Universität Zürich[UZH]

# Zum Zusammenhang zwischen altersbedingter Hirnatrophie und zentralem Hörverlust

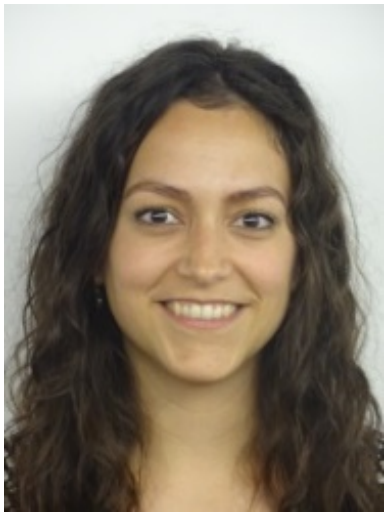
Martin Meyer
University of Zurich, Switzerland
20.09.2019

# CogTAiL

Cognition, Tinnitus, Aging, and Sensorineural Hearing Loss



Laura Jagoda



Nathalie Giroud



Pia Neuschwander



Jolanda Galbier



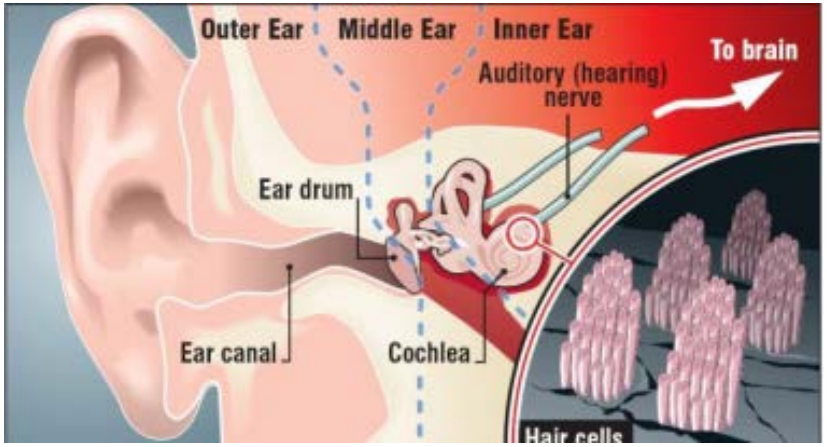
Matthias Keller

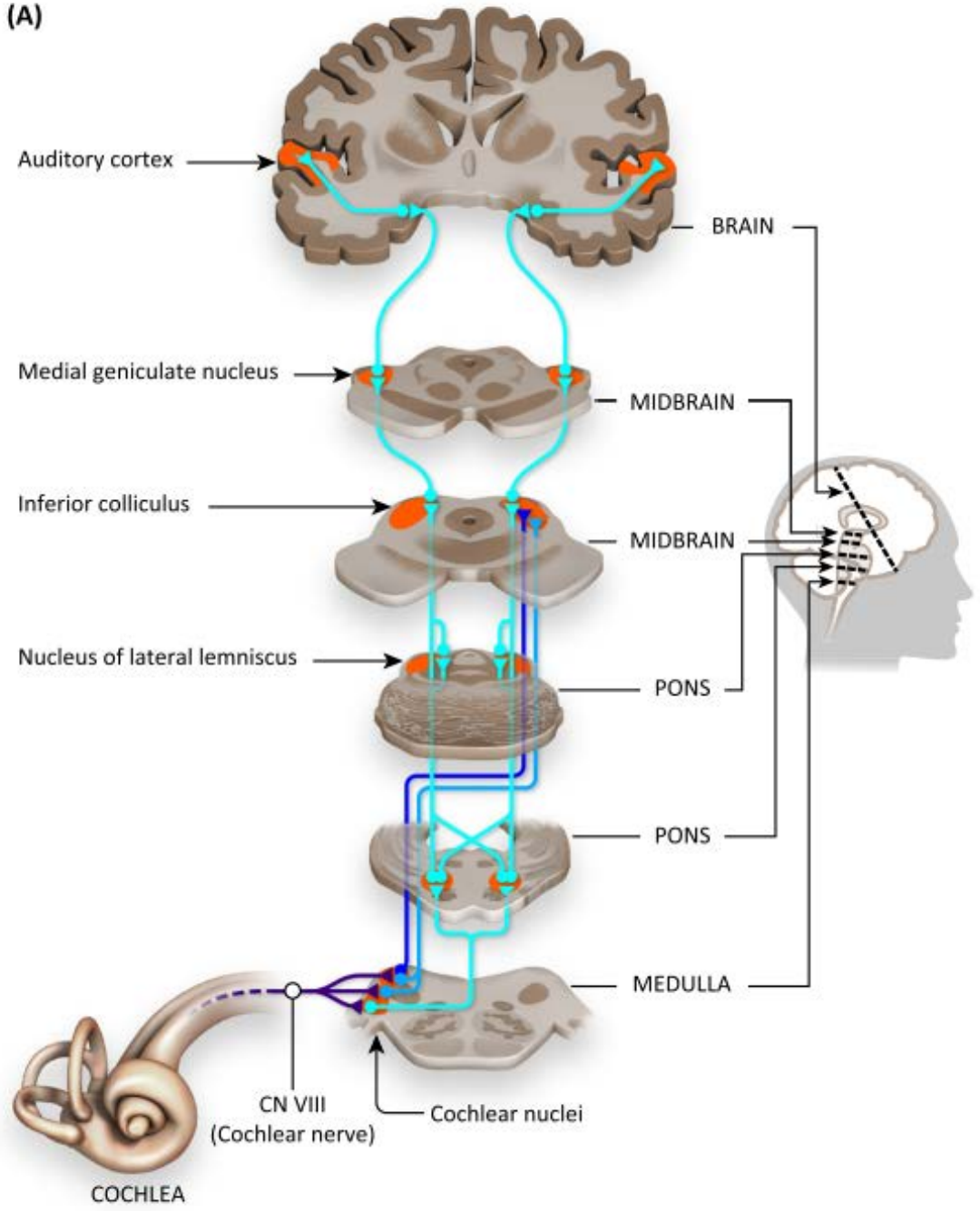


Benjamin Isler



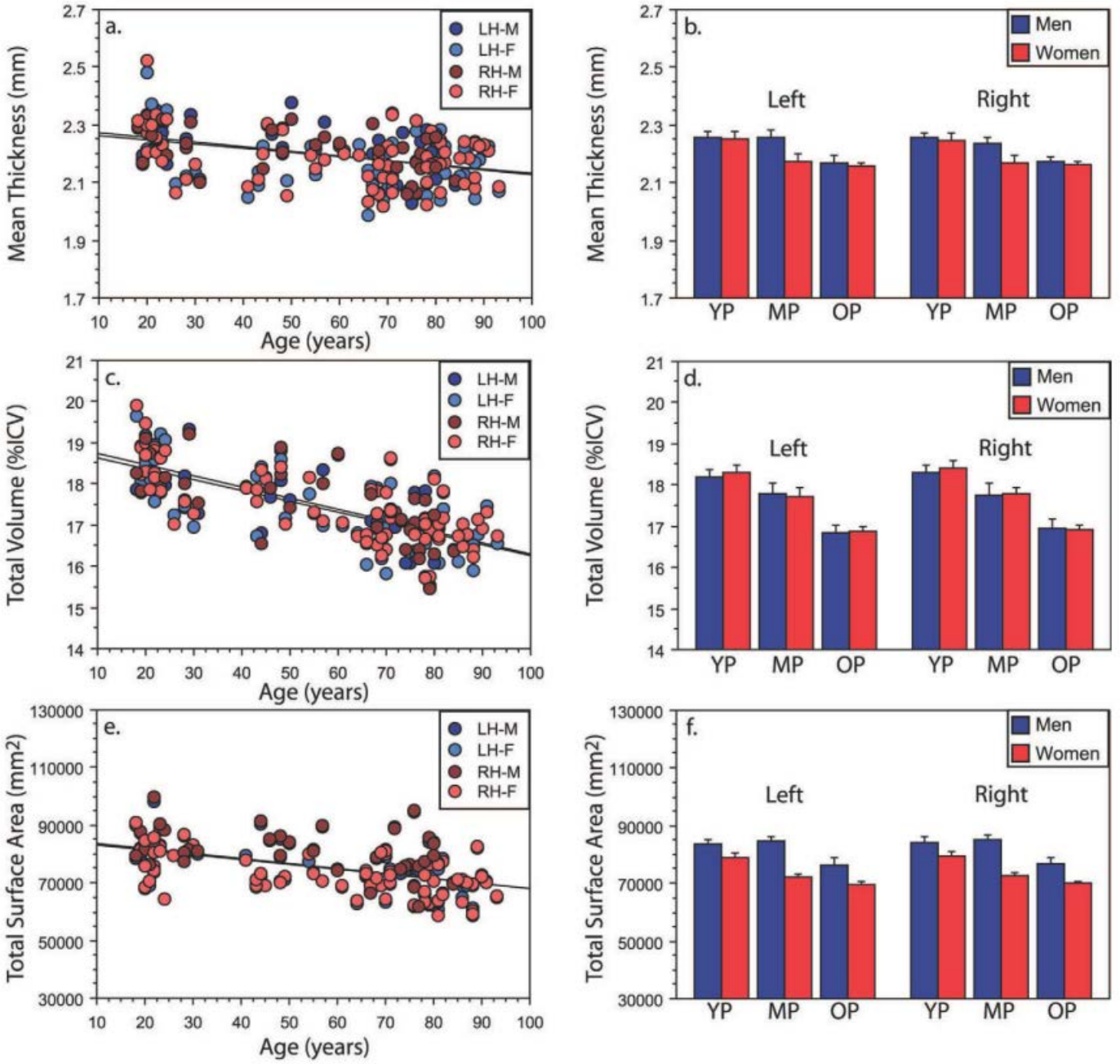
# Die Hörbahn



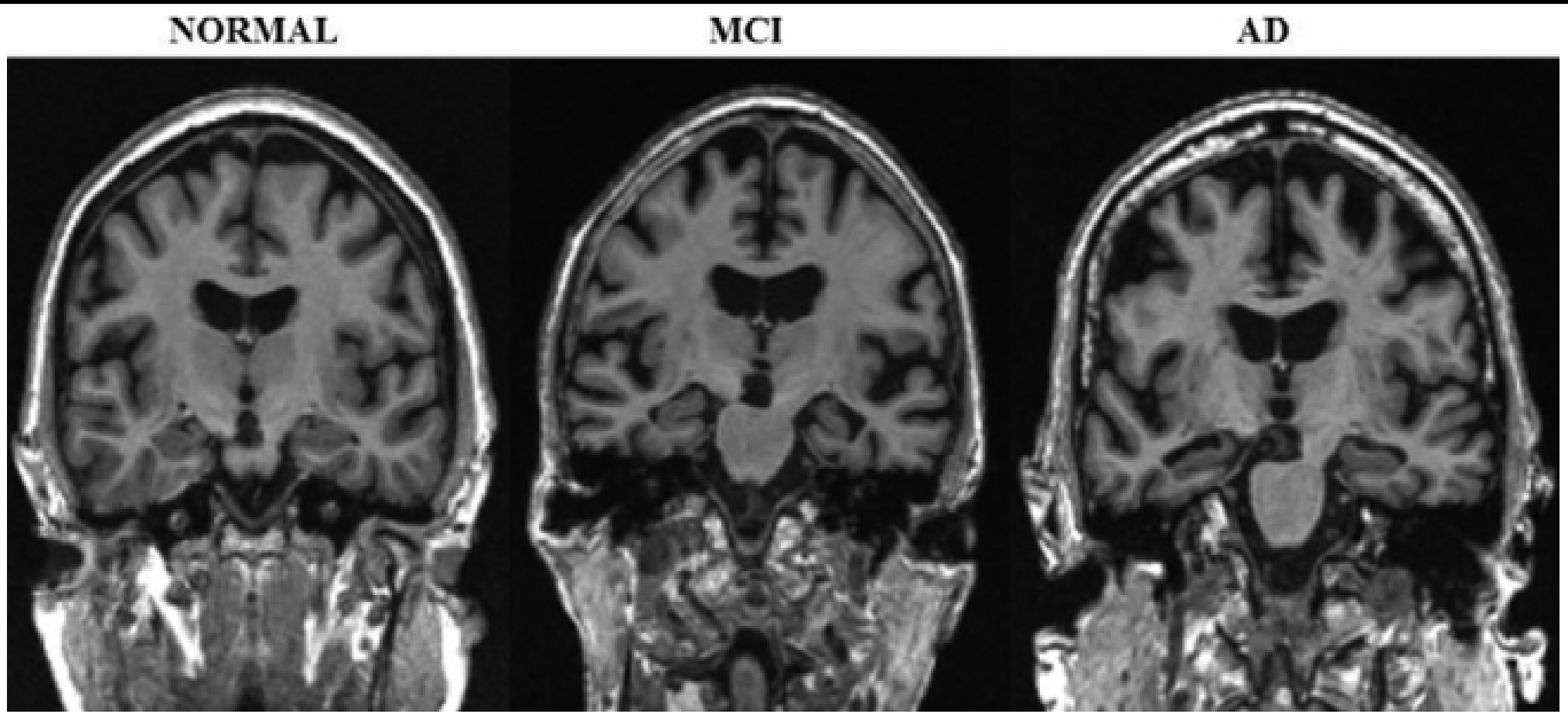

Peele & Wingfield (2016) TINS

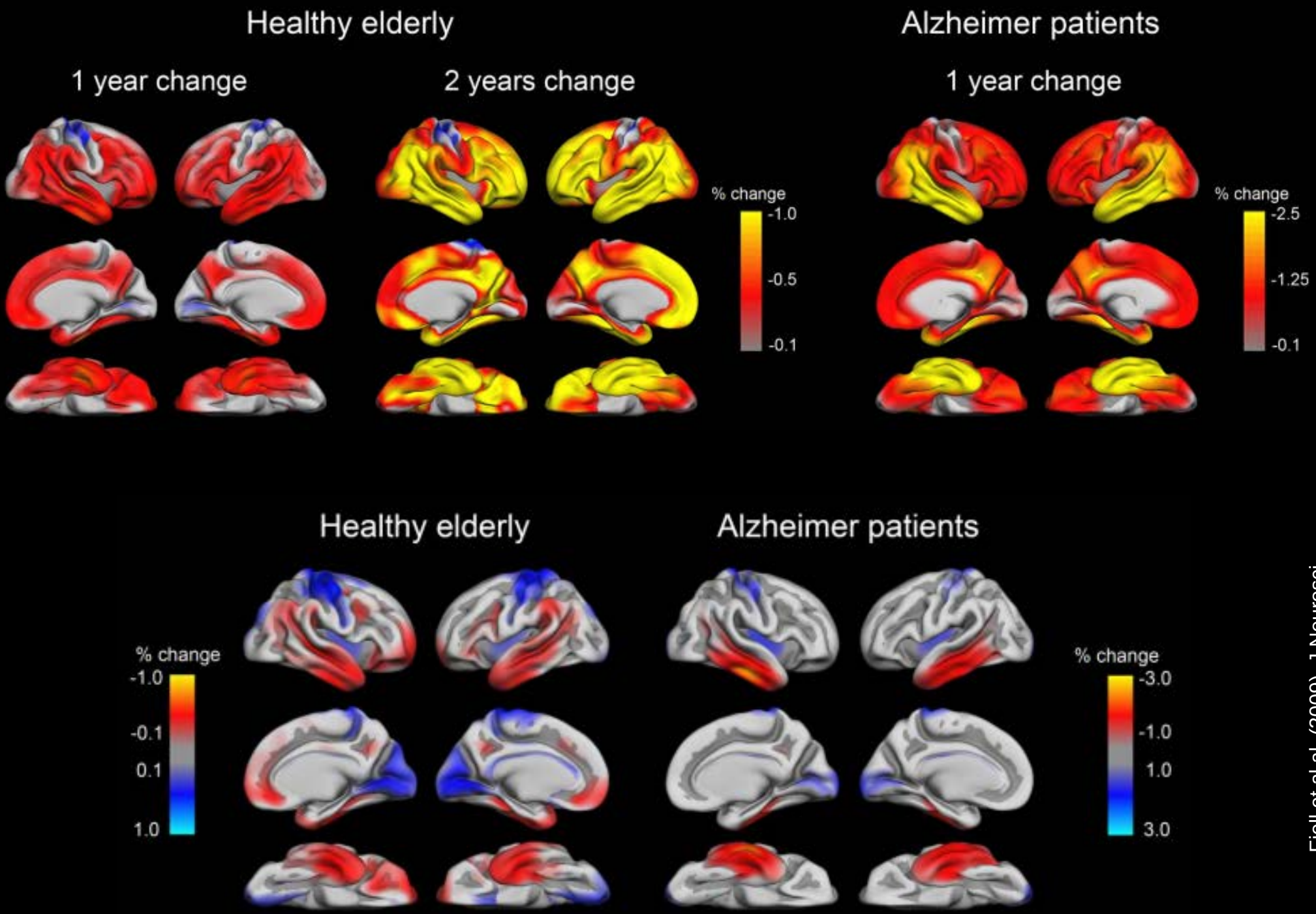
# Alterungsbedingte Hirnatrophie




Salat et al. (2004), Cereb Cortex

# Normales oder nicht normales Altern ???

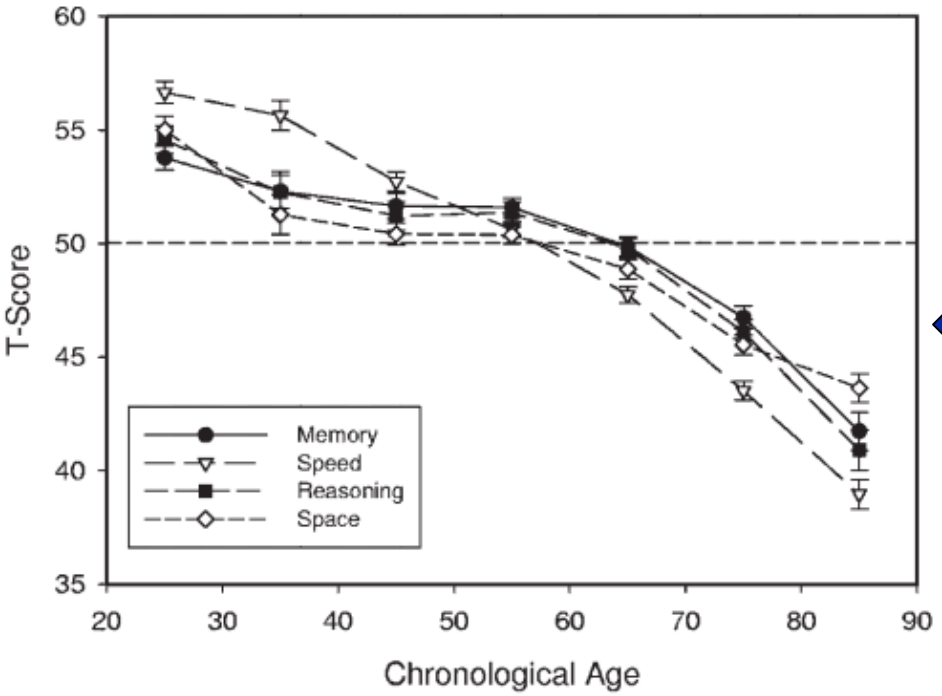




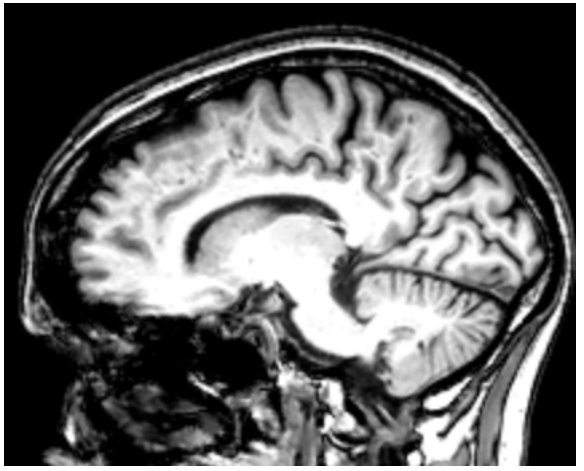

Fjell et al al. (2009), J Neurosci

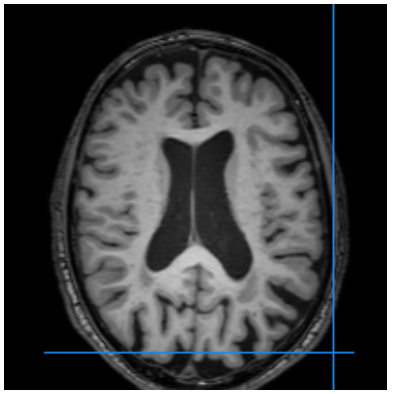
# «Normales Altern»

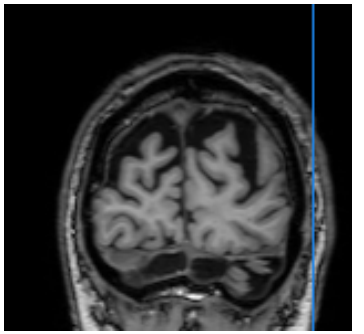
Wechselwirkungen ?

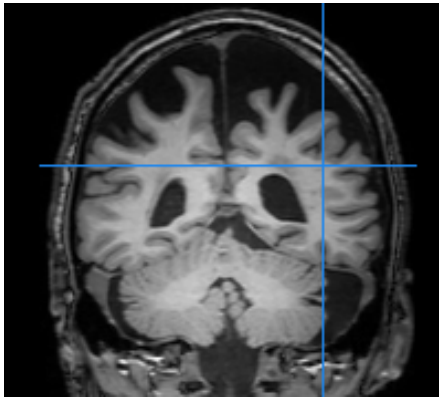



Salthouse, 2011, in Psychological Bulletin

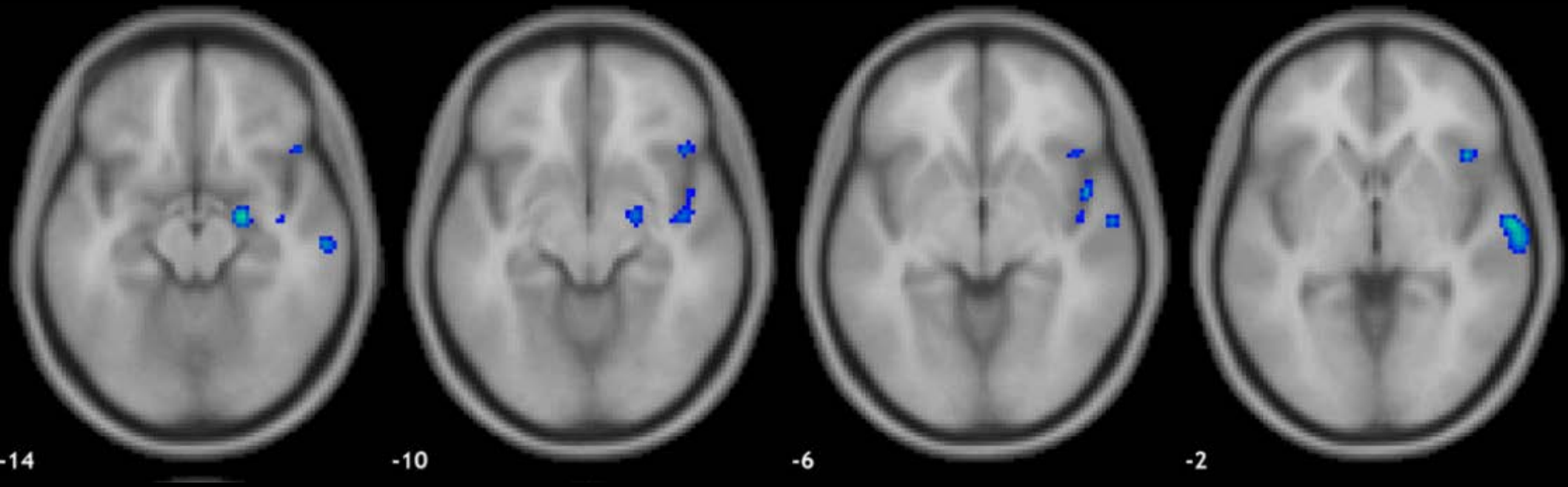








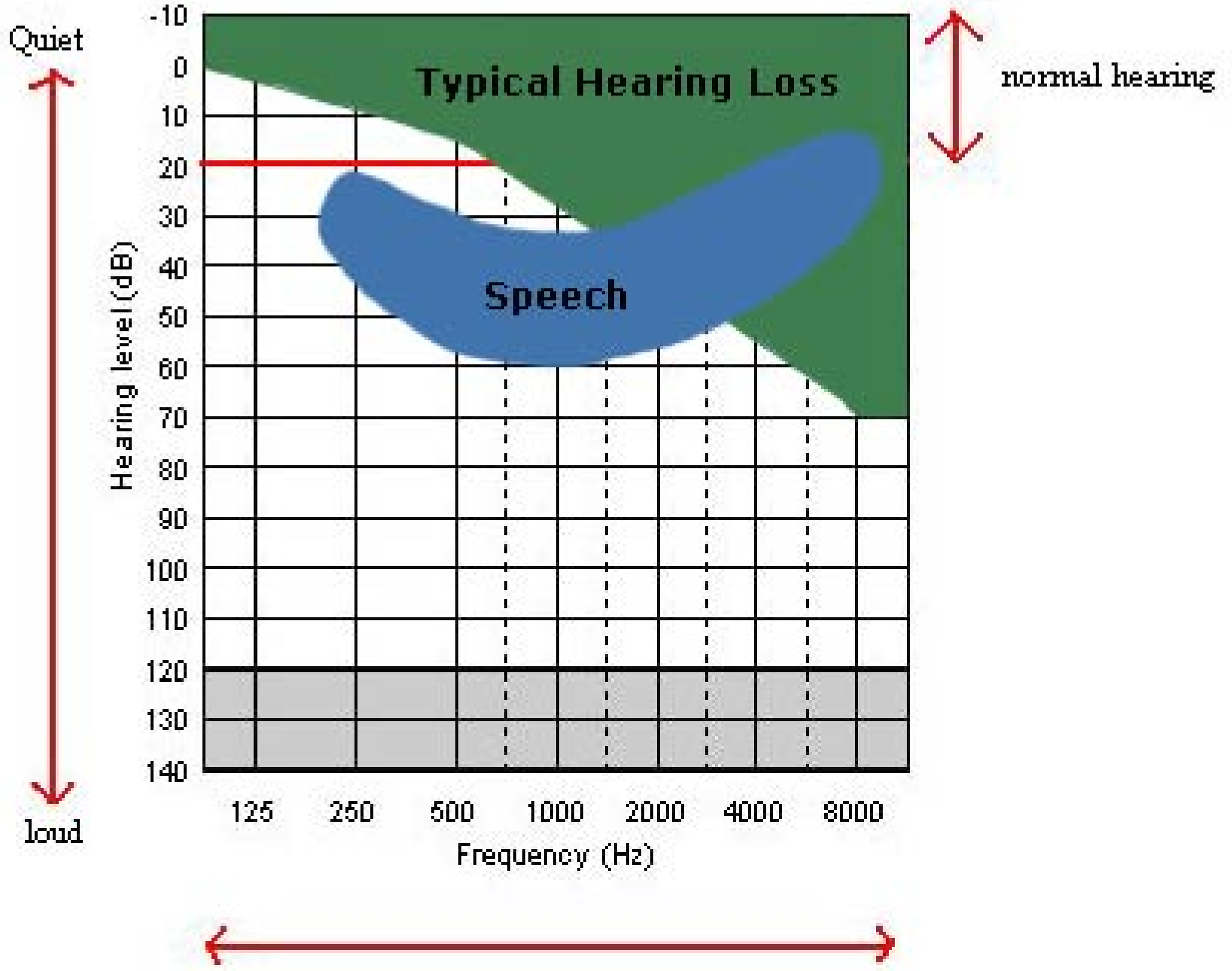
# Hörverlust und anatomische Veränderungen




Rückbau grauer Substanz in peri-auditorischen Arealen infolge von Hörverlust

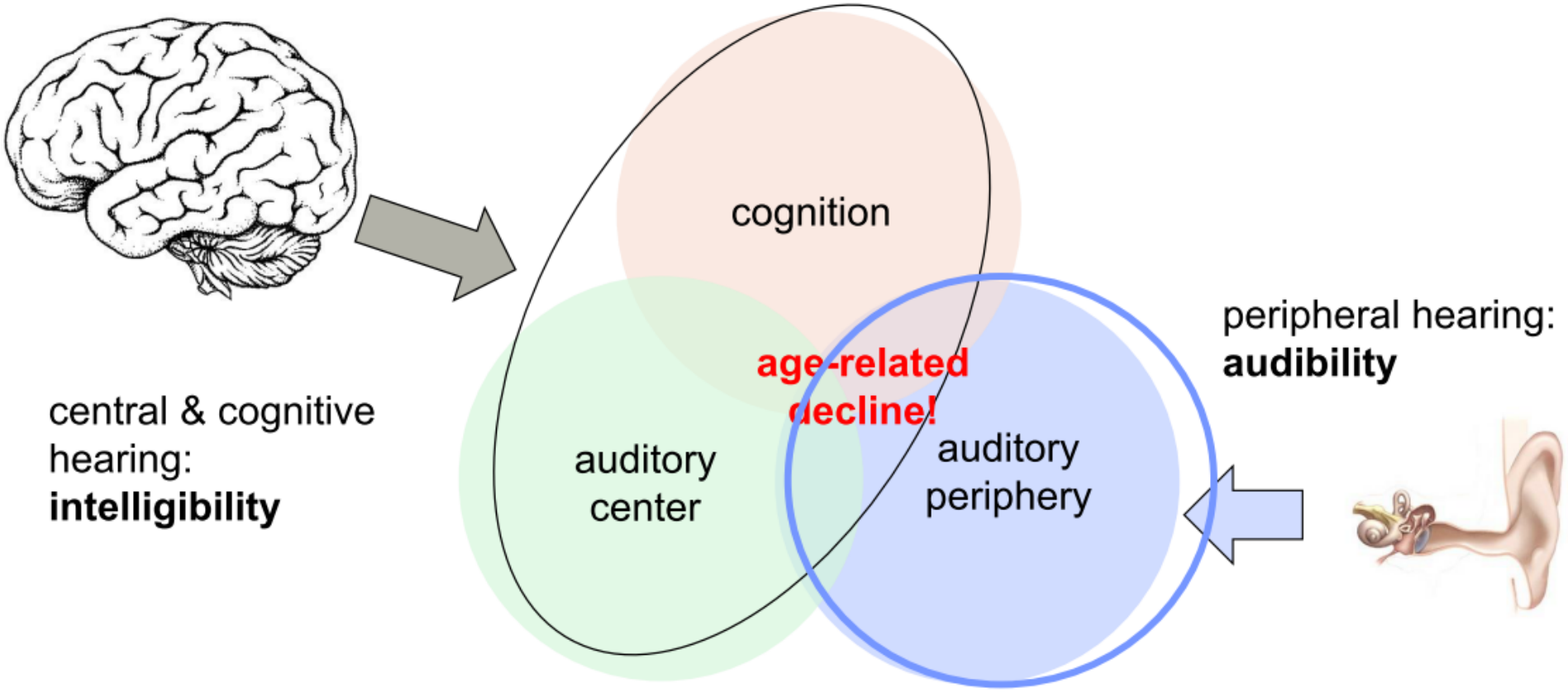
Lin et al. (2014), NeuroImage

# Hörverlust im Alter - Auswirkungen



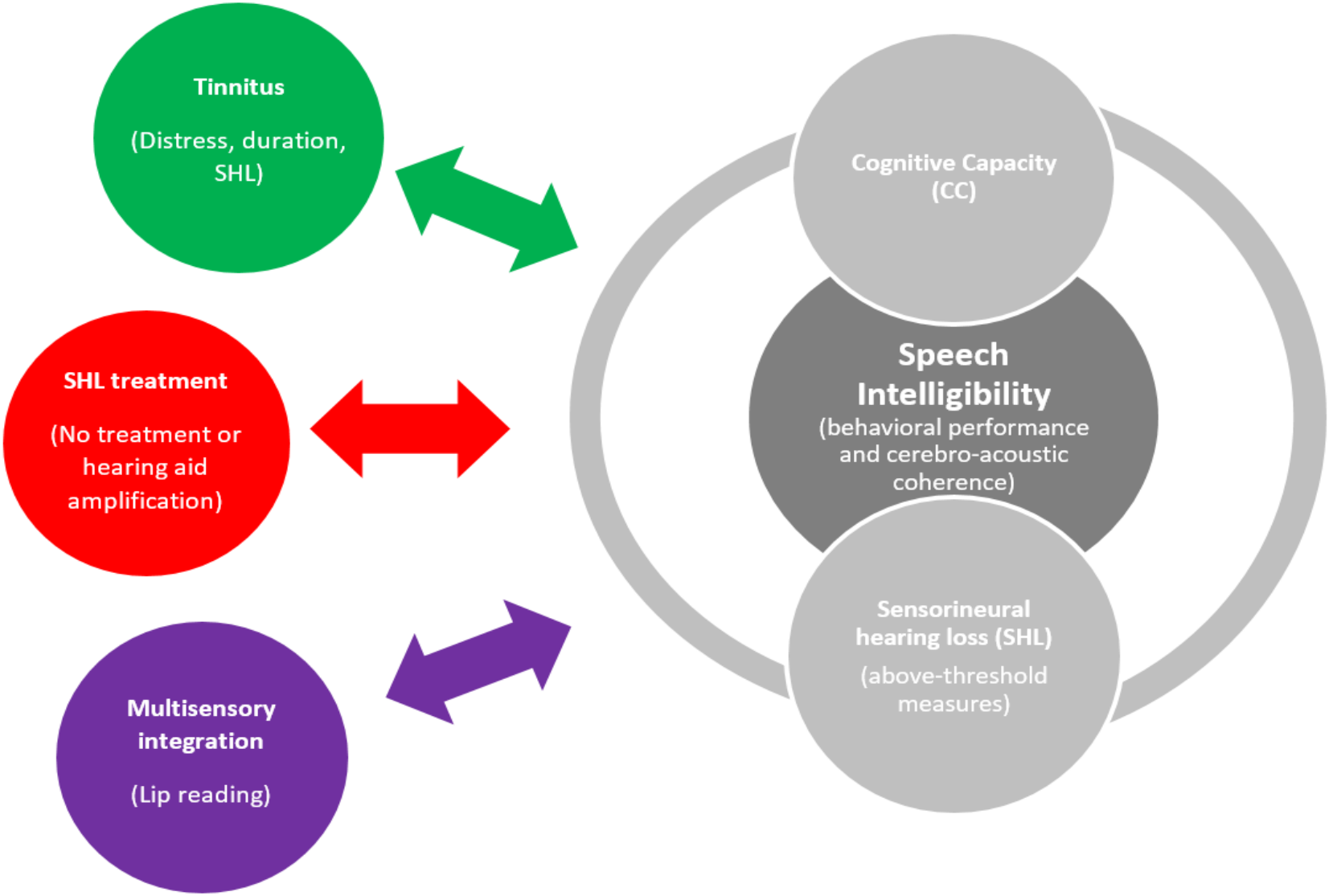

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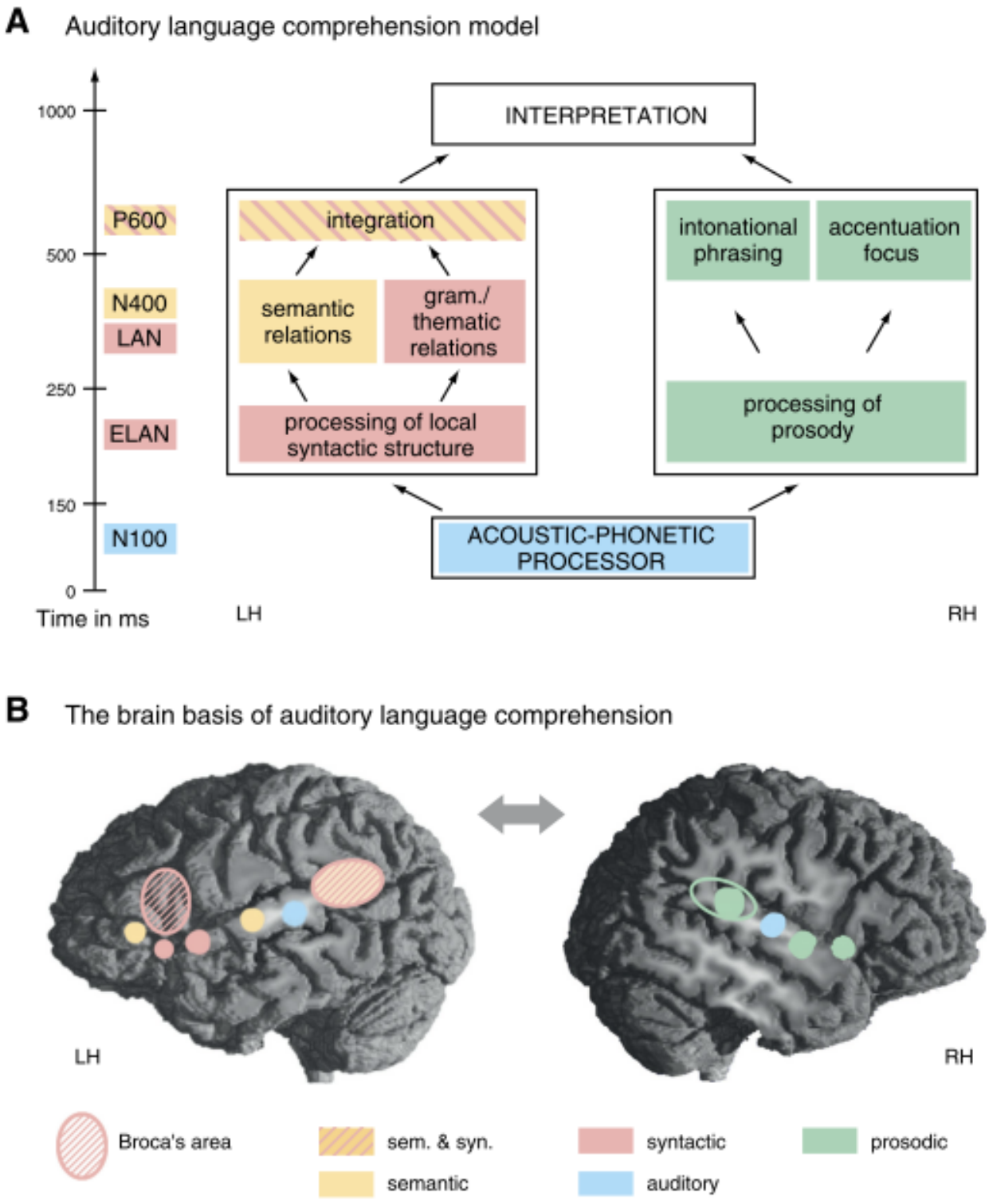
# Kognitives Hören



# CogTAiL

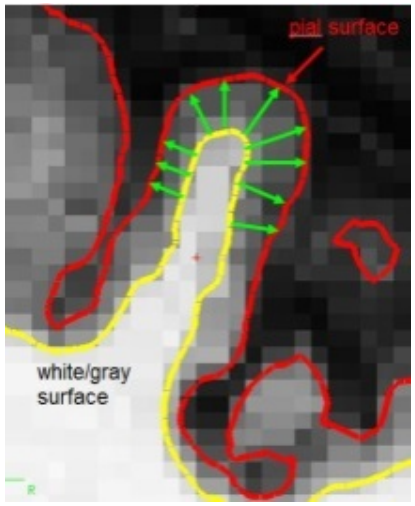
Cognition, Tinnitus, Aging, and Sensorineural Hearing Loss

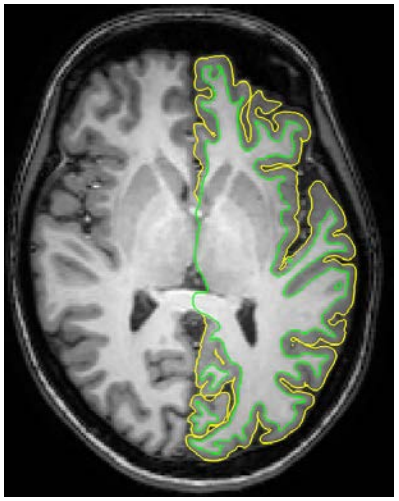


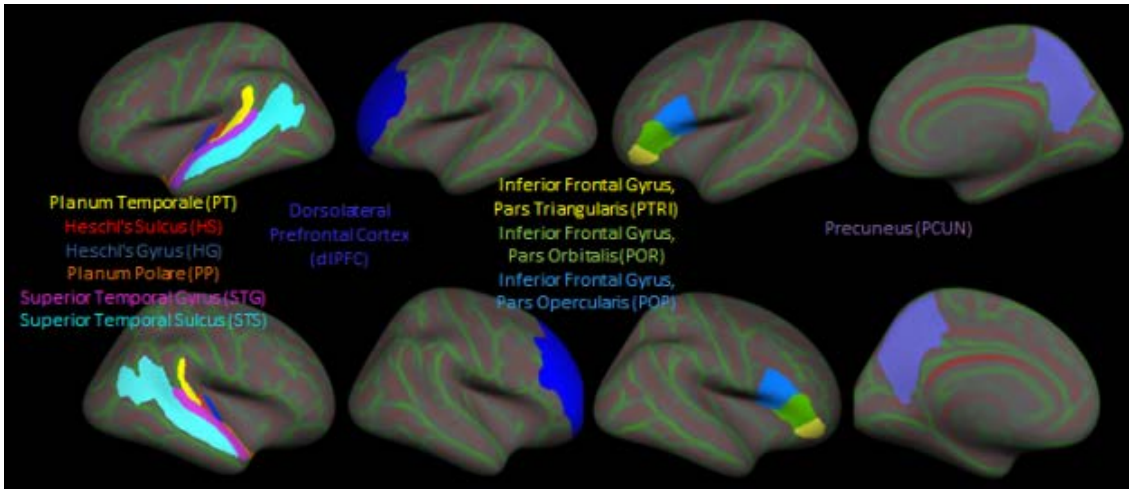


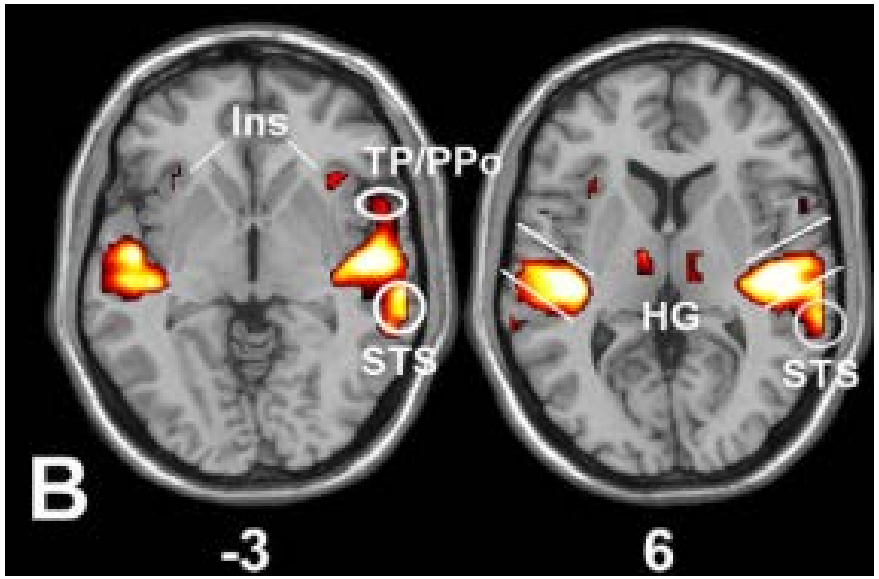

Friederici (2011) Physiolo Rev

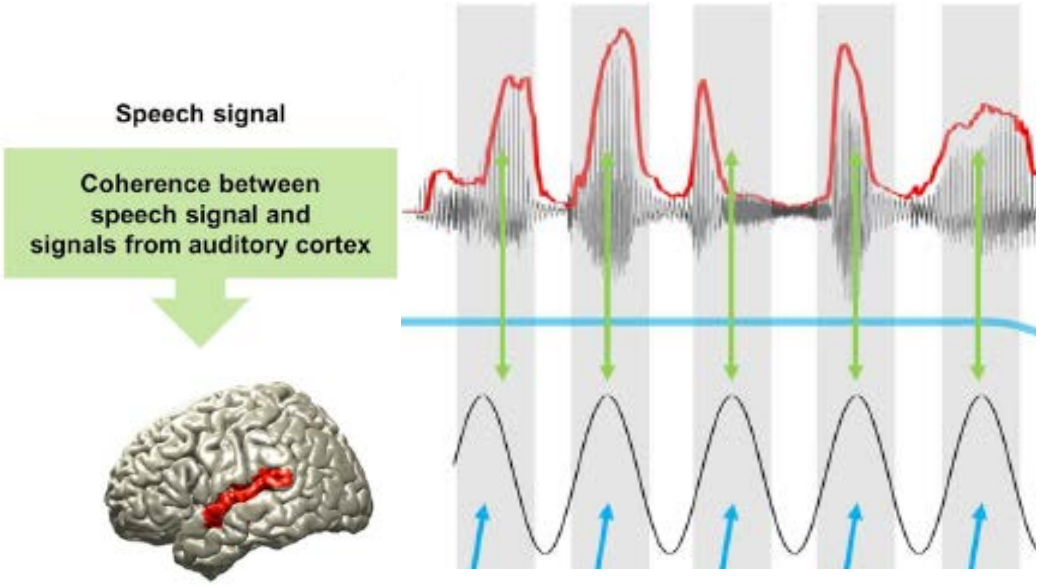
# Multimodal Imaging Approach



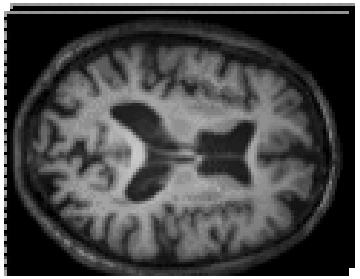






Park et al., 2015

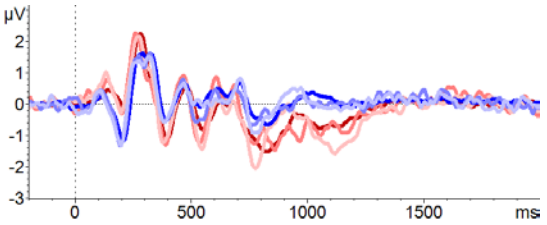


Kortikale Atrophie **(Hörrinde)**

Auditorische **Wahrnehmung**



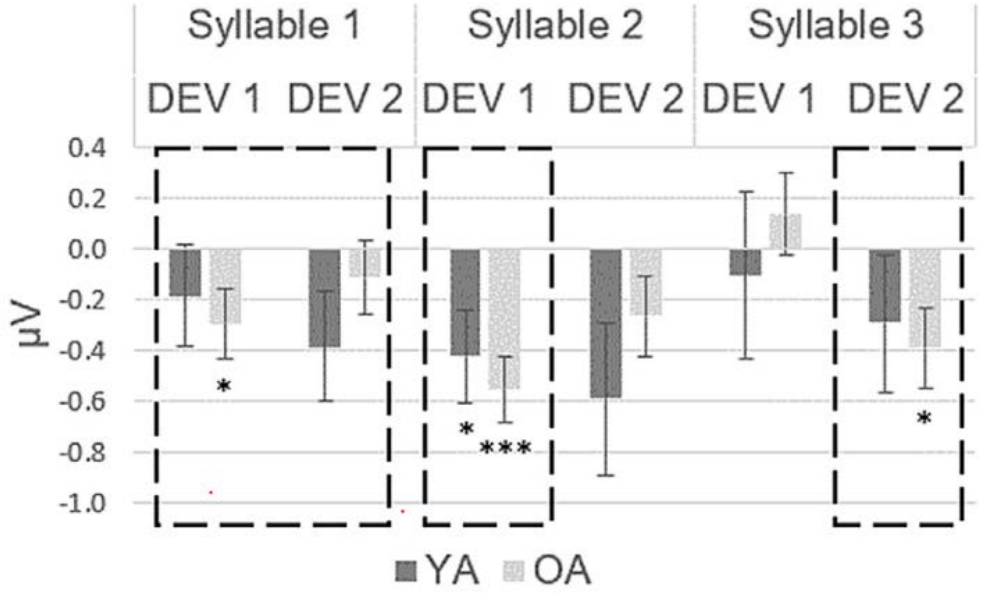
Kortikale Verarbeitung **(Hörrinde)**

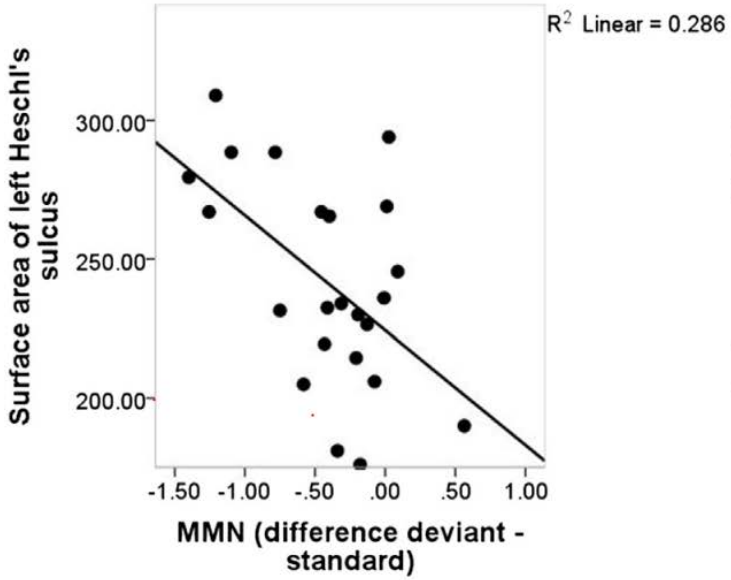


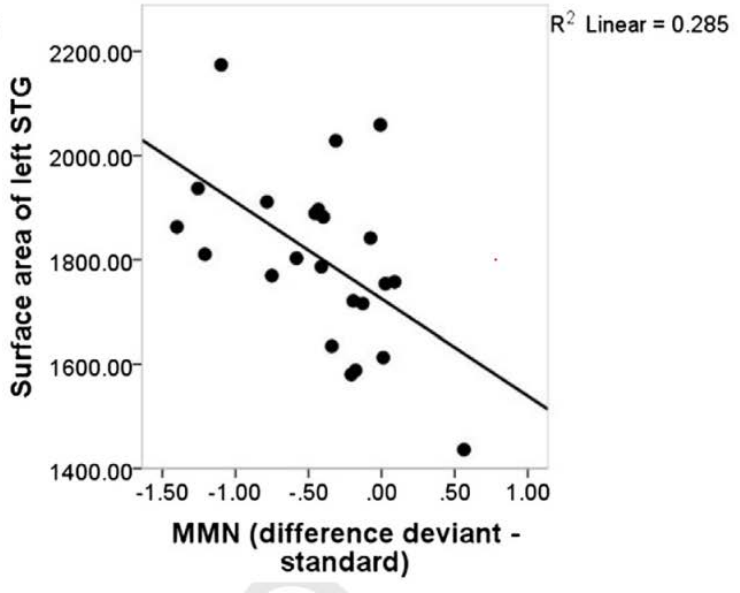

**Ältere Probanden mit “normalem” peripherem Hören**

**Keine Hörgeräte, keine Demenzdiagnose**

# When right becomes less right ….

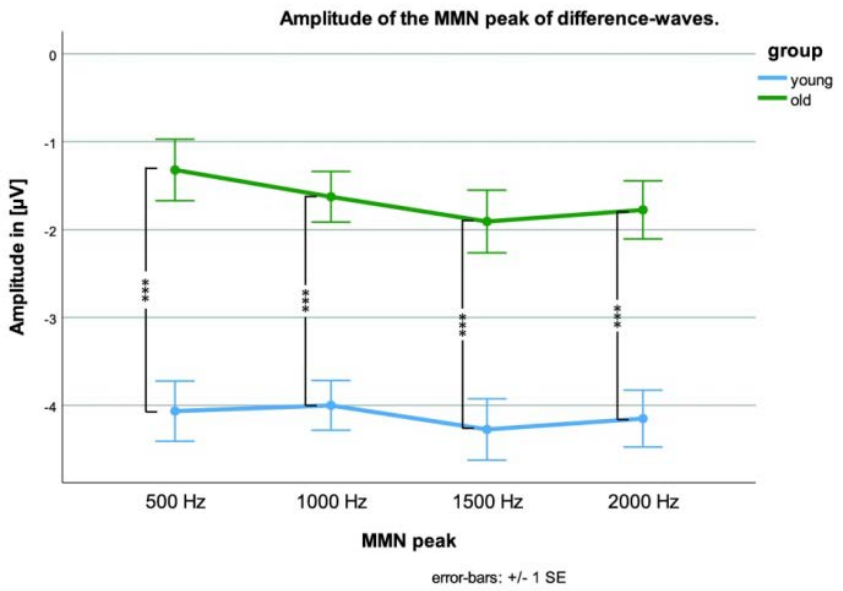


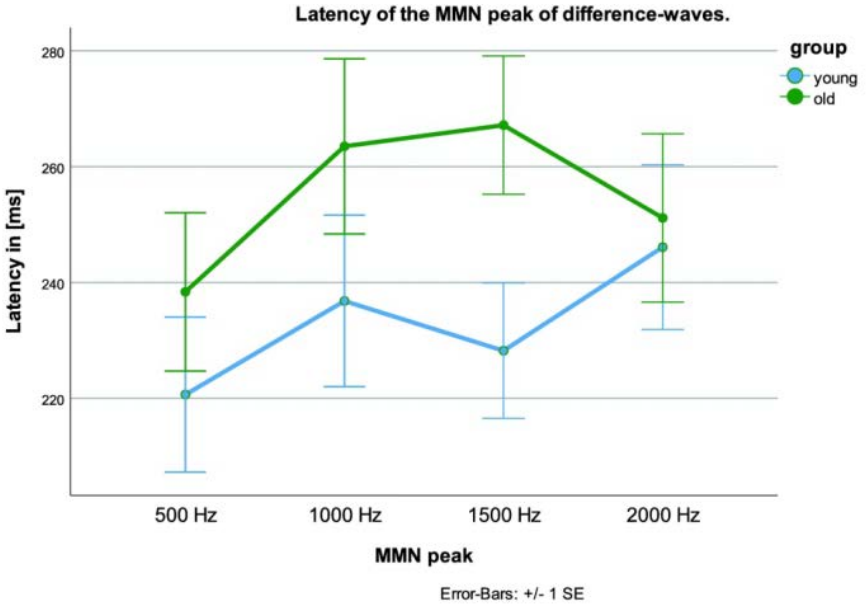



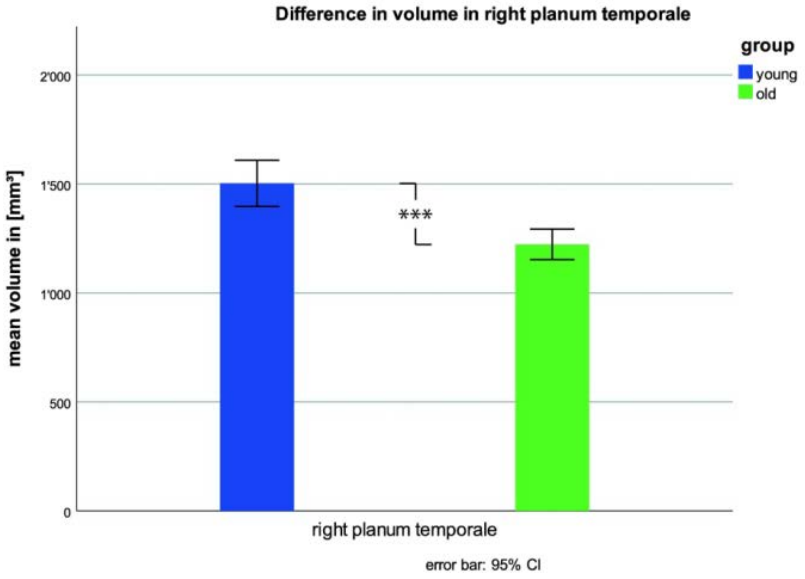



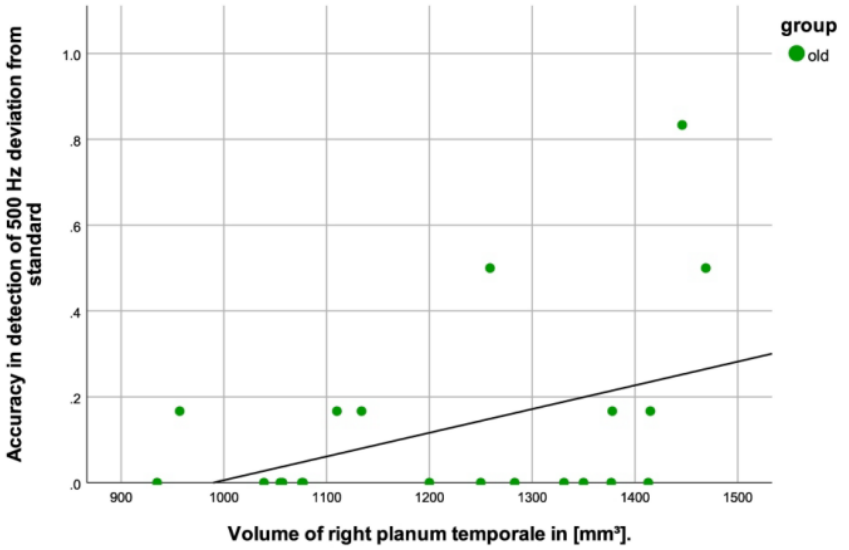

Giroud et al. (2019), Neurbiol. Age

# Atrophie und spektrale Verarbeitung im rechten auditorischen Kortex

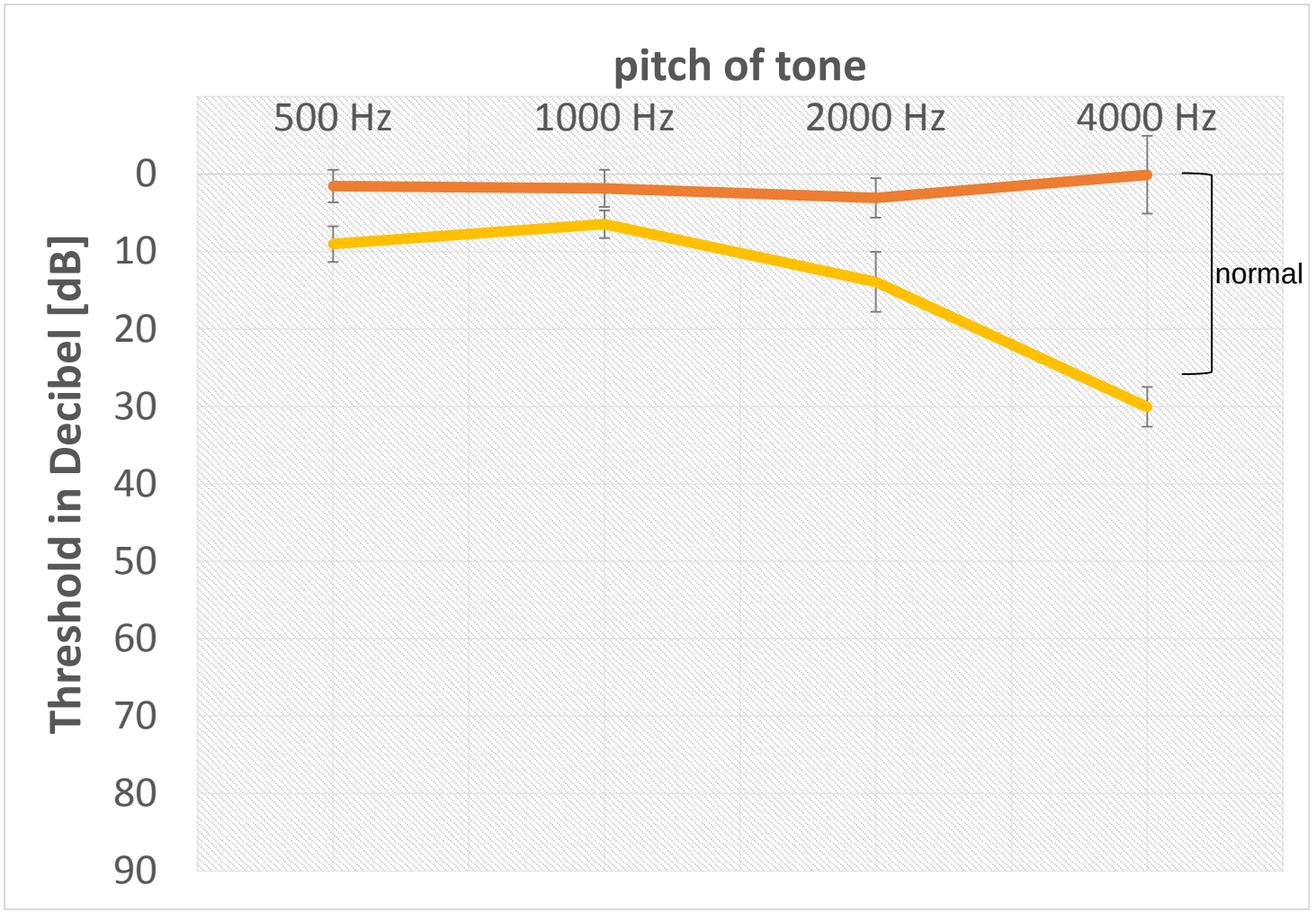


# Probanden




**27 young adults**

mean age = 23,29

age range = 19-29

(Audiometry: -10)

(MRI: -2)

**24 older adults**

mean age = 73,4

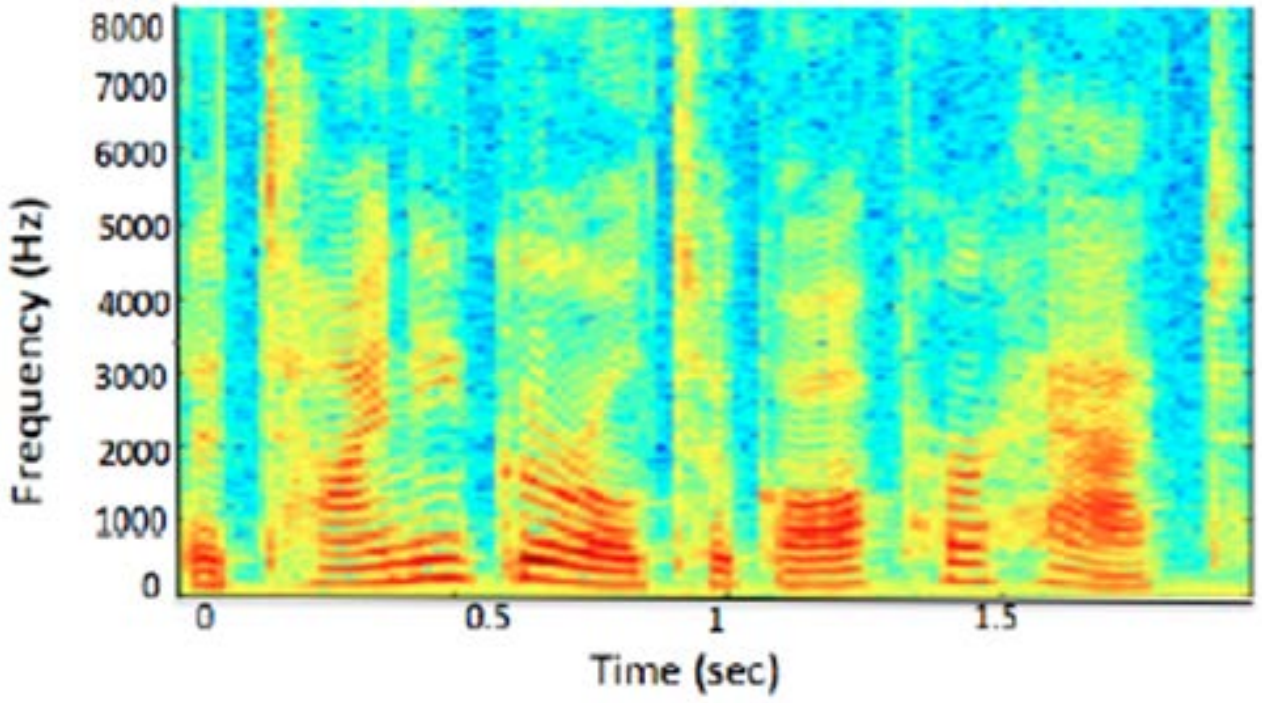
age range = 68-84

# Measuring Hearing Acuity: Central Hearing

**Temporal Compression (TC):** ability to detect small temporal gaps between the presentation of two tones

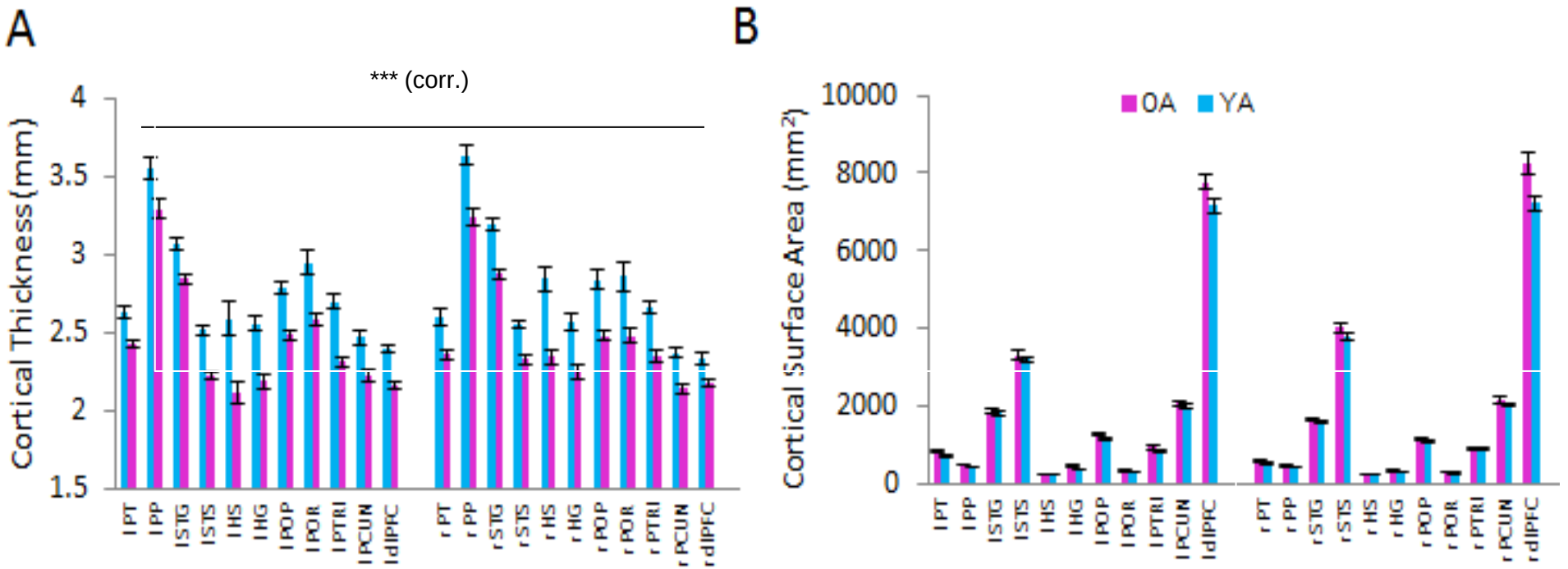
**Frequency Selectivity (FS):** ability to detect small frequency differences between two tones (Lecluyse et al., 2013)

**Speech-in-Noise Tests (OLSA)**



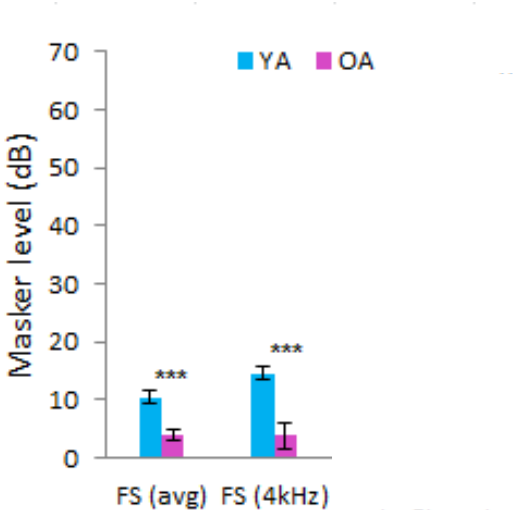

Sprache verstehen statt Töne hören

# Resultate




Giroud et al. (2018) Brain Struct Funct

# Resultate




- Zentraler Hörverlust in älteren Personen nachgewiesen – trotz «normalem» peripheren Hören
- Ich kann Dich hören, aber ich kann Dich nicht verstehen !!!!!
- Sensorische Deprivation führt sukzessive zu sozialer Deprivation
- Implikationen für Audiologie und ORL-Medizin, niedergelassene Allgemeinmedizin und Psychiatrie

Giroud et al. (2018) Brain Struct Funct

# Hörverlust und Lebensqualität

(Ciorba et al. 2012, Gopinath et al. 2012)

Hörverlust führt zu Problemen bei Kommunikation (gerade auch am Telefon)

Langfristig kann Hörverlust zu sozialem Rückzug, Isolation und Einstellen physischer und sozialer Aktivität oder sogar zu depressiven Symptomen und erhöhtem Mortalitätsrisiko führen (Karpa et al. 2010)

Einsamkeit im Alter das grösste Krankheitsrisiko

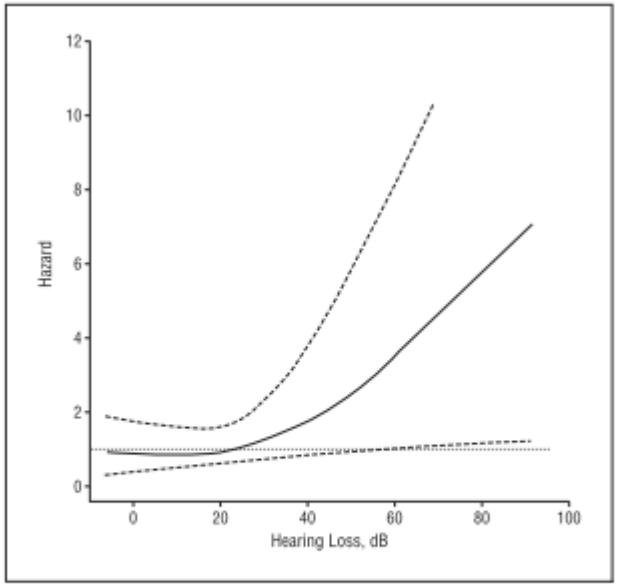


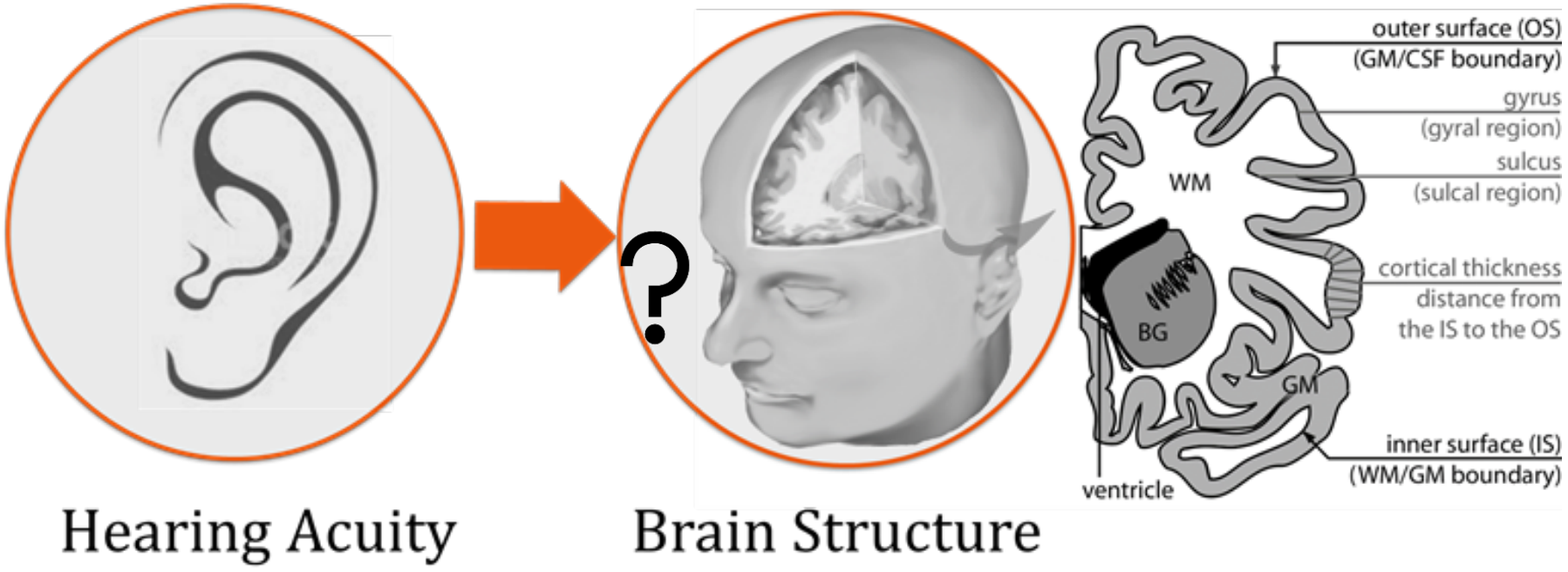

**Figure 2.** Risk of incident all-cause dementia by baseline hearing loss after adjustment for age, sex, race, education, diabetes mellitus, smoking, and hypertension. Hearing loss is defined by the pure-tone average of thresholds at 0.5, 1, 2, and 4 kHz in the better-hearing ear. Upper and lower dashed lines correspond to the 95% confidence interval.

Es gibt Hinweise auf einen schwachen Zusammenhang zwischen Hörverlust und neurodegenerativen Erkrankungen (Alzheimer, andere Demenzen) (Lin et al. 2011)

Diese sind deutlich schwächer für peripheren HL (im Vergleich zu zentralem HL)

HL zu einem gewissen Grad ein indirekter Moderator (Einschränkung von sozialen und physischen Aktivitäten, weniger Kommunikation und Interaktion) (Bennett et al. 2006)

Characterize the relationship between hearing acuity (peripheral & central) and brain morphology in a sample of healthy older participants with a surface-based morphometry approach (SBM)

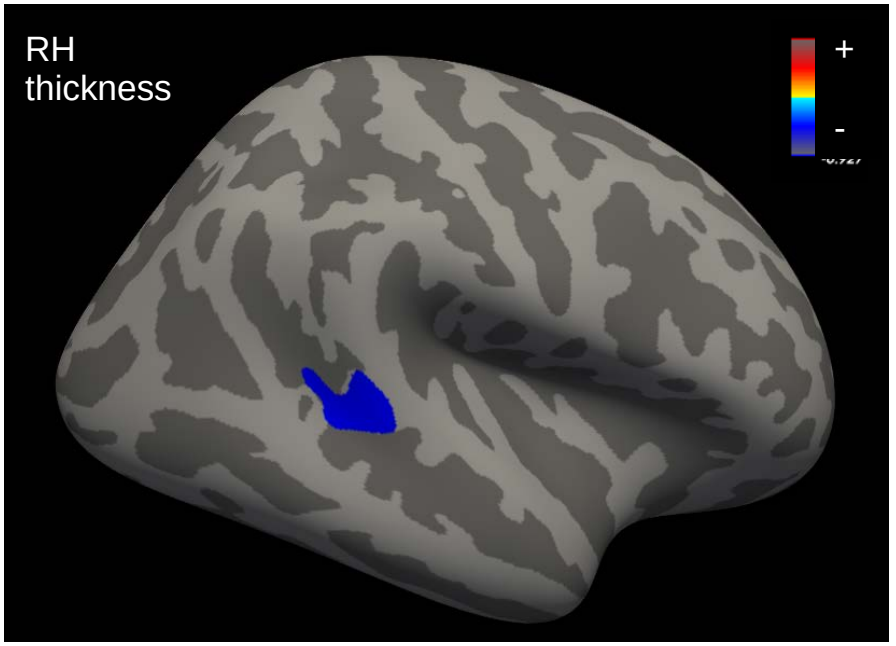


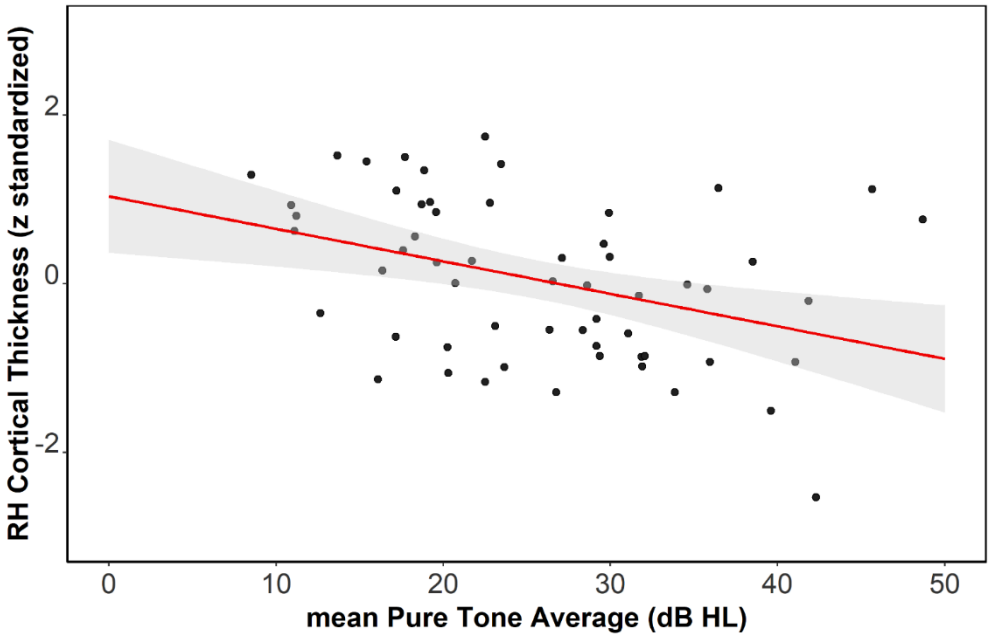
# Results – Peripheral Hearing: mPTA

CogTAiL
Cognition, Tinnitus, Aging, and Sensorineural Hearing Loss

**Table 1**:

| Measure | | Annotation | Max | NVts | Size ($mm^2$) | MNI | | | *CWP* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | X | Y | Z | |
| **RH** | thickness | STS bank | -2.9 | 975 | 346.8 | 46 | -37 | 5 | 0.008 |



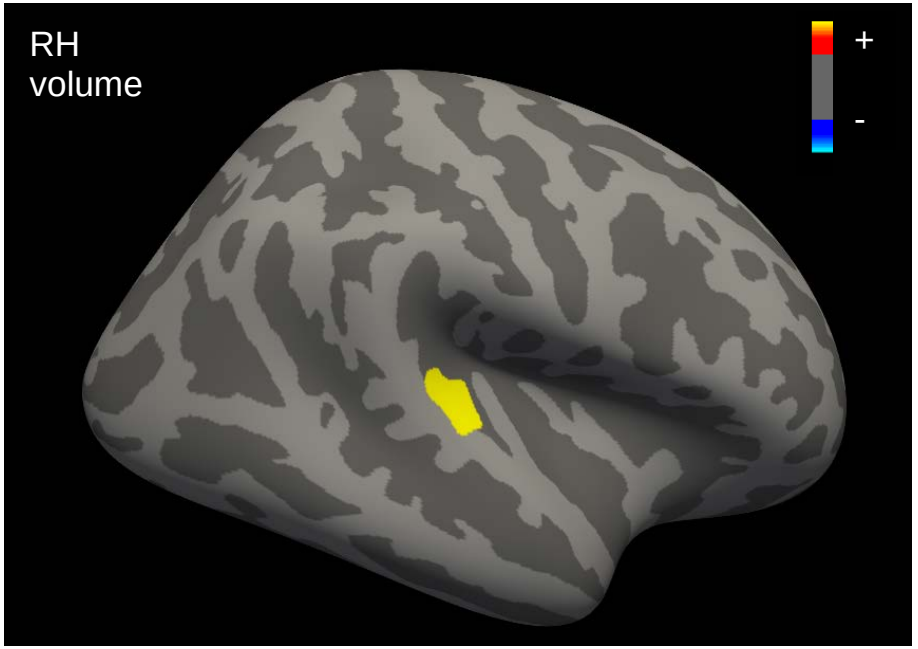



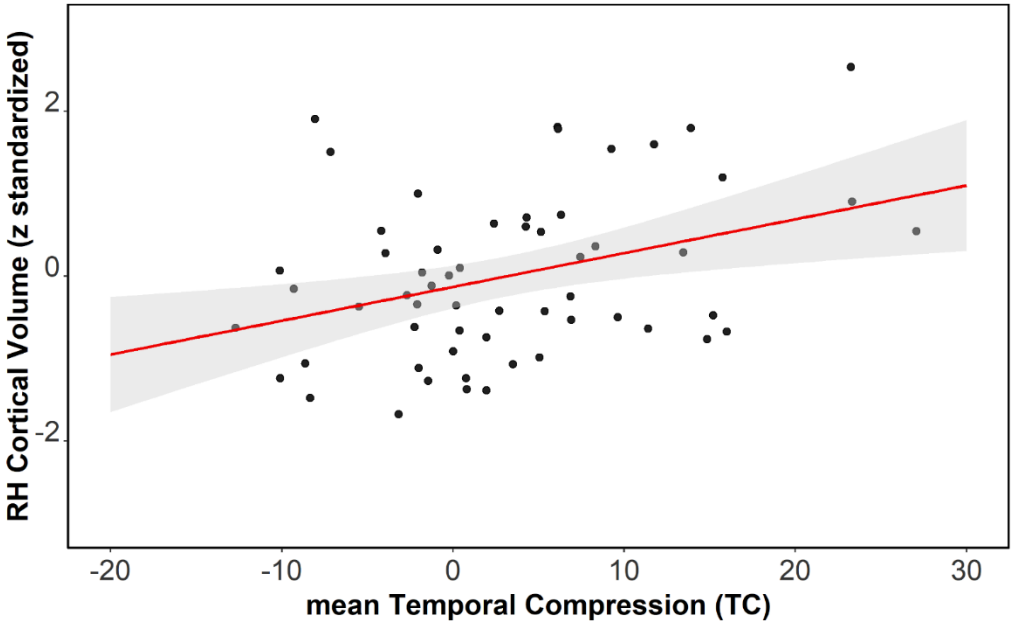
# Results – Central Hearing: TC

CogTAiL
Cognition, Tinnitus, Aging, and Sensorineural Hearing Loss

**Table 2**:

| Measure | | Annotation | Max | NVts | Size ($mm^2$) | MNI | | | *CWP* |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | X | Y | Z | |
| **RH** | volume | superiortemporal | 1.8 | 592 | 299.4 | 57 | -30 | 8 | 0.04 |

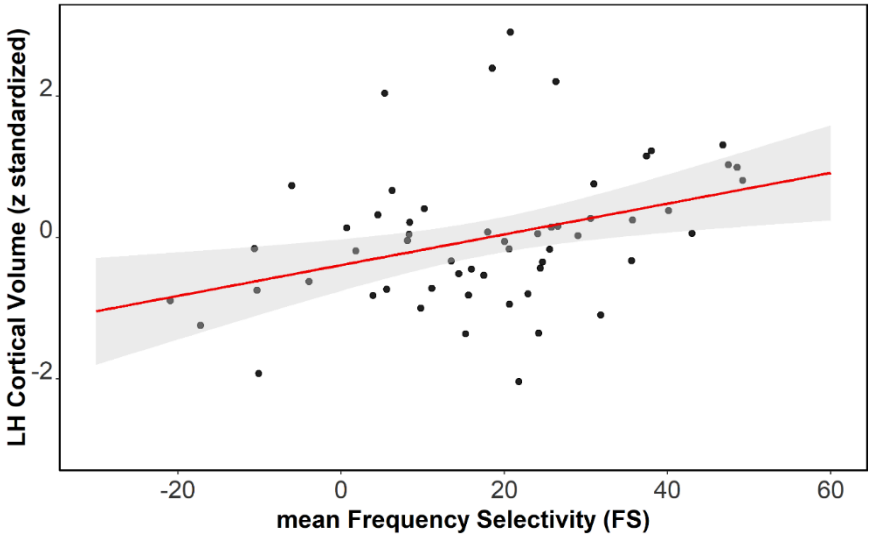


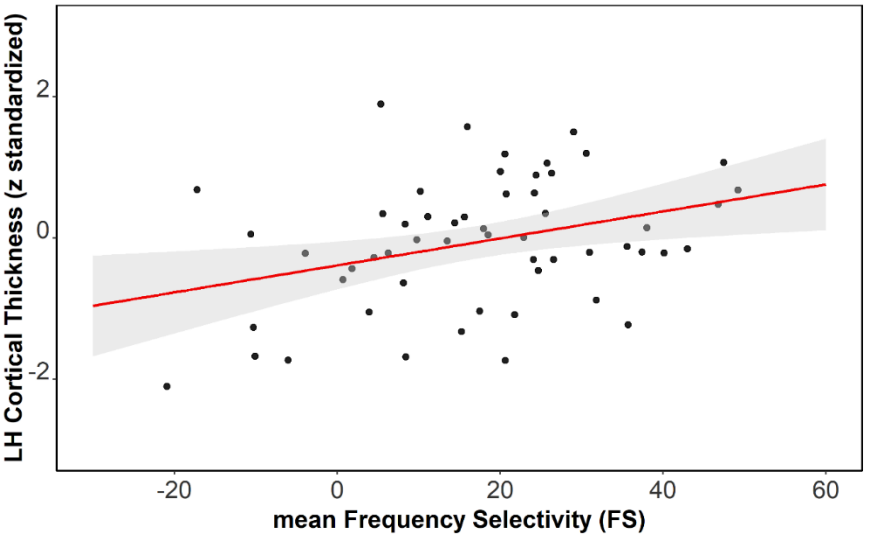
# CogTAiL

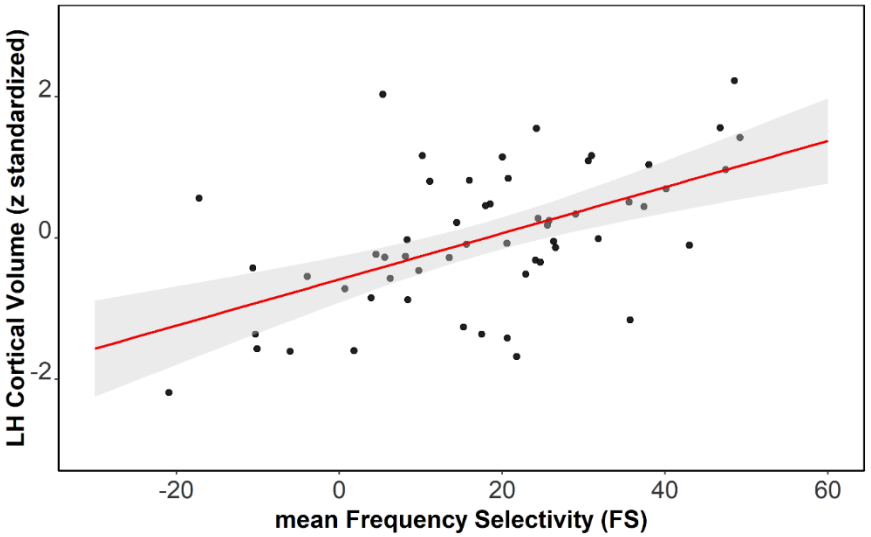
Cognition, Tinnitus, Aging, and Sensorineural Hearing Loss

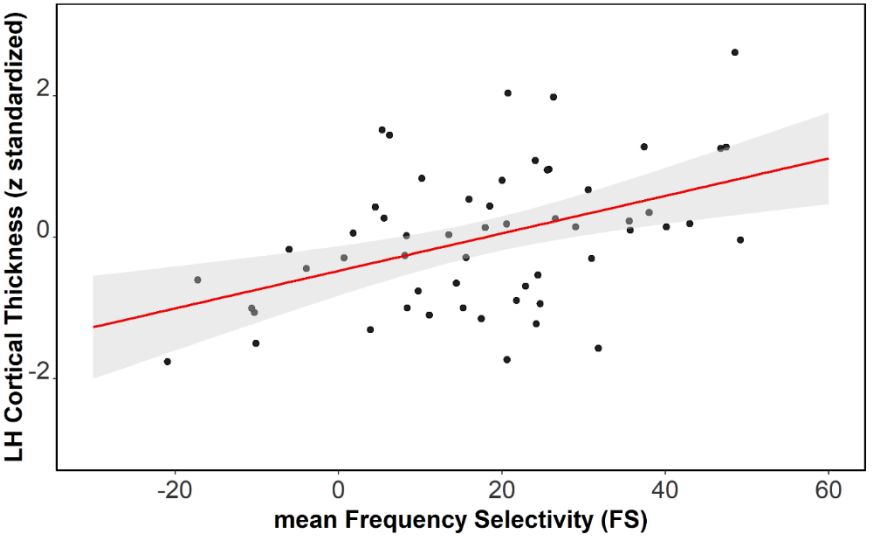
## LH volume ~FS




## LH thickness ~FS

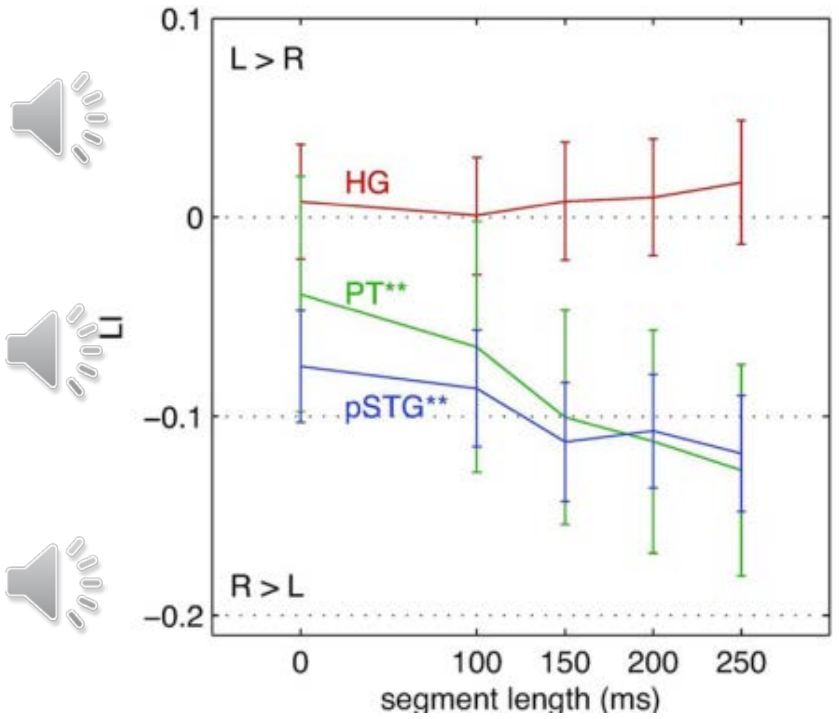


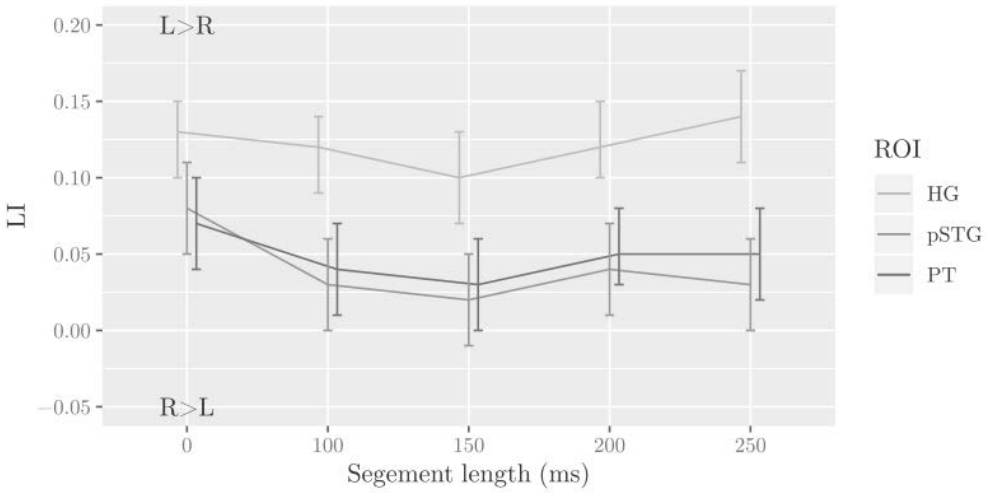



# Compensation or De-differentiation ???

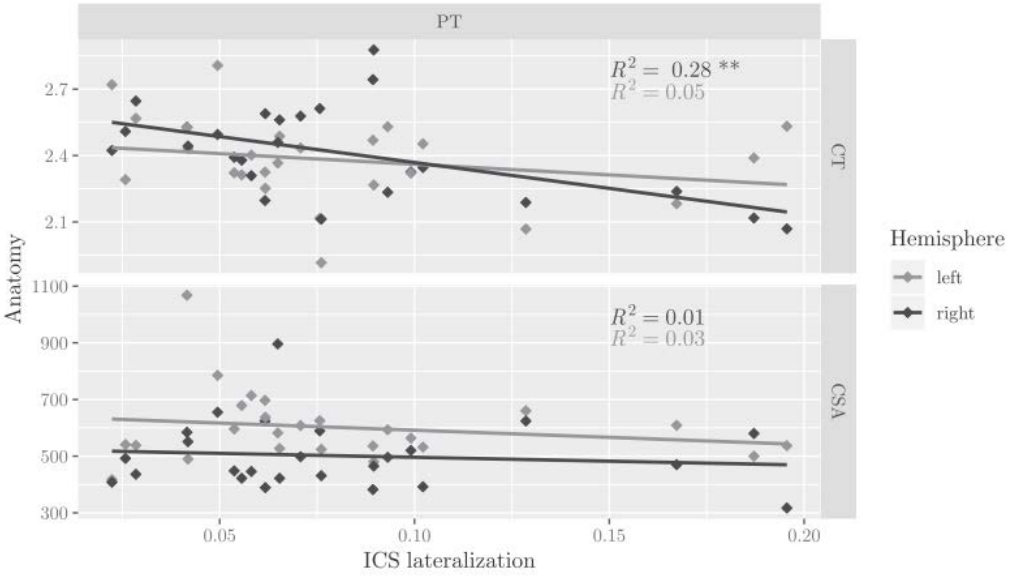
Liem et al. 2014 (Hum Brain Mapp)



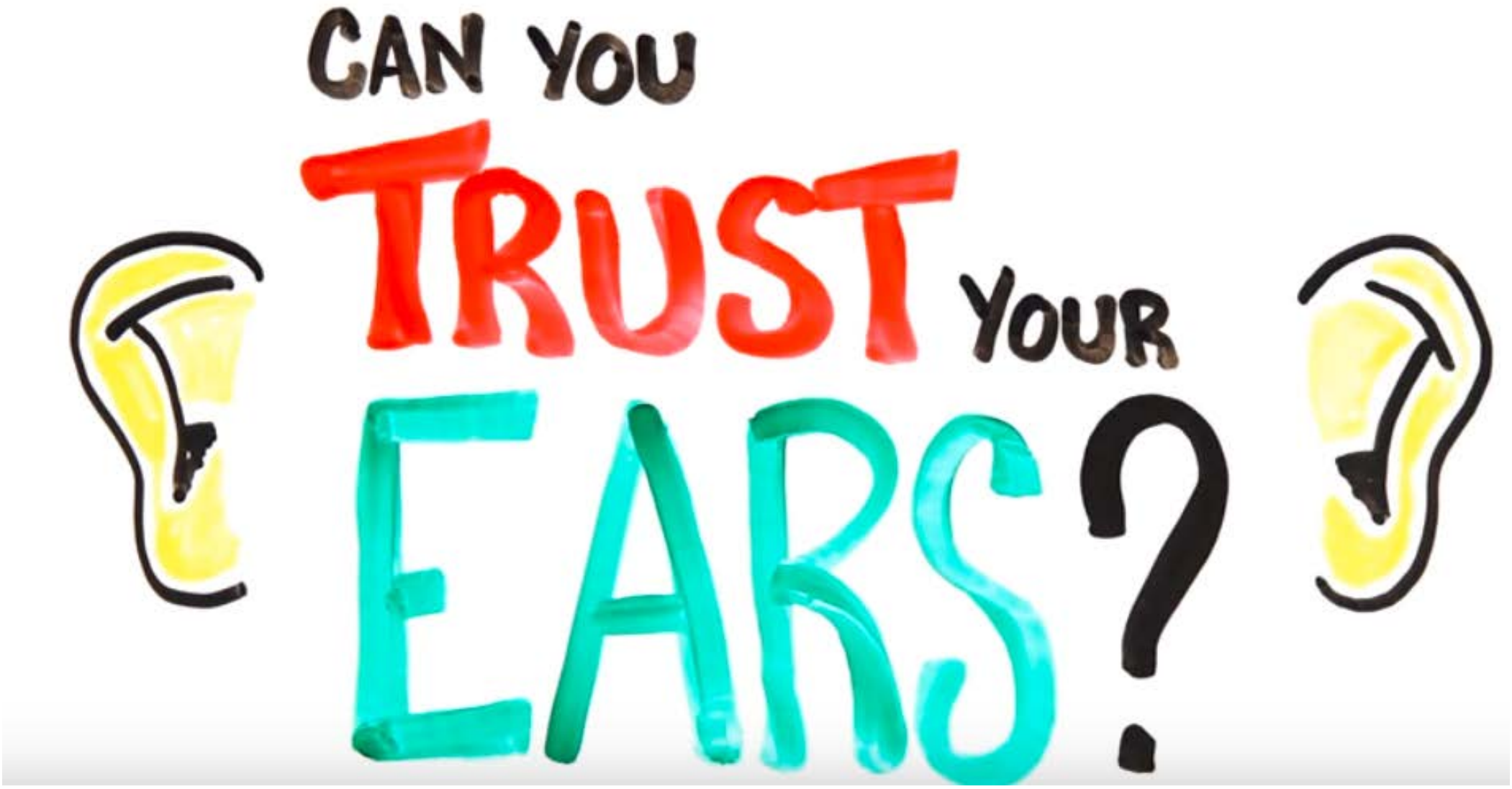




Keller et al. 2019 (NeuroImage)

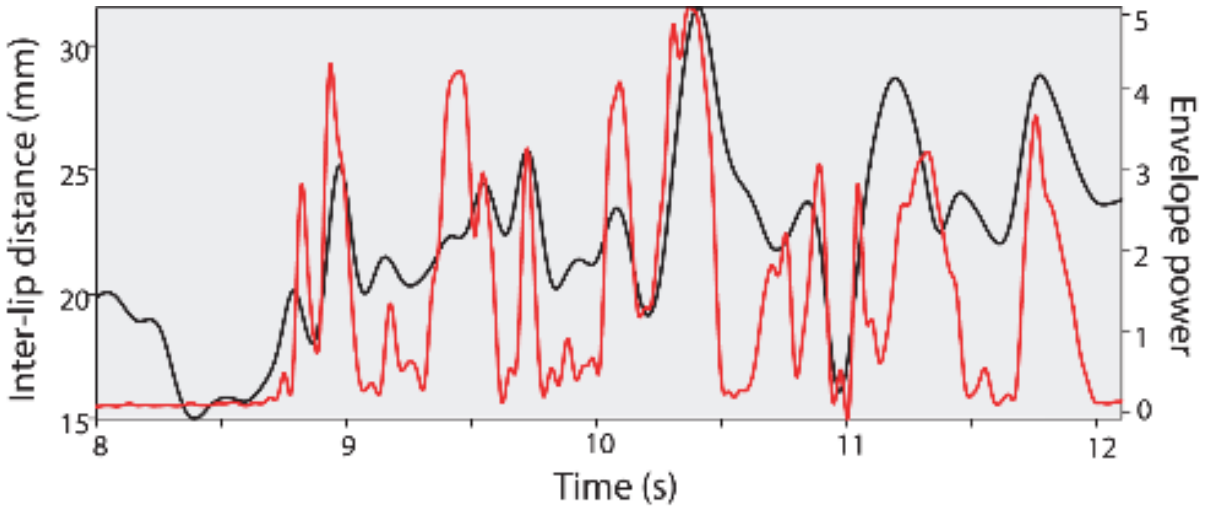
The brain buys robustness at the cost of specialization



Der McGurk Effekt (1976)

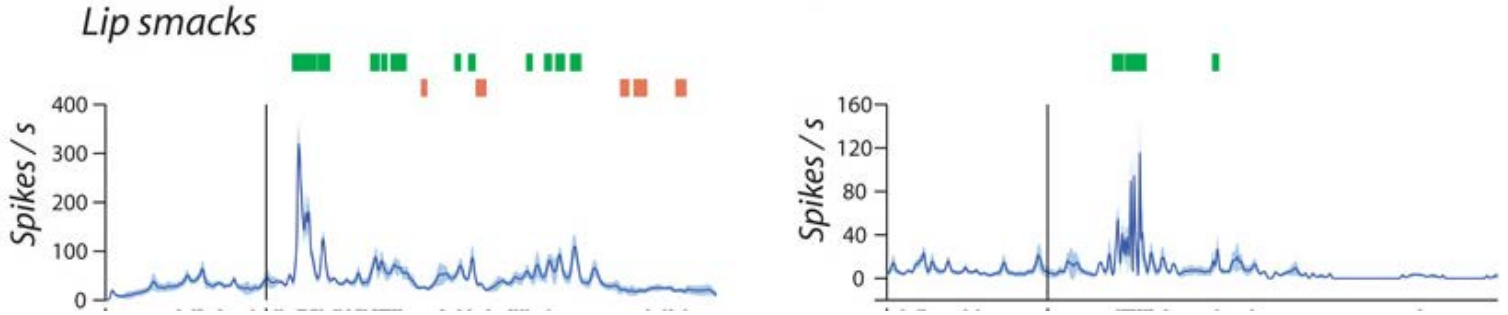


# Evolution von Lautsprache



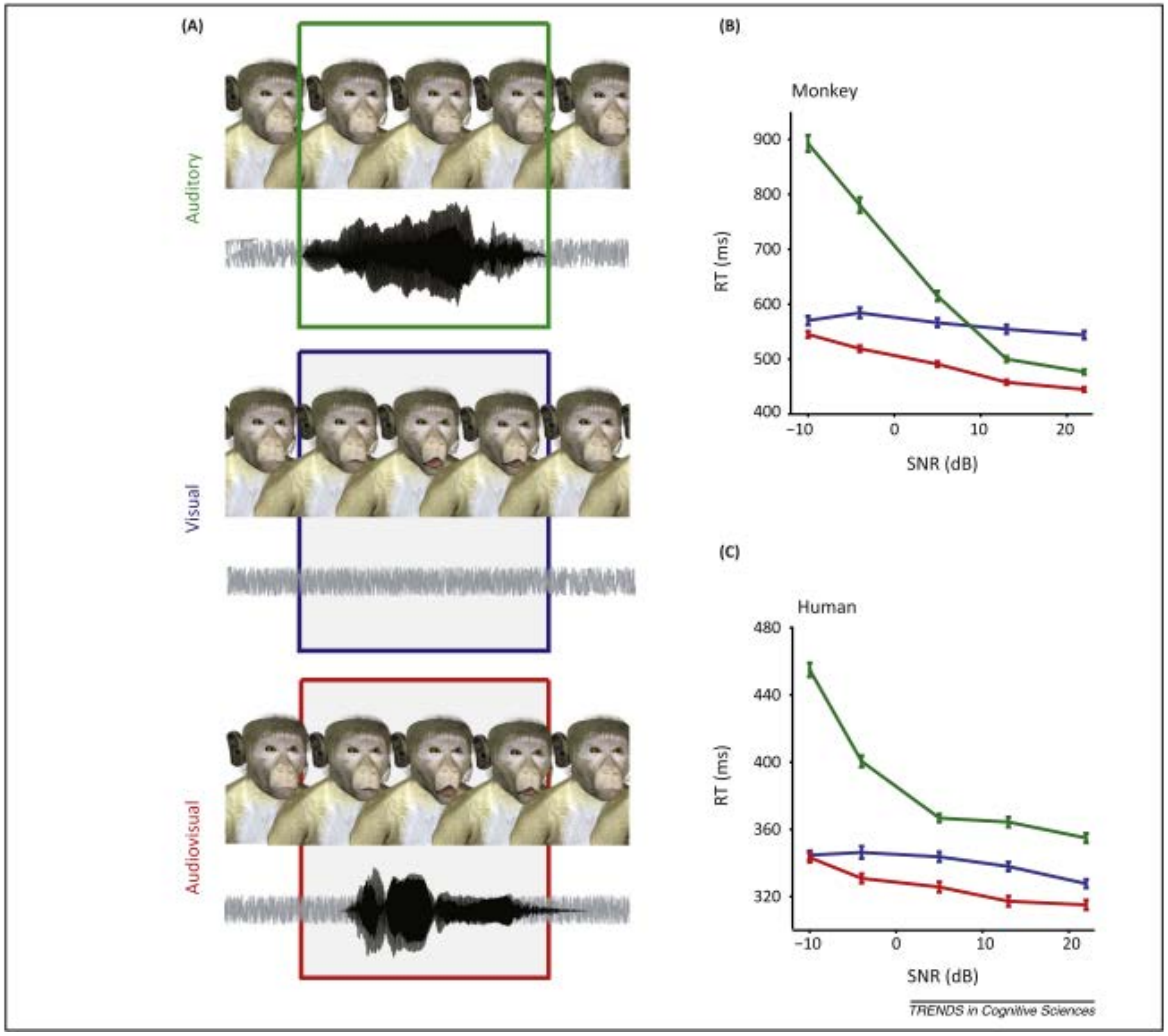







Ghazanfar et al. 2010, Giraud & Poeppel (2012)

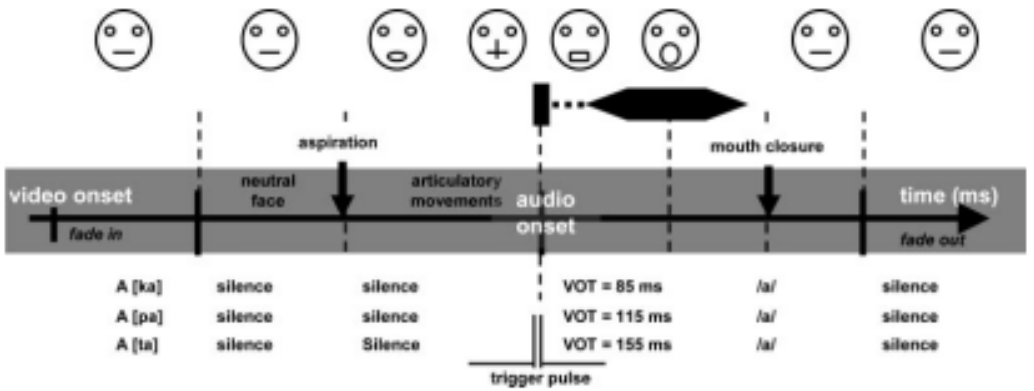
# Die Evolution der Sprache: Rhythmus, Mimik, Vokalisation

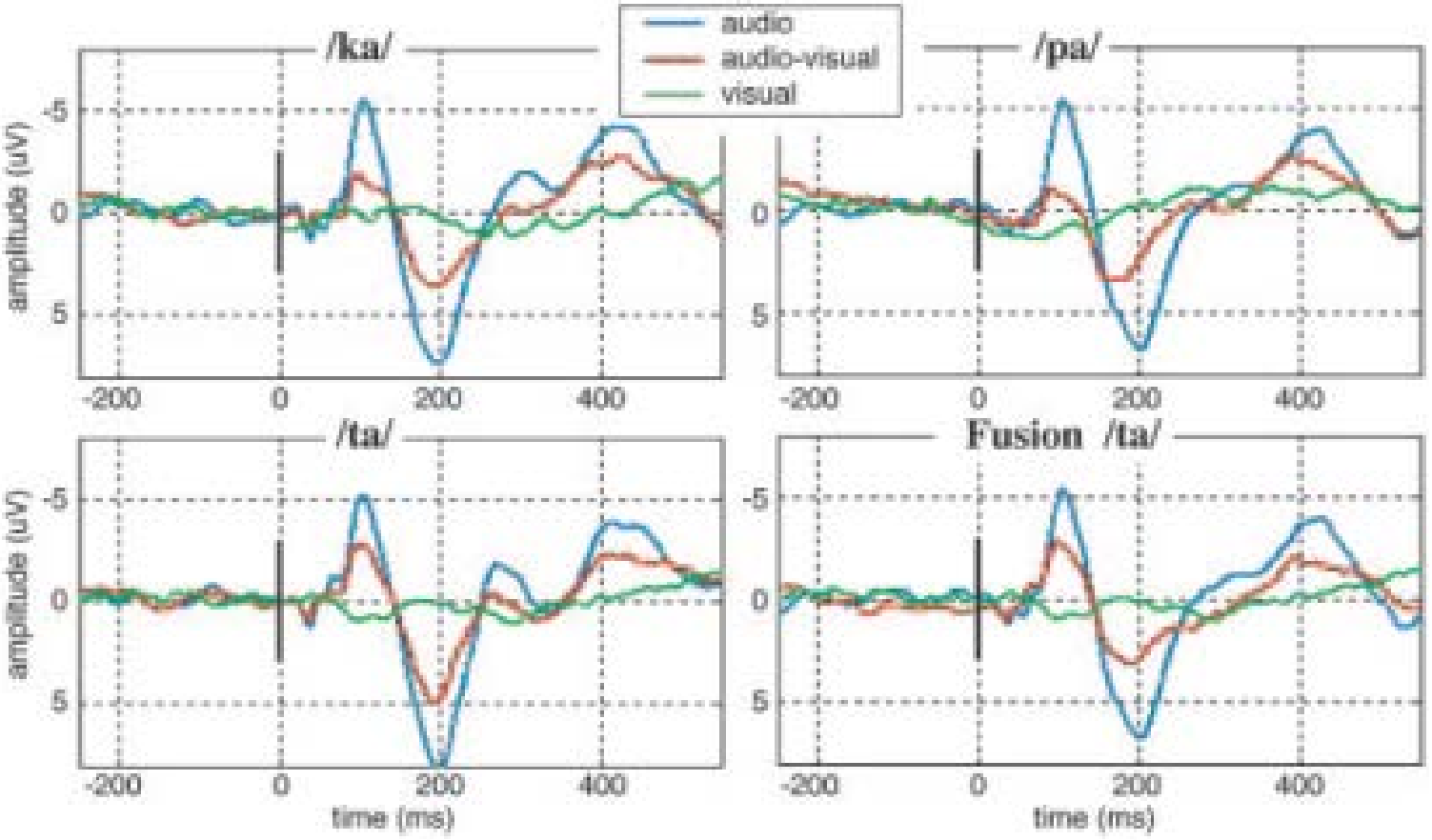



Ghazanfar et al. 2014 (TICS)

«Audiovisual» or «multisensory» speech is really the primary mode of speech perception

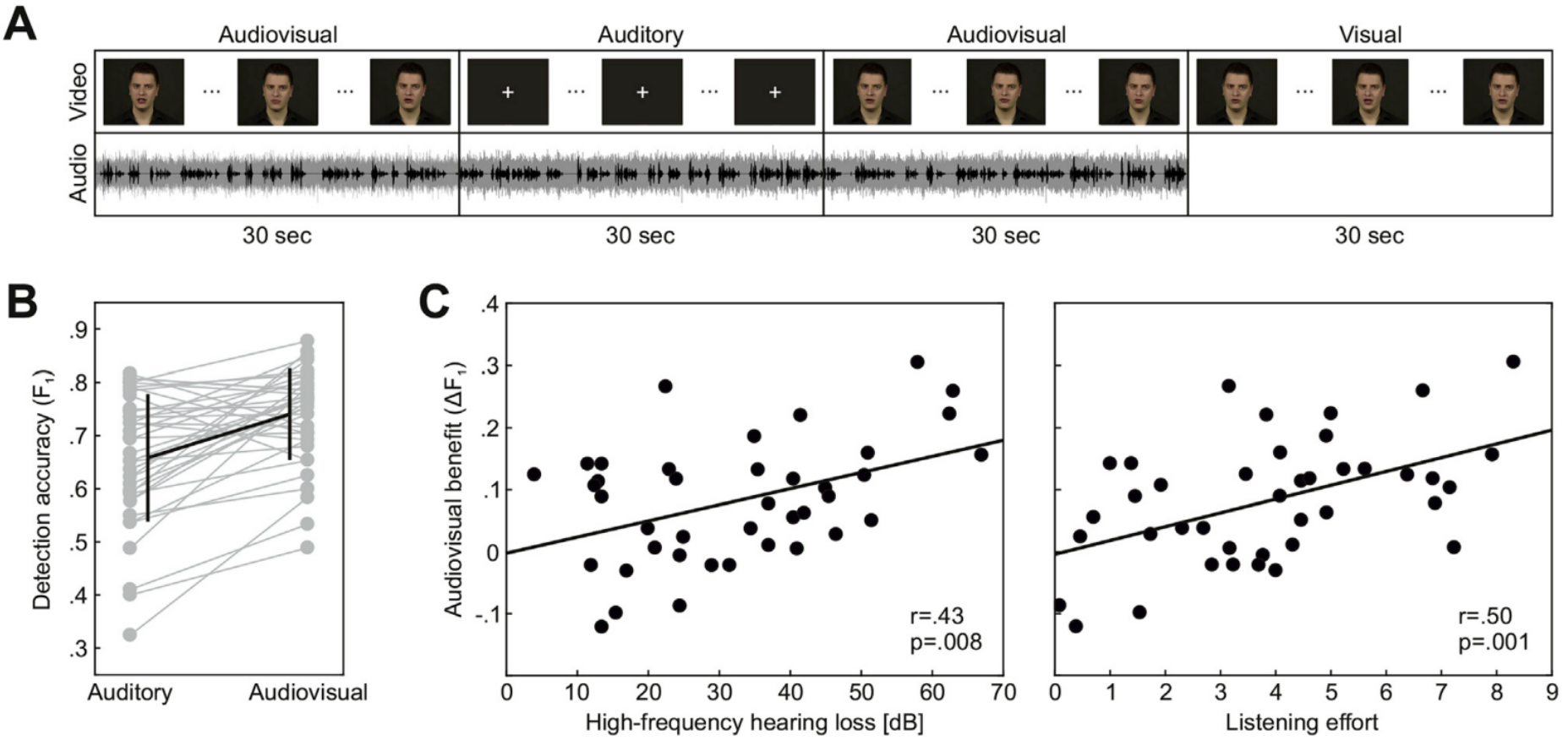
# Visuelle Sprache beschleunigt auditorische Verarbeitung




Van Wassenhove et al. 2005 (PNAS)

# AV-Vorteil bei Hörverlust für Speech in Noise

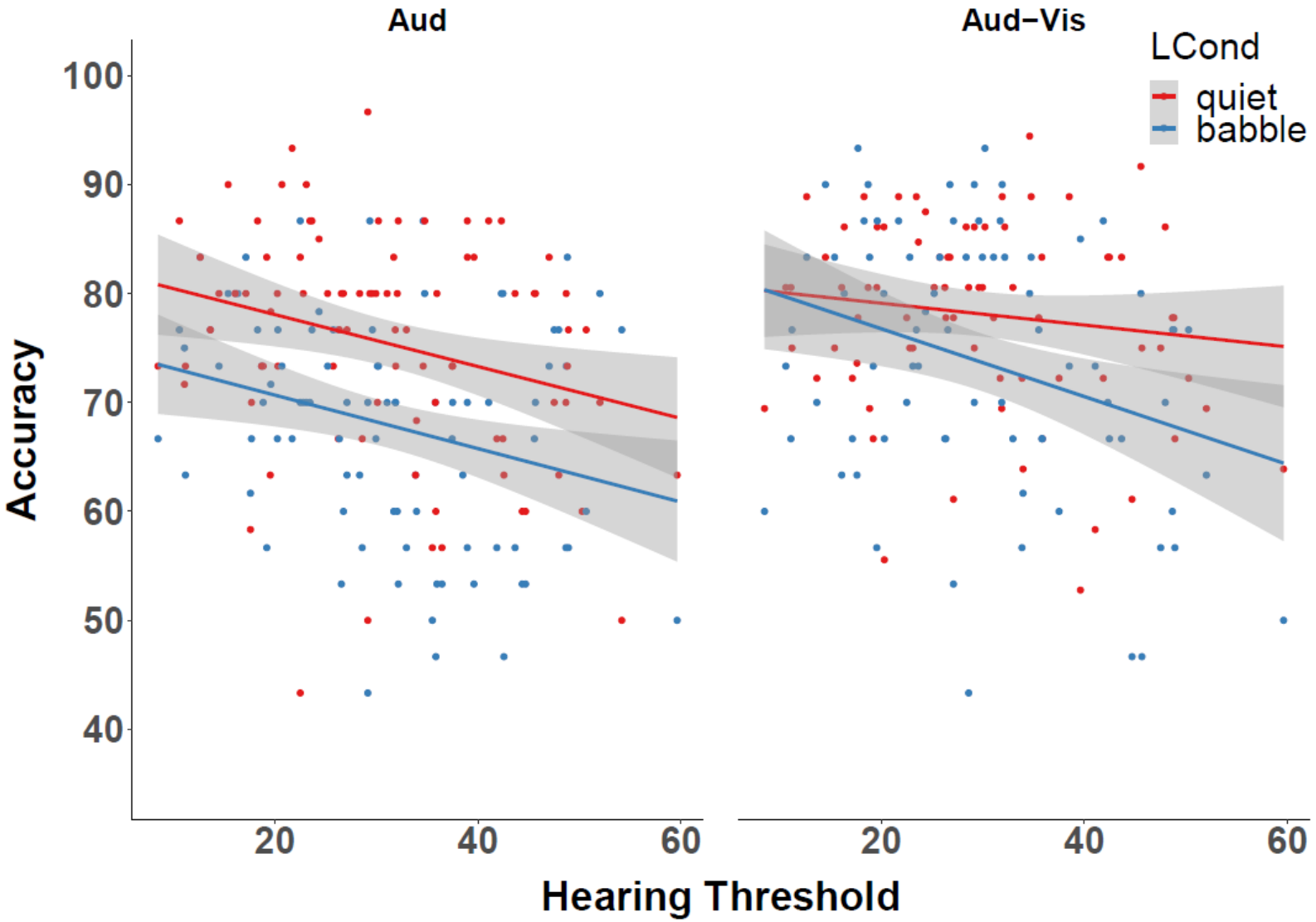



Puschmann et al. 2019 (NeuroImage)

Evidenz für einen audiovisuellen «Benefit»

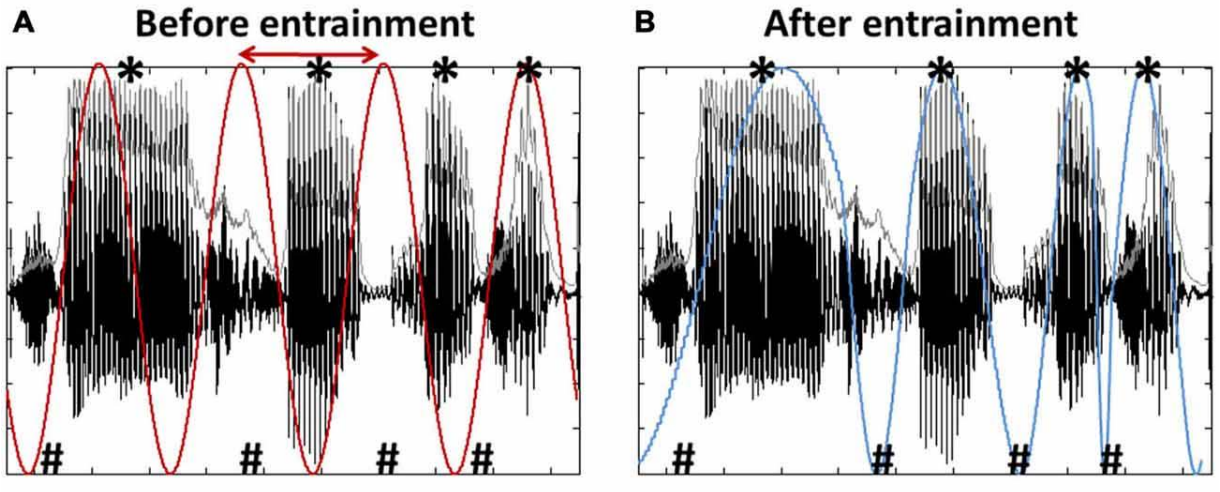
# CogTAiL

Cognition, Tinnitus, Aging, and Sensorineural Hearing Loss

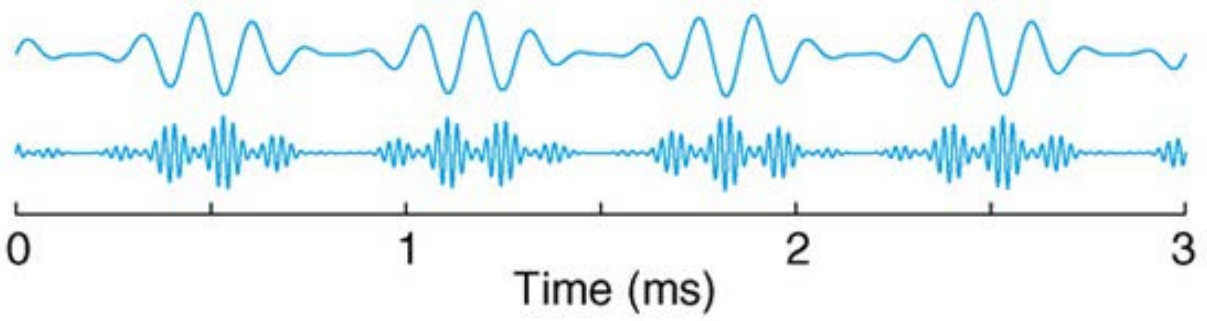


# Phase Locking

Schwingungen des Gehirns passen sich akustischen Modulationen in der Sprache an.

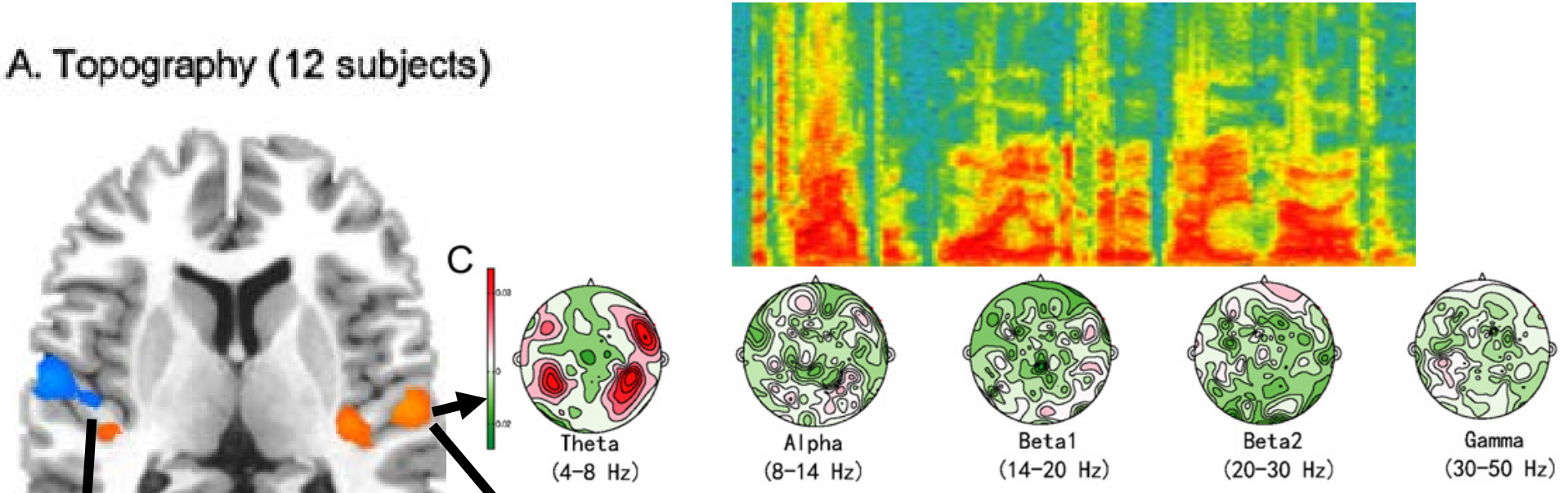



Gehirnschwingung




Sprachschwingung

# Endogene und evozierte Oszillationen während auditorischer Satzverarbeitung




Luo & Poeppel (2007, Neuron)

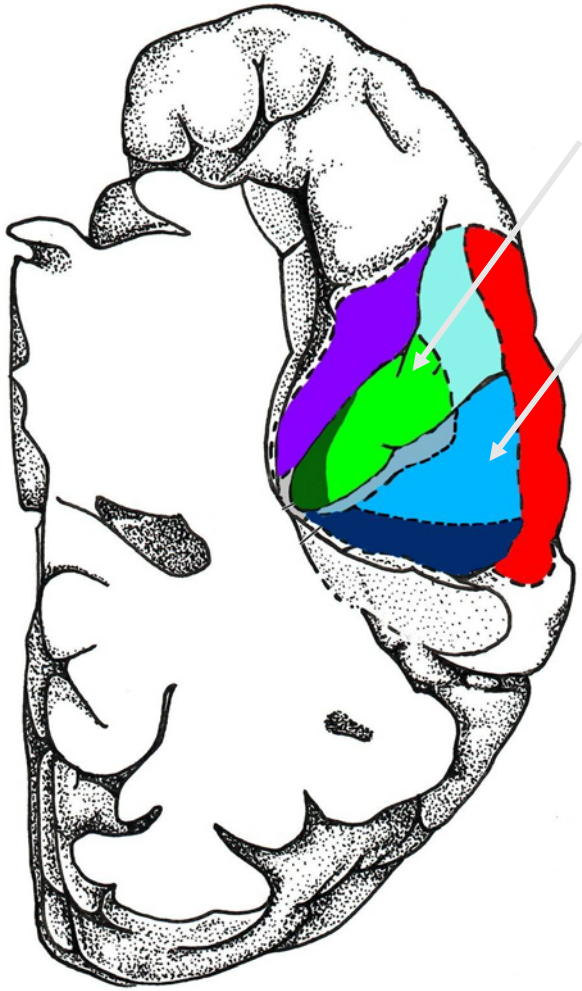
Langsame EEG-Frequenzen korrespondieren mit suprasegmentaler Sprachverarbeitung

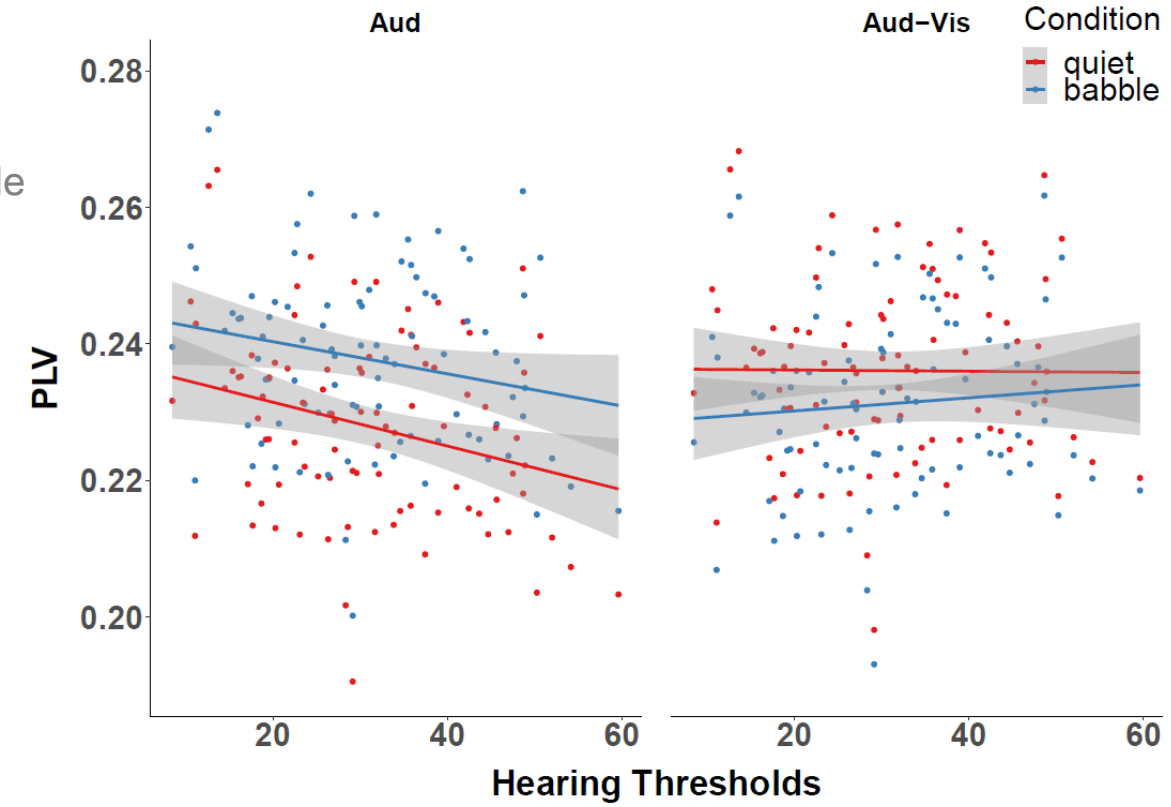


Giraud et al. (2007), Neuron

# CogTAiL

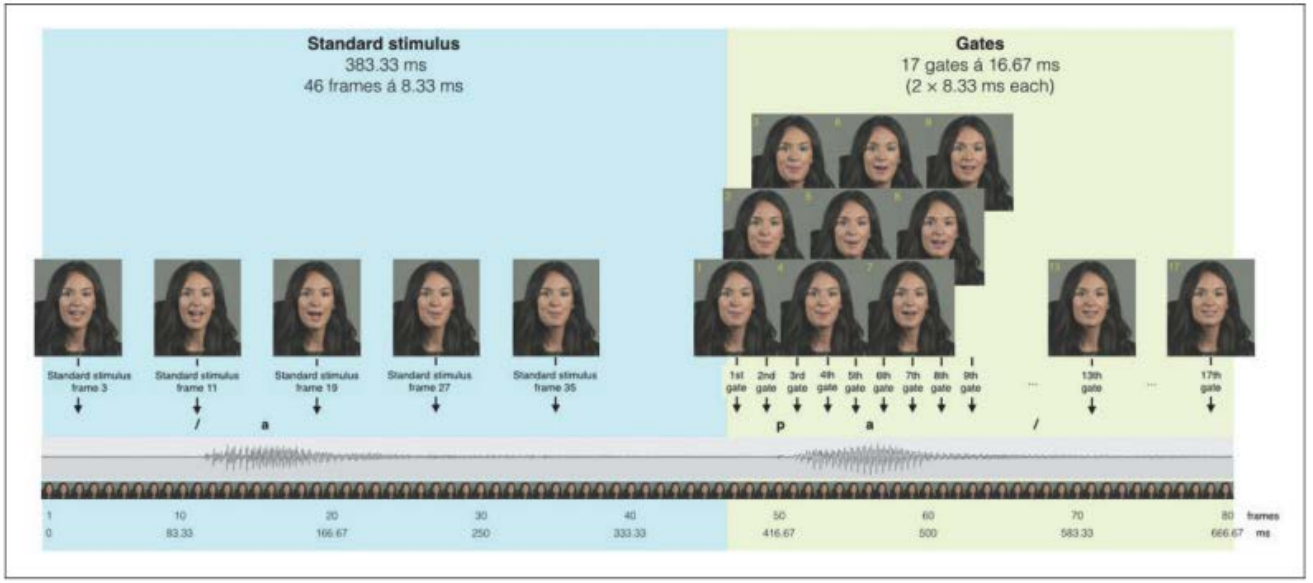
Cognition, Tinnitus, Aging, and Sensorineural Hearing Loss




Kontrolliert für Accuracy

# Effekt der audio-visuellen Kommunikation




Moradi et al. 2016

Hörgeräteträger zeigen bessere Effekte als Menschen ohne Hörgerät

Diese Befunde zeigen sich vor allem auf der Ebene gesprochener Sätze

Effekte von Längsschnittraining ist aber unklar

# Key Take Home

- Zentrale Sprachverarbeitung und Atrophie dürfen bei Beurteilung eines Hörverlust im Alter nicht unterschätzt werden

- Bei älteren Probanden ohne gravierenden Hörverlust findet De-differenzierung in den sprachrelevanten Kortexarealen statt

- Bei älteren Probanden mit merklichem Hörverlust => Abkehr vom Modell der elementaren Sprachverarbeitung bei jungen Erwachsenen, aber ohne eindeutiges Muster

- Audiovisuelle Sprachverarbeitung hat unter Umständen einen Benefit. Es gibt aber einige wichtige Aspekte zu beachten (Hörgerät, Umgebungslärm, Kognition)

# Thanks for your attention !!

ZSH
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