Temporal features of Alzheimer's spontaneous speech

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Overview

The temporal features of spontaneous speech in Alzheimer's Disease (AD) have not been examined so far. The main purpose of this research is to study the temporal features of spontaneous speech in different stages of Alzheimer's Disease compared to each other and to age matched healthy control. The following parameters were measured among these native Hungarian speaking patients: articulation rate, speech tempo, the ratio of pause (RPS) and signal time. There were significant differences in most speech parameters among AD groups. A patient with AD in mild/early stages differs from normal control in RPS. This parameter of speech may have a diagnostic value of early-stage AD. These findings help us to map the relationship between language processes and memory systems.

Participants

	MMSE			Age			Education		
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range
AD early/mild (n = 10)	25.8	0.42	25-26	71	8.5	55-77	11.8	0.42	11-12
AD moderate (n = 10)	19.4	1.54	18-21	69.4	9.4	59-82	13.5	5.05	8-20
AD severe (n = 10)	9.4	2.54	5-12	71.4	3.09	66-74	11.2	1.3	8-16
NC (n = 15)	28.6	0.42	27-30	67.8	8.5	55-80	12.06	3.7	8-20

All AD participants met the DSM-IV criteria for probable Alzheimer's disease. Results of neurological, laboratory (including computed tomography (CT) or magnetic resonance (MR) scan), and neuropsychological assessment failed to suggest other causes of dementia. The AD participants were mildly to moderately demented as gauged by the Hungarian version of Mini-Mental State Examination. All participants were native speakers of Hungarian. The healthy controls and AD participants were not significantly different in either age (F(3,41)=0,578, p=0,632) or years of education (F(3,41)=0.391, p=0.759)

Method

The focus of the measurement was the temporal features of spontaneous speech. The experimenter conducted a controlled conversation with the participant and this was recorded by a dictaphone.

In case of AD persons the recordings were carried out in a single session at the clinic, while in case of healthy older adults the recordings were made partly in the same environment and partly in home setting.

The conversations were phonetically transcribed and also oscillograms were created with the help of a computer. The following data were measured: 1) articulation rate, 2) speech tempo, 3) the ratio of pause and signal time.

1) Articulation rate: the ratio between the amount of time devoted to the production of a given sequence of speech sounds and the number of speech sounds or syllables produced, namely the time of articulation without pauses. The unit of measurement is speech sound/sec.

2) The speech tempo (or speech rate) is determined by two factors: a) articulation rate, b) the duration of pauses. Unit of measurement: speech sound/sec.

3) The ratio of pause (silent and filled) and signal time: the percentage of all pause duration in the rate of the signal time (meaning the whole duration, concerning articulation and all pauses).

These parameters determined the statistical analysis among the mild, moderate and severe AD groups and normal control.

Results

Differences between normal and early AD group – There were no significant differences between them in the articulation rate (t=-1, 228, df=23, p=0,231), Levene's test for equality of variances (F=1,988, p=0,24). The speech tempo between the normal and early AD group shows significant differences (t=-3.575, df=23, p=0,001), Levene's test for equality of variances (F=1,383, p=0,565). The ratio of pause and signal shows significant differences between the two groups (t=4,579, df=23, p=0,001), Levene's test for equality of variances (F=1,781, p=0,321). (Fig. 1.)

Differences among severe, moderate and mild/early AD groups -

There were no significant differences among three AD groups (mild, moderate and severe) in articulation rate F(2,27)=2.35 p=0.11. There were significant differences in speech tempo among AD groups (F(2,27)=6,38, p=0.005). The post hoc analysis (HSD Tukey) shows that the early AD group significantly differs from moderate and severe group (p<0.05). There were significant differences in the ratio of pauses and signal time (F(2,27)=16.27, p=0.000) among these groups. The early AD group shows significant difference compared to the other AD groups.

To sum up, there are no significant differences between the moderate and severe AD groups, while the early/mild AD group shows significant differences in the speech tempo and the ratio of pauses and signal time.

The comparison of articulation rate (sound/sec), speech tempo (sound/sec) and the ratio of pauses and signal time (%) between early/mild AD and normal control group.
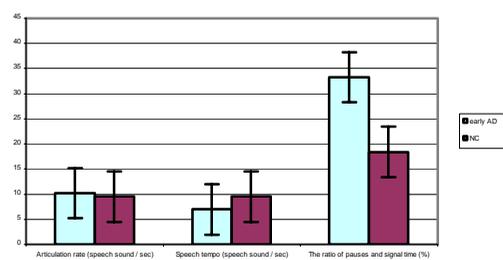
Conclusion

As we supposed, we have found that AD dementia makes an effect also on the temporal features of speech.

Our main result is that in the speech tempo and the ratio of pause and signal time the healthy elderly group and AD persons show significant differences from each other. And because of the standard deviations, it is the ratio of pauses and signal time variable that may have a diagnostic value in case of early AD. And it can also differentiate between the stages (mild and moderate/severe) of AD.

In conclusion, the method used in this study is appropriate for neuropsychological mapping of the relationship between the language and memory processes as well as for early detection of Alzheimer's disease.

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