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Author(s): Borbála Keszler and Judit Bóna

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Pausing and disfluencies in elderly speech: Longitudinal case studies

Borbála Keszler¹ and Judit Bóna²

¹Department of Modern Hungarian Linguistics, ELTE Eötvös Loránd University, Budapest, Hungary

²Department of Applied Linguistics and Phonetics, ELTE Eötvös Loránd University, Budapest, Hungary

Abstract

The aim of this paper was to investigate the changes in fluency of speech during ageing. The novelty of the examination is that this is a longitudinal study: it analyses the speech of 7 speakers from middle or young-old age to old-old age. Pausing strategies and frequency of disfluencies were analyzed. Results show that active aging helps to preserve certain parameters of speech characteristics of young speakers.

Introduction

Occurrence of disfluencies in spontaneous speech is influenced by several factors like speaker's age (e.g. [de Andrade & de Oliveira Martins, 2010](#)) and speech task (e.g. [Beke et al., 2014](#)). There are several studies in the literature about the changes in elderly speech compared to the speech of young adults. We know that during ageing, speech rate and articulation rate decelerate (e.g. [Duchin & Mysak, 1987](#)), *f*₀ and voice quality change; or articulation becomes less accurate ([Torre & Barlow, 2009](#)). These changes are due to altered cognitive, hormonal and psychological functions and aging of speech organs ([Hnath-Chisolm et al., 2003](#)).

There are relatively few studies about disfluencies of elderly speech. One of its most important characteristics is word-finding difficulty (e.g. [Burke et al., 1991](#)). Some authors found that there were no differences between the speech of young and old speakers in the frequency of disfluencies ([Duchin & Mysak, 1987](#); [Searl et al., 2002](#); [de Andrade & de Oliveira Martins, 2010](#)). Other authors found that old speakers produced more disfluencies than young speakers did ([Yairi & Clifton, 1972](#)). Analyzing the speech of seven mentally intact 100–103-year-old speakers, it was found that disfluencies occurred with the same frequency in their speech as in the speech of 70–80–90-year-old speakers ([Searl, Gabel & Fulks, 2002](#)). Similar results were found in the study of [de Andrade and de Oliveira Martins \(2010\)](#), in their research there was no significant difference between the speech of 60, 70 and 80+ year-old people, although there was an increasing tendency of the disruption rates along the decades.

However, the above-mentioned studies were cross-sectional examinations. The novelty of this study is that it analyses the occurrence of disfluencies in speech samples of the same speakers in a longitudinal examination. At the time of the first recordings the speakers were already middle-aged or young-old, while at the time of the third recordings they were old-old. Participants were researchers and/or teachers who were quite active professionally despite their old age. The questions were the followings: 1) How does the frequency of disfluencies change during ageing? 2) What kinds of disfluencies appear in different ages? 3) Does the examined group's speech show any difference from that of the average speaker discussed in the literature? (Given that this study deals with a quite specific population.)

We had two hypotheses: 1) Fluency of speech changes during ageing also in the various stages of elderly life. The older the speaker, the more frequent are the disfluencies. 2) The biggest difference will be measured at the oldest age compared to the others.

Methods

Speech samples were selected from the Spoken Language Database of the Department of Modern Hungarian Linguistics (ELTE Eötvös Loránd University). Speech recordings of 7 native Hungarian researchers and/or teachers (1 female, 6 males) were analysed. Speech samples of the same speaker were recorded three different times. At the first time speakers were middle-aged or young-old, the second recording was taken about 10 years or more later, at the age of 70 or above (except for the female speaker), while the third recording was taken at the age of 75+ (Table 1).

Recordings contain spontaneous speech samples: birthday interviews, interviews at award ceremonies, public speeches like comments at conferences and at other professional gatherings. While they are public speeches, their characteristics might differ from those of more informal speeches. However, they weren't previously planned speeches. 4–5 minutes of speech samples were analyzed at each time by each speaker.

Speech samples were annotated using Praat 5.0 software ([Boersma & Weenink, 2008](#)), i.e. speech

Table 1. Age of participants at the time of the three recordings (years) (F = female, M = male).

Speaker	First time	Second time	Third time
F1	54	64	76
M1	62	72	81
M2	62	72	83
M3	61	72	82
M4	61	70	76
M5	49	70	82
M6	59	77	90

units (between two pauses) and pauses were segmented and annotated. After that, the duration of speech units and pauses were printed out in an Excel spreadsheet with a script, and the number of syllables of the speech samples were automatically counted. Based on the data, the following parameters were calculated: proportion of pauses in the total speaking time, frequency of pauses (number of pauses in 100 syllables), mean duration of pauses, frequency of filled pauses and their proportion in the total pausing time, and frequency of all disfluencies (number of disfluencies in 100 syllables). Filled pauses were considered in phonetic sense, i.e. pauses that are filled with sounds (not words) (Fletcher, 2010).

The frequency of all disfluencies (calculated per 100 words) was defined for all speakers. Each occurrence and type of disfluencies were identified and coded by both authors. The rate of agreement was 98% between the two coders. The following types of disfluencies were analyzed: filled pauses, filler words, word- or phrase-repetitions, part-word repetitions, lengthenings, pause-within-the-words, revisions (Roberts et al., 2009).

Data were examined and compared by descriptive statistic methods in case of each speaker and each recording. Other statistical analysis was not carried out because the age of the speakers was different, so they couldn't form a homogeneous group. So, the data were examined as case studies.

Results

Figure 1 shows the frequency of pauses in 100 syllables. There is a slight increase of the frequency in the speech of 5 speakers compared to the first measurement, while the frequency decreased or hardly changed in the speech of two speakers. The connection between the pauses and the actual speech situation is confirmed by the fact that the value measured at the second time is quite varied: it is the lowest or it is between the values of the first and the third measurements.

The proportion of pauses in the total speaking time also depended on the speaker and speech

Figure 1. Number of pauses in 100 syllables.

situation (Figure 2). Values ranged from 11.7 to 26.4% at the first measurement, 12.3 to 33.5% at the second measurement, and 14.7 to 34.1% at the third measurement. This parameter showed a large increase with age by some speakers (F1, M1, M6), while it did not or only slightly changed in case of others (M2, M3, M4, M5) in the third measurement compared to the first measurement. Data from the second measurement also varied widely, indicating that age is only one factor among many others that influence temporal parameters in speech.

It should also be emphasized that the results of any speaker measured at any time (even the proportions measured in the oldest ages) are not higher than the values characteristic of native Hungarian young speakers (Bóna, 2014).

Figure 2. Proportion of pauses in the total speaking time per speaker and per measurement.

The average duration of pauses (Table 2) was longer for five speakers (F1, M1, M4, M5 and M6) at the third measurement than at the first measurement. For M2 and M3, shorter average duration of pauses was reported in the oldest age than at the first measurement.

Figure 3 shows the frequency of filled pauses. In four speakers (F1, M3, M4, M6), the change at the three measurements is very small, while in three speakers filled pauses were more frequent at the third measurement than at the first measurement. The effect of the given speech situation is indicated by the fact that in M2, filled pauses were the most frequent at the second measurement. So, it did not depend on the speaker's age.

The proportion of filled pauses in the total amount of pauses also changed mostly depending on the speaker and the actual speech situation. This

Table 2. Mean duration of pauses (*F* = female, *M* = male).

Speaker	Mean duration of pauses (ms)		
	First time	Second time	Third time
F1	427	345	538
M1	448	626	622
M2	650	624	627
M3	593	537	578
M4	329	364	367
M5	489	386	590
M6	424	316	495

proportion was very low for each speaker. In one speaker (F1), filled pauses appeared only in the speech sample recorded at the oldest age, and in a very small ratio (only 0.9% of the total pause time). In the case of four speakers (M1, M2, M3 and M5), proportion of filled pauses increased in the oldest age compared to the youngest age, but the dependence of this parameter on the speech situation is well indicated by the highest proportion at the second measurement in M2 and M5. In M4 and M6, the proportion of filled pauses was either reduced or unchanged at the third measurement compared to the first measurement.

Figure 3. Number of filled pauses in 100 syllables.

In the frequency of disfluencies, we do not see any tendency, either (Figure 4). In four speakers (F1, M1, M3, M5) there was a slight but more frequent occurrence of disfluencies, while in three speakers it decreased (M6) or almost did not change (M2 and M4) at the third measurement compared to the first one. Since the data of the second measurement varied in different ways, they confirm that the frequency of disfluencies also largely depends on the current speech situation, the current state of the speaker and the topic.

Discussion and conclusion

This study analyzed the changes of fluency of speech in speech samples of 7 speakers across several decades. We had two hypotheses. One of them was partly confirmed while the other wasn't.

The first hypothesis was that the older the speaker, the more frequent the disfluencies are. This was not

Figure 4. Number of disfluencies in 100 syllables.

confirmed. There was no clear connection between ageing and fluency. Although the speech of certain speakers became less fluent, there were other speakers who produced similarly fluent speech at the third measurement compared to the first one. Obviously, we don't know if the speakers spoke with similar fluency and pausing in every speech situation at the given age. In other words, one recording is only relevant for that very speech situation. However, this means that there were at least three speakers who were able to speak with the same fluency both at the time of the first and the last measurement. According to our expectations, the proportion of pauses would be higher in parallel with ageing. This parameter did not change in case of one speaker, changed only slightly in case of three, and changed considerably in case of another three speakers. We also hypothesized that pauses would be more frequent in older age. This is proved in case of four speakers, while three other speakers produced pauses less frequently than in their younger age. These results show that age-dependent changes show great individual variability. The most coherent changes were measured in the mean duration of pauses. This duration became longer by the oldest age in five speakers (but the increase was not linear with ageing), while in case of other two speakers it decreased slightly.

According to the second hypothesis, the greatest change was expected in the oldest age. This was only partially confirmed and mostly typical for the ratio of pauses. There were no changes in all parameters and in all speakers. Moreover, the direction of the changes was not always as it had been expected.

Results led to the following conclusion. Age does not affect the fluency of speech for every speakers. It can be assumed that the background of the data is that active life, frequent public speaking helps to preserve the mobility of speech organs and the speed of speech planning processes. A particularly important result is that the data of the very old speakers in our study were similar to those of young adults. This shows that, although the literature suggests that aging results in a slowing down of speech tempo and more pauses, some speakers can preserve a speech similar to that of young speakers.

However, some changes were found in pausing strategies (proportion of pauses and their average duration). This is due to several factors. On the one hand, during ageing (some parts of) the planning processes might become slower, and the speakers try to gain time for these processes by taking longer silent pauses. This time is enough for further planning—speakers do not need to take more pauses at older age. On the other hand, it can also be related to breathing. It was not analyzed in this study, but from an earlier study (Bóna, 2018) we know that older people breathe more often (audibly) during speaking than young people. The breath-taking pauses are also statistically longer than breathless pauses (Gyarmathy, 2019).

Our results confirm the experience that active aging helps to preserve certain parameters of speech characteristics of young speakers. In addition, research shows that speakers who are accustomed to public speaking are less disfluent than someone who started public speaking later in life. Data indicate that practice patterns have a significant effect on the fluency characteristics of public speaking performance, as speakers who started practicing earlier were less disfluent than those who started later (Goberman et al., 2011), at least professional or good speakers are expected to be more fluent (Das et al., 2019). This seems to be true even in the very old age. As the analysis of the same speakers' recordings across decades is rare in both Hungarian and international literature, our results provide important new insights for a more accurate understanding of the characteristics of elderly speech.

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