SPEECH RATE STRATEGIES IN YOUNGER AND OLDER ADULTS
Hayo Terband1, Frits van Brehm2, Rafael Neto Henriques3, Pascal van Lieshout3, Ben Maassen1 & Anja Lowit2

1Centre for Language and Cognition & University Medical Centre, University of Groningen, Groningen, the Netherlands; 2Div. of Speech and Language Therapy, University of Strathclyde, Glasgow, UK; 3Department of Speech-Language Pathology, Oral Dynamics Lab; Department of Psychology; Institute of Biomaterials and Biomedical Engineering, University of Toronto, and Toronto Rehabilitation Institute, Toronto, Canada.

Method & materials

Participants: Sixteen healthy native speakers of Dutch: 8 young, 8 elderly.

target words /aːpi/ and /ipaː/.

Speech task with target words /aːpi/ and /ipaː/.

Results

Effects of speech rate changes on kinematic movement characteristics and stability of speech movements were assessed in younger and older speakers using electromagnetic mid-sagittal articulography (EMMA).

Several studies have indicated a general decrease in speed and accuracy of speech output in older compared to younger speakers [1-4]. In a previous study investigating reiterating productions of syllables /p/-/a/ and /a/-/p/ at different speech rates, we found that older adults when slowing down, more prominently increased duration and decreased peak velocity in closure movements compared to younger adults [5-6]. As a possible explanation we proposed that older adults may evidence a mechanism that facilitates a closed loop control system to maintain movement stability, possibly due to a reduced quality of somatosensory feedback.

The aim of the present study is to investigate this phenomenon further using a reiterating speech task with target words /aːpi/ and /ipaː/ which regarding jaw and lips, involve three-step movement schemes consisting respectively of one closing and two opening movements and two closing and one opening movement (Tab. 1, Fig. 1).

Table 1: Description of the different phases in movement cycles of bilabial opening/closure for the reiterating productions of [aːpi] and [ipaː].

<table>
<thead>
<tr>
<th>Movement phase</th>
<th>[aːpi]</th>
<th>[ipaː]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Half closure</td>
<td>from full opening [p]</td>
<td>to full bilabial closure [p]</td>
</tr>
<tr>
<td>2. Half opening</td>
<td>to full bilabial closure [p]</td>
<td>to full closure [a]</td>
</tr>
<tr>
<td>3. Half closure</td>
<td>to full opening [a]</td>
<td>to frontal opening [i]</td>
</tr>
</tbody>
</table>

Data collection: EMMA (Carstens AG100).

Data analysis: Movement cycle durations bilateral opening/closure (BC), tongue body (TB), lower lip & jaw.

Statistics: Linear Mixed Model analysis.

Speech rate (Fig. 2): Both groups successfully changed speech tempo across rate conditions (Rate F(2,64,859) = 75.038, p < 0.001).

Variability (cSTI, Fig. 3): No effects of Rate, Group or Target.

Movement cycle durations (Figs. 4 & 5):

In the fast rate condition, no 3-step movement cycles were recognizable in the majority of utterances. Therefore, only the slowest rate and normal conditions are analyzed.

When slowing down speech rate, the elderly adults increased the duration of the full opening from [p] to [a] in /aːpi/ more compared to the young adults (Group F(1,77.837) = 28.328, p < 0.001; Group*Rate F(2,103.748) = 4.544, p < 0.05; Group*Movement cycle F(10,54.125) = 2.705, p < 0.001).

However, for both /aːpi/ and /ipaː/, the results also indicate that elderly adults when slowing down, more prominently increased the duration of the voiced-to-voiceless transitions compared to younger adults (Fig. 7).

Together, these results can be interpreted as elderly speakers exploiting a strategy that favors closed loop control.

Discussion & Conclusions

• Elderly adult speakers appear to be capable of slower repetition rates while maintaining the same stability compared to young adults (Fig. 6).

• In contrast to our expectations, the results on 3-step movement cycles showed the most prominent increase for elderly adults compared to younger adults for the duration of the full opening from [p] to [a] in /aːpi/ (Fig. 3).

• Elderly adults had slower at normal and slow rates compared to young adults, but equally fast at the fast rate (Group F(1,77.837) = 6.369, p < 0.05; Group*Rate F(2,64,859) = 7.945, p < 0.001).

• In contrast to our expectations, the results on 3-step movement cycles showed the most prominent increase for elderly adults compared to younger adults for the duration of the voiced-to-voiceless transitions compared to younger adults (Fig. 7).

Together, these results can be interpreted as elderly speakers exploiting a strategy that favors closed loop control.

References