UNIVERSITEIT GENT

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Measuring articulation rate:

A comparison of two methods

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Introduction

An inappropriate rate of speech can interfere with a person's ability to communicate effectively.

- Too fast: The listener will be overloaded with information and cannot understand the message upon first hearing.
- Too slow: The flow of information is interrupted.
  The listener's attention will decrease and the number of his responses will be reduced.

Rodero, 2012; Sturm & Seery, 2007

Introduction

Speech rate is of interest for SLPs working with fluency clients because:

- It has been used to define speech fluency.
- It has proven to be a sensitive measure for describing important speech behaviours (together with stuttering frequency and speech naturalness).
- It is a frequent target of treatment, especially in adults and adolescents.

Chon, Sawyer, & Ambrose, 2012; Ingham & Ingham, 2011; Sturm & Seery, 2007

Introduction

Speech rate

- Speaker's management of global aspects of speech production
- Overall time used for spoken delivery of a message

Articulation rate (AR)

- Speed of movement of the articulators
- How quickly sound segments are produced

Disfluency

- Speaker-specific ways of conveying information, such as pausing, hesitations, …

Chon et al., 2012; Jacewicz, Fox, & O'Neill, 2009; Sturm & Seery, 2007

Introduction

Main approach

- Mark all hesitations, pauses, interjections, … .
  - > 250 ms: hesitancy
  - < 50 ms: articulatory
  - 50-250 ms: mixed
- Subtract disfluent time from total duration.

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Alternative

- Select perceptually fluent utterances.
- Determine AR.
- Calculate mean.
- “MAR”

Robb, Maclagan, & Chen, 2004; Van Zaalen – op ‘t Hof, Wijnen, & De Jonckere, 2009

Methods: Participants

- 80 normally fluent adults
- 20 – 59 years
  - Mean = 40.25 years
  - SD = 12.075 years
- Flemish native speakers

Table 1. Number of participants according to age group and gender

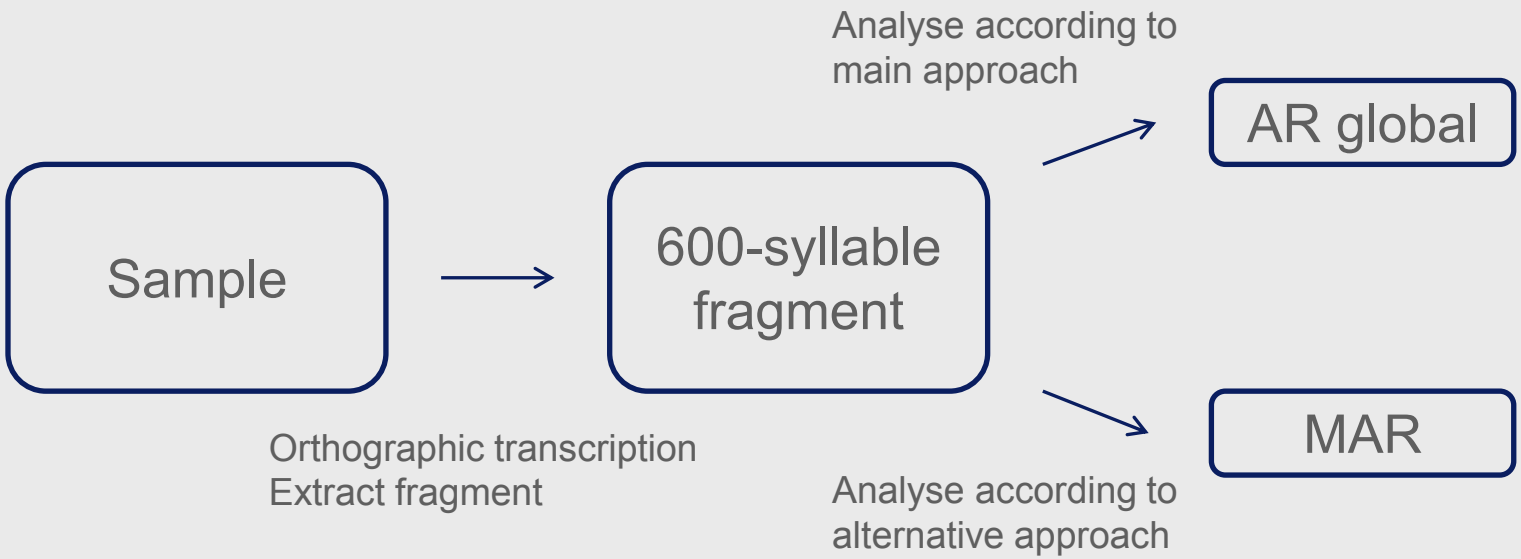
Age	♂	♀	Total
20-29	10	10	20
30-39	10	10	20
40-49	8	11	19
50-59	11	10	21
Total	39	41	80

Methods: Data collection

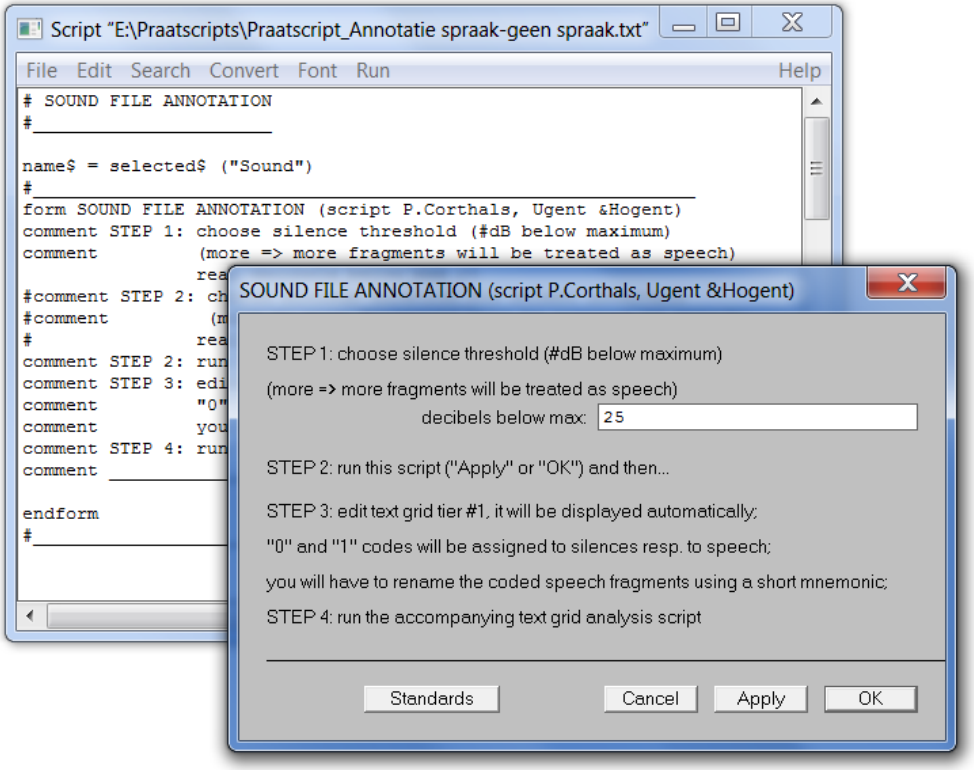
Speech samples were audio-recorded using a condenser microphone, a laptop, and Praat (Boersma & Weenink, 2014).

- Spontaneous speech (work, family, leisure activities, …)
- Reading a standardized text (“De kapitein”; Boey, 2007)
- Microphone to mouth distance = 30 cm

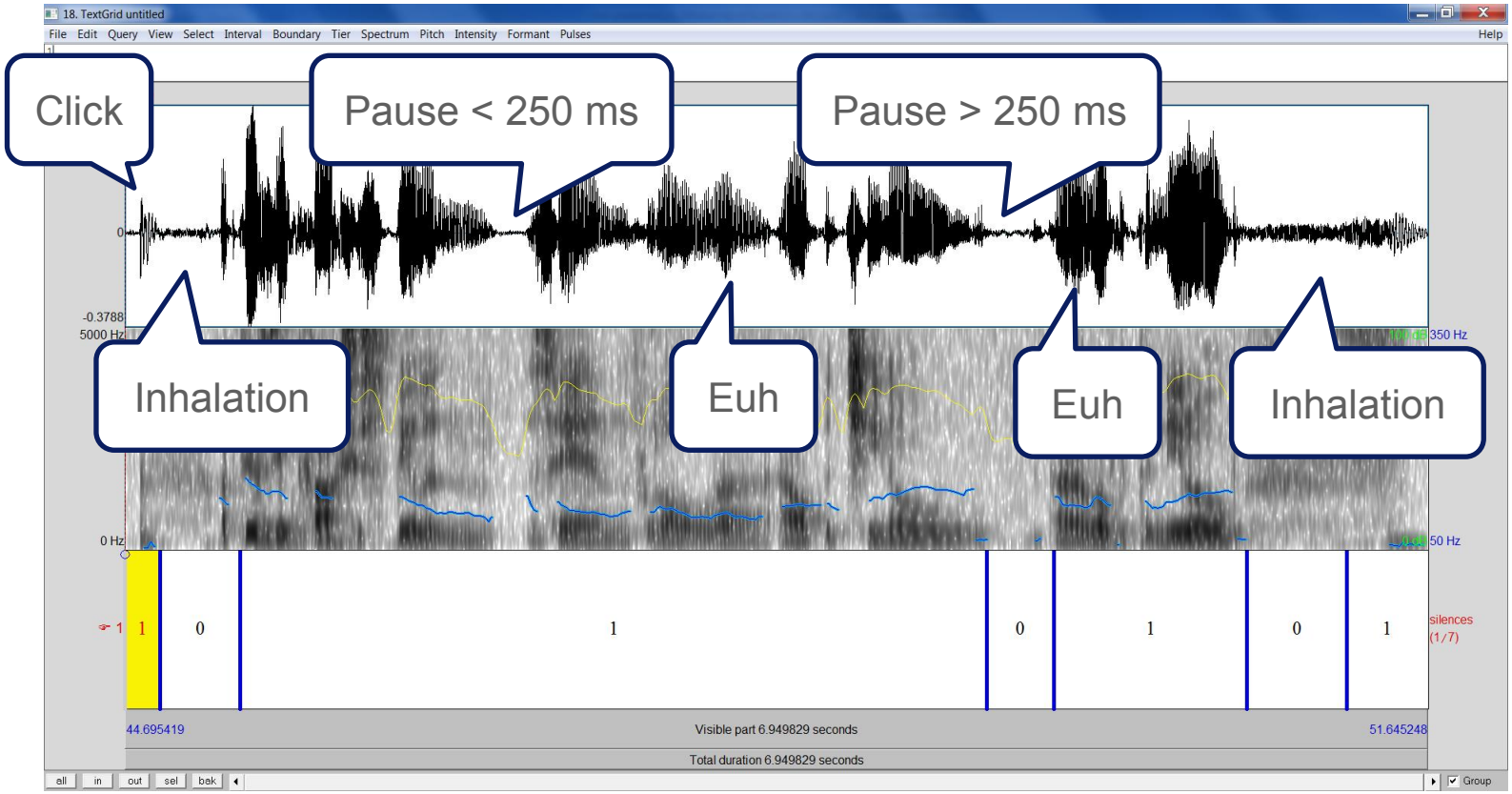
Methods: Data analysis



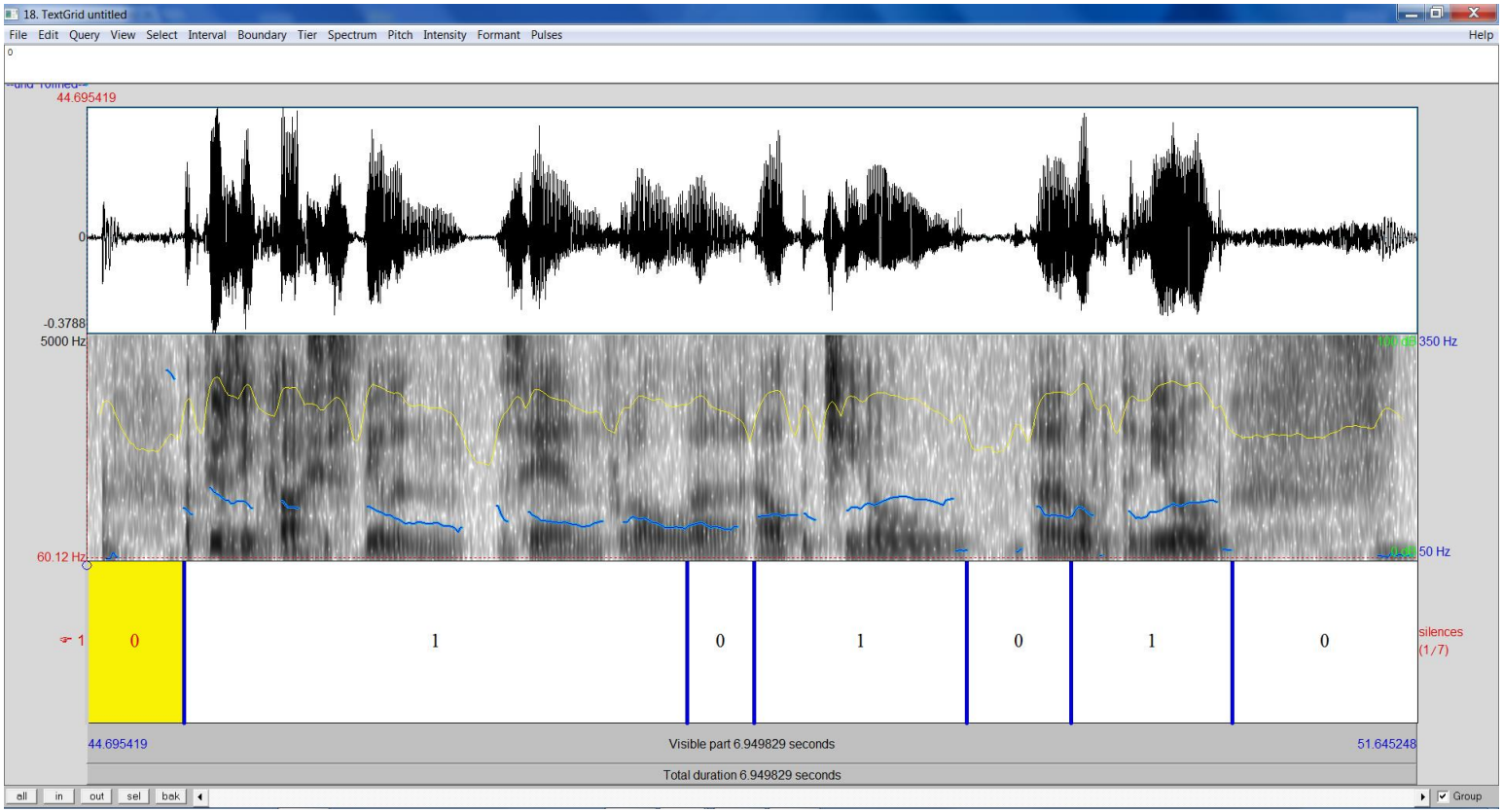
Global method



Global method



Global method



Global method

Script "E:\Praatscripts\Praatscript_Textgridanalysis_Packman & Ons...

File Edit Search Convert Font Run Help

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#DESCRIPTIVES FROM TEXTGRID
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name$ = selected$ ("TextGrid")
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Extract rows whe
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Set column label
Insert column (i
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Insert column (i
Set column label
Insert column (i
Set column label

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totaalduur = 0
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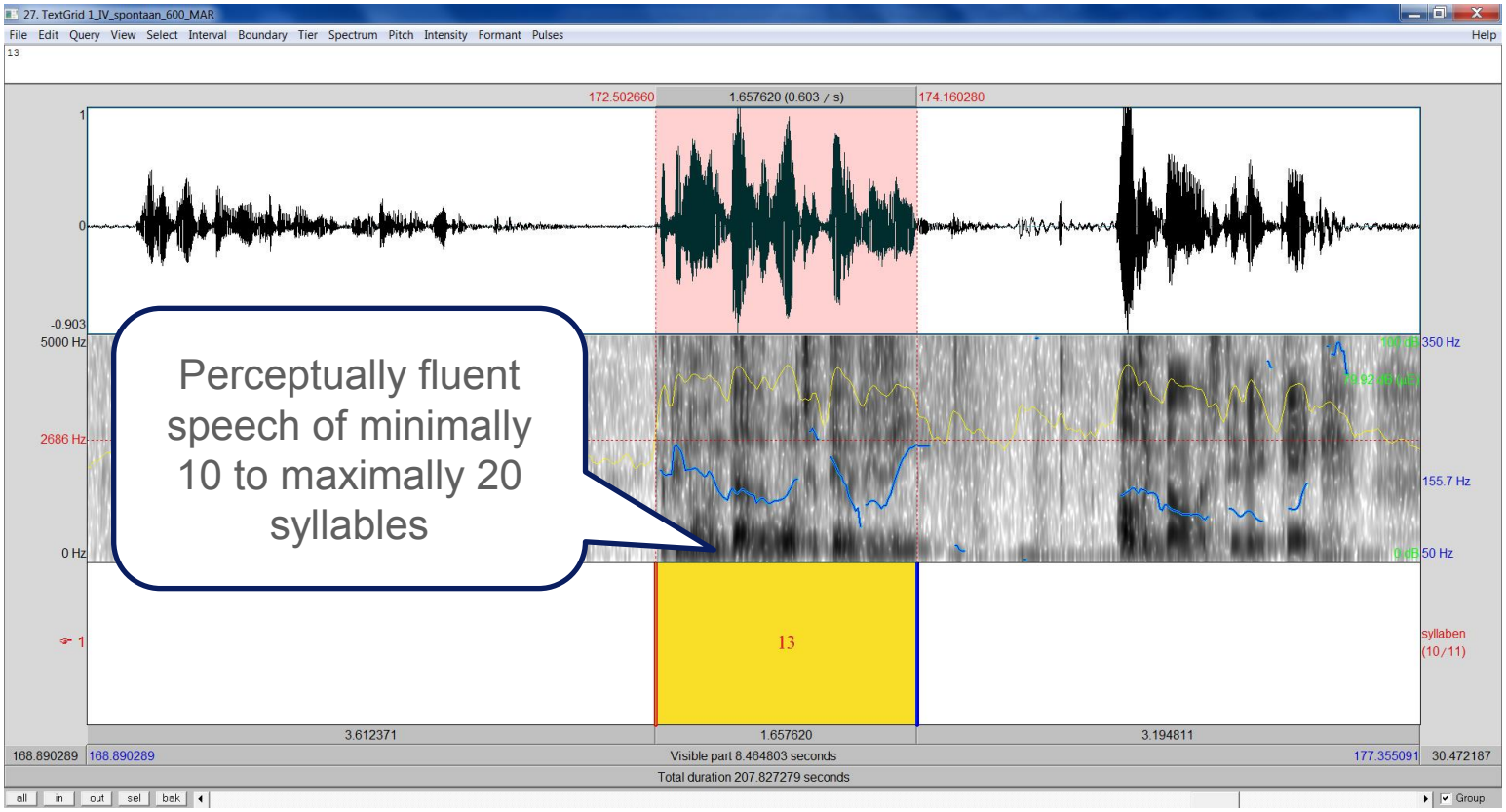
        totaaldu
endfor
```

25. Table untitled

File Edit Query Help

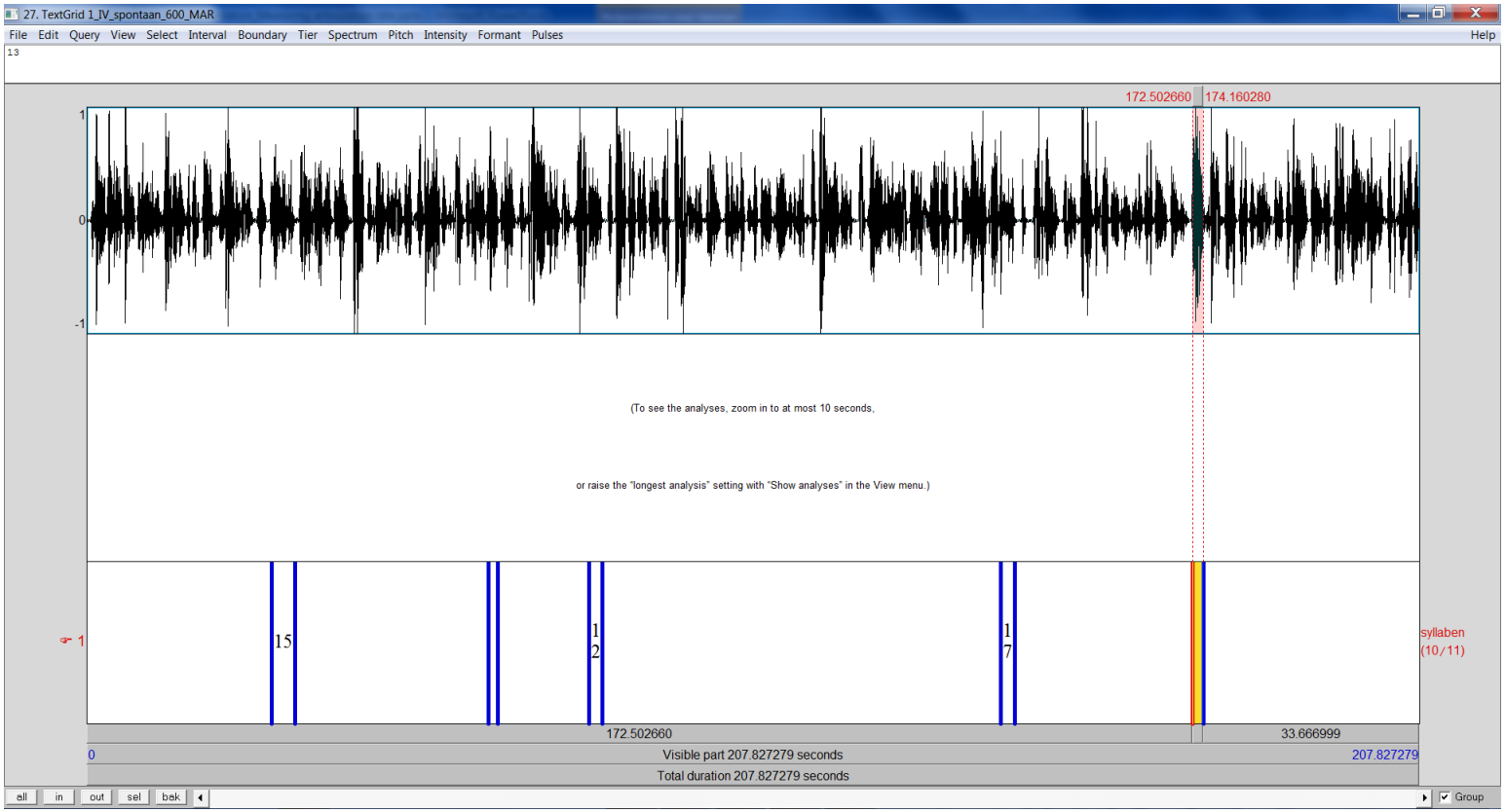
row	1 rowLabel	2 Frequency	3 Mean duration(sec)	4 (Sub)Total(sec)	5 Percentage (time)
1	FLUENT speech fragments	3	1.527662824110389	4.5829884723311665	100
2	SUM	0	0	4.5829884723311665	100
3	DISFLUENT(incl.superfl.)/FLUENT RATIO	0	0	0	0
4	DISFLUENT(excl.superfl.)/FLUENT RATIO	0	0	0	0

MAR



Perceptually fluent speech of minimally 10 to maximally 20 syllables

MAR


27. TextGrid 1_IV_spontaan_600_MAR
File Edit Query View Select Interval Boundary Tier Spectrum Pitch Intensity Formant Pulses
Help
13
172.502660
174.160280
1
0
-1
(To see the analyses, zoom in to at most 10 seconds,
or raise the "longest analysis" setting with "Show analyses" in the View menu.)
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12
17
syllaben
(10/11)
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Total duration 207.827279 seconds
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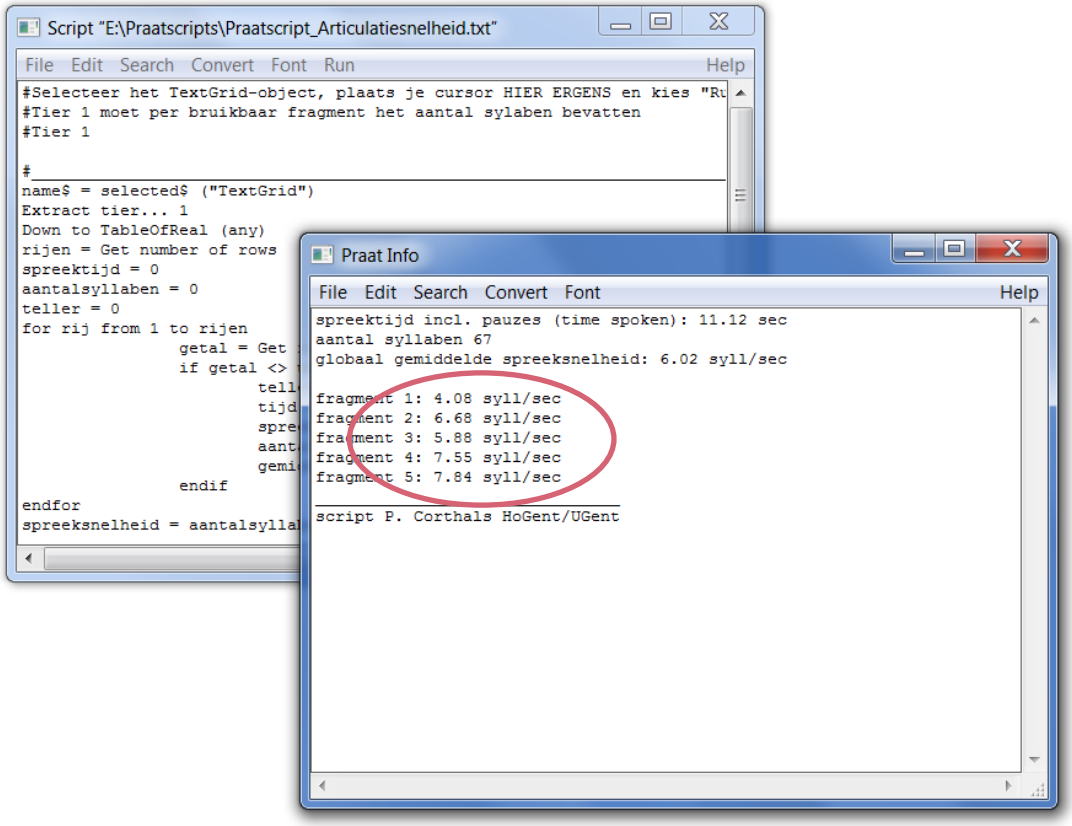
MAR


Script "E:\Praatscripts\Praatscript_Articulatiesnelheid.txt"
File Edit Search Convert Font Run Help
#Selecteer het TextGrid-object, plaats je cursor HIER ERGENS en kies "Ru
#Tier 1 moet per bruikbaar fragment het aantal sylaben bevatten
#Tier 1
#
name$ = selected$ ("TextGrid")
Extract tier... 1
Down to TableOfReal (any)
rijen = Get number of rows
spreektijd = 0
aantalsyllaben = 0
teller = 0
for rij from 1 to rijen
getal = Get
if getal <>
endif
endfor
spreeksnelheid = aantalsylla
Praat Info
File Edit Search Convert Font Help
spreektijd incl. pauzes (time spoken): 11.12 sec
aantal syllaben 67
globaal gemiddelde spreeksnelheid: 6.02 syll/sec
fragment 1: 4.08 syll/sec
fragment 2: 6.68 syll/sec
fragment 3: 5.88 syll/sec
fragment 4: 7.55 syll/sec
fragment 5: 7.84 syll/sec
script P. Corthals HoGent/UGent

Results

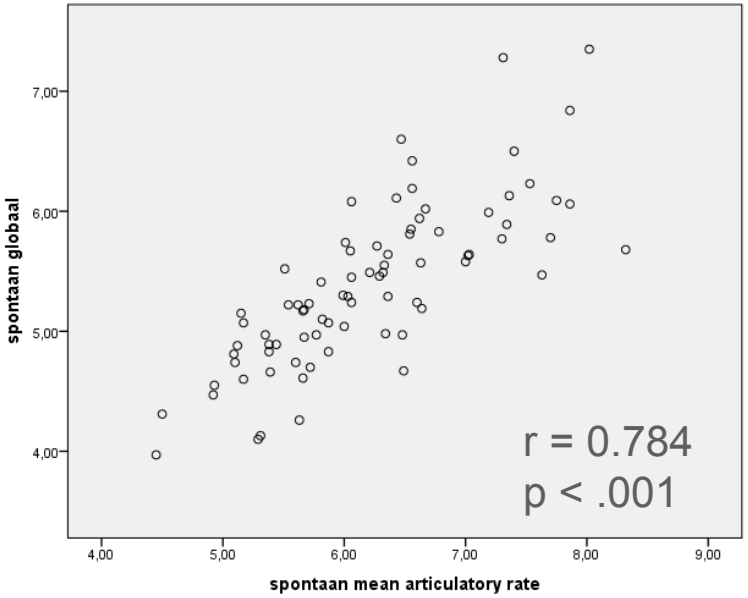


Figure 1. Scatter plot showing global method vs. MAR for spontaneous speech

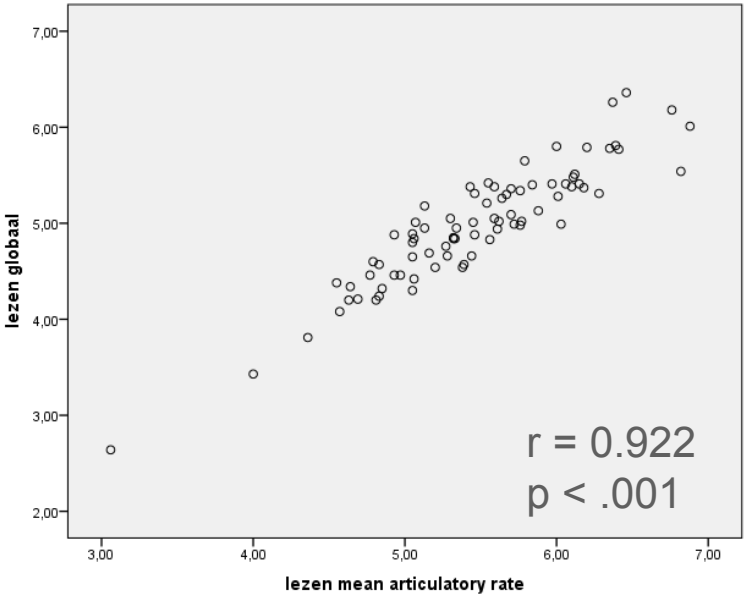


Figure 2. Scatter plot showing global method vs. MAR for reading

Results

Table 2. Results of the paired samples t-tests

Task	Method	Mean	SD	t	df	p
S	Global	5.39	0.677	- 13.69	79	< .001
	MAR	6.21	0.863			
R	Global	4.98	0.614	- 17.29	79	< .001
	MAR	5.47	0.653			

S = Spontaneous speech
R = Reading

Results

Table 3. Results of lineair regression

	B	SE	β	p
Ct	0.321	0.012		< .001
SMAR	- 0.021	0.002	- 0.784	< .001

Ct = Constant
SMAR = MAR for spontaneous speech

$$Sglobal = \frac{1}{0.321 - 0.021 * SMAR}$$

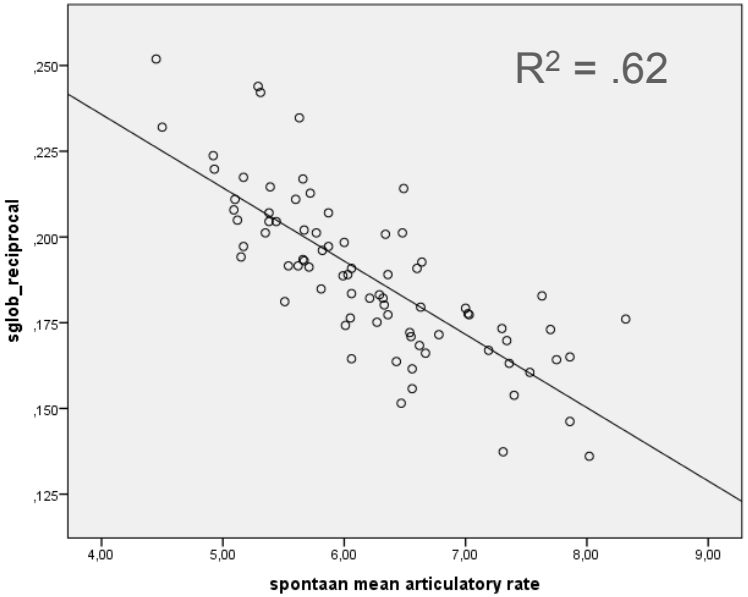


Figure 3. Scatter plot showing 1/global method vs. MAR for spontaneous speech

Results

Table 4. Results of lineair regression

	B	SE	β	p
Ct	- 0.251	0.022	- 0.913	< .001
RMAR	- 0.081	0.004		< .001

Ct = Constant
RMAR = MAR for reading

$$Rglobal = \frac{1}{10^{-0.251-0.081*RMAR}}$$

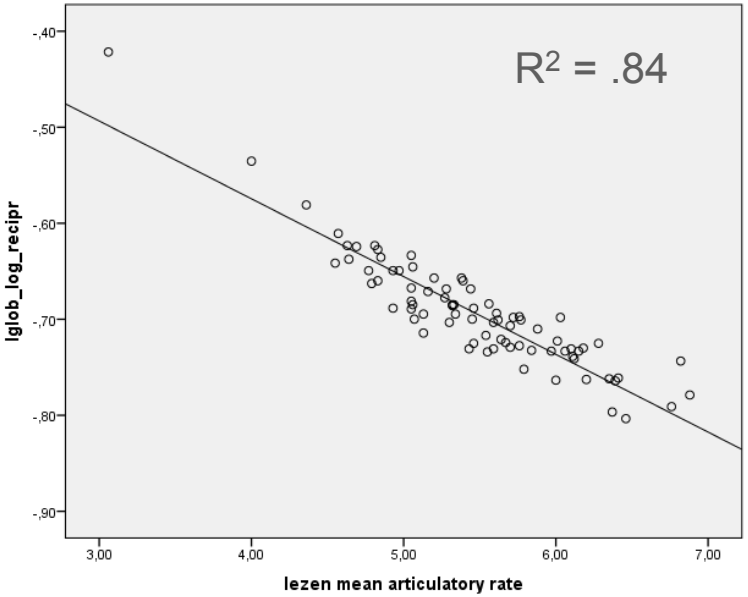


Figure 4. Scatter plot showing log(1/global method) vs. MAR for reading

Discussion

Global method and MAR cannot be used interchangeably.

- Do not lead to the same results
- Significantly higher values for MAR
- Probably due to inclusion/exclusion of pauses
  - Global method: < 250 ms were retained
  - MAR: No pauses at all

Discussion

One can be computed from the other.

- For spontaneous speech, 62% of the variation in global method is explained by MAR.
- For reading, 84% of the variation in global method is explained by MAR.
- Probably due to more AR variation in spontaneous speech

Discussion

MAR is less time consuming than the global method, making it attractive for clinical use. However, Further research is needed and should focus on:

- Number of rate measurements
- Type of utterances used
- Reliability
- …

References

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