An Electrophysiological Study of Initial American Sign Language Acquisition in Adult Learners

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Introduction

- Changes in event-related potentials (ERPs) to L2 words are noticeable after the first fourteen hours of instruction, before overt behavioral changes [1]
- Previous research using ERPs to measure learning of a written L2 indicate the N400 component to be particularly sensitive to language learning [2]
- The current study investigates:
  - What neural changes underlie learning American Sign Language (ASL) signs by naïve hearing adults?
  - Are these changes similar to effects seen in the written forms of spoken languages?
  - Does acquiring a small ASL vocabulary effect the way unknown ASL signs are processed?

Methods

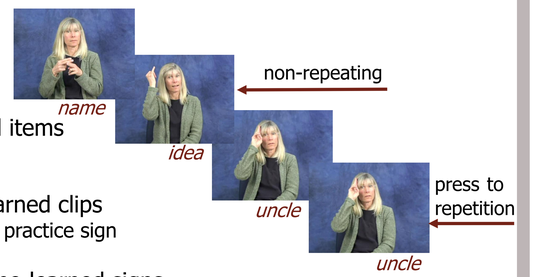
Participants

- N=19, 19-29 years old (mean age: 23), right-handed, normal-to-corrected vision, normal neurological profile, monolingual, native English speakers with NO knowledge of signed languages

Stimuli

- 180 short video clips of isolated ASL signs; average duration 1887ms (SD: 328ms)
  - 160 critical items (80 to-be-learned clips; 80 untaught clips)
  - 20 probes were 11% of stimuli (repeated signs for baseline, person signs for post-learning)

Procedure



Session 1:

1. **Baseline EEG recording** to 160 critical items
   - go/no-go task – repeated signs as probes
2. Associative learning task for 80 to-be-learned clips
   - English word → ASL clip → English word → practice sign
3. Forced-choice translation task for 80 to-be-learned signs
   - ASL clip → two English word choices → press to correct translation

Session 2 (24 to 48 hours after Session 1):

1. Forced-choice translation task (same as Session 1)
2. Associative learning task (same as Session 1)
3. Forced-choice translation task (same as Session 1)

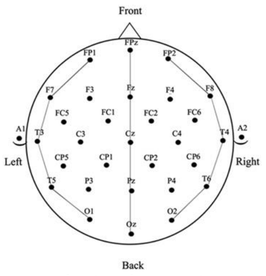
Session 3 (24 to 48 hours after Session 2):

1. **Final EEG recording** to 160 critical items
   - go/no-go task – person signs as probes (e.g., uncle, nurse)

Clips were presented one by one with 1200ms between the end of one clip and the beginning of the next clip.

EEG recording

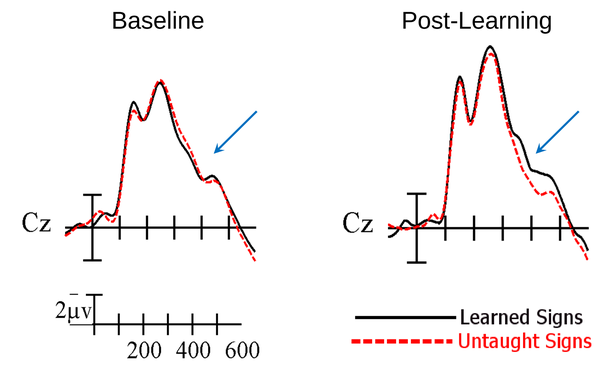
Twenty-nine channels of EEG data were recorded and averaged off-line to form ERPs to the learned and untaught sign conditions time-locked to clip onset.



electrode montage

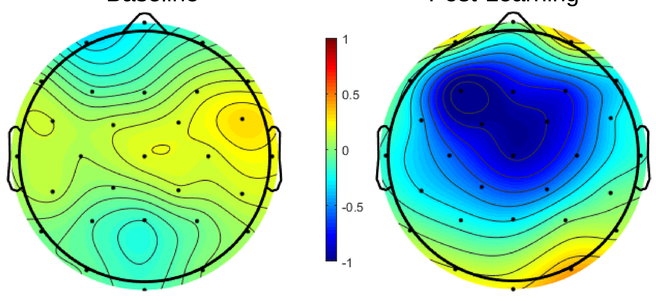
Results

Averaged ERPs to the learned and untaught signs



voltage maps

- Average voltage between 300ms and 500ms
- Learned signs - untaught signs



300ms-500ms

References

[1] McLaughlin, J., Osterhout, L., & Kim, A. (2004). Neural correlates of second-language word learning: Minimal instruction produces rapid change. *Nature Neuroscience, 7*, 703–704. doi: 10.1038/nn1264

[2] Soskey, L., Holcomb, P.J., & Midgley, K.J. (in revision) Language effects in second-language learners: A longitudinal electrophysiological study of Spanish classroom learning, *Brain Research*

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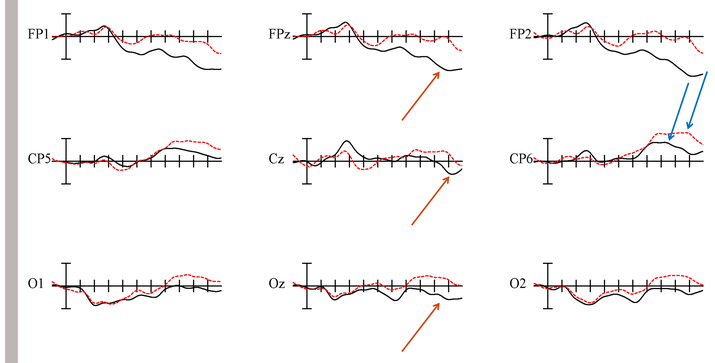
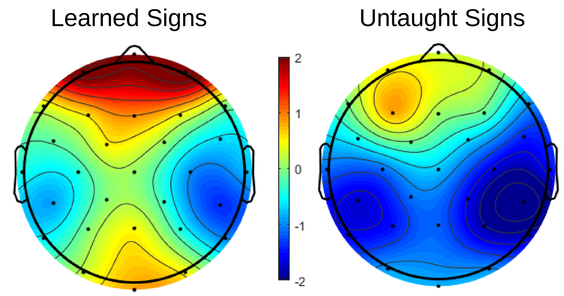
Results – *difference waves*

Baseline ERPs subtracted from post-learning ERPs



voltage maps

- Average voltage between 800ms and 1000ms
- Post-learning - baseline



800ms-1000ms

Conclusions

•Pre-learning, there were no ERP differences between the to-be-learned signs and the untaught signs. Post-learning, the learned signs exhibited an N400-like negativity compared to untaught signs, which is similar to previously reported effects for spoken and written language learning.

•Later (800-1000ms post video onset) learned signs, in contrast to pre-learning baseline, produced an enhanced midline positivity and lateral negativity, whereas untaught signs only produced the lateral negativity. This pattern of effects has not been previously reported for spoken language learning. These late effects may reflect the establishment of lexico-semantic representations that require information processing across the entire sign duration.