AN ANALYSIS OF SPEECH RATE STRATEGIES IN AGING

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Aging and speech production
- Older adults decrease their average rate of speech, compared to younger adults.
- A frequently used strategy is increasing syllable- and segment duration.
- Goosse et al. [1] found lip- and tongue movement cycle durations for younger adults to be shorter for the closure and opening phases at self-chosen moderate and fast rates than for older adults.
- Possible explanations:
  - Aging affects the ability to speak faster.
  - Older adults employ a different speed/accuracy trade-off strategy.

Current study
Aim: to evaluate the influence of age on movement cycle durations during the production of reiterated non-nuclear utterances with a controlled speech rate using an anemolytictune.

Research questions:
1. Can the rate of articulation modeled by an external metronome be matched equally well by younger and older adults.
2. How is movement cycle duration used as part of a strategy to increase and decrease syllable repetition rates in both young and older adults.

Methodology
- Participants: Sixteen healthy native speakers of Dutch: 8 young, 8 elderly.
- Young adults: 2 male, 6 female. Age 21.4; 27.2 y;m, mean 23;8, sd 2;3.
- Older adults: 4 male 4 female. Age 66.0; 84.2 y;m, mean 74.8, sd 6.8.
- Tasks:
  - Repetition of /pa/, /sa/ and /ta/ in 12-sec recording trial.
  - Pacing conditions: self-paced and metronome-paced.
    - Self-paced: slow, habitual and fast.
    - Metronome: modeled at 2.5, 3, 3.5 and 4 bps prior to recording; stopped at beginning of recording.

Results
Syllable repetition rates were analyzed for Group, Rate and Task effects (Huynh-Feldt Syllable repetition rates correction where the sphericity assumption was violated). See figure 1.

Mean movement cycle durations were calculated for the metronome condition only, because speech rate was comparable across groups (unlike non-metronome condition). See figure 2 for results.

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Results:
- Results were collapsed over speech task in the absence of task and rate effects, with Direction of movement as factor: opening vs. closing durations.
- Increasing speech rate leads to a decrease in movement cycle duration (Rate $F(1.51,21.13) = 87.14, p < .001$).
- Cycle duration is marginally longer for younger adults, compared to older adults (Group $F(1.46) = 5.22, p < .05$).
- Cycle duration is longer for closing movements, compared to opening movements (Direction $F(1.46) = 70.01, p < .001$).
- This effect is more apparent for older adults, compared to young adults (Direction*Group $F(1.46) = 4.2, p < .05$).
- Increases with decreasing speech rate (Direction*Rate*Group $F(1.67,23.33) = 16.53, p < .001$).

This effect is asymmetric with respect to direction of movement, a power law scaling function $dur = 1/rate$, except for opening movements.<br>

- Cycle duration is marginally longer for younger adults, compared to older adults (Group $F(1.46) = 4.2, p < .05$).
- Increasing speech rate leads to a decrease in movement cycle duration (Rate $F(1.89,87.01) = 15.84, p < .001$).

Cycle duration is marginally longer for younger adults, compared to older adults (Group $F(1.46) = 5.22, p < .05$).

Future research
In order to gain more insight in speech rate strategies and performance, we are now working on analyzing additional kinematic and dynamic parameters, phase relations and functional synergies between different articulators, (non)linear analysis of variability of articulatory and acoustic data (cyclic) spatio-temporal index and functional data analysis.

References