



Speaking rate and spectral context affect the Dutch "a" – "aa" contrast

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- Dutch listeners distinguish the vowels "a" and "aa" by *duration* (temporal content) and by *timbre* (spectral content)
- But speakers differ in timbre and speaking rate
- > Speech sounds are interpreted relative to temporal and spectral context

Do compensation for durational and spectral variation occur at the same processing level?

Different levels could be assumed if there was a difference in the timing of compensation for context

What is the time course of temporal and spectral context effects?

Methods

28 minimal pairs (e.g., *gas* – *gaas*; "gas" – "gauze")
Pretest: select temporally and spectrally ambiguous vowel

Categorization of vowel continua along two dimensions:

Duration: varied from 100 ms to 180 ms

Timbre: F2 value of recorded "aa" was altered in steps of 75 Hz from +100 Hz to -200 Hz of original value

Percent "a" responses

		Duration				
		long	←→			short
Timbre	high	0	0.03	0.11	0.33	0.64
		0.02	0.03	0.1	0.36	0.67
		0.03	0.09	0.31	0.77	0.86
		0.22	0.31	0.69	0.92	0.95
low	0.32	0.49	0.81	0.93	0.98	

"a"

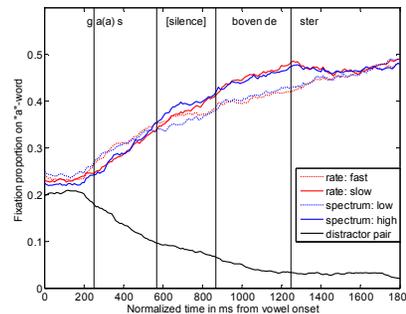
Experiment 1:

Printed-word eye tracking
Manipulated sentences, 4 context conditions

rate	timbre	expected fixations	smak	gas
slow	high	-> more "a"	△	☆
slow	low			
fast	high		gaas	smaak
fast	low	-> more "aa"	□	○

Klik nu een keer op het woord ga(a)s boven de ster
"Now click once on the word gas/gauze above the star"

Random disambiguation of the target by the shape



Fixation lag: 250 ms (fixations on distractor decrease)
More looks to "a" words

- in the slow rate condition
- in the high timbre condition

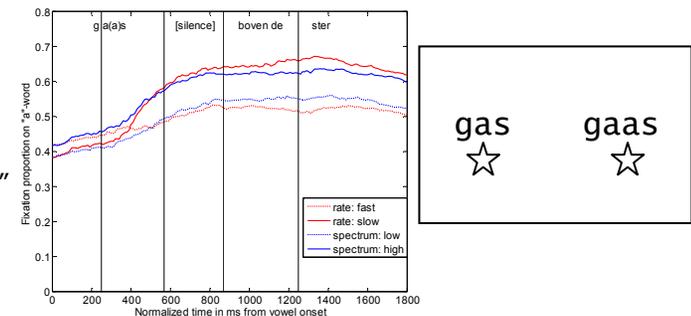
Numerical precedence of spectral information over temporal information

Overall context effects are similar in size but late and emerge at or after word offset

- > First saccade is driven by word onset, not by the vowel
- > Random disambiguation may increase uncertainty

Experiment 2:

Printed-word eye tracking
Two alternative forced choice task
Same speech materials as in first experiment but following context did not disambiguate the words



Effects of rate and spectral context

- in listeners' responses
- in eye movements

Time course effects emerge during target processing

- Spectral context from 140 ms after vowel onset
- Rate context from 180 ms after vowel onset

CONCLUSIONS

Speaking rate and spectral information of a context sentence influence phoneme perception

These compensation processes operate over a very similar time-span

-> **Suggests similar levels of context processing**

Small precedence of spectral over temporal context influences

-> **Could reflect differences in cue uptake rather than different compensation mechanisms**