

Speech changes during adulthood: maturity and decline? Evidence from temporal aspects of speech

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The most documented change in speech evolution in adulthood is slowing down in old age (see [1] for a review), which has been associated with age-related physiological-, motor-, cognitive- or social- changes and interpreted as a sign of attrition in speech. In an earlier study ([2]), we showed that changes in speech rate are much more gradual than previously thought, requiring a better definition of ‘stages’ in adult speech, and greater attention to the age groups being compared in aging studies. Indeed, if we want to know whether speech evolves across adulthood, we must know at what age the speech system reaches maturity.

In this work, we further investigate this issue by exploring a large cross-sectional database of 252 French-speaking individuals aged from 15 to 90 years recorded with the same protocol, originally constructed for the assessment of speech disorders ([3, 4]). One advantage of this database is that it allows the characterization of the same individuals on a wide array of speech features, speech tasks and with multiple datapoints.

Here, we will concentrate on temporal aspects of speech in a text reading task (8 sentences, 500 words) and in a diadochokinetic (DDK) performance task, where speakers have to repeat continuously - as fast and as precisely as possible - a sequence of either the same syllable (here /bababa/, /dedede/, and /gogogo/, DDK_AMRcv) or 3 different syllables (here /badego/, DDK_SMR). Speakers are compared on the following temporal aspects: (a) articulation rate (ph/s), measured in the text reading task on 23 to 49 inter pausal units (IPU) per speakers; (b) rate regularity, expressed as the coefficient of variation of articulation rate between the different IPU in the text; (c) pause duration and (d) number of pauses; (e-f) DDK rate (syll/s) measured over 4 sec of uninterrupted repetitions for the DDK_AMR and DDK_SMR.

Results are illustrated in Figure 1 (a to f). For ease of visualization, speakers have been artificially grouped in the graphs into 5 age-groups of comparable size, approximately 50 speakers each, but trends are analyzed across the entire age range (15 to 90 years).

As evidenced in Fig.1a, articulation rate does not change only at old age. Between 15 and 25 years, age does not seem to have an effect on articulation rate: it depends on the speaker, with large variation across individuals. From the age of 25 onwards, articulation rate varies according to age, but the trend is not linear.

A clear reduction of articulation rate appears from around the age of 70. Interestingly, only about half of speakers over 70-75 articulate more slowly, and also tend to have a less stable articulation rate (Fig1b), and make more and longer pauses (Fig1c, d). Interestingly, most older speakers perform well on DDK tasks (i.e. as well as the middle-aged speakers), suggesting a good control of articulation rate abilities into old age.

Before the age of roughly 25, speakers are quite heterogeneous in terms of rate and regularity, and DDK performance is not excellent. It seems that before around 25, the speech production system is still maturing with variable individual profiles.

It is strikingly apparent that between the ages of around 25 and 35, a homogeneous group of speakers stands out from their younger and older counterparts: they articulate more quickly, have a more regular articulation rate and perform very well in the DDK tasks. These speakers demonstrate optimal control of articulation, at least in its temporal dimension.

Other speakers aged 25 to 35 are currently being added to the cohort in order to consolidate this result. Measure of articulatory precision remains to be done in order to test whether the patterns observed do correspond to changes in the spatio-temporal tradeoff of articulation across ages.

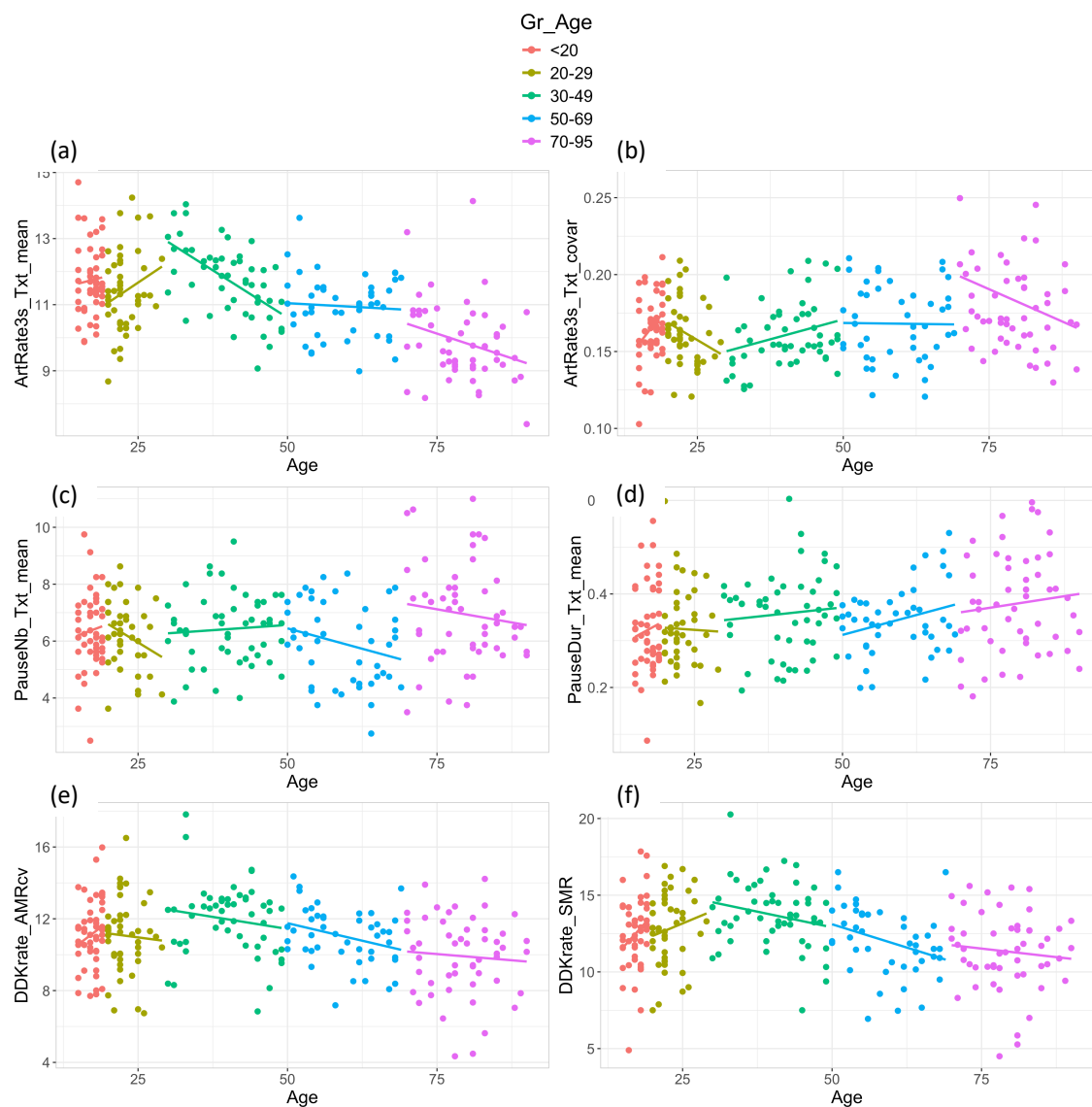


Fig. 1. Per speaker (N=252) ordered by age: (a) articulation rate (ph/s) in text reading task, (b) variation coefficient of rate (over 23 to 49 IPU per speakers, (c) number of pauses made in the text reading, (d) mean duration of pauses, (e) DDKrate (syll/sec) for the same syllable repetition (AMRcv), (f) DDKrate (syll/sec) for the tri-syllabic repetition /badeɡo/. For ease of visualization, speakers have been artificially grouped in the graphs into 5 equal-sized age-groups of approximately 50 speakers each, but trends are analyzed across the entire age range (15 to 90 years).

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References

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