Enhancement dynamics of cortical representation by masker priming during attentional selection in the cocktail party problem

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Auditory system segregation Problem

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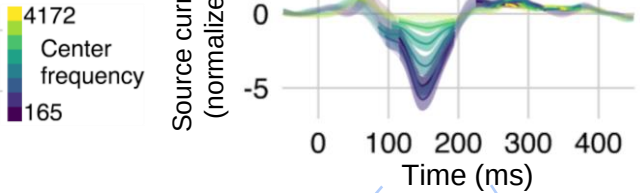
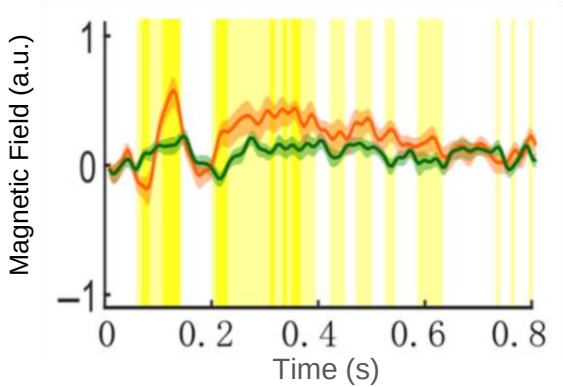
Overlapping auditory objects is challenging since one single mixture maps to several sources

Cortical enhancement of attended speakers

Attentional effects begin around 100 ms and may be sensitive to target repetitions



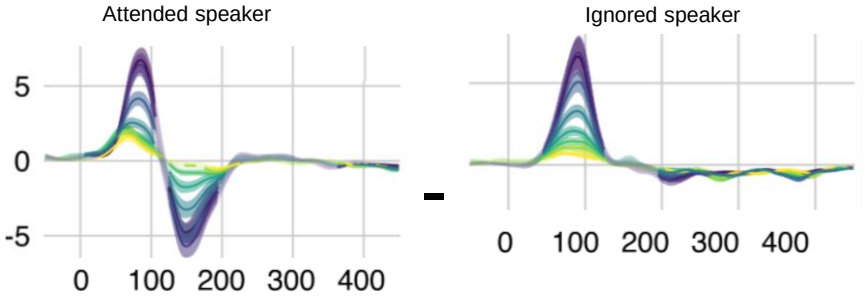
Brodbeck et al. (2020)

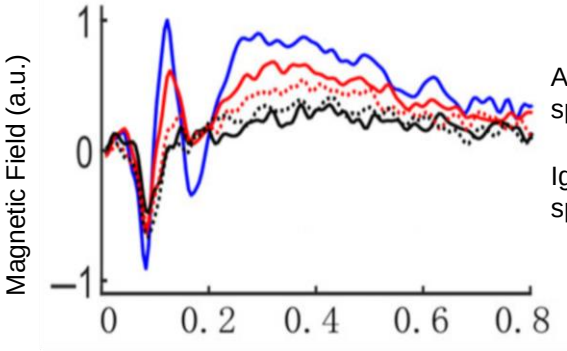


No priming

Target priming

TRF show differential neural representations of foreground vs background objects





NP TP

Attended speaker

Ignored speaker

Wang et al. (2019)

Hypothesis

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Attention increases the cortical response to a target (attentional effect).
Familiarity with stimulus may reduce cortical responses.

In a cocktail party situation, we expect that attention and previous experience will interact and be reflected in the cortical response:

- The AE may be reduced in magnitude due to foreground knowledge, compared to no prior knowledge.

- The AE may be increased due to background knowledge, compared to no prior knowledge.

Stimuli database

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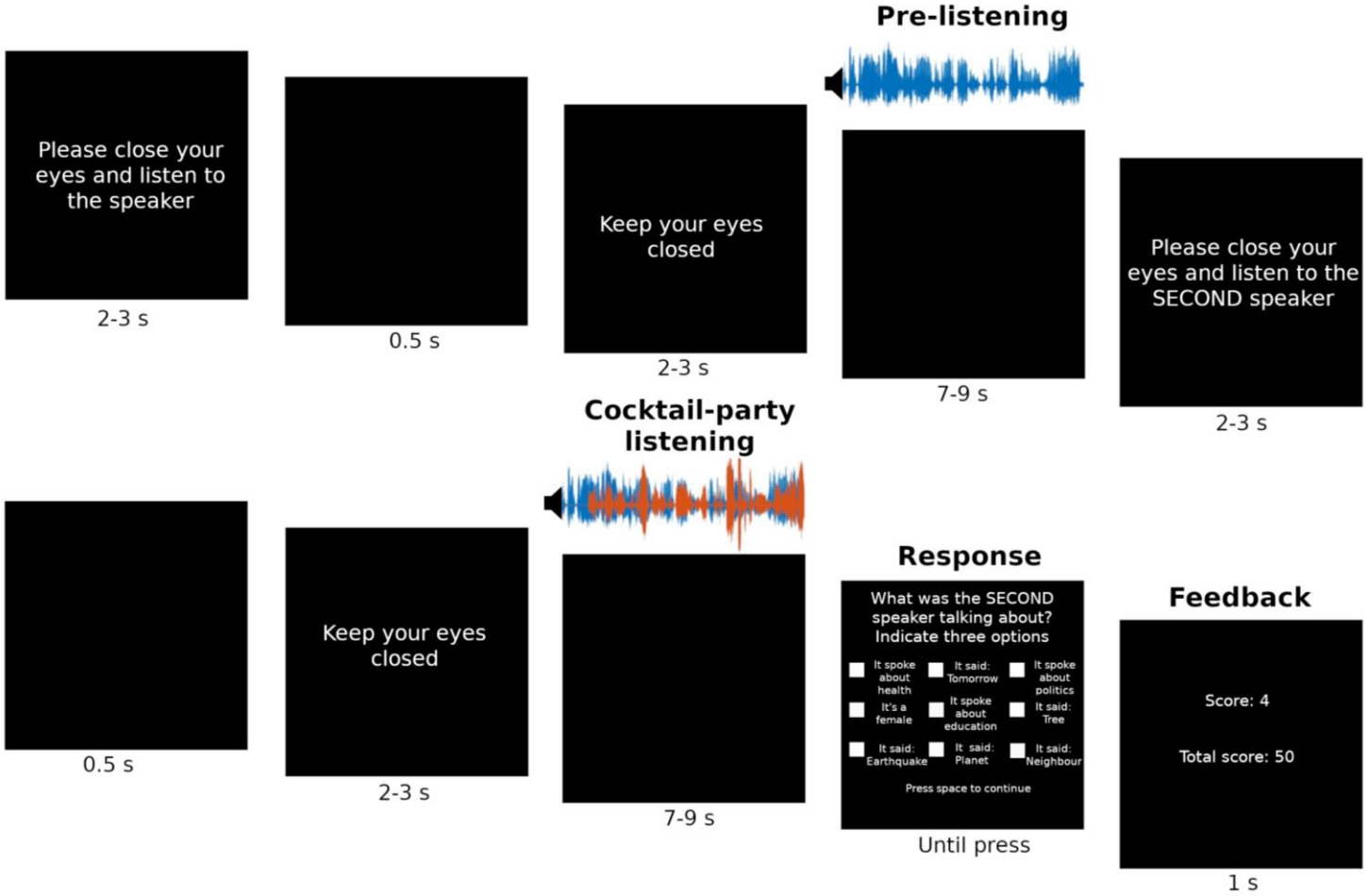
- 254 single speakers audios (127 female).
- Clear and complete sentences were selected.
- Stimuli were extracted from radio, TV channels, podcasts and youtube videos of Uruguayan Spanish accented speakers.
- Questions about topics, gender and age were asked for each trial.

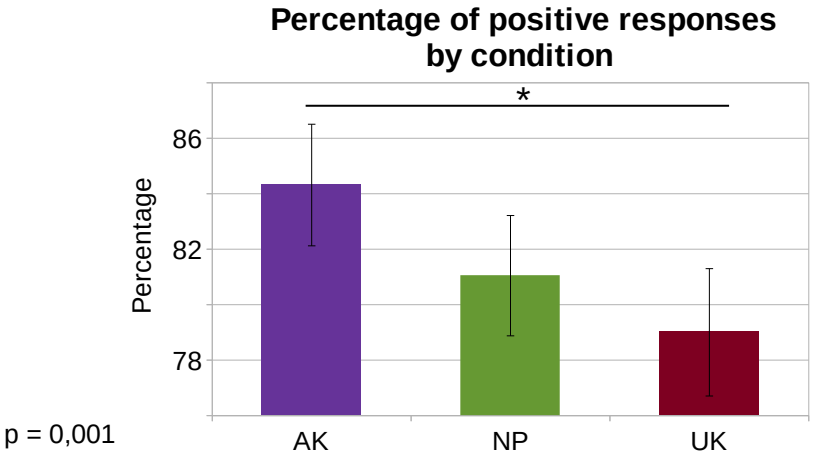
Audio	Politics	Gov't	Sports	Religion	Educ.	Key1	Key2	Key3	Key4	M/F	Age
1		X			X	Biases	Brain	Financial	Invest	F	Younger
2	X					Retire	Write	Journal	Stuff	M	Older
3					X	Tourism	Illusion	Transform	Experience	M	Younger
4		X				Advances	Rights	Money	Depression	F	Older

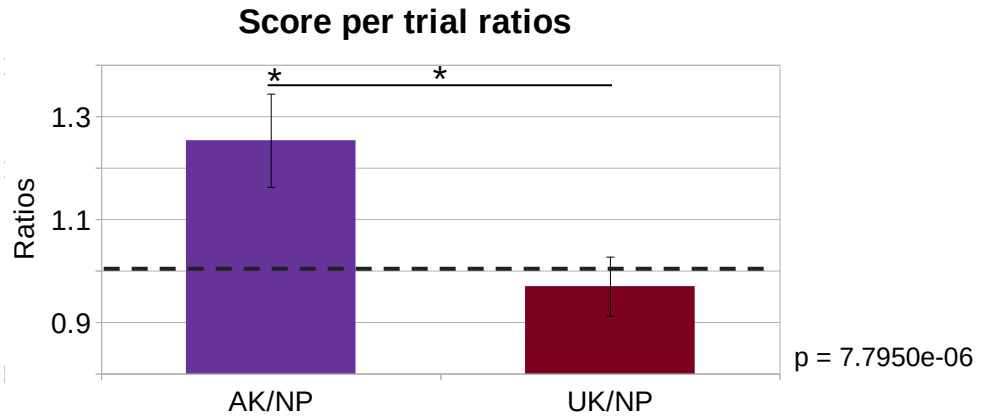
Please close your eyes and listen to the FIRST speaker

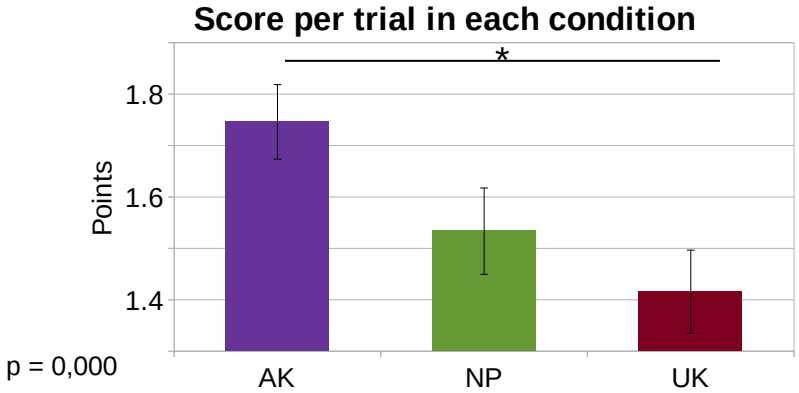
Experimental design



Behavioral results







AK= Attended known
NP= No prior condition
UK= Unattended known

Participants presented an improvement in performance of their prior experience to solve the cocktail party for a target but didn´t improved for UK

Neural results

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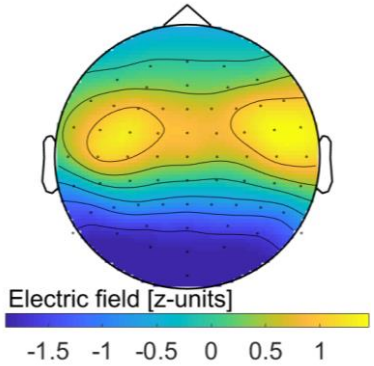
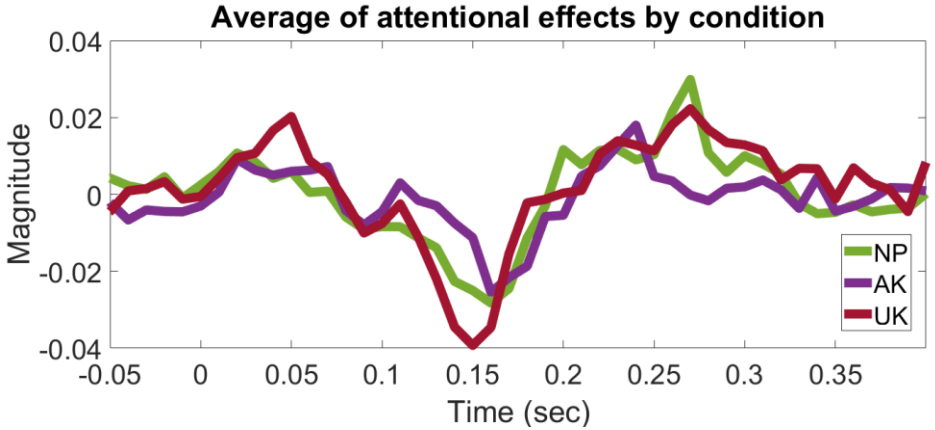
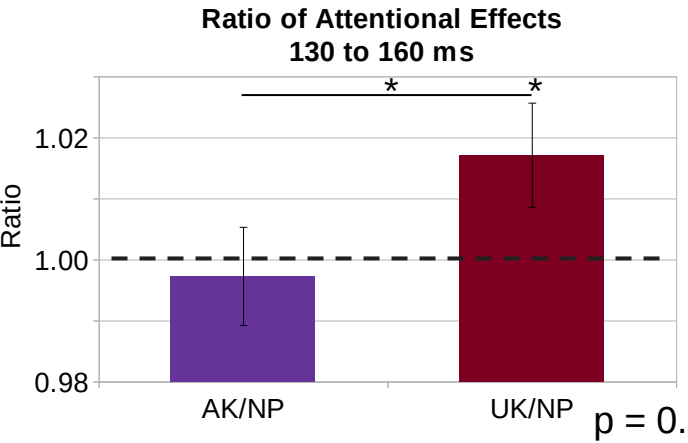
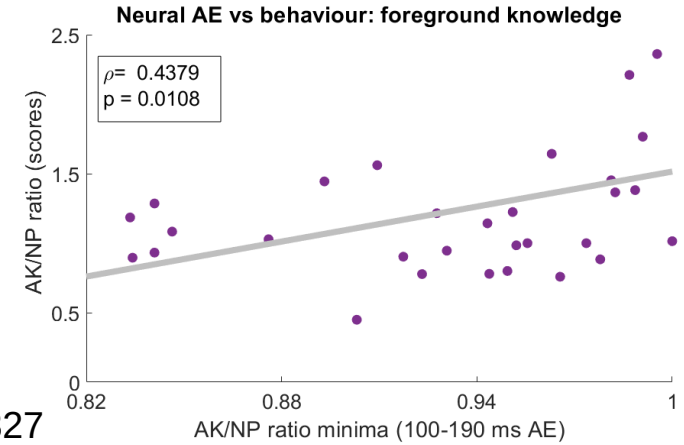
Auditory spatial filter
Natural speech listening







p = 0.0327



- Priming influences attentional effect between 100 - 200 ms.
- The AE appeared reduced for target knowledge, while for masker it increased on average, however
- There is a correlation between facilitation in scoring and AE; participants who scored better had neural ratios close to 1.
- AE TEMPRANO

P1-N1 analysis of attended and unattended speech
Average of TRFs

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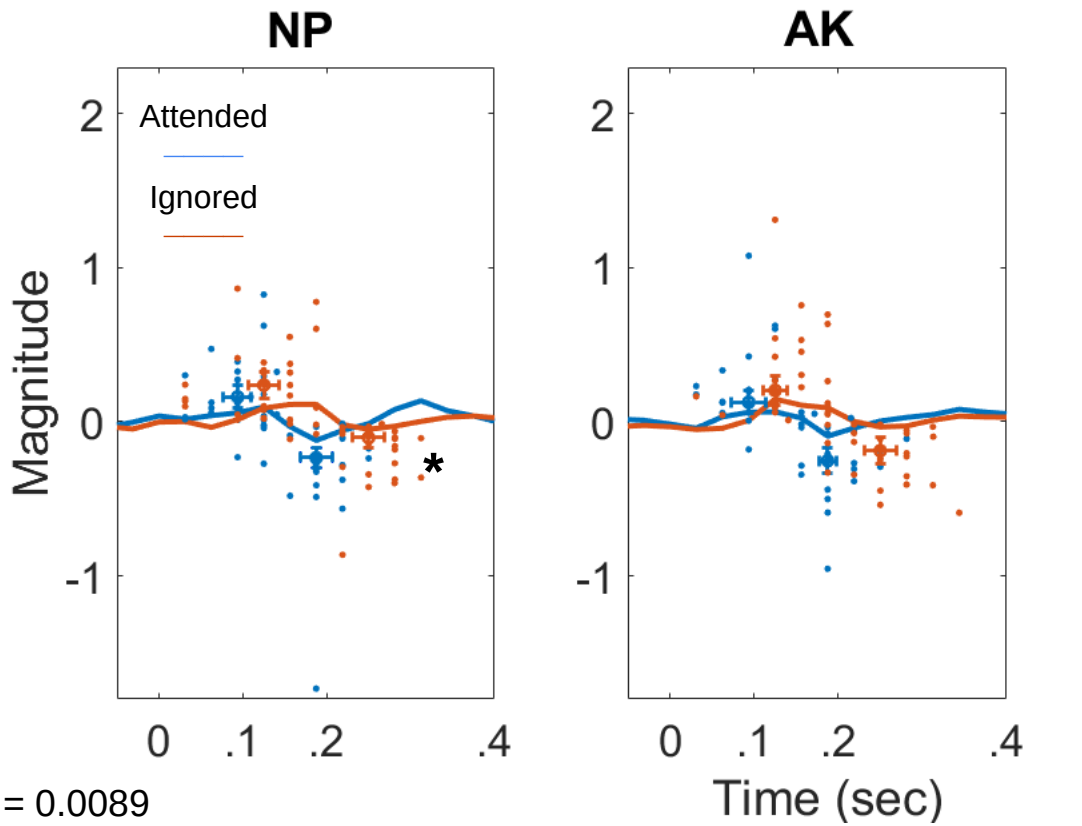
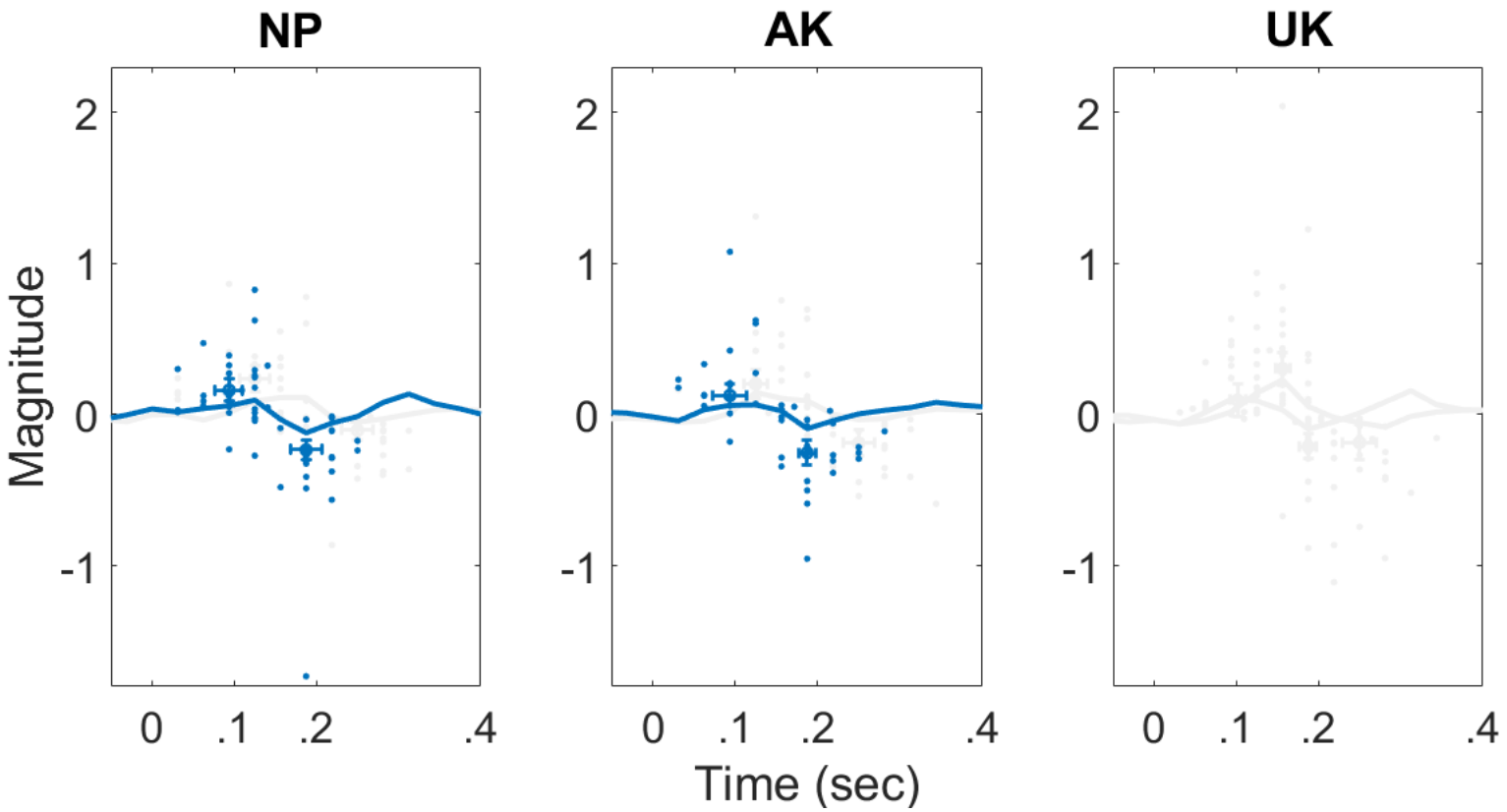


p = 0.0089

p = 0.0054

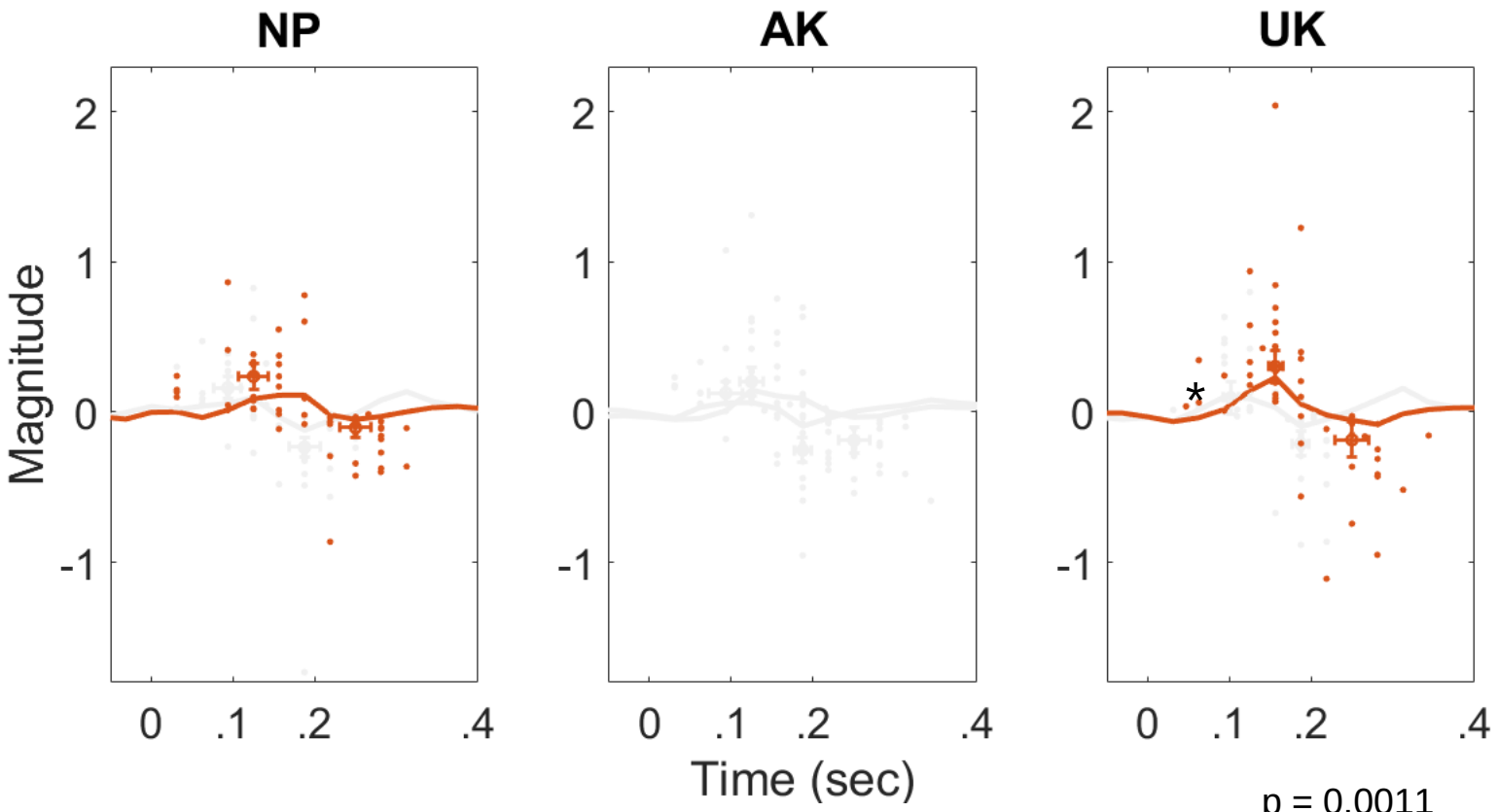
- Neural tracking of attended speech is earliest in P1 and N1.
- An increase in the N1 for the TRF of the target is observed.
- UK shows an increasement of P1 peak for masker

Experience effect: Foreground knowledge



We found no differences for target priming

Experience effect: Background knowledge



P1 processing stage is sensitive to background information that is to be filtered.

p = 0.0011

Discussion

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- Target knowledge (AK) facilitates cocktail party behavior, but masker knowledge (UK) doesn´t.
- Attentional effects (AE) change according to prior knowledge:
  - Following AK:
    - AE were absent during late processing (250 to 300 ms)
    - Participants whose AE are not substantially reduced in 100 – 190 ms due to AK, also show greatest facilitation behaviorally.
  - Following UK:
    - AE were increased around 150 ms
    - An early (50 ms) AE was also found

Discussion

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- Cortical processing of attended speech occurred earlier than unattended.
- Only for NP the target N1 peak was larger than the masker's.
- P1 peaks in UK were larger for ignored than attended speakers:
  - Ignored speakers were also more represented at P1 when known.
  - AE increases following UK reflect changes to masker P1 rather than target N1.
  - Yet the earliest AE (around 50 ms) was due to faster P1 growth for attended speakers.
- The results suggest the P1 stage is sensitive to masker learning at the CP
  - First, experience-dependent mechanisms supressed the relative contribution of the predicted masker preattentively (P1 growth).
  - P1 peak biases for masker representations afterwards via top-down knowledge.

Thank you for your attention!

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