A pilot study of individual cognitive factors in speech rate tracking

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Background

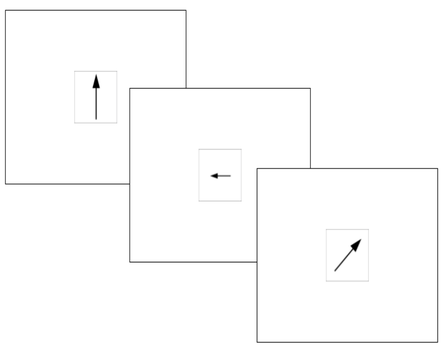
- Listeners track speech rate to make predictions about the timing of upcoming sounds [1].
- Individual differences in **working memory** [2], **rhythm perception** [3], and **executive functions** [4] influence speech perception and production.

Participants

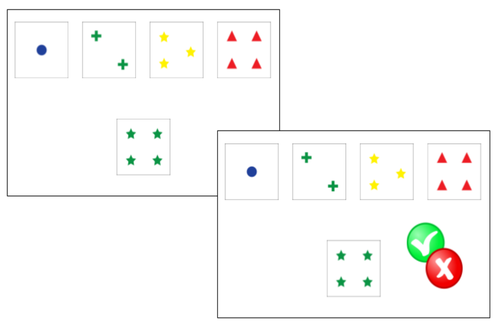
- Pilot 1: Five L1 English adults.
- Pilot 2: Ten L1 English adults.

Does individual variation in working memory, metrical stress detection, auditory attention, and cognitive flexibility predict listeners' ability to track speech rate?

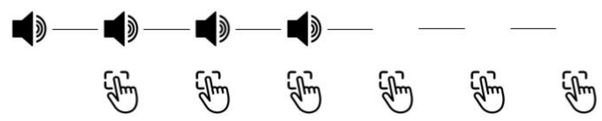
Predictor: Working Memory
- Assessed by *Arrow Span Task*



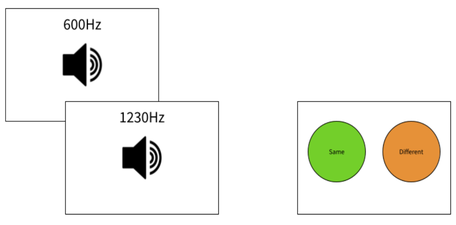
Predictor: Cognitive Flexibility
- Assessed by *Card Sorting Task*



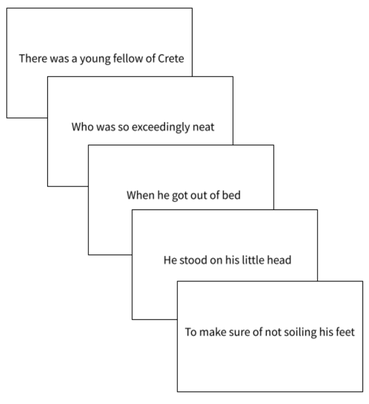
Rate Tracking: Perception
- Assessed by *Finger Tapping Task*



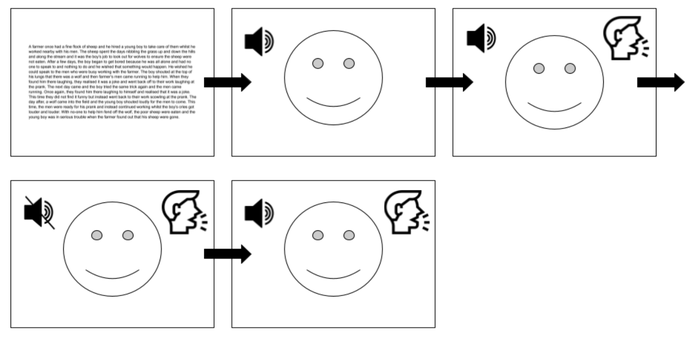
Predictor: Auditory Attention
- Assessed by *Dichotic Listening/TAIL*



Predictor: Metrical Stress Detection
- Assessed by *Limerick Task*



Rate Tracking: Speech Production
- Assessed by novel *Pickup ask*



Results

- **Working memory:** Used edit-distance scoring [5]:
  Pilot 1: Range 8 – 27.
  Pilot 2: Range 9 - 24.
- **Metrical stress detection:** Used accuracy measures:
  Pilot 1: Range 0-8 (out of 14).
  Pilot 2: switched to signal detection analysis to calculate d'
  Range 1.65 - 2.82
- **Cognitive flexibility:** Used accuracy measures
  Pilot 1: potential ceiling effects, Range 41-53 (out of 53).
  Pilot 2: switched to combined speed and accuracy scores [6]
  Range 19.3 - 88.6.
- **Auditory attention:** Used accuracy measures:
  Pilot 1: poor performance, Range 29-34 (out of 72).
  Pilot 2: switched to combined speed and accuracy scores [6]
  Range 4.43 - 239.74.

Rate Tracking Perception and Production (Fig. 1) assessed via circular statistics [7].
Optimal consistency of 1 (lack of variability).
Optimal accuracy of 0 (proximity to target).

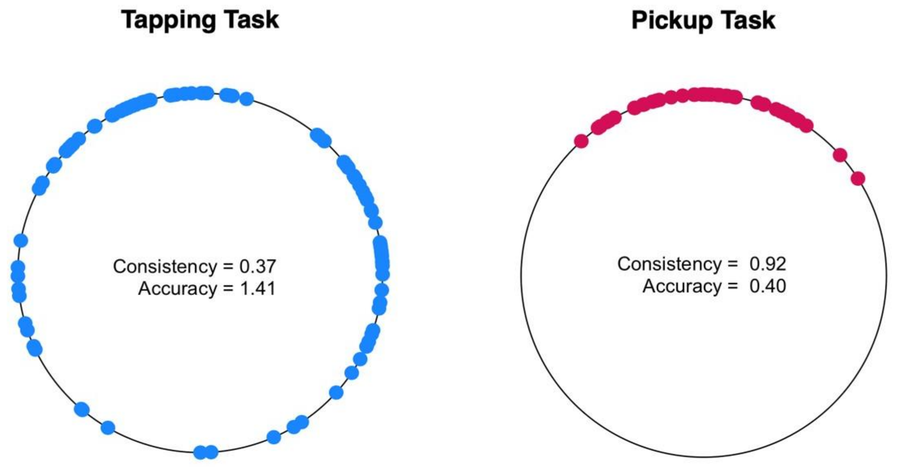


***Figure 1**: Comparison of one participant's rate tracking in perception vs production, here accurate in production task.*

Discussion

- Individual performance varies across predictor tasks; combined speed/accuracy measures useful.
- Rate tracking tasks effective; analysed with circular statistics.

Full-scale testing to begin shortly

References. [1] White et al. (2022) *Proceedings of Speech Prosody, Lisbon.* [2] Heinrich et al. (2016) *Front. Psychol.* [3] Boll-Avetisyan et al. (2017) *Lab. Phonol.* [4] Amunts et al. (2020) *Sci. Rep.* [5] Gonthier (2023) *Behav. Res. Methods.* [6] Woltz & Was (2006) *Mem. Cogn.* [7] Fisher (1995) *Statistical Analysis of Circular Data.*

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