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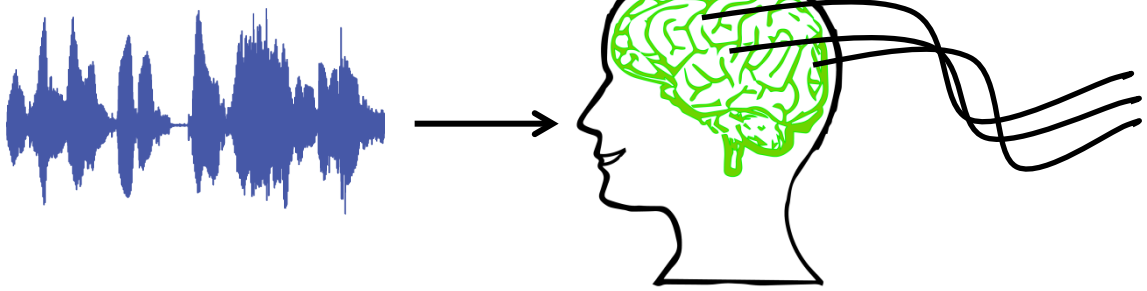
Neural oscillations reflect attentional challenges of understanding speech in noise

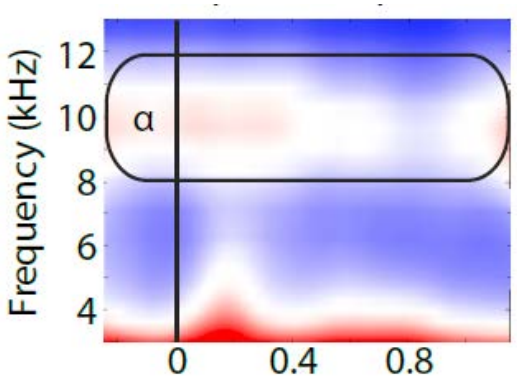
Malte Wöstmann

Max Planck Research Group "Auditory Cognition",
Max-Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

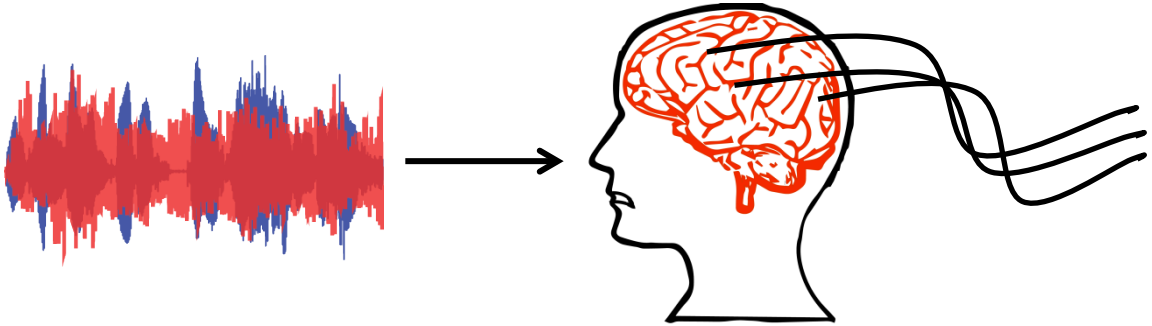
A common observation

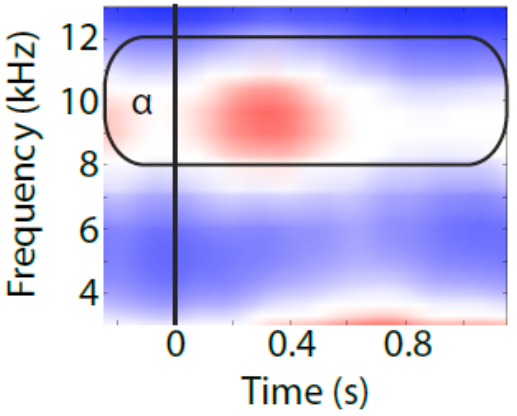
automatic/effortless





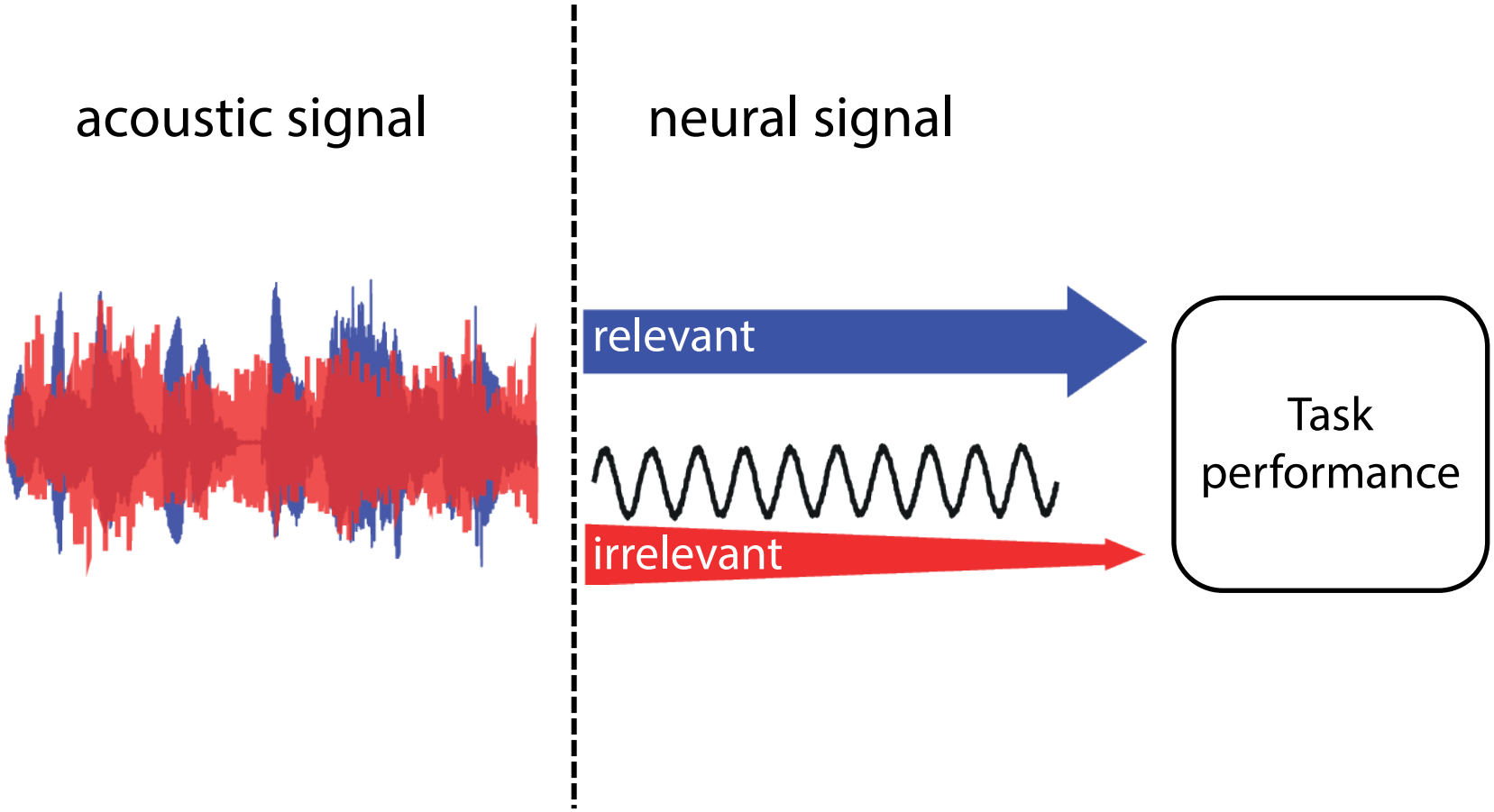
effortful/attention-demanding





Strauß, Wöstmann, Obleser (2014). *Front Hum Neurosci*.

Functional interpretation



Straußß, Wöstmann, Obleser (2014). *Front Hum Neurosci*. see also: Jensen & Mazaheri (2010). *Front Hum Neursoci*.

Today's Questions

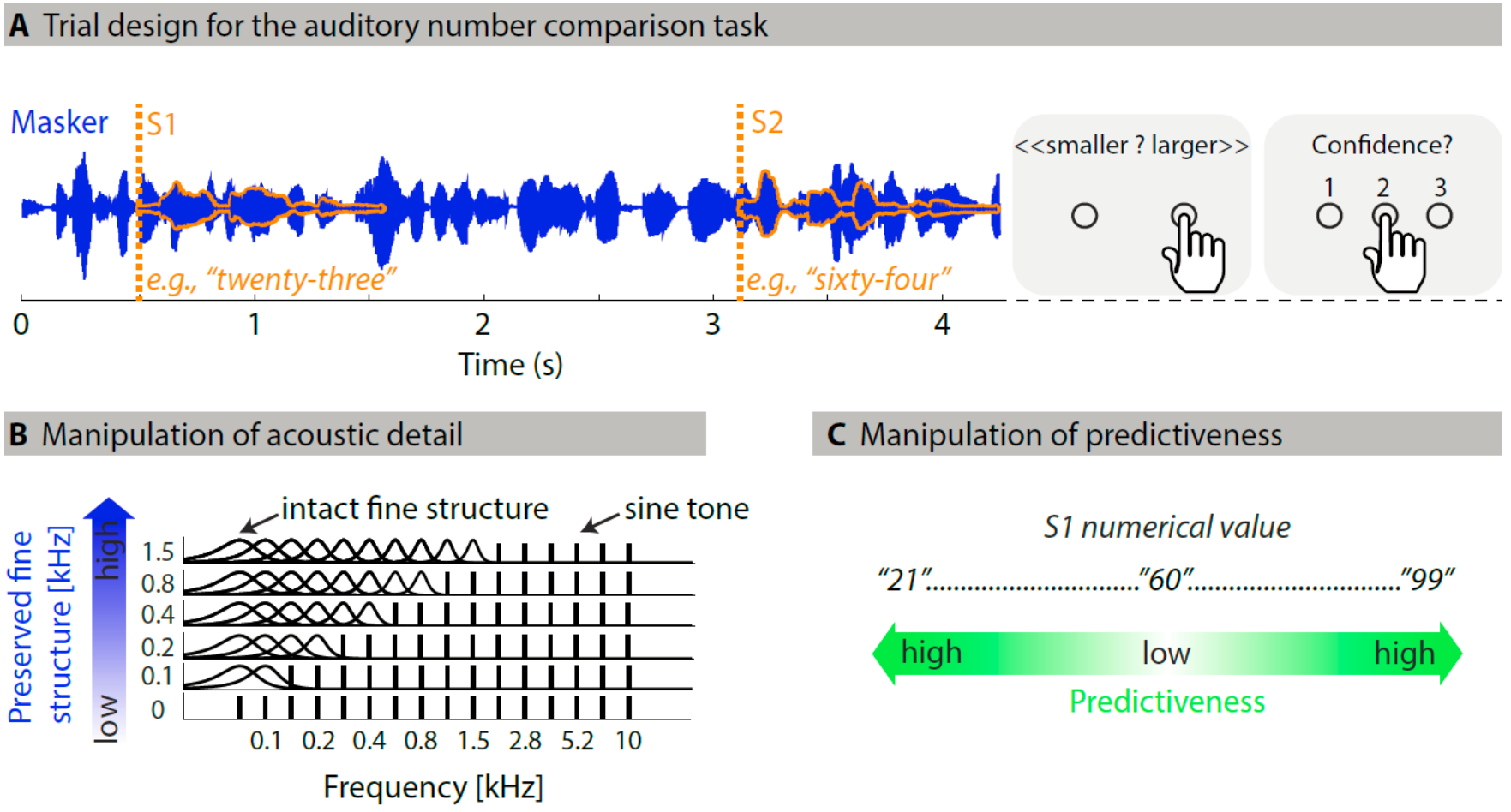
1) Do alpha power dynamics reflect listening challenges experienced…

… at an older age?

… with progressive hearing loss?

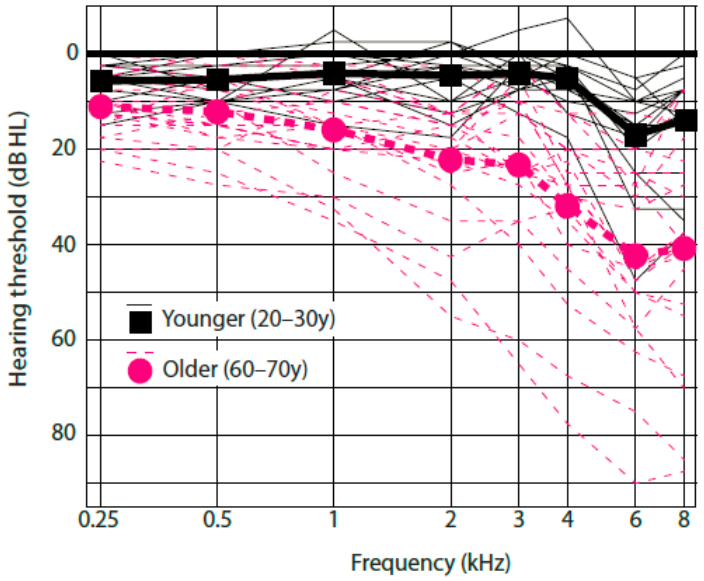
2) "Can alpha oscillations in the brain protect speech signals against interfering distractors?"

Attentional challenges in the ageing listener

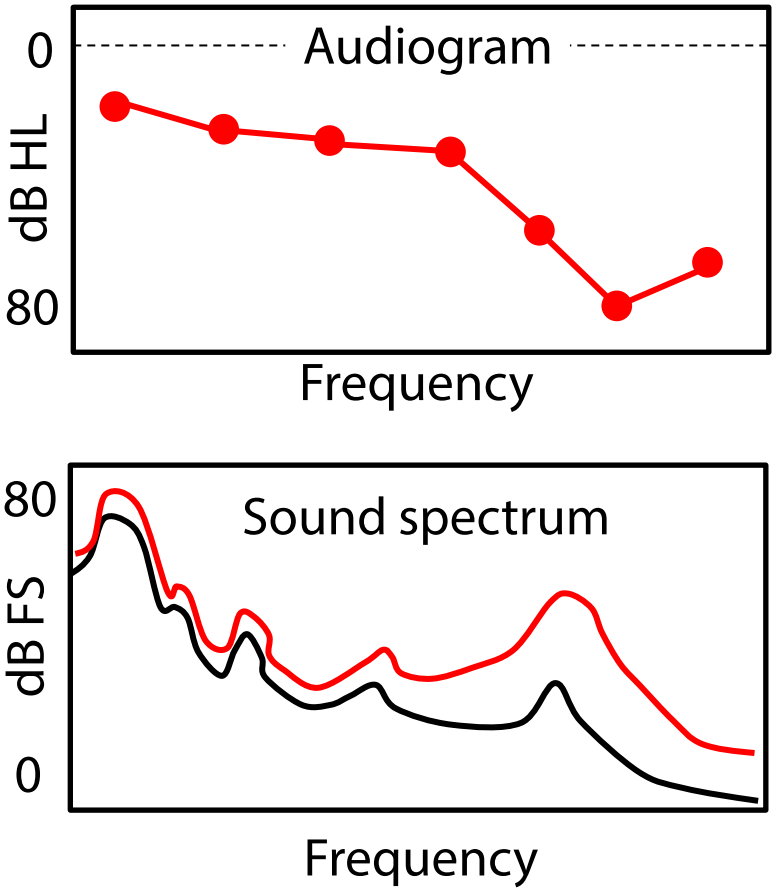


Wöstmann, Herrmann, Wilsch, Obleser (in press). *J Neurosci.*

Excluding trivial effects of stimulus audibility

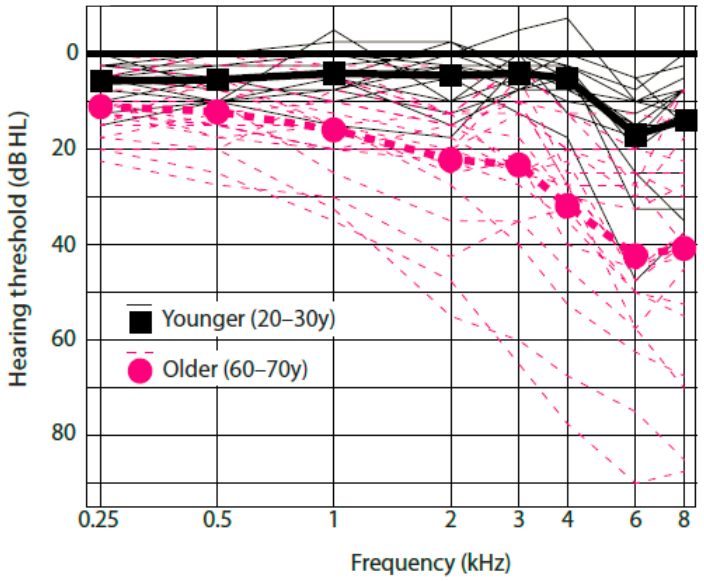


Frequency-specific amplification

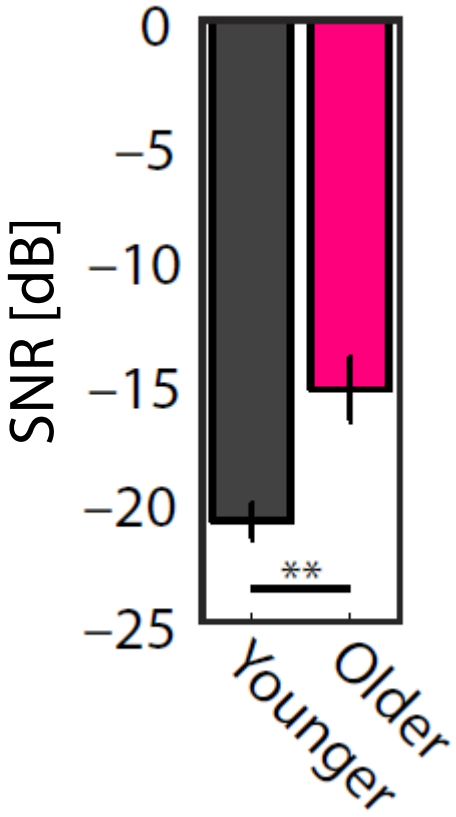


Moore et al., (1998). *Br J Audiol.*

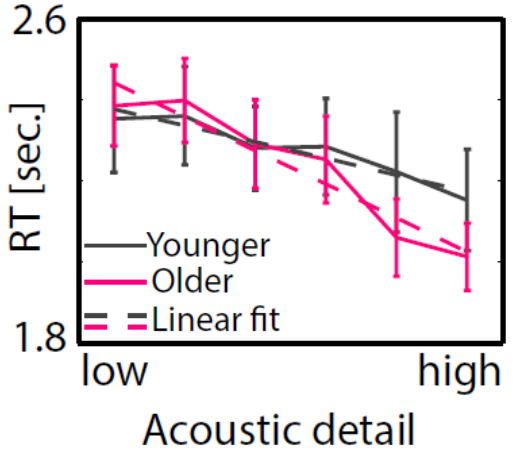
Excluding trivial effects of stimulus audibility

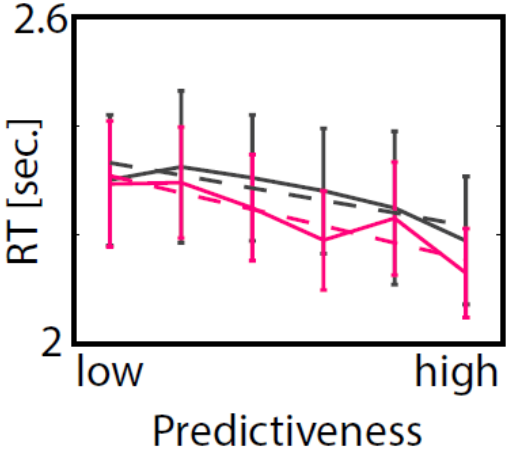


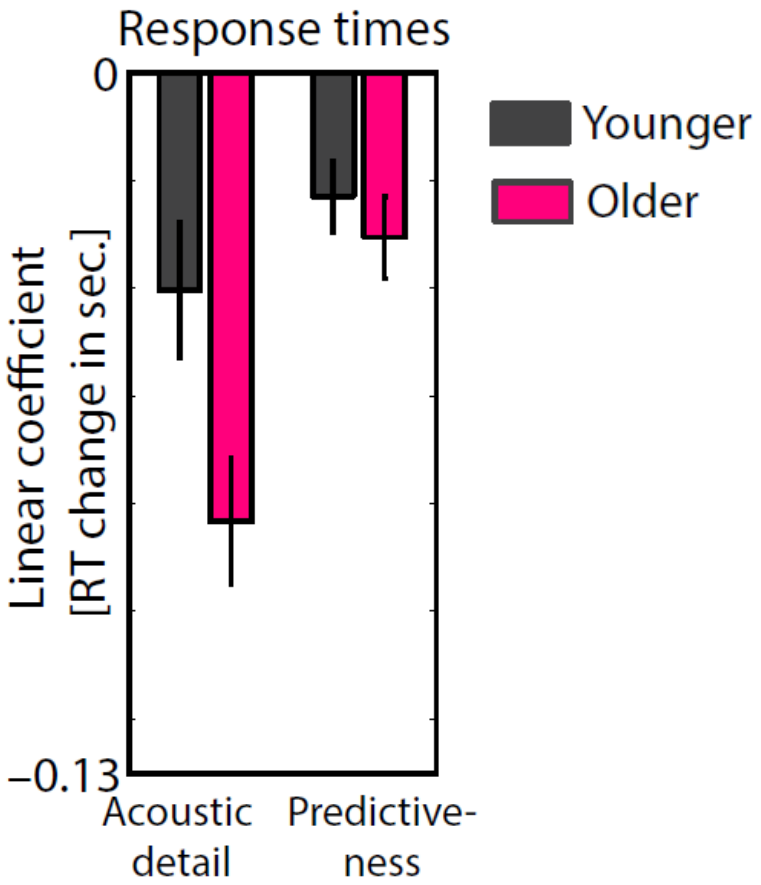
Individual SNR estimation
(for ~70 % accuracy)



Response times in the number comparison task

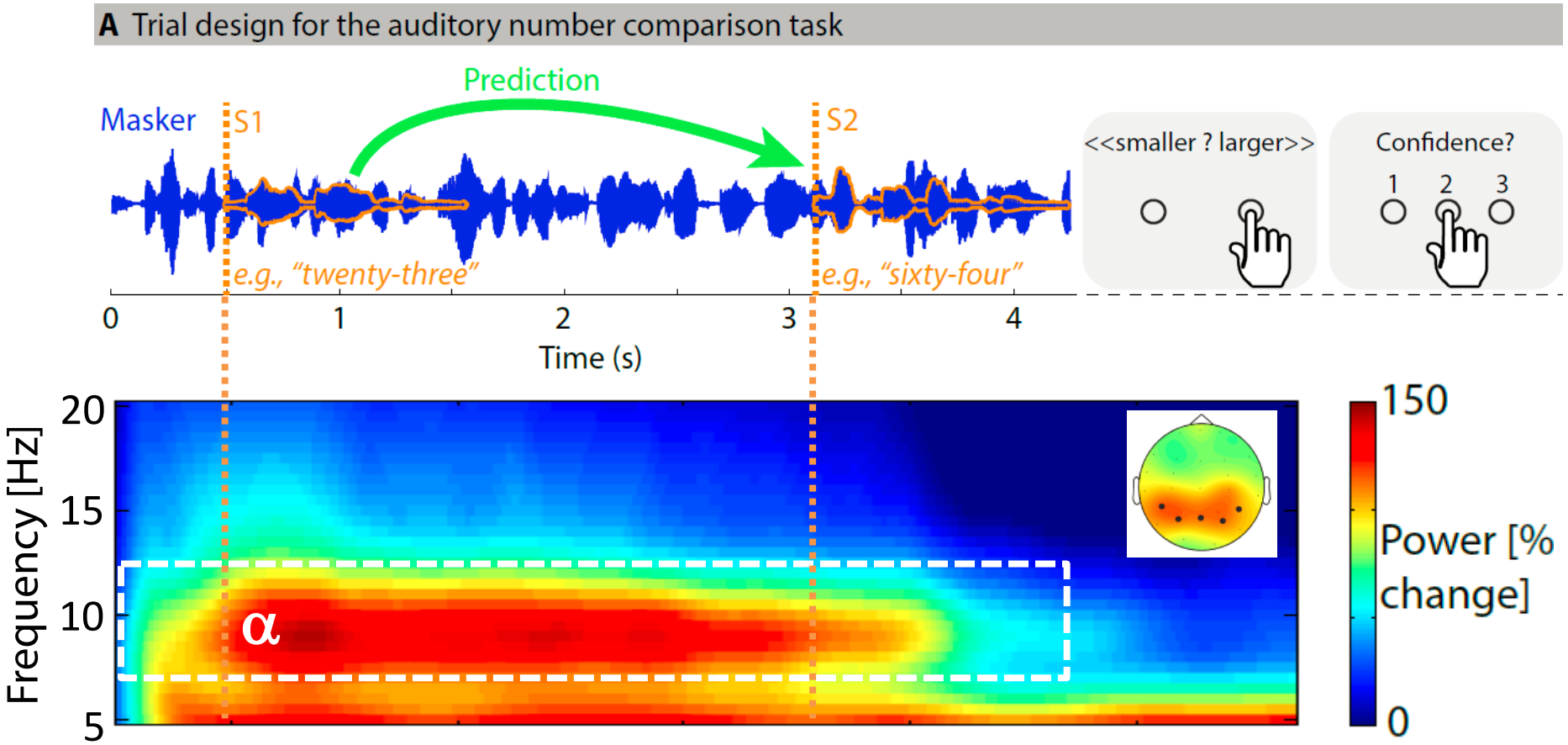






Wöstmann, Herrmann, Wilsch, Obleser (in press). *J Neurosci.*

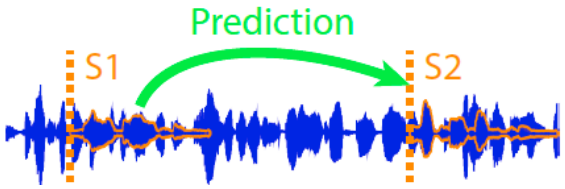
Alpha power during number comparison

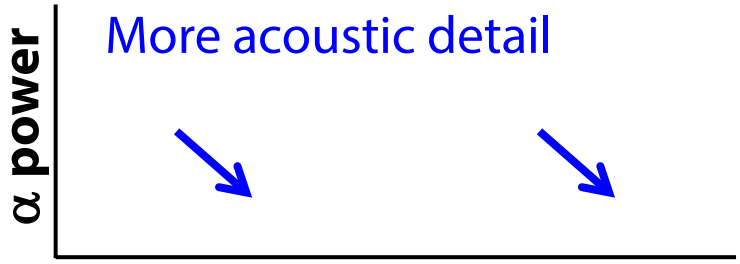


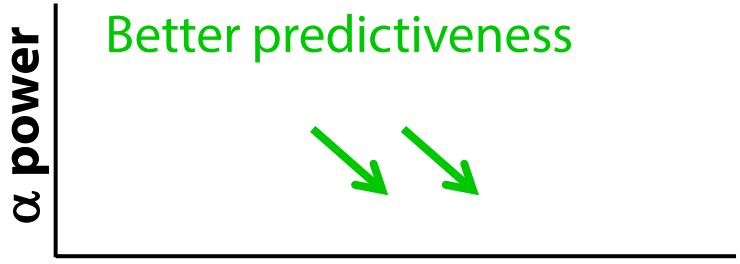
Wöstmann, Herrmann, Wilsch, Obleser (in press). *J Neurosci.*

Age-effects on alpha power modulations

A Alpha power modulations







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Age-effects on alpha power modulations

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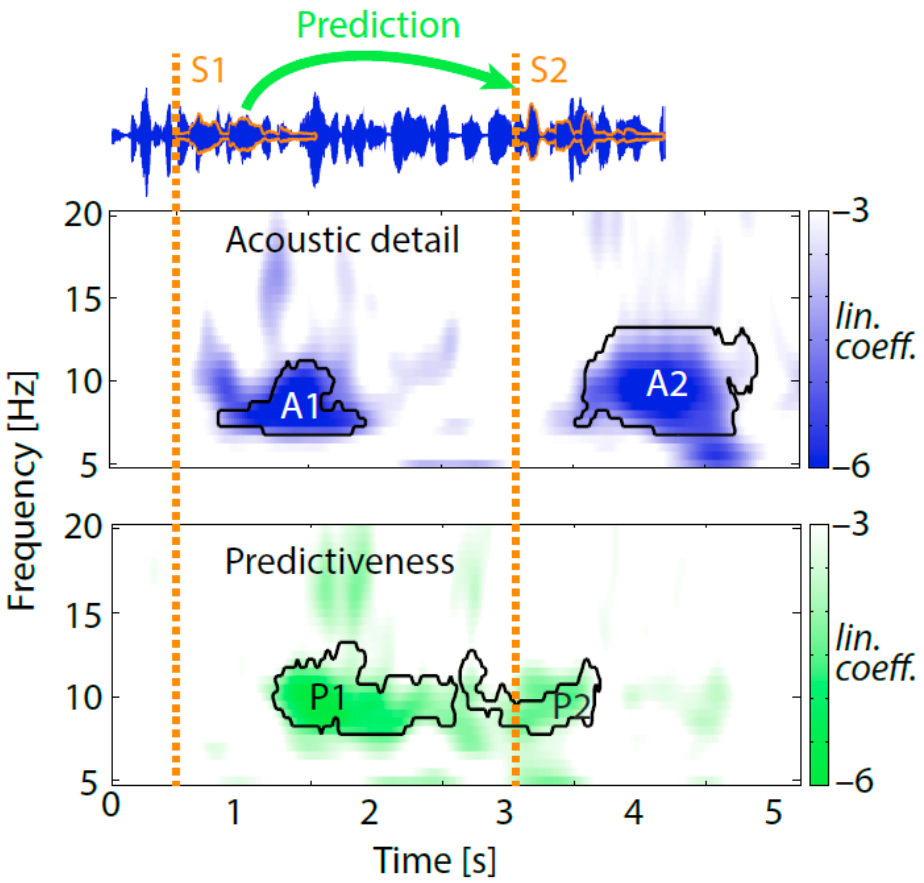
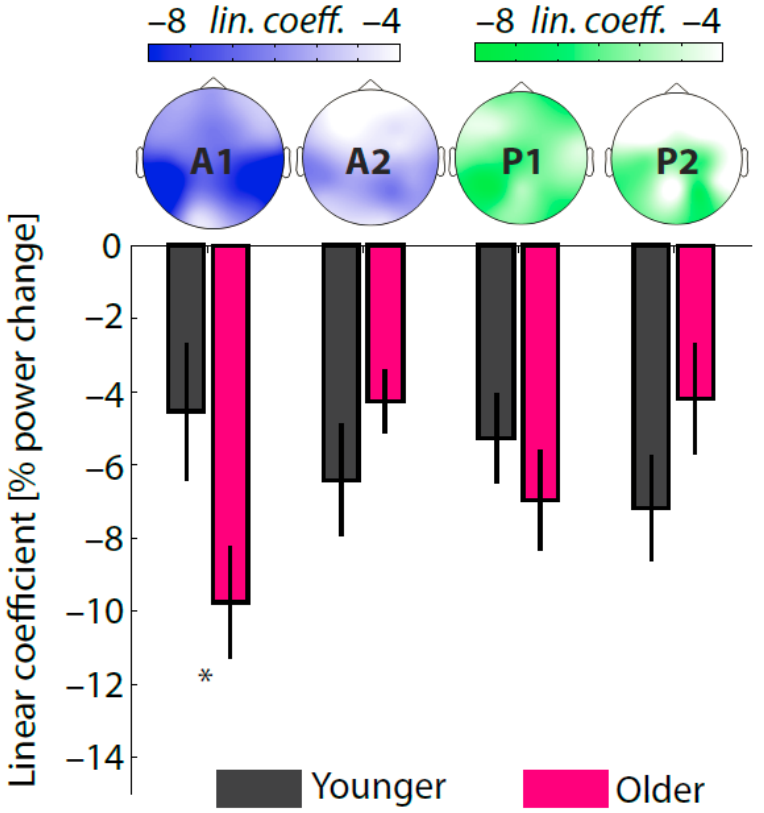


B Effects of age on alpha power modulations



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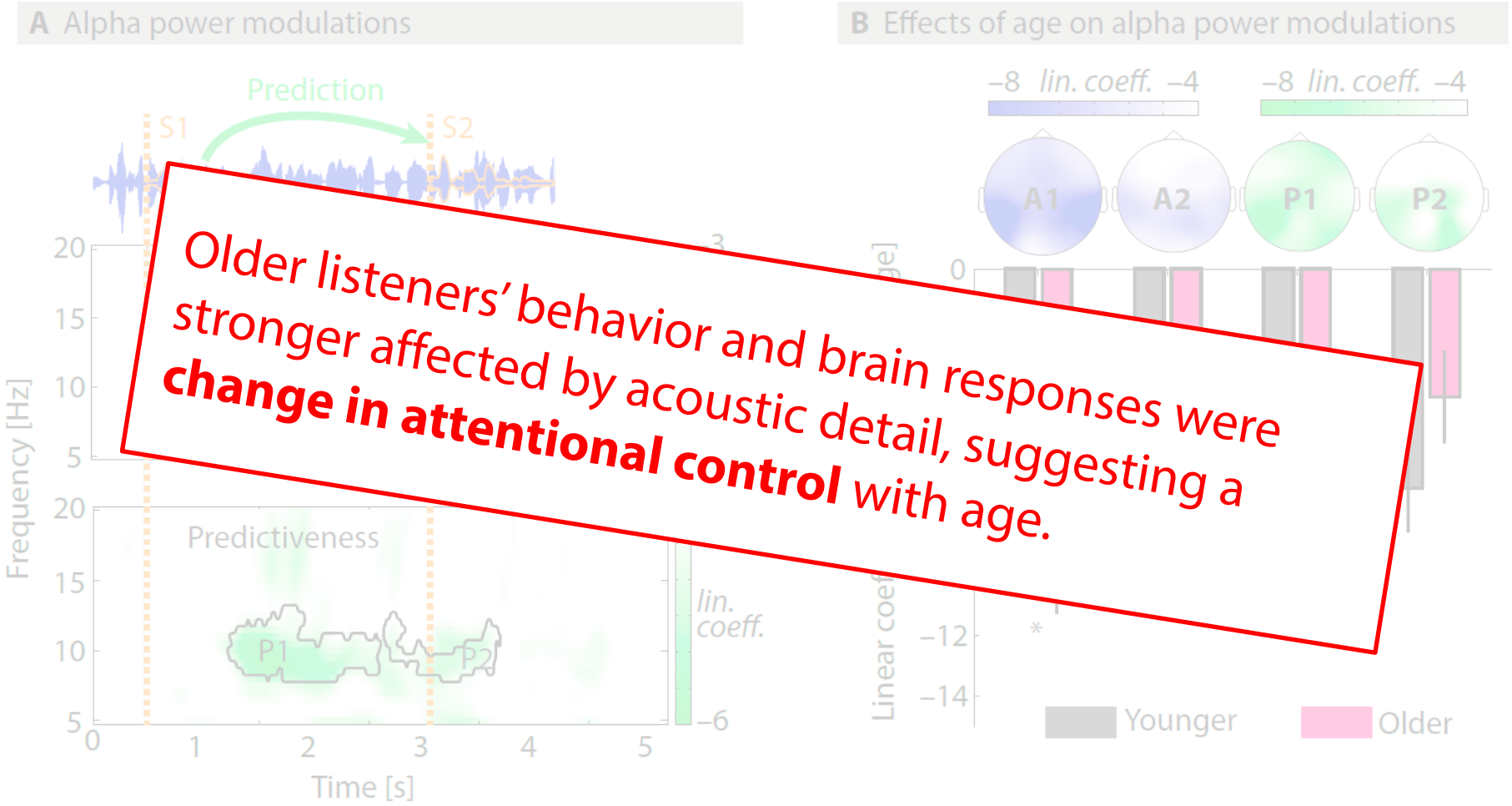
Age-effects on alpha power modulations



Wöstmann, Herrmann, Wilsch, Obleser (in press). *J Neurosci.*

Today's Questions

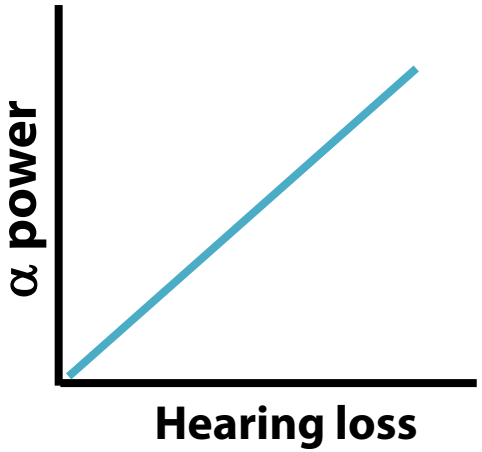
1) Do alpha power dynamics reflect listening challenges experienced…

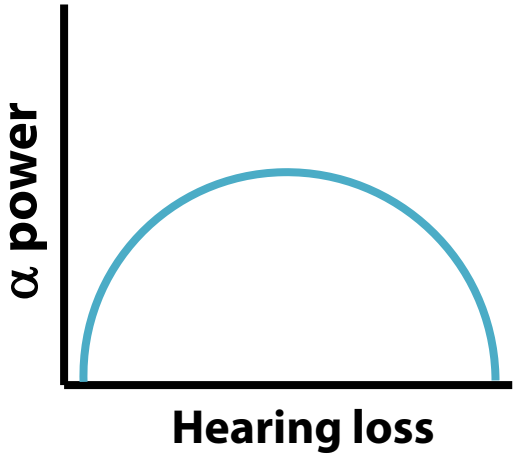
… at an older age?

… with progressive hearing loss?

2) "Can alpha oscillations in the brain protect speech signals against interfering distractors?"

Does hearing loss affect alpha power dynamics?





P8 **Influence of hearing impairment on alpha power during retention of auditory stimuli**

Eline Borch Petersen[1,2], Malte Wöstmann[3], Jonas Obleser[3], Stefan Stenfelt[2], Thomas Lunner[1,4]
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[2]Technical Audiology, Dep. of Clin. and Exptl. Medicine, Linköping University, Sweden
[3]Max Planck Inst. for Human Cognitive and Brain Sciences, Res. Group 'Auditory Cognition', Leipzig, Germany
[4]Swedish Inst. for Disability Res., Linnaeus Centre, HEAD Linköping University, Sweden
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Presented at the 7th Speech in Noise (SpiN) Workshop, Copenhagen, Denmark, January 8-9, 2015

E. Borch-Petersen

T. Lunner

Linköping University

EriksholmResearchCentre
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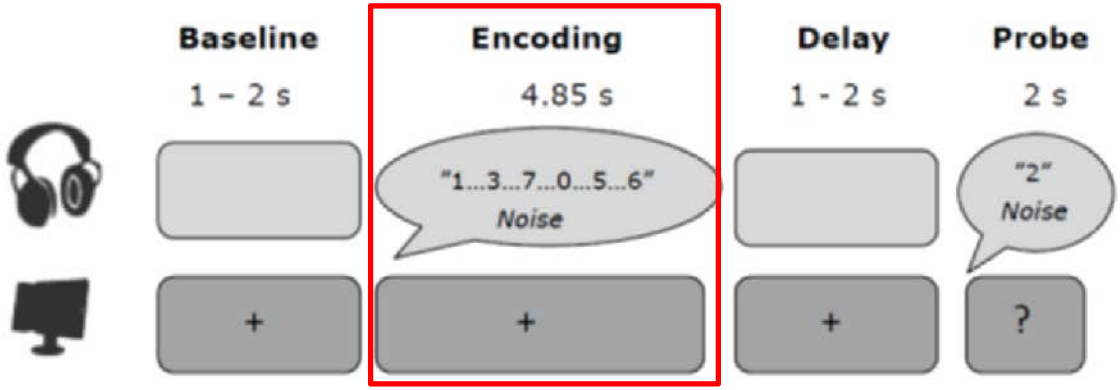
Borch-Petersen, Wöstmann, Obleser, Stenfelt, Lunner (under review).
See also: Reuter-Lorenz & Cappell (2008). *Curr Dir Psychol Sci*.

Does hearing loss affect alpha power dynamics?



3 (Memory load: 2, 4, 6 digits)

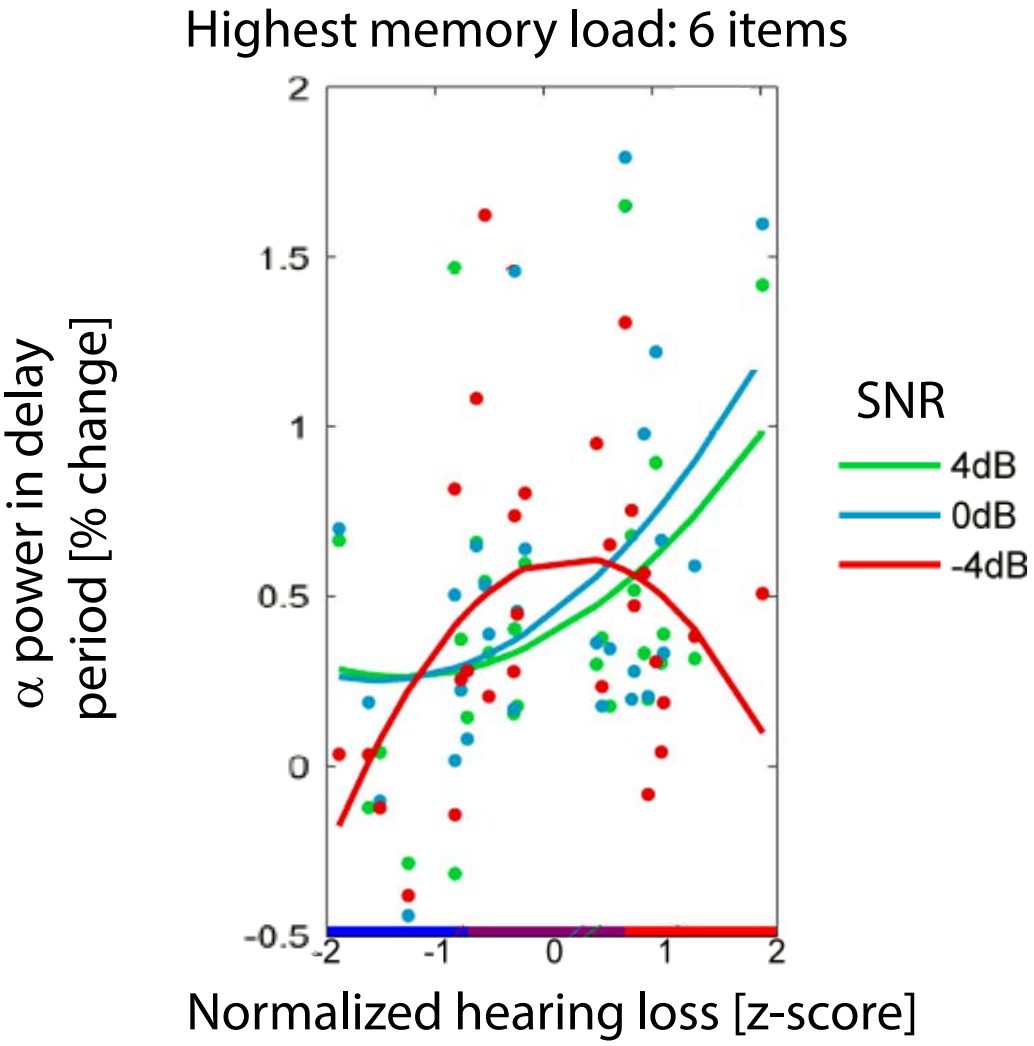
x

3 (SNR: 4, 0, -4 dB)

n = 29; 62-86 years

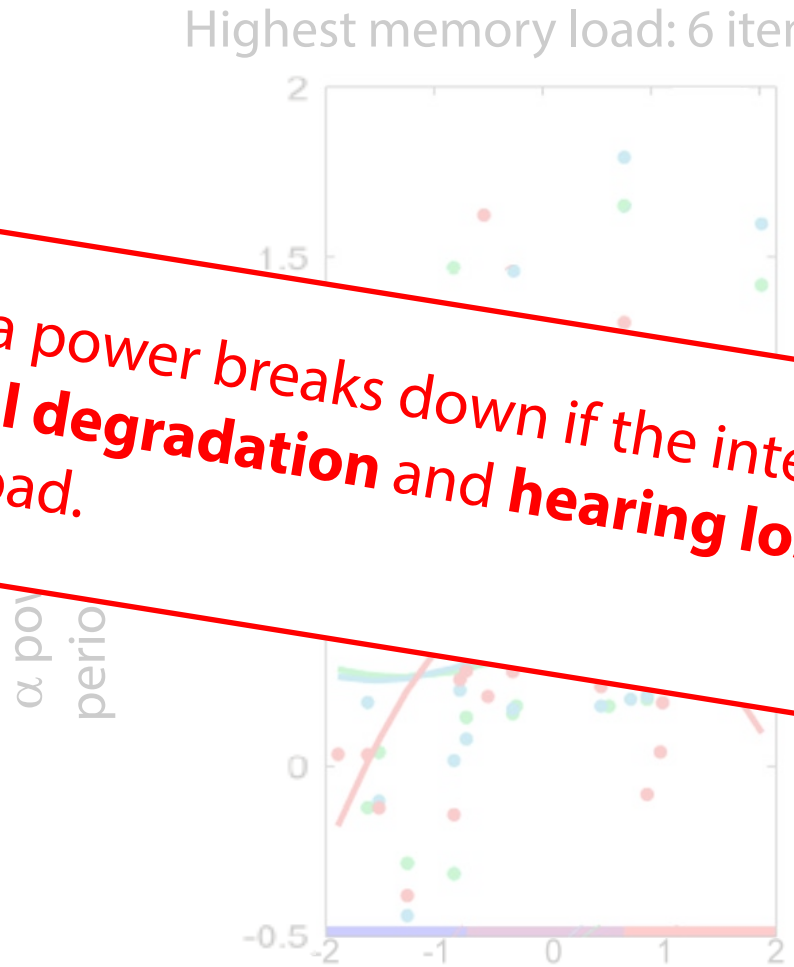
Borch-Petersen, Wöstmann, Obleser, Stenfelt, Lunner (under review).

Does hearing loss affect alpha power dynamics?



Borch-Petersen, Wöstmann, Obleser, Stenfelt, Lunner (under review).

Does hearing loss affect alpha power dynamics?



Alpha power breaks down if the interplay between ***signal degradation*** *and* ***hearing loss*** *induces a high task load.*

Borch-Petersen, Wöstmann, Obleser, Stenfelt, Lunner (under review).

Today's Questions

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Can alpha oscillations in the brain protect speech signals against interfering distractors?

Malte Wöstmann [1,2], Antje Strauß [1], & Jonas Obleser [1]

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[2] International Max Planck Research School on Neuroscience of Communication, Leipzig, Germany

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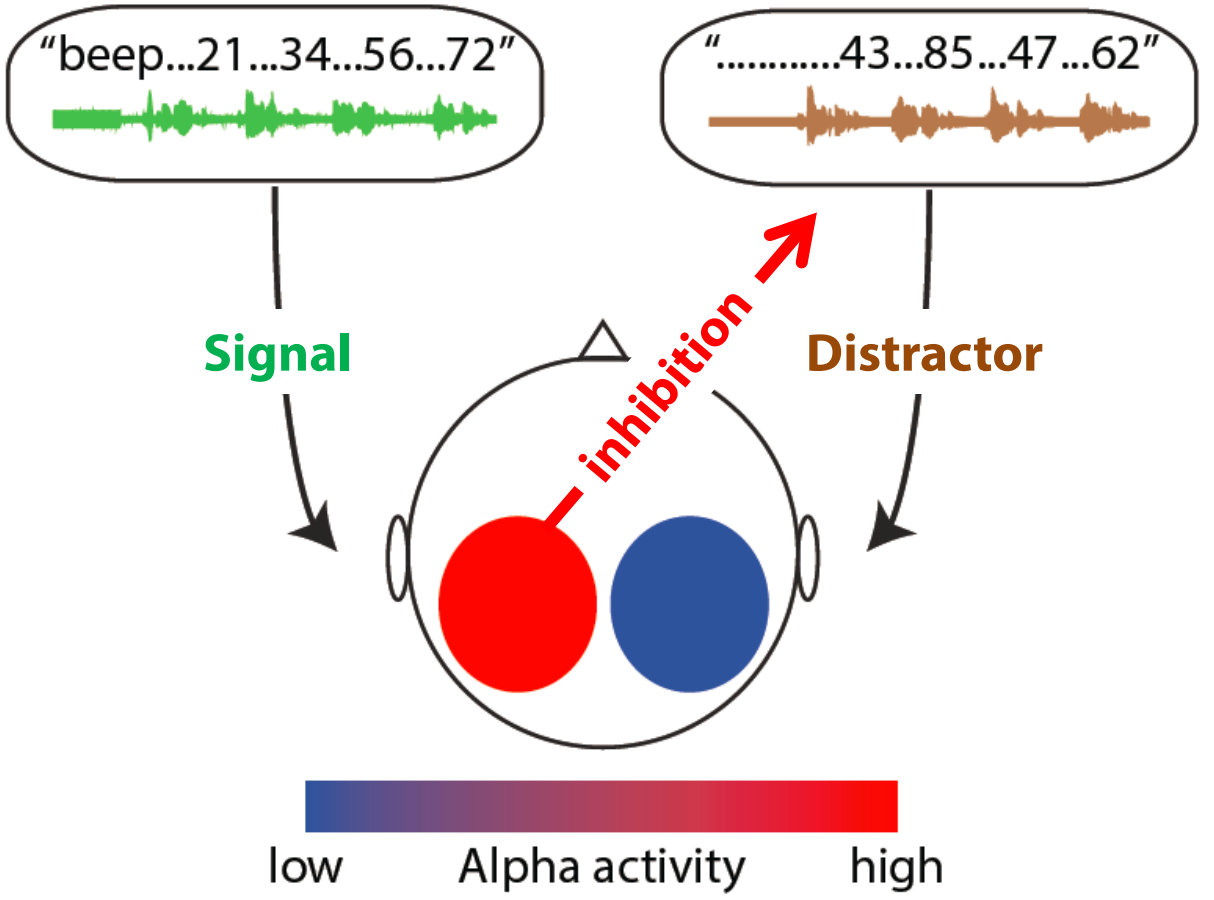

Can alpha oscillations in the brain protect speech signals against interfering distractors?

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[1] Max Planck Research Group "Auditory Cognition", Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

[2] International Max Planck Research School on Neuroscience of Communication, Leipzig, Germany

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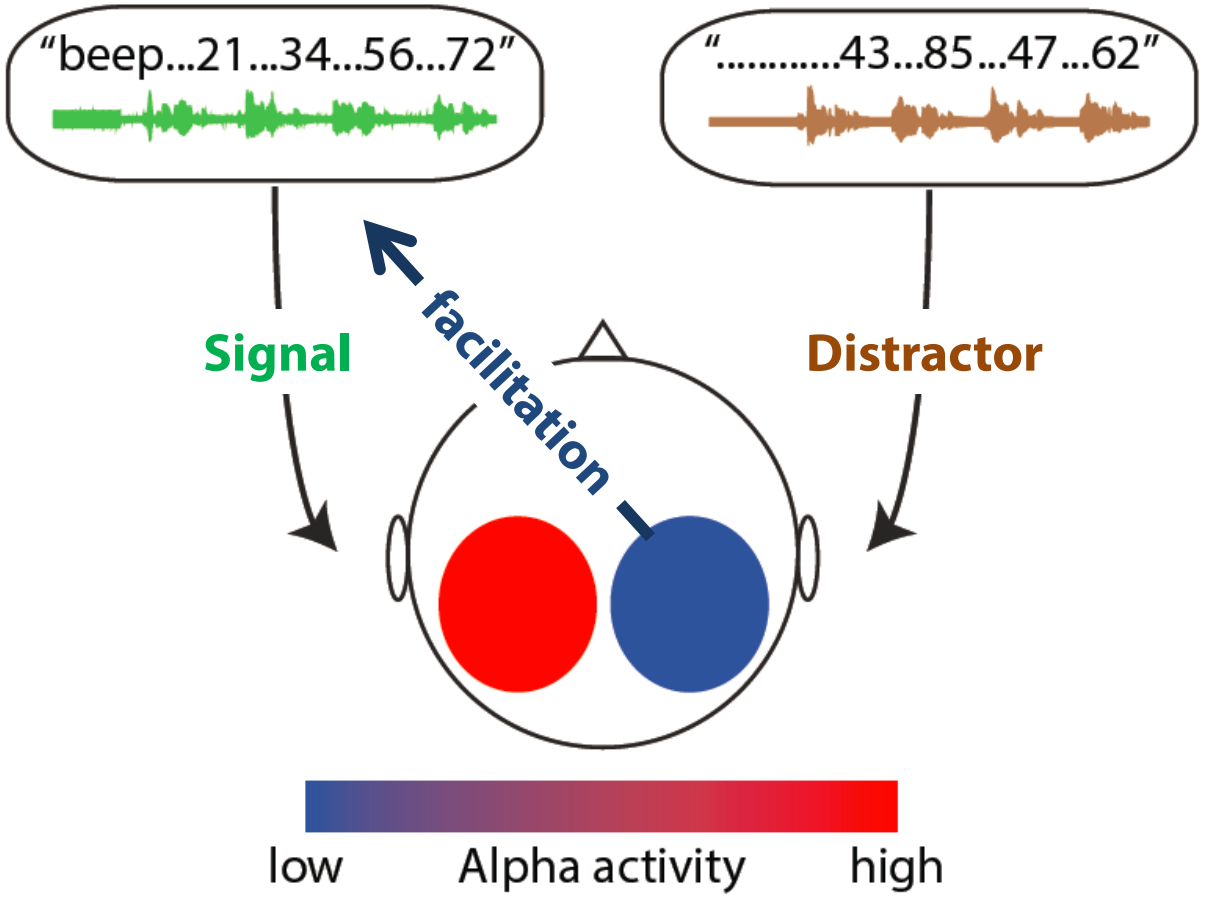
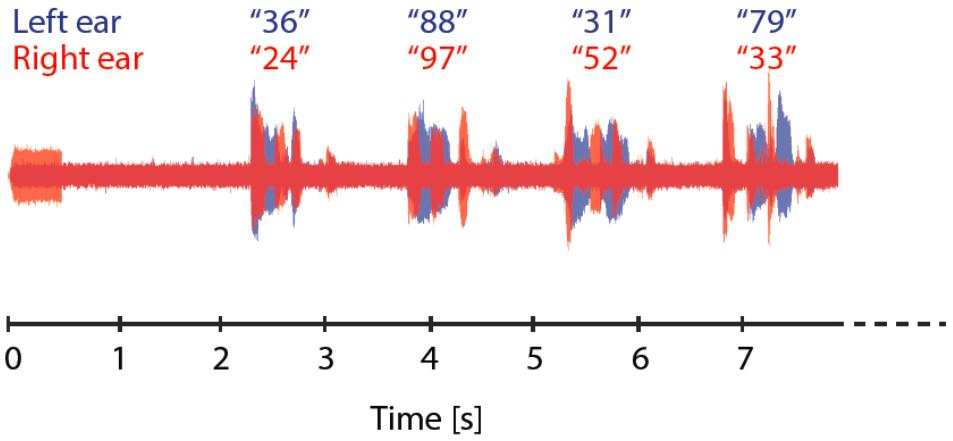
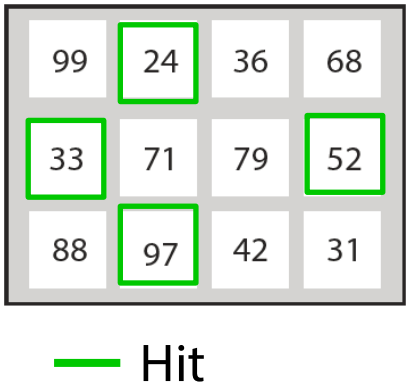
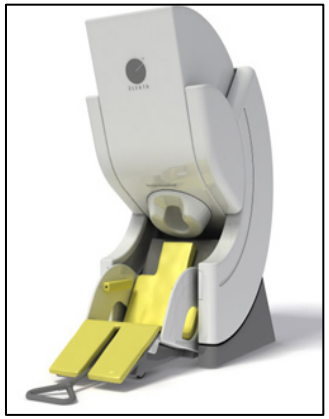


Auditory spatial attention task

Dichotic listening; n = 19; (20 – 35 years)





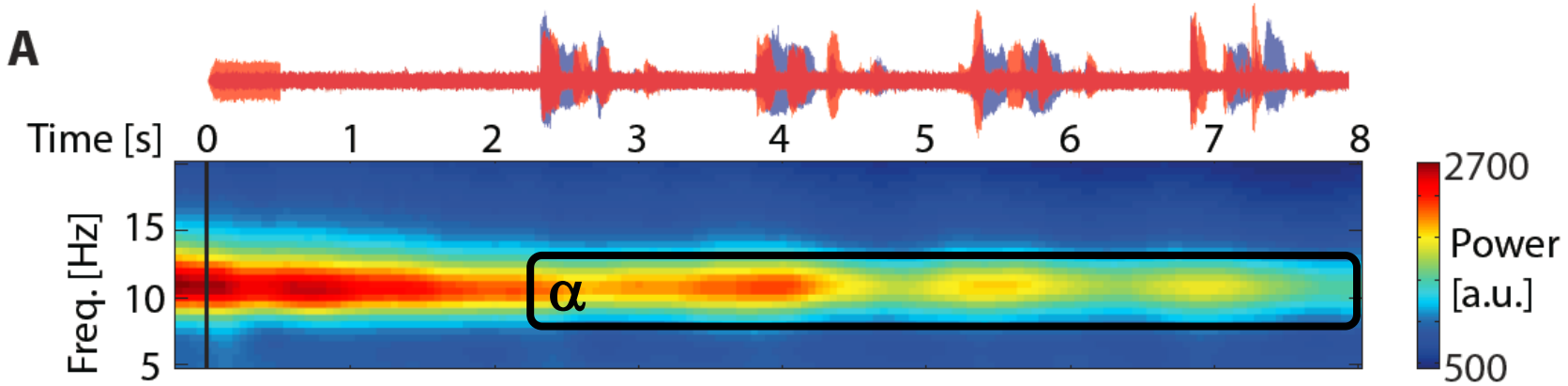


CORRECT TRIAL: 4 Hits; INCORRECT TRIAL: < 4 Hits

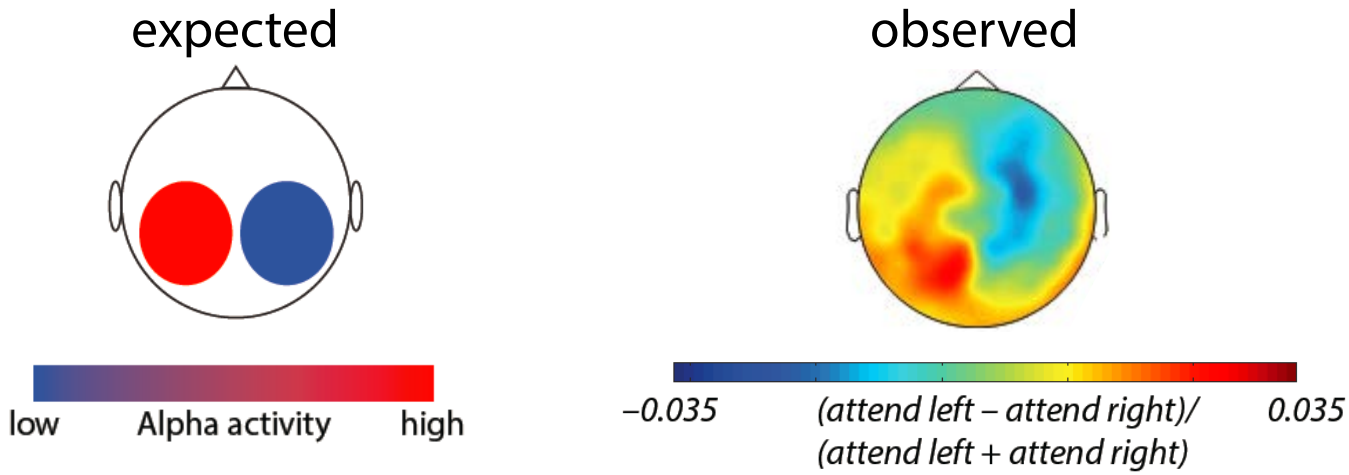
Wöstmann, Herrmann, Maess, Obleser (in prep.)

Alpha power lateralization

Absolute power



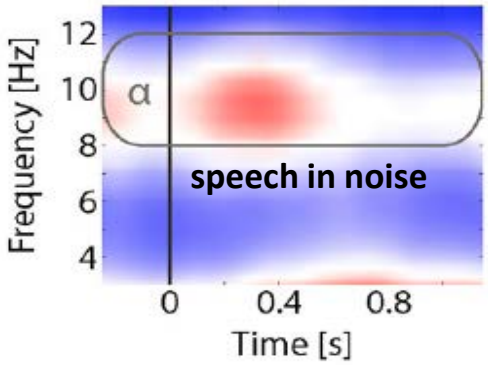
α (~10 Hz) lateralization



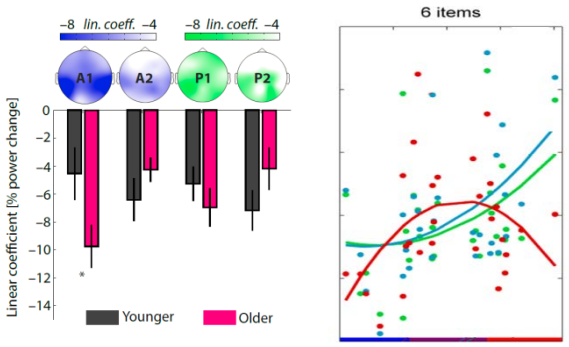
Wöstmann, Herrmann, Maess, Obleser (in prep.)

Summary

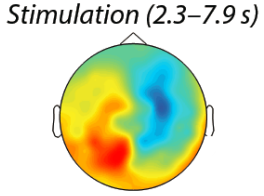
Processing degraded speech is **attention-demanding** and enhances **alpha power.**



Alpha dynamics reflect (1) changes in listening behavior at an **older age**, and (2) interactions between **signal degradation** and compensated **hearing loss**.



Lateralized alpha oscillations signify successful **attentional selection** of task-relevant speech.



Thanks to…

MAX PLANCK INSTITUTE FOR HUMAN COGNITIVE AND BRAIN SCIENCES LEIPZIG

Jonas Obleser
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Alex Brandmeyer
Sung-Joo Lim
Anna Wilsch
Antje Strauß
Dunja Kunke

Erich Schröger,
University of Leipzig

E. Borch-Petersen & T. Lunner

Linköping University

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