Generalization in Speech Motor Learning: The case of voicing

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plan
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Introduction

- Speakers improved production on phonotactically illegal onset clusters (e.g., **DB**EEGOO, **TP**EEGOO) in speech motor learning paradigm (Buchwald et al., in press; Segawa et al., 2015)
- The nature of precisely what is being learned remains incompletely understood:
  - Lexical level learning? (e.g., DBEEGOO)
  - General coordination pattern? (e.g., stop-stop clusters)
  - Specific coordination pattern? (e.g., DB)
- Generalization paradigm can be used to infer the nature of what is learned (Ballard, 2011, Maas et al., 2008)
  - Structural similarity?
  - Task complexity?
- **Does complexity influence generalization in speech motor learning?**

Examing complexity with voicing

- Voiced stop-stop clusters (e.g., DB) are more complex than voiceless counterparts
  - Both involve two oral gestures
  - Voiced requires coordination between oral and laryngeal gestures

Research questions

- Question 1: Does training on illegal onset stop-stop clusters **generalize** to untrained words with trained clusters?
  - DBEEDOO → DBOODAB ? (✓)
  - TPEEDOO → TPOODAB ? (✓)
- Question 2: Does training on illegal onset stop-stop clusters **generalize (i.e., transfer)** to untrained words with untrained clusters?
  - DBEEDOO → TPOODAB ? (✓)
  - TPEEDOO → DBOODAB ? (✗)

Acknowledgement

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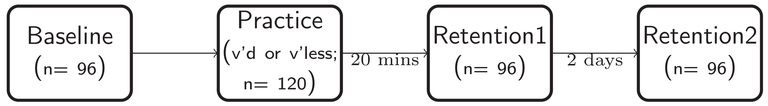
Methods

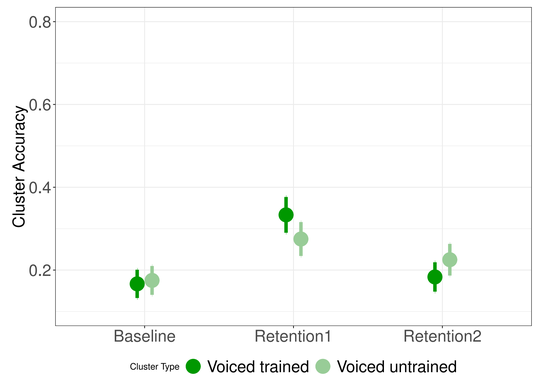
- Speech motor learning paradigm:



  - Nonword production (orthography and auditory model provided)
  - Pre-practice: 2 items (KP & KR feedback provided)
  - Practice: (voiced or voiceless, random and variable practice, no feedback)
    - **Voiced condition:** (5 adult native English speakers)
      - Practice: /db/, /gb/, /gd/ (4 words each, 10 reps)
      - Baseline, R1, R2: both trained (n= 24) and untrained (n= 24) voiced cluster and all untrained voiceless clusters (n= 48)
    - **Voiceless condition:** (5 adult native English speakers)
      - Practice: /tp/, /kp/, /kt/ (4 words each, 10 reps)
      - Baseline, R1, R2: both trained (n= 24) and untrained (n= 24) voiceless cluster and all untrained voiced clusters (n= 48)
  - Analysis: accuracy rated by blinded coders based on acoustics

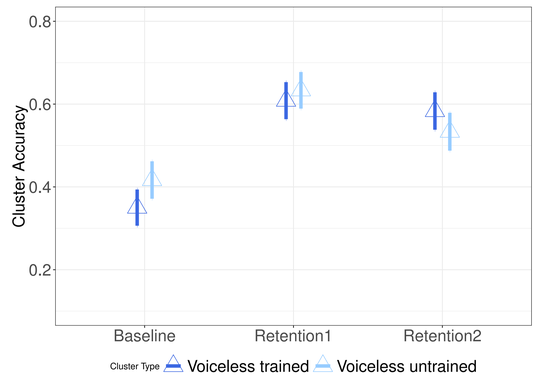
Q1: Generalization to untrained words with trained clusters?

- Does training on voiced clusters **generalize** to untrained words with trained voiced clusters?



  - R1: Improved cluster accuracy on both trained and untrained words
  - R2: Improvement decreased on both trained and untrained words

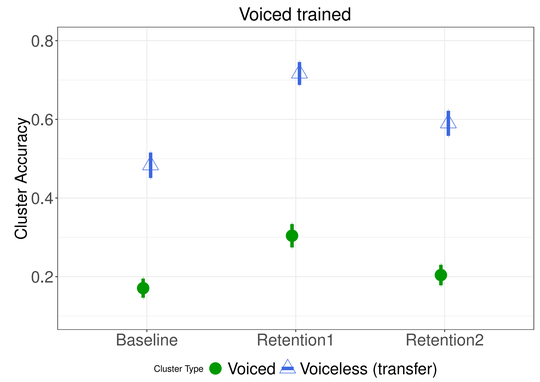
- Does training on voiceless clusters **generalize** to untrained words with trained voiceless clusters?



  - R1: Improved cluster accuracy on both trained and untrained words
  - R2: Improvement persisted on both trained and untrained words

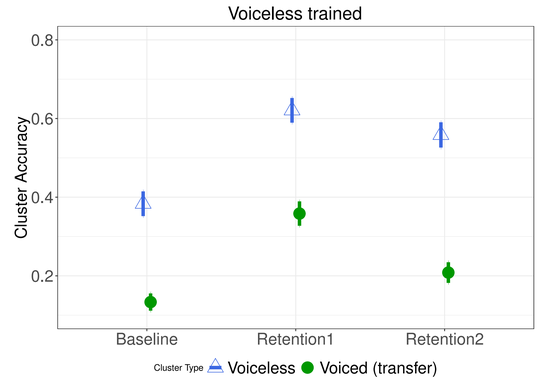
Q2: Transfer to untrained clusters?

- Does training on voiced clusters **transfer** to voiceless clusters?



  - R1: Improved accuracy on trained voiced and transfers to voiceless clusters
  - R2: Small improvement on trained voiced and untrained voiceless clusters

- Does training on voiceless clusters **transfer** to untrained voiced clusters?



  - R1: Improved cluster accuracy on both trained voiceless and untrained voiced clusters
  - R2: Small improvement on both trained voiceless and untrained voiced clusters

Discussion

- Generalization paradigm can be used to study the nature of speech motor learning
- Clinical implications:
  - Better understanding of how generalization works can lead to more effective treatment target selection
- Theoretical implications:
  - Better understanding of what we learn when we learn new motor programs

References

Ballard, K. J. (2001). Response generalization in apraxia of speech treatments: taking another look. Journal of Communication Disorders, 34(1–2), 3–20. Buchwald, et al. (2018, to appear). Using tDCS to facilitate motor learning in speech production: The role of timing. Cortex. Maas, et al. (2008). Principles of Motor Learning in Treatment of Motor Speech Disorders. American Journal of Speech-Language Pathology, 17(3), 277. Segawa et al. (2015). The Neural Correlates of Speech Motor Sequence Learning. Journal of Cognitive Neuroscience, 27(4), 819–831.