**PARADIGM AND STIMULI**

<table>
<thead>
<tr>
<th>Arabic (n=8) and Dari (n=12) learners</th>
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<tbody>
<tr>
<td>Arabic stimuli</td>
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<tr>
<td>standard</td>
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<tr>
<td>deviant</td>
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<td>deviant - standard</td>
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**EEG RESULTS**

**ARABIC LEARNERS (n=8)**

<table>
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<tr>
<th>MMN</th>
<th>T0</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
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<tr>
<td>Fz</td>
<td>![ARABIC LEARNERS (n=8) MMN T0 T1 T2 T3](Image 200x363 to 420x414)</td>
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**ARABIC STIMULI:**

[ha]-std vs. [ha]-dev

**DARI LEARNERS (n=12)**

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**DARI STIMULI:**

[3a]-standard vs. [3a]-deviant

**THE STORY**

**Does MMN to foreign speech sounds change with learning?**

- EEG (and behavioral) from 2 groups: Arabic learners (n=8) and Dari learners (n=12).
- MMN to Arabic sounds and Dari sounds.
- 4 measurements in 2 years: 0 weeks, 3 weeks, 24 weeks, 81 weeks.

**BEHAVIORAL RESULTS**

- Dari learners’ identification of Dari contrast improved after 3 weeks (and was sustained).
- No other effects, and no correlations with MMN.

**INTRODUCTION**

- Does MMN to foreign speech sounds change with learning?
- EEG (and behavioral) from 2 groups: Arabic learners (n=8) and Dari learners (n=12).
- MMN to Arabic sounds and Dari sounds.
- 4 measurements in 2 years: 0 weeks, 3 weeks, 24 weeks, 81 weeks.

**EEG RESULTS**

- MMNs in both groups to Arabic and Dari stimuli at most recordings.
- Arabic learner’s Arabic MMN diminished over time.
- Both groups combined: Increased Dari MMN between T2 and T3

**DISCUSSION**

- Improved Dari perception over time.
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**BEHAVIORAL RESULTS**

- Categorical perception (2AFC)
- Diminished Arabic MMN reflective of intermediate learning?
- Both groups combined: Increased Dari MMN between T2 and T3

**THE DETAILS**

- **Participants**
  - Language officers at the Royal Danish Defence College.
  - All native Danish-speakers, learning either Arabic (n=8) or Dari (n=12).

- **Stimuli**
  - One Arabic and one Dari contrast: [ha] vs. [3a]; [ha] vs. [3a]; [ha] vs. [3a]
  - Duration of the contrasts with 11 steps: 11
  - End points of both continuums were used (also 2 intermediate steps, not reported).

- **Procedure**
  - EEG (ha) and (3a) standards, (ha) and (3a) deviants, (ha) and (3a) deviants presented in isolation (deviants-as-standards). 10 deviants.

- **BrainVision ActiCap**
  - 32 channels, MMN subtraction of [ha]-std and [3a]-std from [ha]-dev and [3a]-dev.

- **Behavioral tasks**
  - 2AFC (identification task) and AX (same-different task).

- **EEG Acquisitions and Analyses**
  - BrainVision ActiCap: 32 channels, MMN subtraction of [ha]-std and [3a]-std from [ha]-dev and [3a]-dev.

- **MMN**
  - Averaging of MMNs for different stimuli as both std and dev. (TOP LEFT) Arabic learners - Arabic stimuli [ha]. (TOP RIGHT) Dari learners - Dari stimuli [3a]. (BOTTOM LEFT) Arabic learners - Dari stimuli [3a]. (BOTTOM RIGHT) Dari learners - Arabic stimuli [3a]. (FAR RIGHT) Windowed mean MMNs at T0, T1, T2, and T3.

- **Significant effects of time**
  - Arabic learners’ MMN to Arabic stimuli diminished over time. (FAR RIGHT, BOTTOM) Behavioral results: slopes of both groups’ identification functions for both Dari and Arabic stimuli at all 4 times of measurement.