The role of acoustic cues in speech perception during homophonic segmentation

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segmentingwordsfromacontiuousstreamisnotatr
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helanguageyouareexposedtoinyourenvironment

The problem of the continuity of acoustic speech signal

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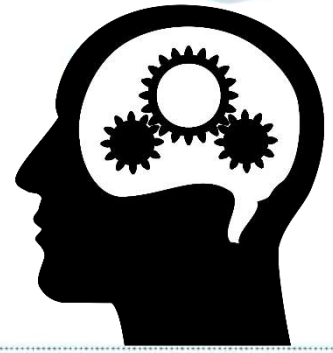

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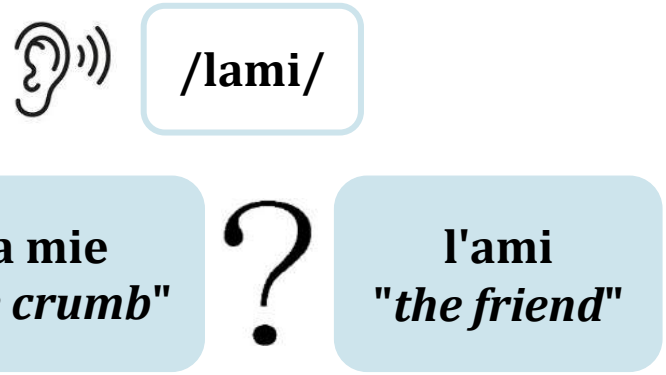
The problem of speech segmentation

- Natural speech is highly complex and variable
- Linguistic input enable to activate or inhibit word representations in mental lexicon (e.g., Gaskell & Marslen-Wilson, 1997)
- Listeners use L1 tacit knowledge to achieve speech segmentation (e.g., Quené, 1992)
- Lexical competition → solve ambiguities and recognise target meaning (Norris, 1994; McClelland and Elman, 1986)

The problem of speech segmentation

- Daily transient segmentation ambiguities
- **What happens to homophonic sequences?**
- Correct segmentation must consider fine-grained acoustic details in speech signal



Exploitation of speech cues

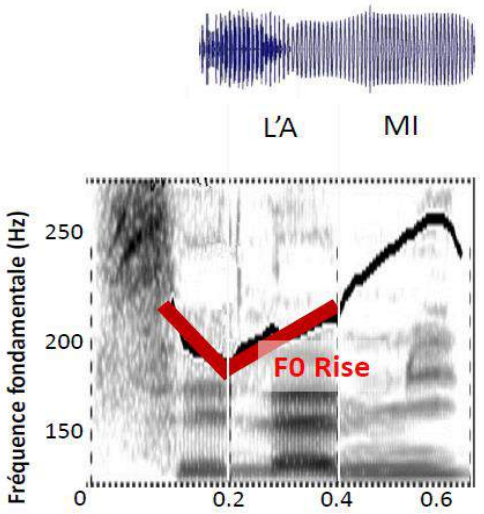
- Native listeners solve speech segmentation by relying on acoustic-phonetic, phonological, lexical, rhythmic, and statistical regularities (Cutler & Norris, 1988; Mattys et al., 2005; Saffran et al., 1996)
- In French → challenge of resyllabification
- If lexical information is informative > acoustic-phonetic cues (Spinelli et al., 2002)
- If lexical knowledge is uninformative < acoustic-phonetic cues
  e.g., *les ailes* vs. *les zèles*, both [le. zɛl] (Shoemaker, 2014; Spinelli et al., 2003)

Exploitation of speech cues in French I

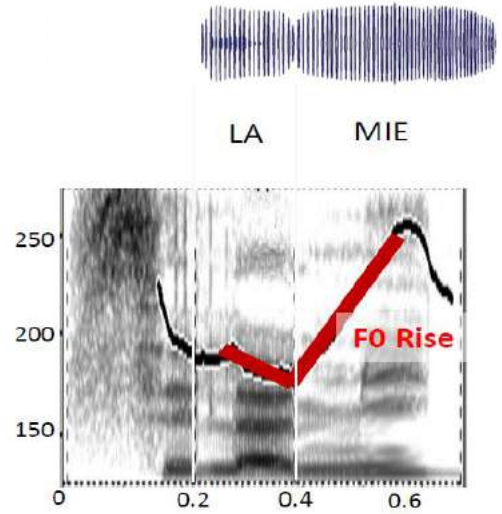
Homophonic sequences like [sɛlami]

- F0 rise often found at the beginning of content words
(Welby, 2003a, 2003b, 2007)

- Can discriminate by 66.3% and identify it correctly by 75.5% (Spinelli et al., 2007)



L'ami = "The friend"



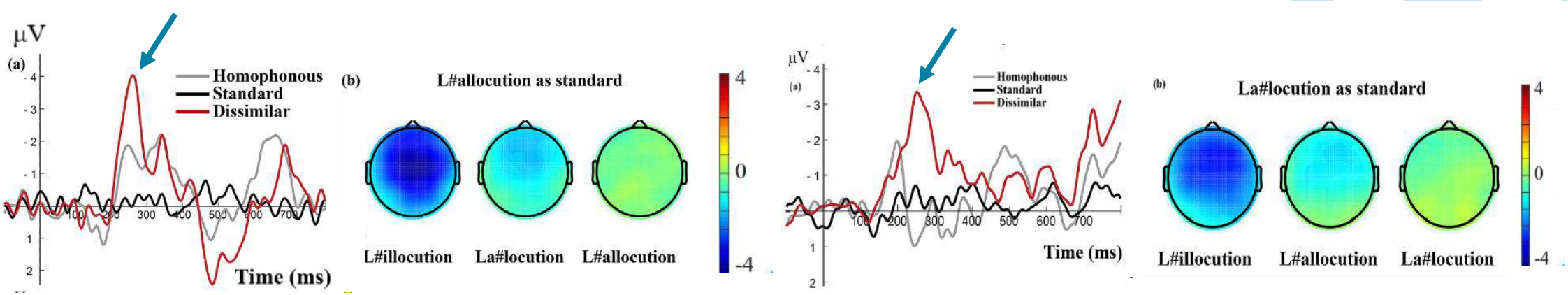
La mie = "The crumb"

Acoustic information in /lami/ is used when presented in isolation **(offline)**

Exploitation of speech cues in French II

Homophonic sequences like [sɛlami]

- Can discriminate by 79%
  (Do Carmo-Blanco et al., 2019)



Acoustic information in /lami/ is used when presented in isolation **(online)**

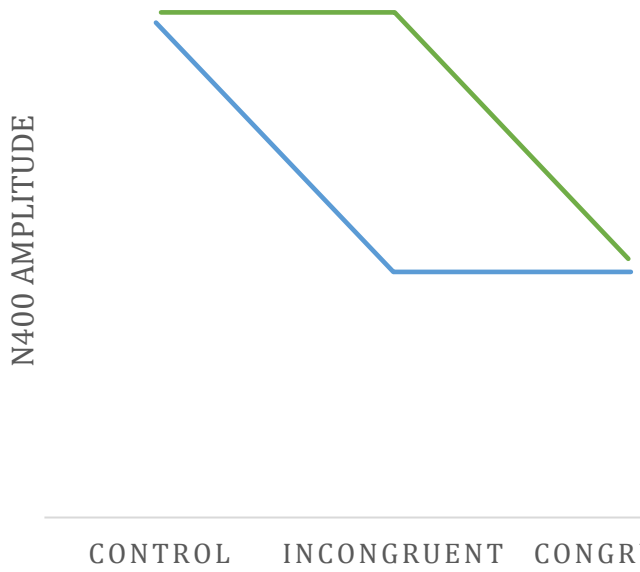
ERPs: light to online speech processing

- Right centroparietal negative component peaking at ~400 ms
  (e.g., Kutas and Hillyard, 1984)
- Ease with which a word or a sentence is integrated into a given context (Chwilla et al., 1995; Friederici, 1995)
  - Incongruent sentences elicit larger negativity than congruent sentences

(Kutas & Federmeier, 2011)

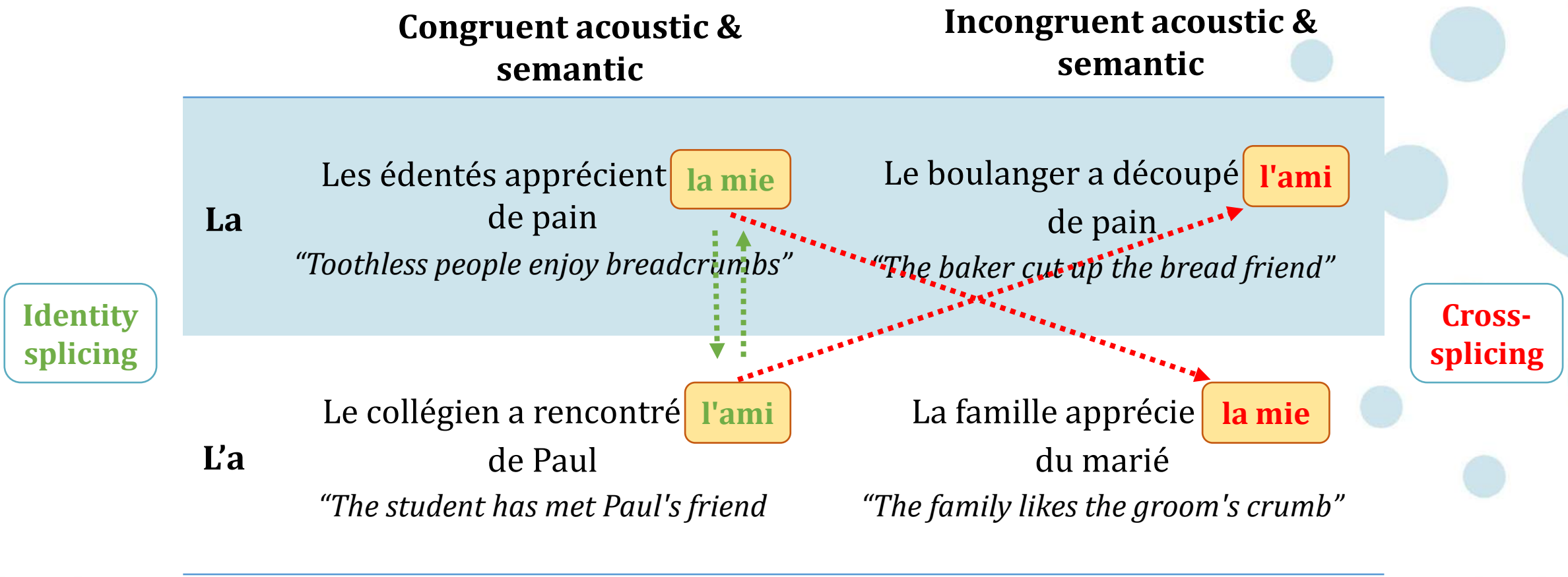
Interest of study and main hypotheses

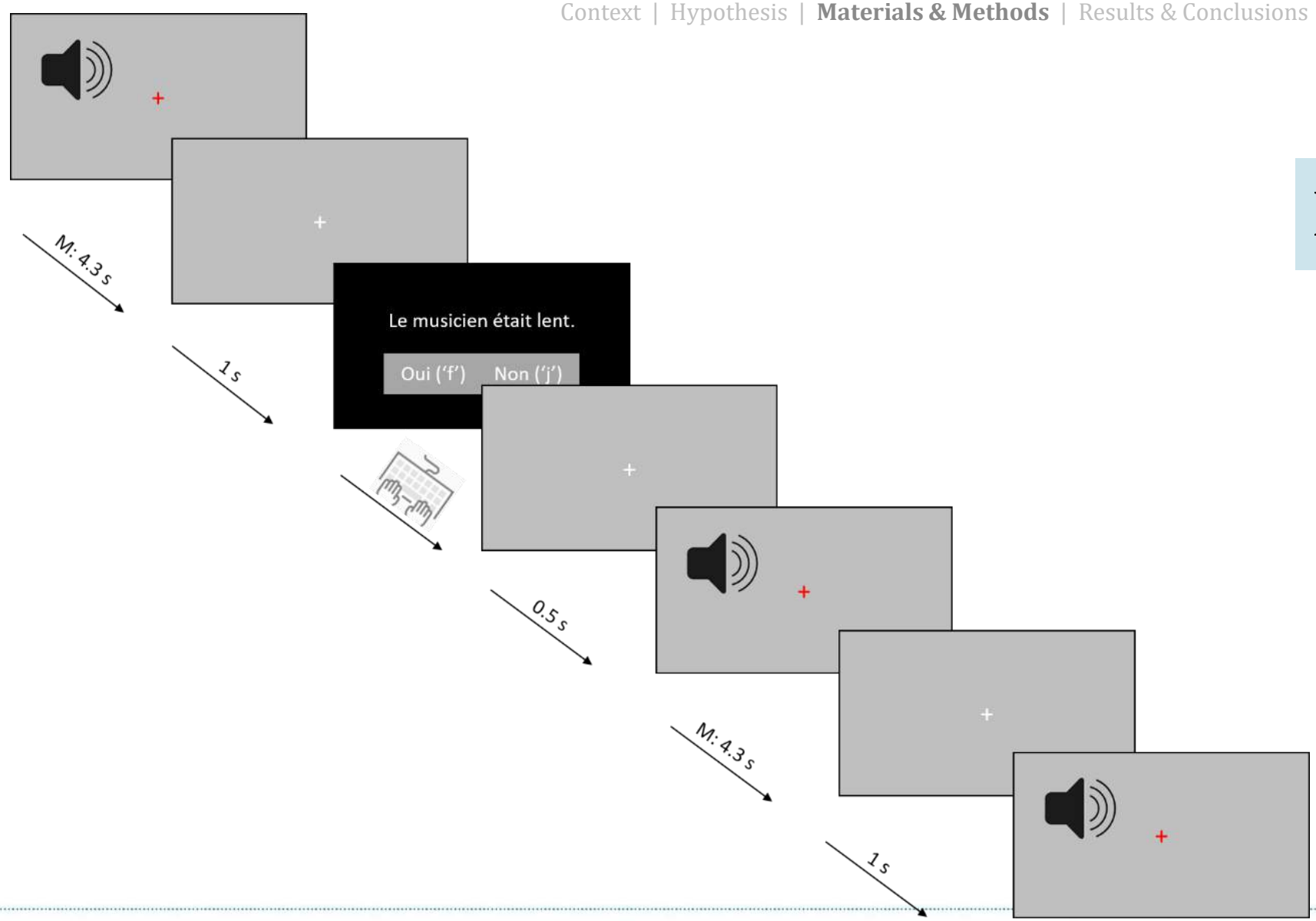
- Examine cues involved in processing word boundaries in French
- How does the sensitivity to fine-grained acoustic details change at sentence level?



- Hyp. 1: Fine acoustic analysis occurs in real-time speech processing
- Hyp. 2: Homophonic representations are accessed through contextual means

Stimuli


Congruent acoustic & semantic
Incongruent acoustic & semantic
La
Les édentés apprécient la mie de pain
"Toothless people enjoy breadcrumbs"
Le boulanger a découpé l'ami de pain
"The baker cut up the bread friend"
L'a
Le collégien a rencontré l'ami de Paul
"The student has met Paul's friend
La famille apprécie la mie du marié
"The family likes the groom's crumb"
Identity splicing
Cross-splicing



Experimental Design

EXPERIMENT 1: EGG

No active task

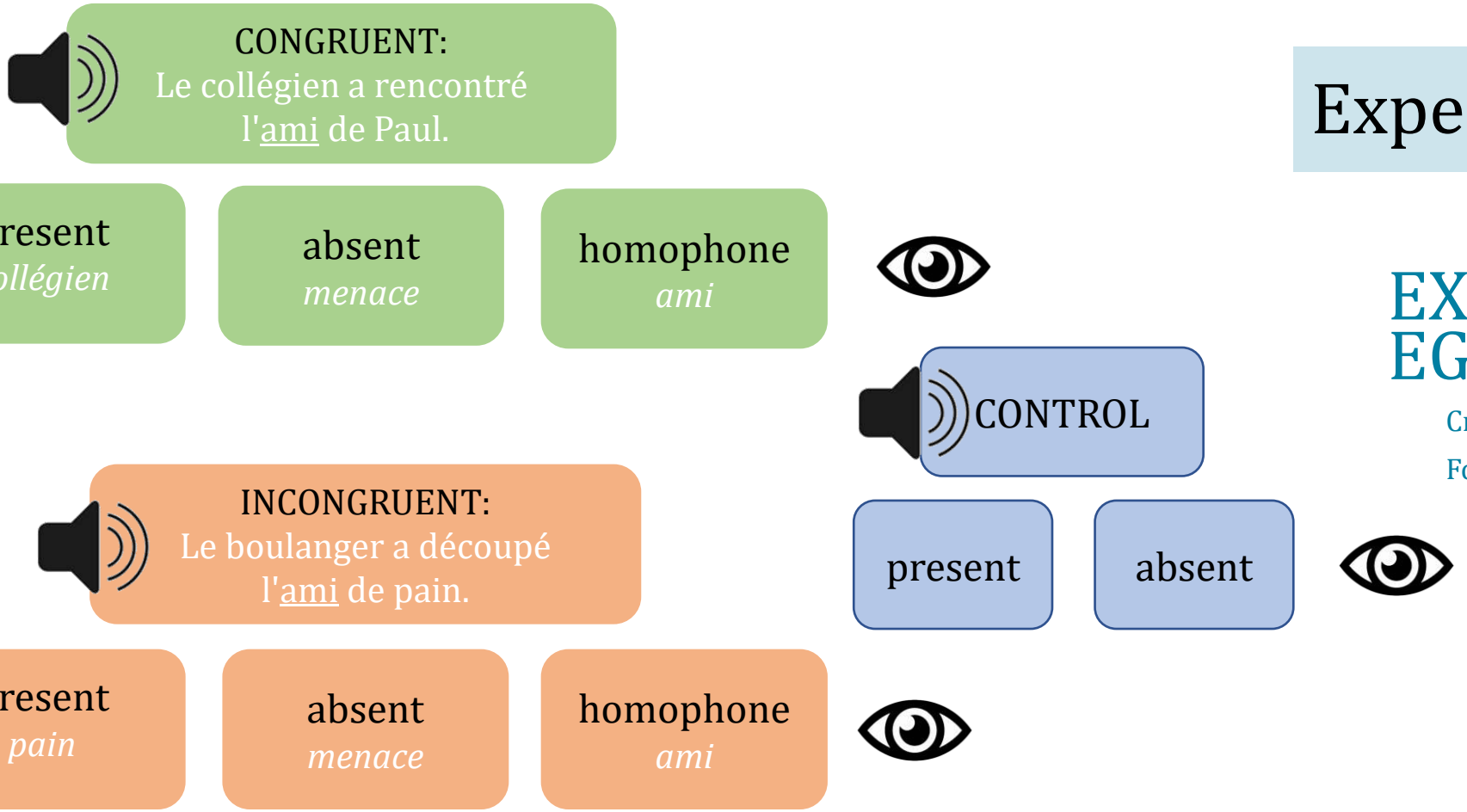
Semantic **judgement task** as control for attention

Experimental Design

EXPERIMENT 2: EGG & Behavioural

Cross-modal **recognition task**

Focus on lexical information (words)



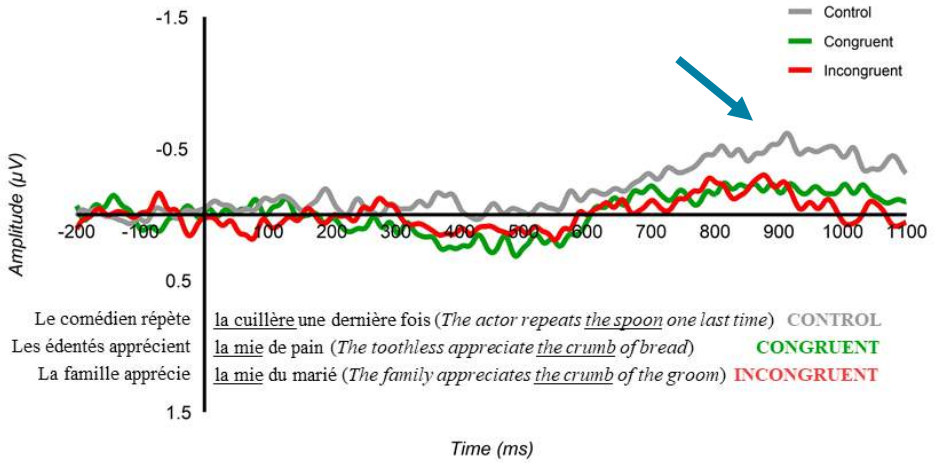
/ La famille apprécie
la mie du marié /

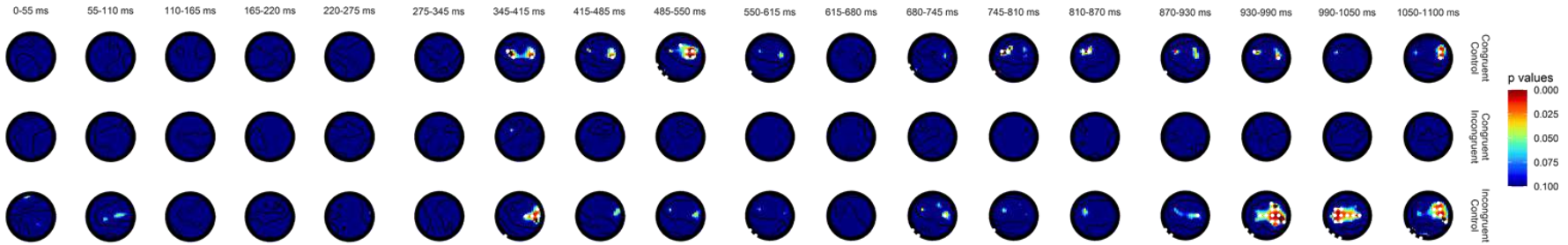
+

MIE

Results & Conclusions : EEG (online measures)

EXPERIMENT 1





→ Congruent = Incongruent in **Experiment 1**

- Fine-grained acoustic information NOT used as cue when exposed to informative-enough context
- When semantic information is present, listeners do not rely on acoustic cues to achieve comprehension

Congruent vs Control
- 345 – 550 ms
- 745 – 1100 ms

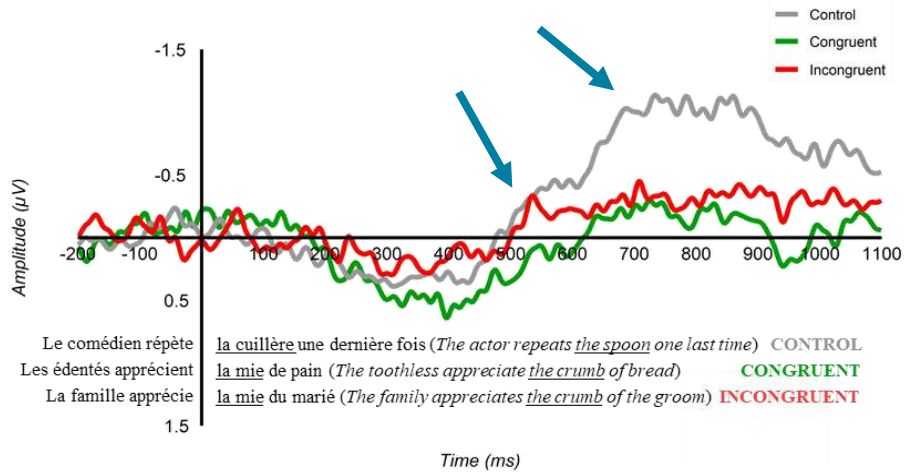
Incongruent vs. Control
- 345 – 415 ms
- 870 – 1100 ms

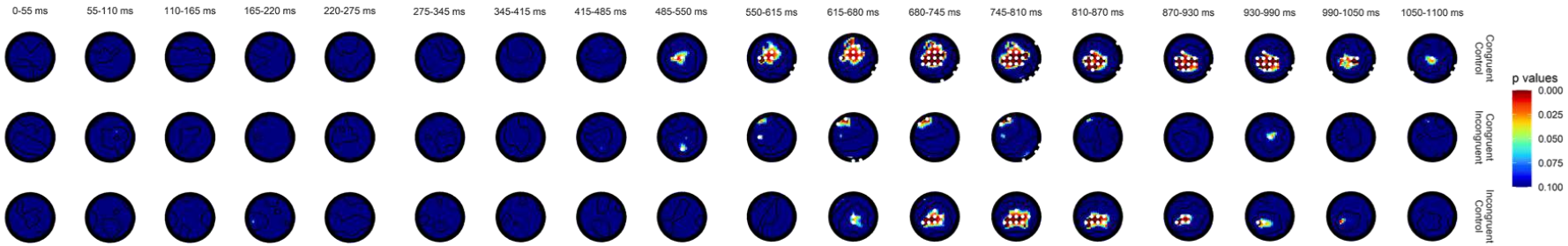
Congruent vs. Incongruent
- *ns*

Global Field Power (GFP): Skrandies, 1990; Delorme and Makeig, 2004; Permutation analyses: Maris & Oostenveld, 2007

Results & Conclusions : EEG (online measures)

EXPERIMENT 2





→ Congruent # Incongruent in **Experiment 2**

- When attention paid to lexical information → Listeners seem to perceive acoustic variations
- Use of cues seems to be situational-dependent
  (inconsistent with Mattys et al. 2005 & 2007)

Congruent vs Control
485 – 1100 ms

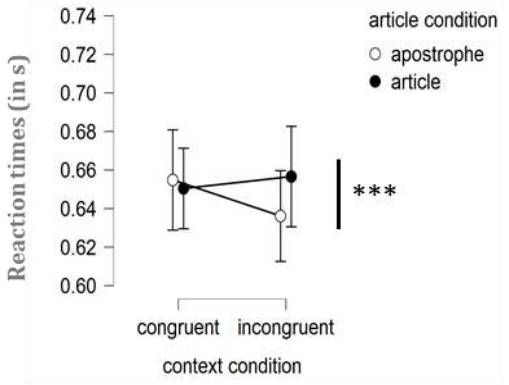
Incongruent vs. Control
615 – 990 ms

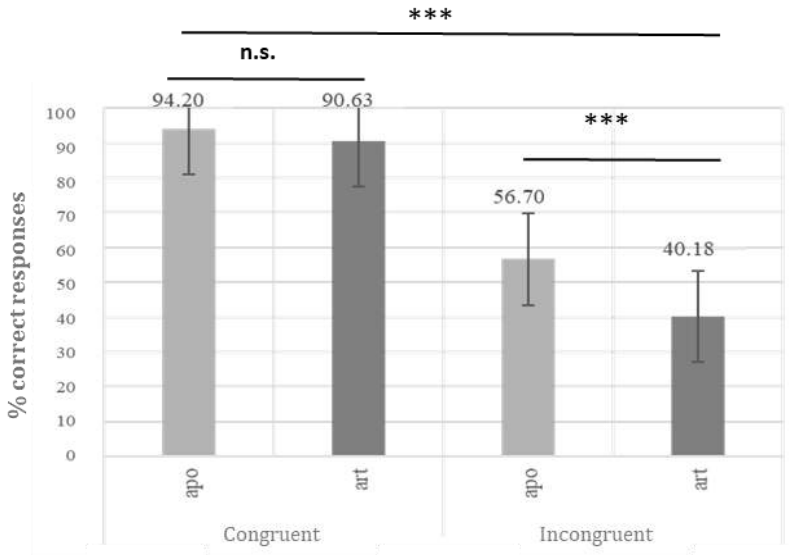
Congruent vs. Incongruent
615 – 810 ms

Global Field Power (GFP): Skrandies, 1990; Delorme and Makeig, 2004; Permutation analyses: Maris & Oostenveld, 2007

Results & Conclusions : Behavioural (offline measures)

EXPERIMENT 2





- Context plays a role when recognizing homophonic sequences
  - Incongruent contexts had lower accuracy rates & slower RTs
- Resyllabification does not seem to difficult word-boundary recognition in French
- Speech perception is modulated by variations in acoustic indices of the signal

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THANK YOU FOR YOUR ATTENTION

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