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## MOTIVATION

- Acoustic cues used for **prosodic phrasing** (as realized by amplitude modulation, pitch contour, rhythmic information) can **determine** the syntactic structure and hence sentence interpretation. **Proper interpretation** of prosodic cues is thus important for communication.
- A noise masker with an **amplitude modulated envelope** is **beneficial** for speech recognition due to 'glimpsing' (e.g., Cooke 2006; Wagener et al., 2006). However, fluctuating (compared to stationary) noise can be more **detrimental** on a cognitive level because it is more difficult to "tune out" or segregate (e.g., Francart et al., 2011).
- It is unclear whether the "prosodic benefit" of speech perception observed in stationary noise (e.g., Carroll, 2013) will also hold for a **fluctuating noise masker**: A **rhythmic disruption** may affect general speech perception in relatively "natural" listening conditions where the masker is not stationary (e.g., entrainment, stream segregation mechanisms).

## PREVIOUS FINDINGS

### The prosodic benefit in stationary noise

Carroll, 2013

- (To what degree) Does stationary noise affect supra-segmental information as opposed to segmental information in sentence processing?

### Material

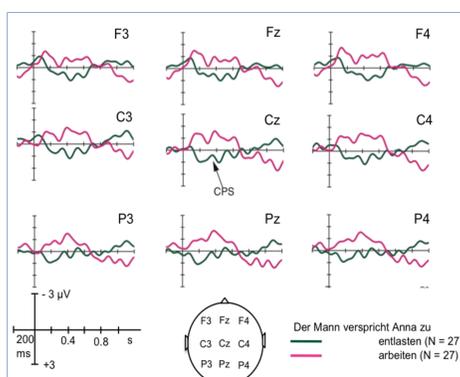
A	[Der Mann verspricht] <sub>IPB1</sub> [Anna zu entlasten] <sub>IPB2</sub> ... The man promises to call Anna ...
B	[Der Mann verspricht Anna] <sub>IPB1</sub> [zu arbeiten] <sub>IPB2</sub> ... The man promises Anna to work...
Continuation	... und das Büro zu putzen. ... and to clean the office.

## Method: Event-Related Potentials

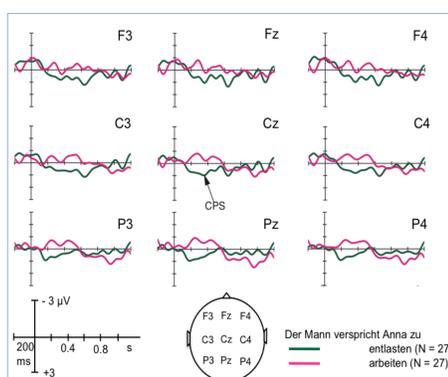
- Closure Positive Shift (CPS, Steinhauer et al., 1999) as prosodic ERP component
- 27 Ag/AgCl electrodes (10/20 system)
- Off-line word recall task
- Participants:** 27 young right-handed listeners (ø 23.1 yrs, 15♀ 14♂), normal hearing
- Manipulation:**
  - Clear speech, 70 dB SPL
  - Speech in stationary speech shaped noise, -3 dB SNR

## Results

### IPB1 in clear speech



### IPB1 in stationary speech shaped noise



- Prosodic (supra-segmental) information still usable in stationary noise
- Reduced effect size, possibly due to larger individual differences (listening effort?)
- NO distinction between rhythmic and pitch-related influences

## CURRENT STUDY

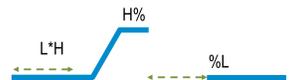
### Reliability of prosodic information against rhythmic disturbance

- Is prosodic information robust against different types of noise maskers? Or
- Does a fluctuating noise masker disrupt the rhythmic structure of the speech signal?

### Material

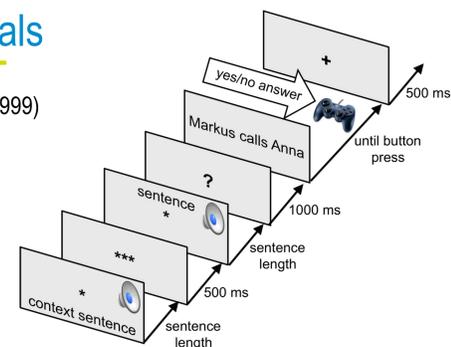
Introduction	Die Schüler sollen eine Brieffreundschaft anfangen. The students are to start a penpalship.
IPB 2	[Ingo schreibt] <sub>IPB1</sub> [Judith nicht] <sub>IPB2</sub> ... Ingo writes Judith (does) not
IPB 1	[Ingo schreibt Judith nicht] <sub>IPB</sub> ... Ingo writes Judith not/ does not write Judith
Continuation	... aber beide bekommen einen Brief. ... but both receive a letter.

- Female speaker recorded in sound attenuated booth
- Consistent realization of IPBs:



## Method: Event-Related Potentials

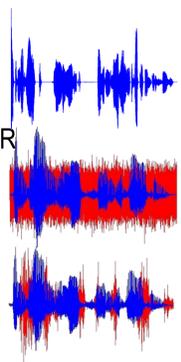
- Closure Positive Shift (CPS, Steinhauer et al., 1999) as prosodic ERP component
- 64 channel Ag/AgCl electrodes (10/20 system)
- Context sentence
- Offline comprehension task: interpretation



- Participants:**
  - 25 young listeners with normal hearing
  - Native speakers of German (bilinguals excluded)
  - Right-handed (adapted Edinburgh handedness inventory, Oldfield 1971)

- Manipulation:**
  - Clear speech (no noise) at normal speech rate
  - Speech in **stationary** speech-shaped noise and supra-threshold SNR **0 dB SNR** (approx. 90% intelligibility)
  - Speech in **fluctuating** (amplitude modulated) speech shaped noise, **-4 dB SNR** (approx. 90% intelligibility)

- Presentation:**
  - Speech in silence at 65 dB SPL (RMS)
  - Speech in noise: speech level kept constant at 65 dB, noise added
  - GENELEC 8020 loudspeakers, ECHO Gina audio interface
  - Sound attenuated & electrically shielded booth



## Expected Results

- Speech in silence:** Closure Positive Shift (CPS) clearly observable at IPBs between 150 and 500 ms post prefinal syllable onset
- Speech in stationary noise:** CPS slightly delayed, reduced amplitude
- Speech in fluctuating noise:** CPS not measurable, reduced amplitude
- Higher error rates** on offline comprehension task in fluctuating noise
- Delayed effect = "listening effort"?
- Reduced amplitude = individual differences / lower reliability, usability of prosodic cues

## REFERENCES

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