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

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Introduction

How does adult non-adjacent dependency (NAD) learning in the non-linguistic domain compare to NAD learning in the linguistic domain? Adults were previously shown to need an explicit task when learning NADs in linguistic sequences¹,² and to need similarity cues to learn NADs in tone sequences³. How do the domains compare when stimuli and paradigm are closely matched?

Which brain regions underlie the learning of non-adjacent dependencies in the linguistic and the non-linguistic domain?

• Controlled learning by adults is expected to engage frontal brain regions
• Activation of similar brain regions while learning linguistic and non-linguistic non-adjacent dependencies (NADs) might suggest a general NAD learning mechanism in both domains.

Behavioral data

Linguistic stimuli:
• 10/56 adults learned
• 2 excluded: Spanish proficiency

Non-linguistic stimuli:
• 15/56 adults learned
• correlation with years of musical experience

Methods

Participants
• 56 healthy German-speaking adults (21 M, 35 F), ages 19-37 (Mean: 24.6)
• fNIRS data included: 35 participants (24 F) in linguistic and 38 (27 F) in non-linguistic experiment.

Stimuli
The linguistic (Italian sentences) and non-linguistic (tone sequences) experiments contain correct stimuli with NADs and incorrect stimuli with NAD violations.

• Italian sentences: NAD between Adverb and Suffix (verb stem as variable middle element)
• Tone sequences: Italian syllables are replaced by pure tones, preserving NADs
• Linguistic and non-linguistic stimuli are matched on mean overall duration and mean duration of the individual tones / syllables.

Paradigm
Stimuli are presented in a passive-listening alternating-non-alternating paradigm. Non-alternating (NA) blocks containing correct items (with NADs) are followed by alternating (A) blocks containing correct and incorrect items (with NAD violations). Comparison of fNIRS responses to alternating and non-alternating blocks reveals whether the dependency was extracted from the input.

Linguistic stimuli:
differences in HbO and HbR between alternating and non-alternating blocks only apparent in participants who learned, located in right inferior frontal and right and left temporal region.

Differences have not been tested for significance.

Non-linguistic stimuli:
HbO different from baseline in right temporal region. No apparent differences between alternating and non-alternating conditions.

Preliminary fNIRS data