

Linguistic competitions when perceiving speech-in-speech

Véronique Boulenger

Laboratoire Dynamique du Langage, CNRS,
Lyon, France

Veronique.Boulenger@ish-lyon.cnrs.fr

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Speech-in-noise comprehension

- « The cocktail party effect » (Cherry, 1953)
- An everyday situation
- Primary problem experienced by hearing-impaired people



↪ Importance of understanding the mechanisms at play during speech-in-noise and particularly speech-in-speech comprehension



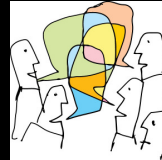
Two types of masking

o Energetic masking



overlap in time and frequency between target speech and background noise so that portions of the target are inaudible

o Informational masking



two or more signals are audible but the listener has difficulties to segregate them into distinct messages

Speech-in-Speech

Bronkhorst, 2000; Brungart, 2001

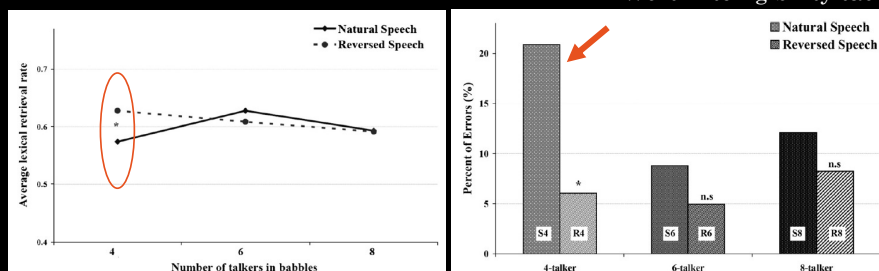
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« Speechness » of the background noise (Hoen et al., 2007)

Target word intelligibility is poorer in 4-talker natural than in 4-talker time-reversed speech babble

Word intelligibility task



Natural babble causes increased informational masking due to activation of words from the babble that compete with target word identification

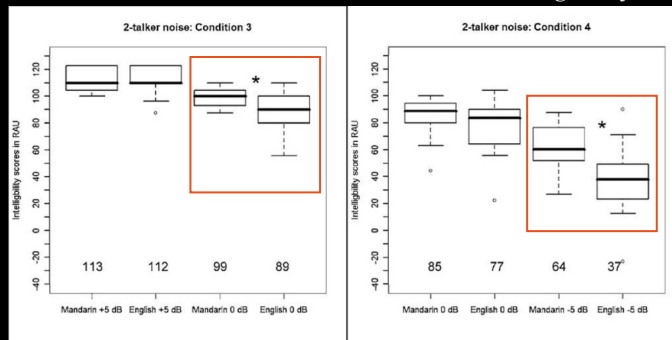
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Language of the background noise (Van Engen and Bradlow, 2007)

The intelligibility of target speech is better when the language of the interfering noise mismatches the language of the target

Sentence intelligibility task



Linguistic interference plays a role in the perception of speech-in-noise

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Aim of our work

- According to psycholinguistics, speech contains multiple levels of information (prosodic, phonological, lexical, semantic) than can compete when available.
- Break down informational masking into its different constituents during speech-in-speech comprehension
 - How do the different levels contribute to informational masking ?
 - How do word characteristics come into play in Cocktail Party situations ?

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Lexical competitions

Boulenger, Hoen, Ferragne, Pellegrino & Meunier, in press
Speech Communication

- To what extent lexical information from background is processed and can influence target speech comprehension?
- Effect of frequency of words that compose the babble on target speech recognition

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Methods

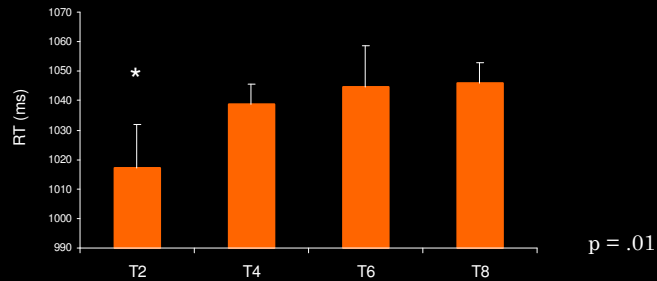
- Participants
32 healthy right-handed French native speakers
 - Stimuli
120 mono-syllabic words and 120 mono-syllabic pseudo-words embedded in mixed multi-talker babble

4 Number of Talkers
x
2 Babble Word Frequency
-
- ```
graph TD; T2 --> F2_minus[F-]; T2 --> F2_plus[F+]; T4 --> F4_minus[F-]; T4 --> F4_plus[F+]; T6 --> F6_minus[F-]; T6 --> F6_plus[F+]; T8 --> F8_minus[F-]; T8 --> F8_plus[F+];
```
- Task  
Lexical decision: decide as quickly as possible whether the target item is a word or a pseudo-word by pressing a button.  
Measure of Reaction Times (RTs)

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## Results – Effect of number of talkers

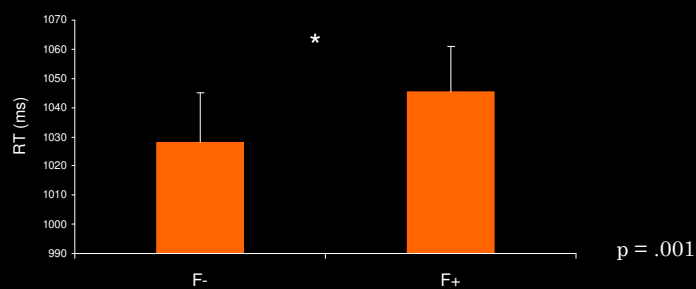


- Shorter RTs in the 2-talker than in the 4-, 6- and 8-talker conditions

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## Results – Effect of babble word frequency

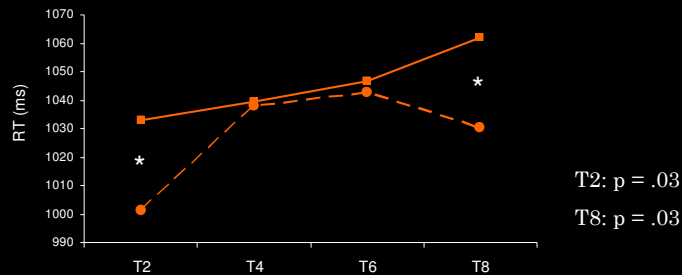


- Shorter RTs when the multi-talker babble is composed of low-frequency words than of high-frequency words

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## Results – Effect of babble word frequency



- Effect of babble word frequency only in the 2- and 8-talker conditions

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## What does that mean?

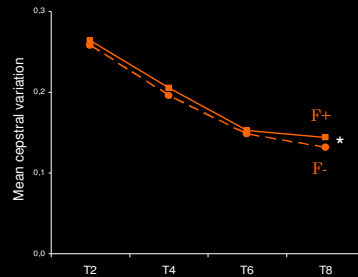
- In the 2-talker condition, high-frequency words from the babble can elicit lexical competitions and affect target word identification
  - In the 8-talker condition, complete lexical items are no longer available due to increased spectro-temporal saturation
- ➔ energetic and informational masking at a lower linguistic level for 8 talkers?

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## Acoustic analysis of the babble

- Measure of mean cepstral variation (Hoen et al., 2007)
- Increased saturation for an increasing number of talkers
- Larger cepstral variation for the high-frequency babble than for the low-frequency babble for 8 talkers



- ➔ Acoustic/energetic features distinguished between F- and F+ in the 8-talker babble

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## Discussion

- Increasing the number of talkers increases spectro-temporal saturation and thus reduces speech intelligibility (Brungart et al., 2001; Simpson & Cooke, 2005)
- Lexical factors such as the frequency of words that compose the babble contribute to informational masking during speech-in-speech comprehension
- Stronger lexical competition between target and background when the babble is composed of high-frequency words than of low-frequency words

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## Phonological competitions

Monatte, Gautreau, Hoen & Meunier

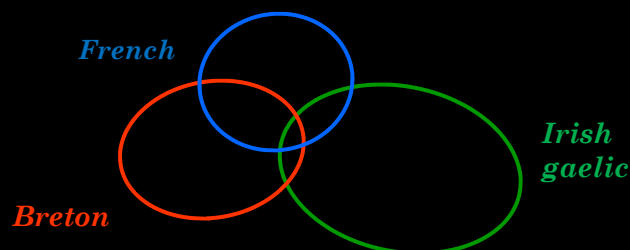
- To what extent phonological information from background can compete with target speech identification?
- Different languages have different
  - acoustical properties (prosody, accentuation etc.)
  - phonological registers
- Compare the effect of using different languages as targets or maskers in cocktail party situations
- Identify acoustical/phonological traits that warrant best noise resistance

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## Phonological proximity

- Looking at phonological competitions by manipulating phonological proximity between languages
- Language selections depending on their number of phonemes shared with the target language :
  - Target language : French
  - Masker languages : French or Irish or Breton



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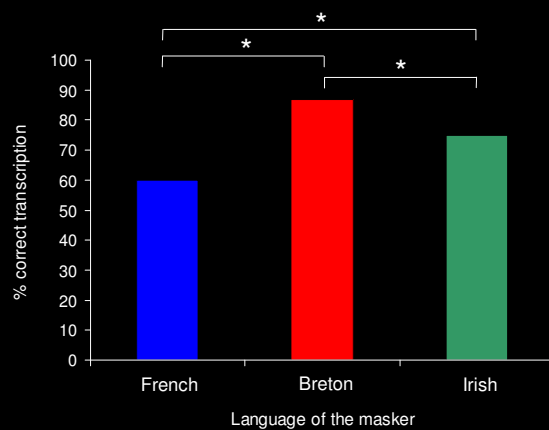
## Methods

- Participants  
40 healthy right-handed French native speakers in each experiment
- Stimuli  
136 bisyllabic words embedded in mixed multi-talker babble
- Cocktails  
French, Irish or Breton (4 talkers)
- Task  
Target word retranscription - % correct responses

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## Results (in progress...)



Effect of the language of the masker but does not entirely follow predictions!

*French* < *Breton* < *Irish*



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## Future investigations...

- Not only phonological competitions!
- Look at potential acoustic differences between the different languages used as maskers (F0, speech rate...)
- Identify the phonemes that are more resistant to noise
- Suggestions?

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## Speech-in-speech comprehension:

- A privileged situation to look at competitions between different candidates at various linguistic levels (phonological, lexical and semantic) during word identification
- Investigating unconscious speech processing : a new paradigm to study auditory priming and the processing levels at which it occurs?

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Thank you!

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<http://www.ddl.ish-lyon.cnrs.fr/spin>

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