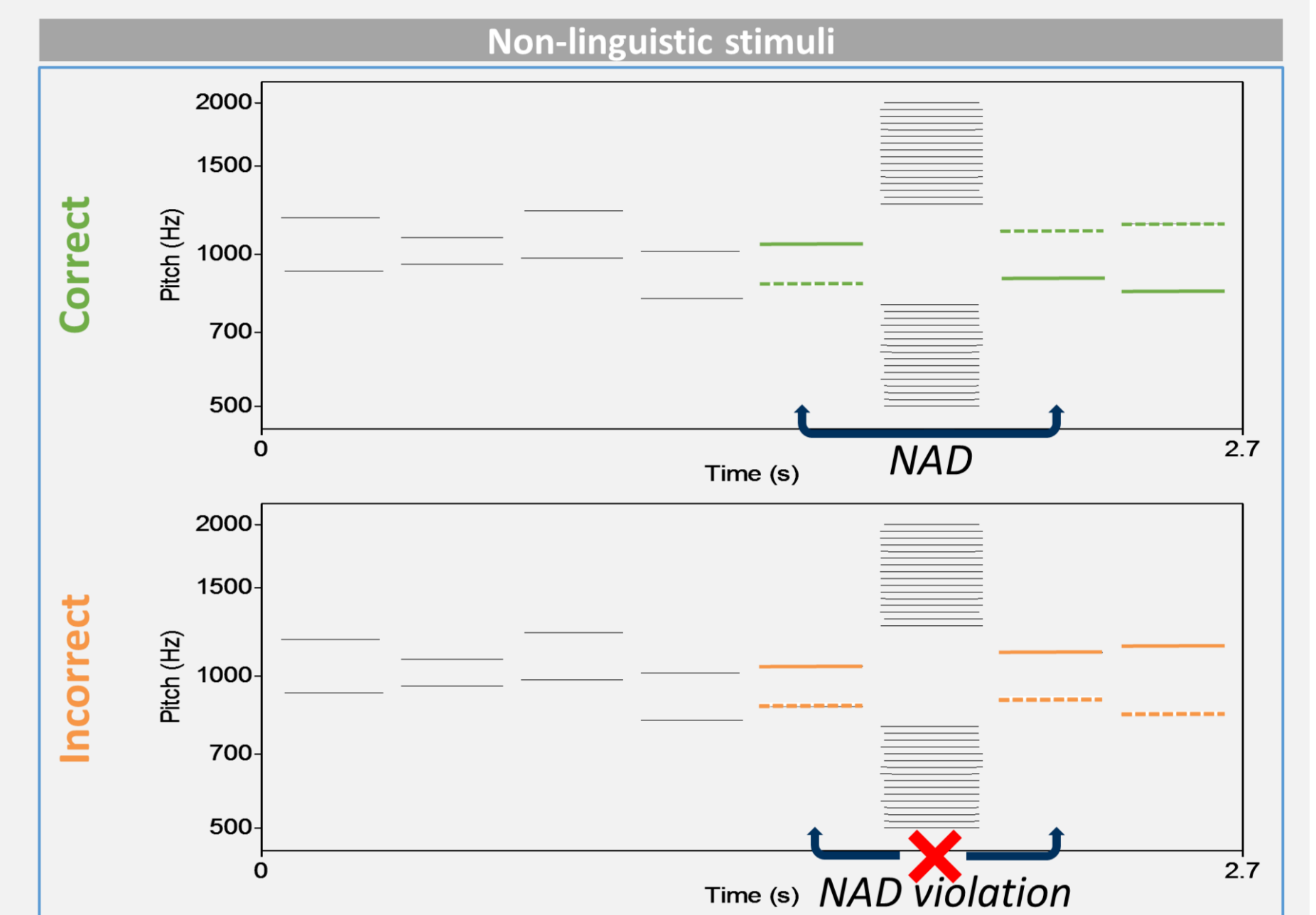
Method

Functional Near-infrared spectroscopy (fNIRS): bilateral frontal, temporal & parietal cortex + 2AFC task

Stimuli

- Linguistic (Italian sentences) and non-linguistic (tone sequences) stimuli containing **non-adjacent dependencies**
- Italian sentences: NAD between Aux/Mod and Suffix (verb stem as variable middle element)
- Tone sequences: Italian syllable positions replaced by pure tones, preserving NADs
- Linguistic and non-linguistic stimuli are matched on mean overall duration, mean duration of the individual tones / syllables and overall duration of pauses.

Linguistic stimuli			
NP (n=2)	Aux (n=2)	V-stem (n=32)	suffix (n=2)
Correct: La sorella	sta	cant-	ando
La sorella	puo	cant-	are
NAD			
Incorrect: *La sorella	sta	cant-	are
*La sorella	puo	cant-	ando
NAD violation			



Paradigm

- passive-listening alternating-non-alternating paradigm.
- **Non-alternating (NA) blocks** → correct items (with NADs)
- **Alternating (A) blocks** → correct and incorrect items (with NAD violations).
- Comparison of fNIRS responses to NA and A blocks reveals whether the dependency was extracted from the input.

Preliminary fNIRS data

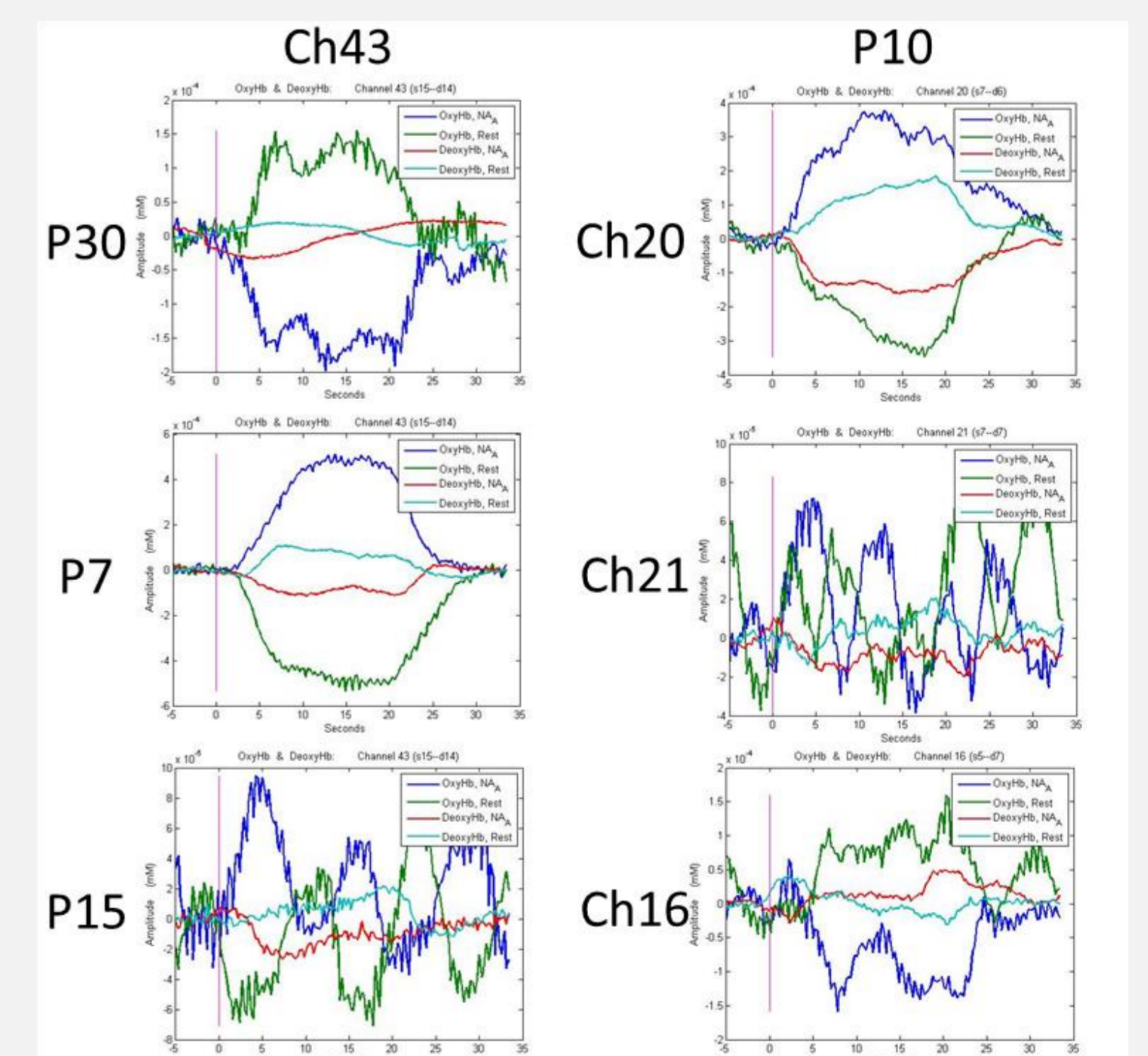
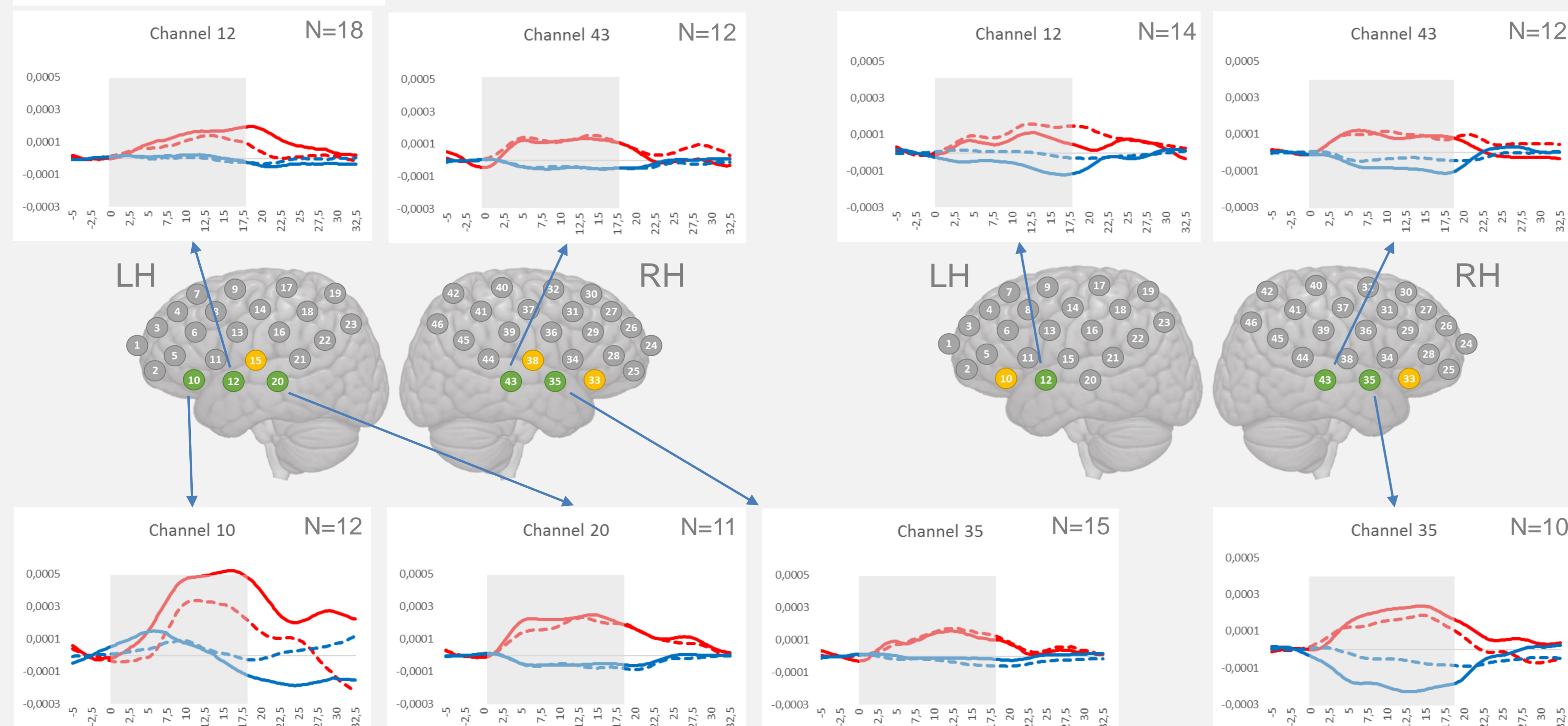
Linguistic stimuli:

- Significant (FDR-corrected) HbO changes compared to baseline for NA and A blocks in **bilateral temporal channels 12, 20, 35 & 43**
- Significant HbR changes for both conditions only in **channels 20 & 43**
- HbO in **channel 10 only significant for alternating condition**
- **No differences between NA and A blocks**

Non-linguistic stimuli:

- Significant HbO changes compared to baseline for both NA and A in **right temporal channels 35 and 43** (FDR-corrected)
- HbR significantly different from baseline in **channel 43** only
- **No differences between A and NA blocks**

— HbO NA — HbO A — HbR NA — HbR A



Data issues:

- Meyer waves with amplitudes highly varying across participants and channels
- "Reversed" response found across participants and channels