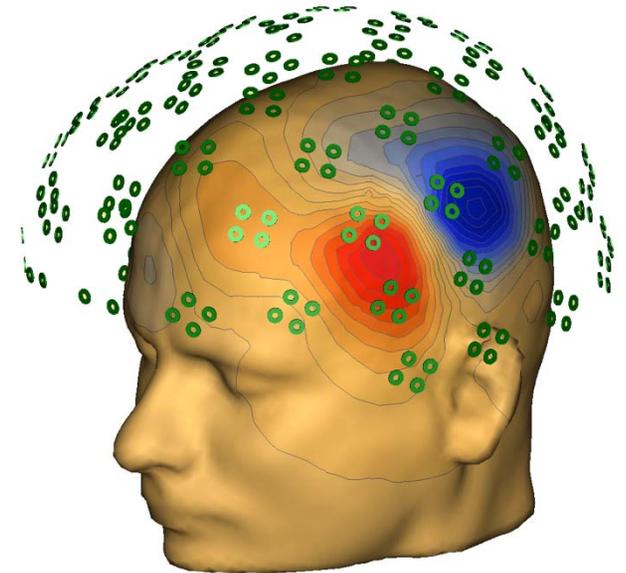




UniversitätsKlinikum Heidelberg

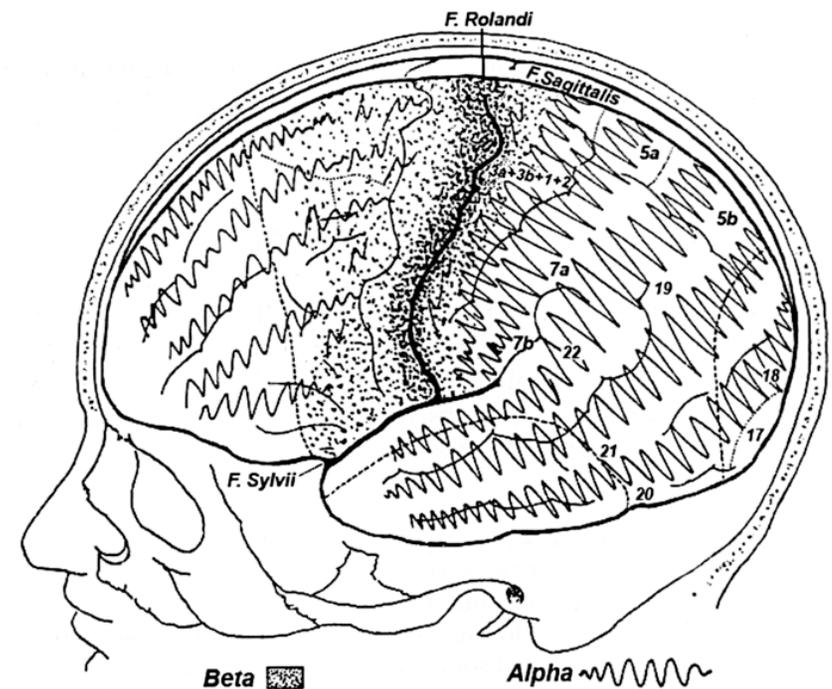
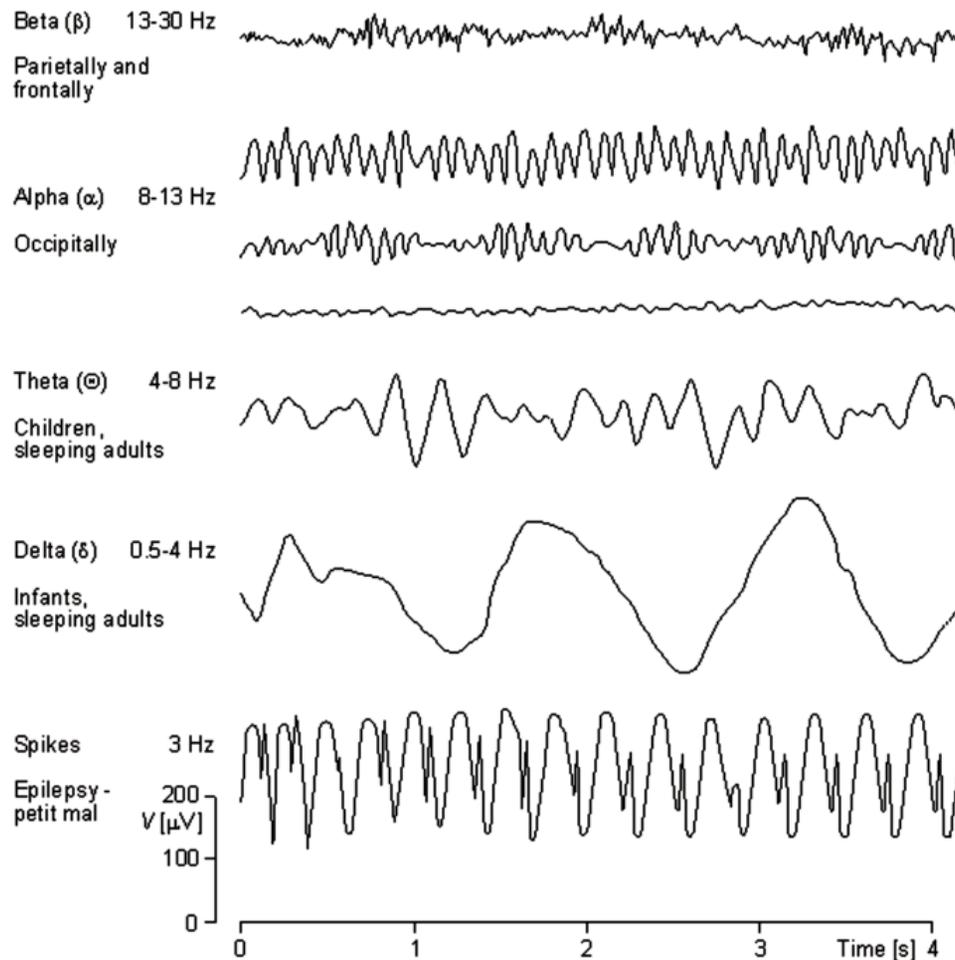
Physiologische Messungen am Gehirn bei bewussten und unbewussten Wahrnehmungen



André Rupp
Sektion Biomagnetismus
Neurologische Universitätsklinik



Elektroenzephalographie - EEG





Gliederung

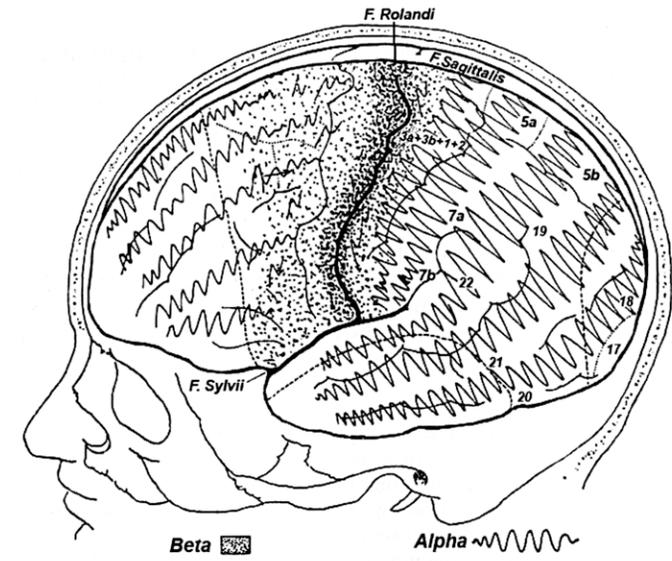
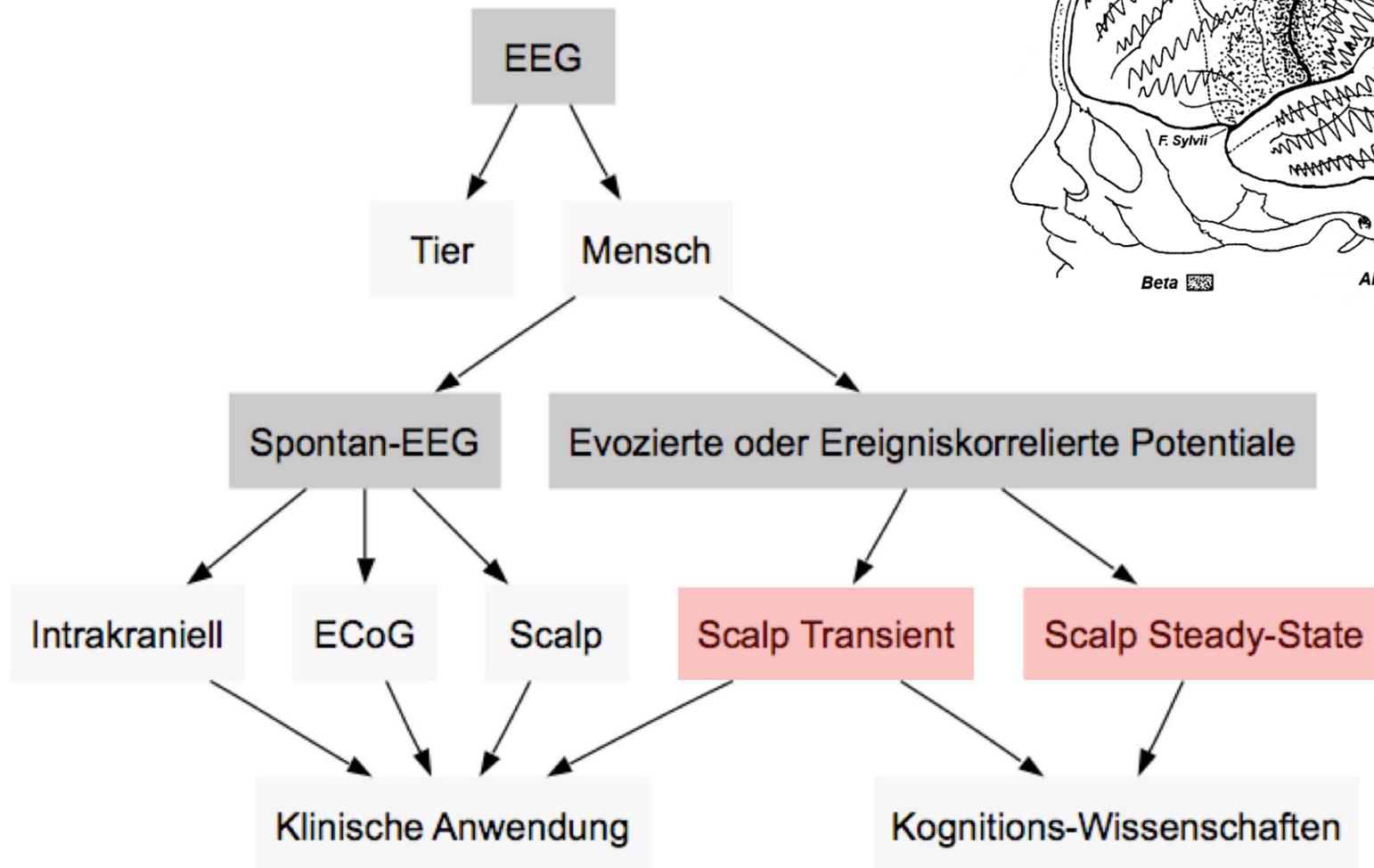
1. Methodik - Neurophysiologische Ableitungen
2. Frühe und späte Potentiale/Felder
3. Aufmerksamkeitseffekte des Hörens
4. Prä-attentionale Effekte
5. Cocktail-Party-Effekt



1. Methodik

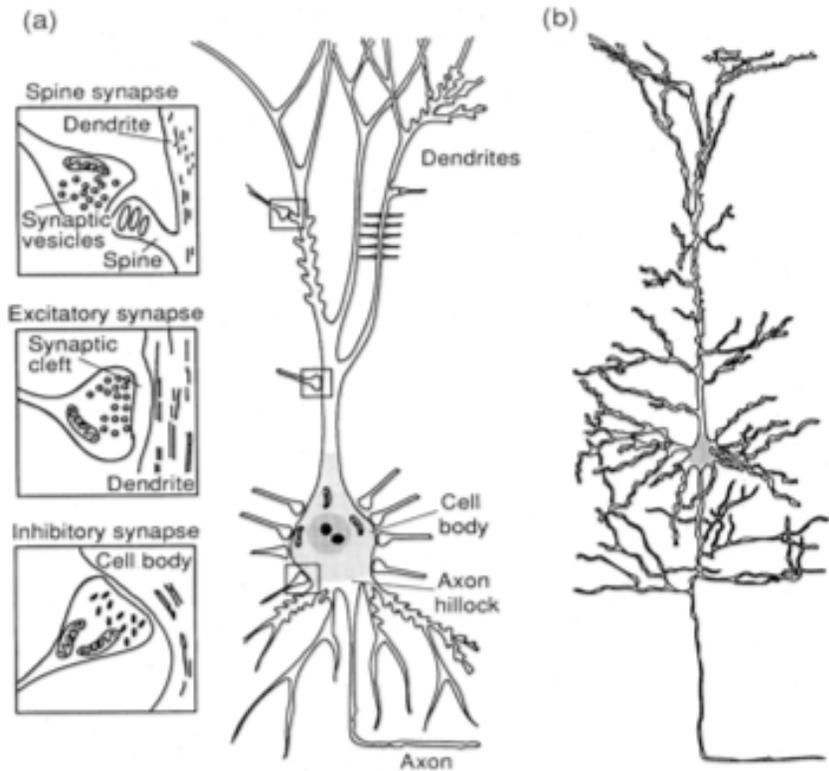


Einteilung und Definition





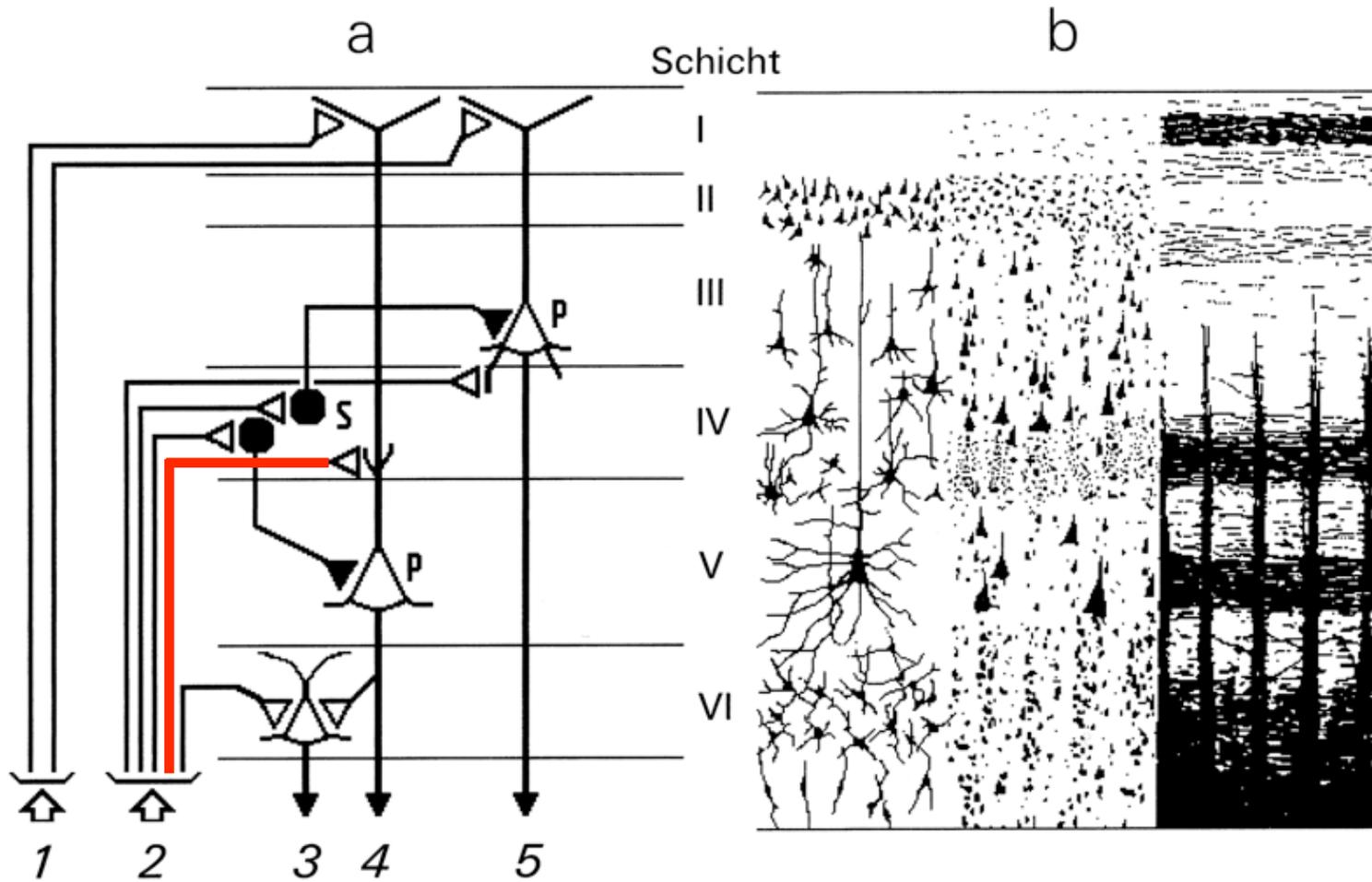
Schnitt durch den Neocortex



Ramón y Cajal, 1888

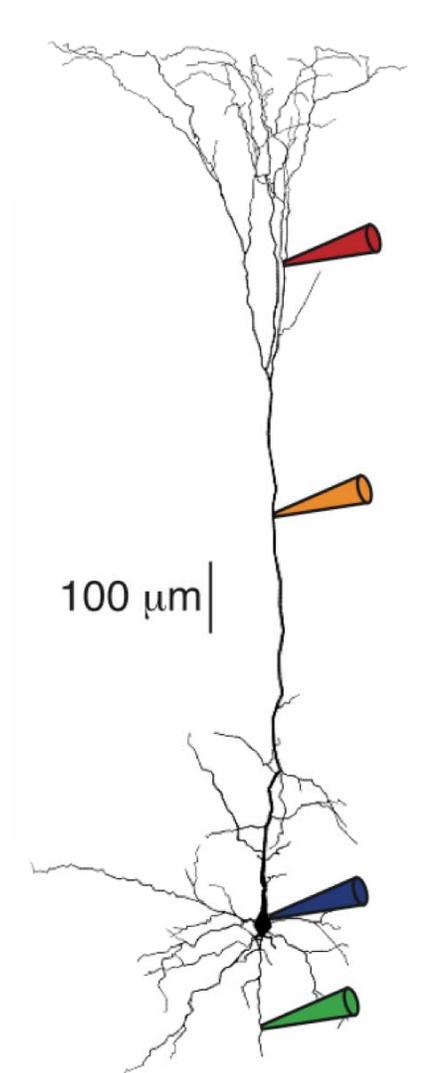
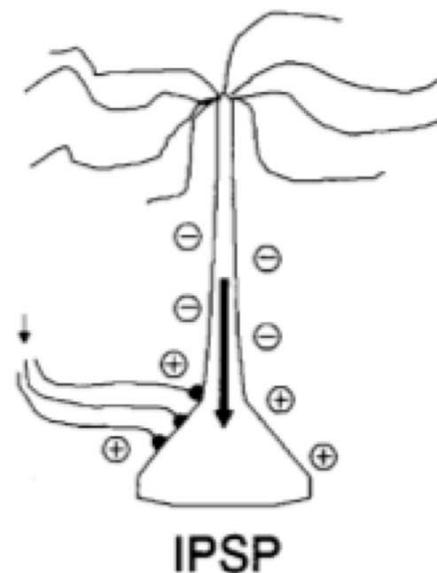
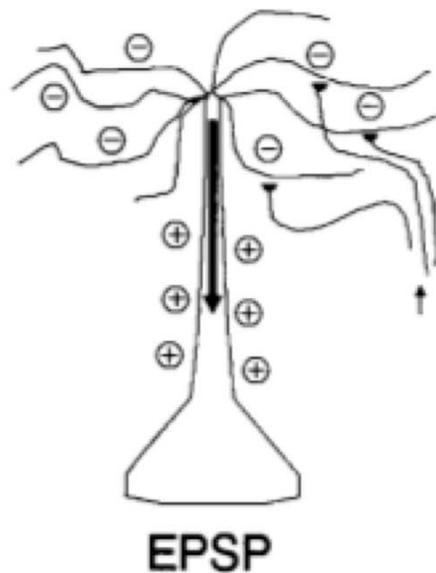


Spezifische Erregung im Cortex





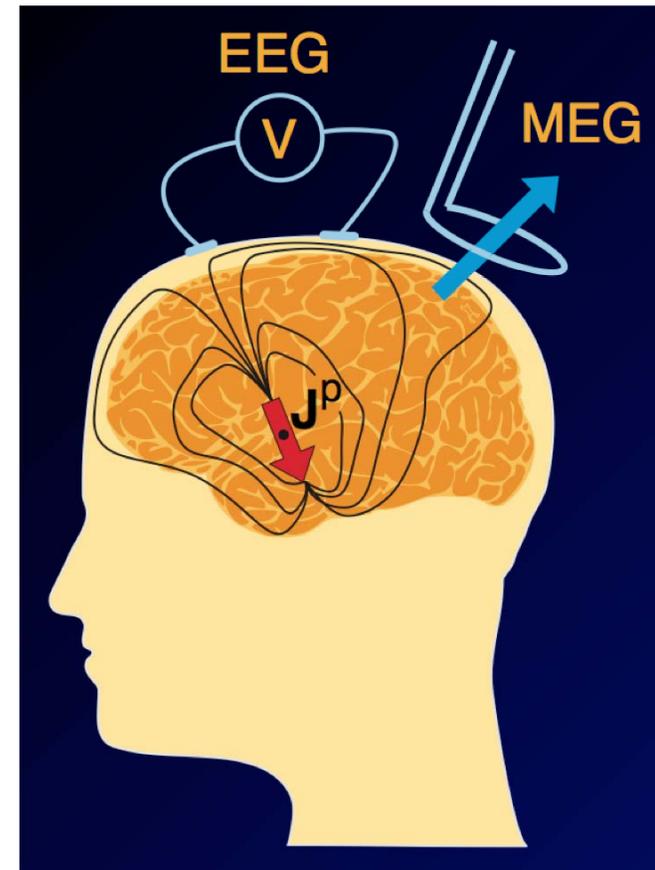
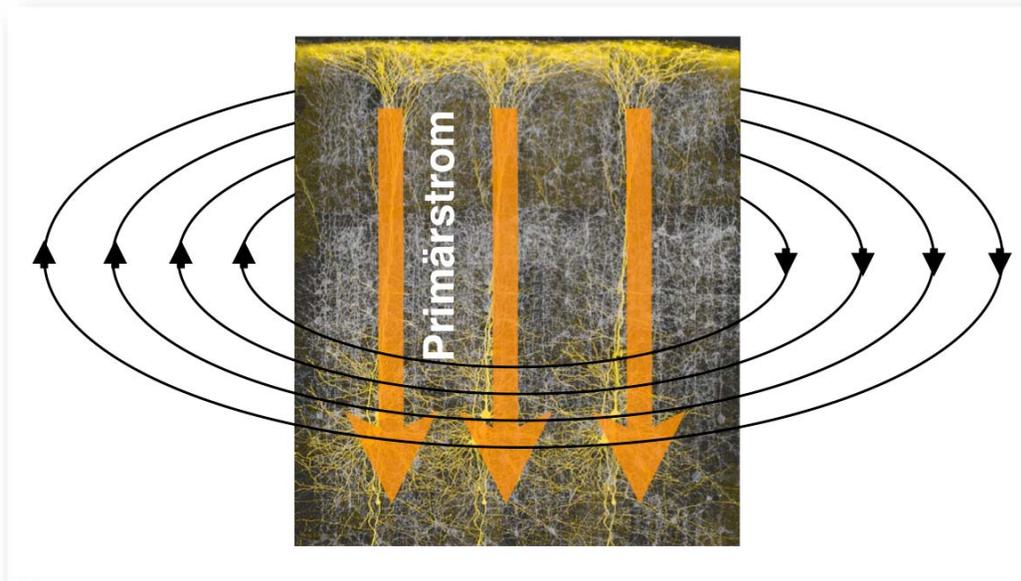
Aufbau von Dipolfeldern



Der ungleiche Schwerpunkt von Ein- und Ausstromzonen an Pyramidenzellen in Richtung der vertikalen Kolumnen des Kortex bewirkt ein effektives Dipolfeld bei der Messung an entfernten Elektroden. Aus Scherg, 1991.

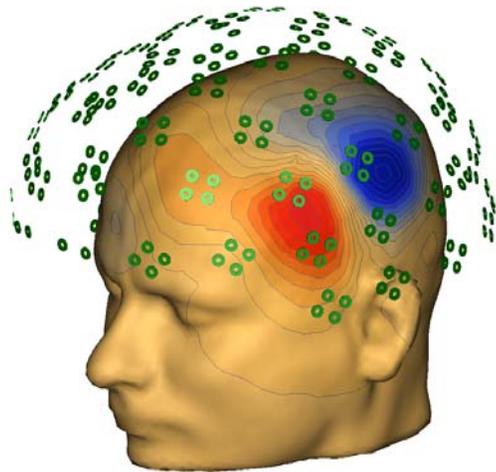


Ableitung spezifischer Aktivität im Cortex





Magnetoenzephalographie (MEG)



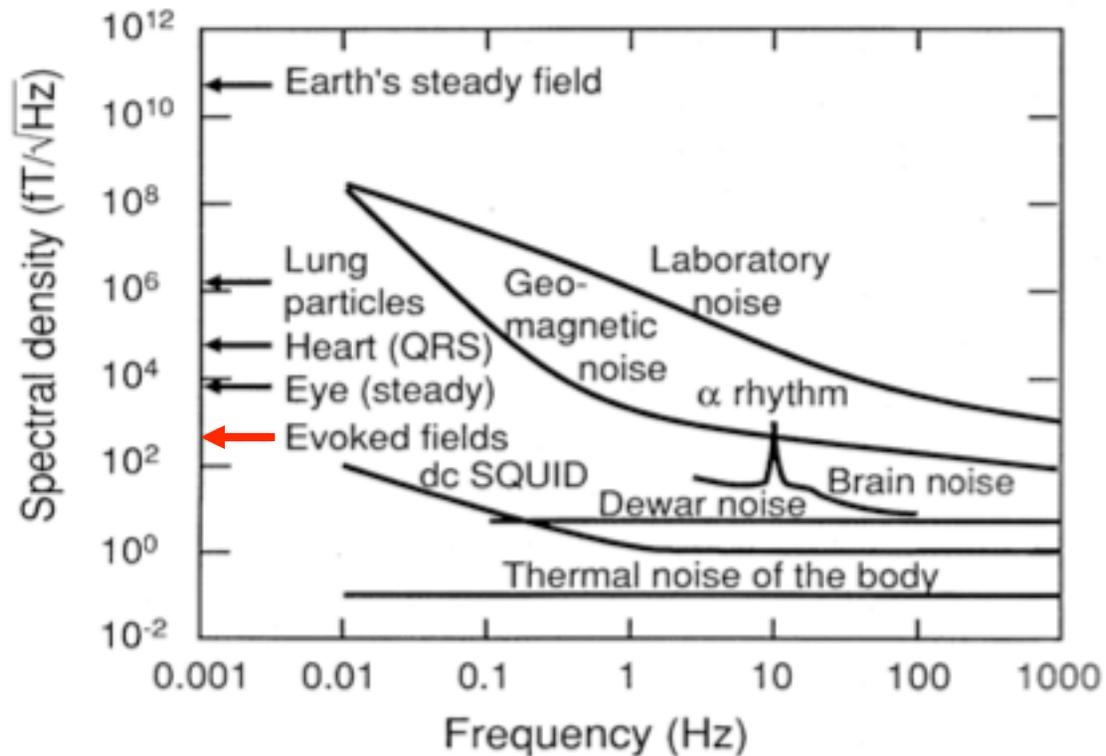
122 Sensoren

Messung der Felder
im Bereich von 10^{-15} Tesla





Größenordnungen von Magnetfeldern

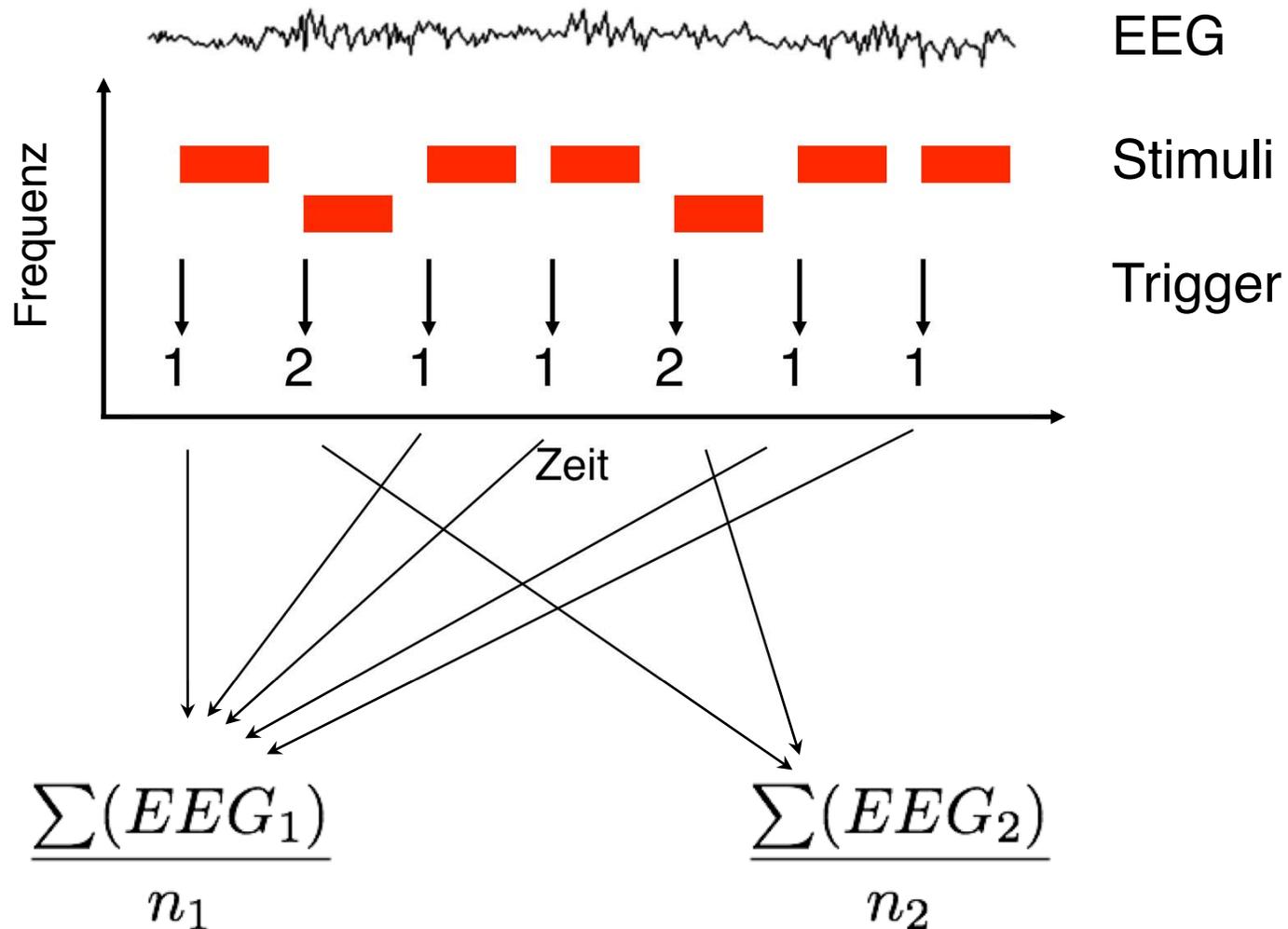


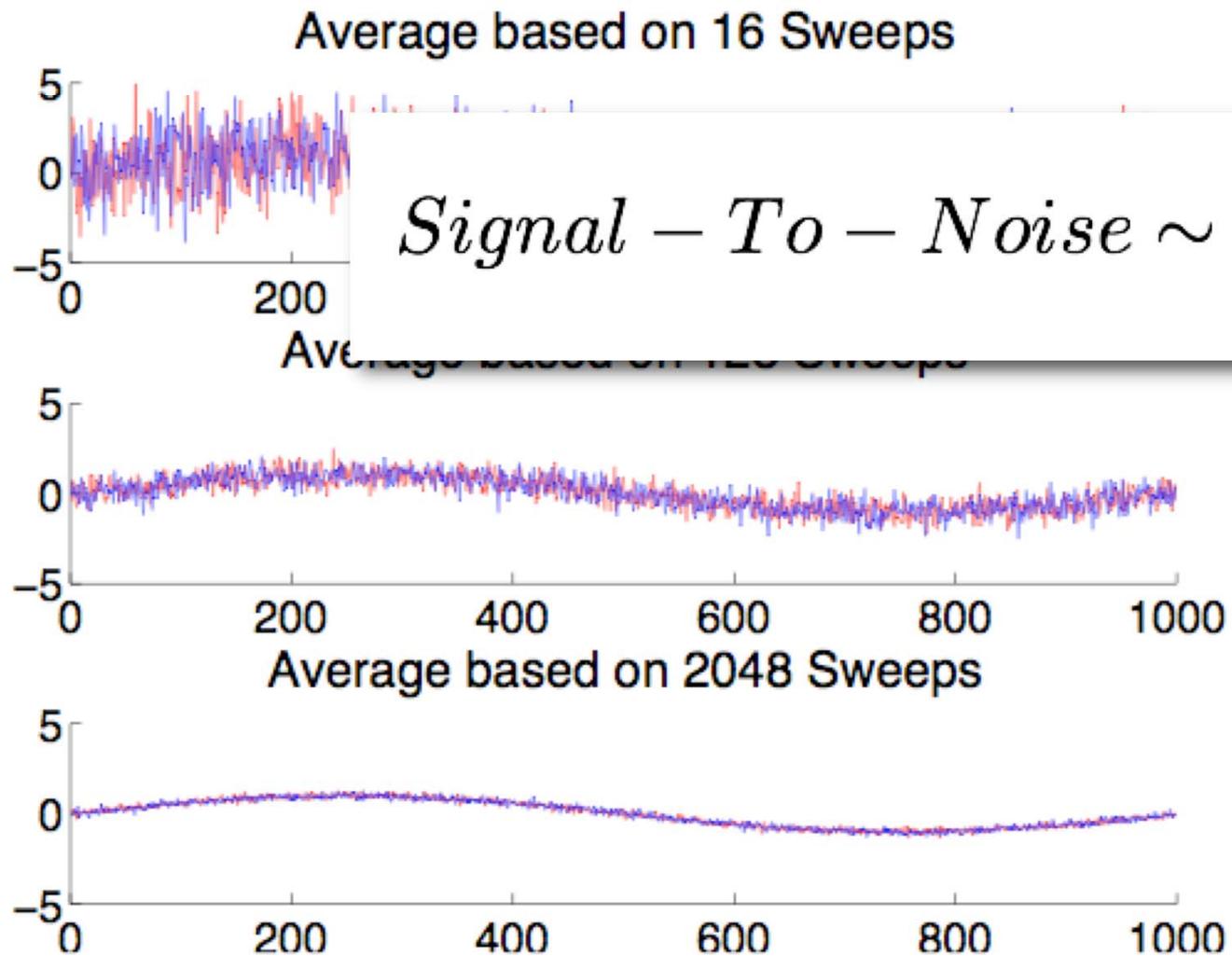


2. Evozierte Potentiale / Felder



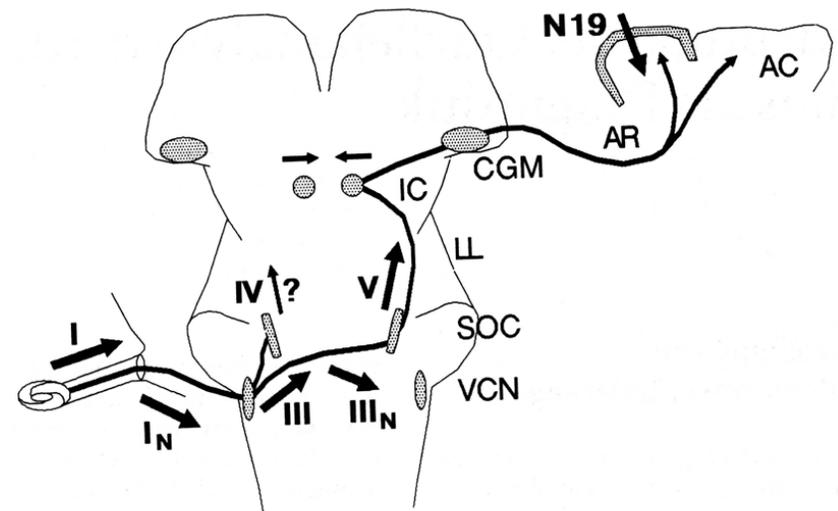
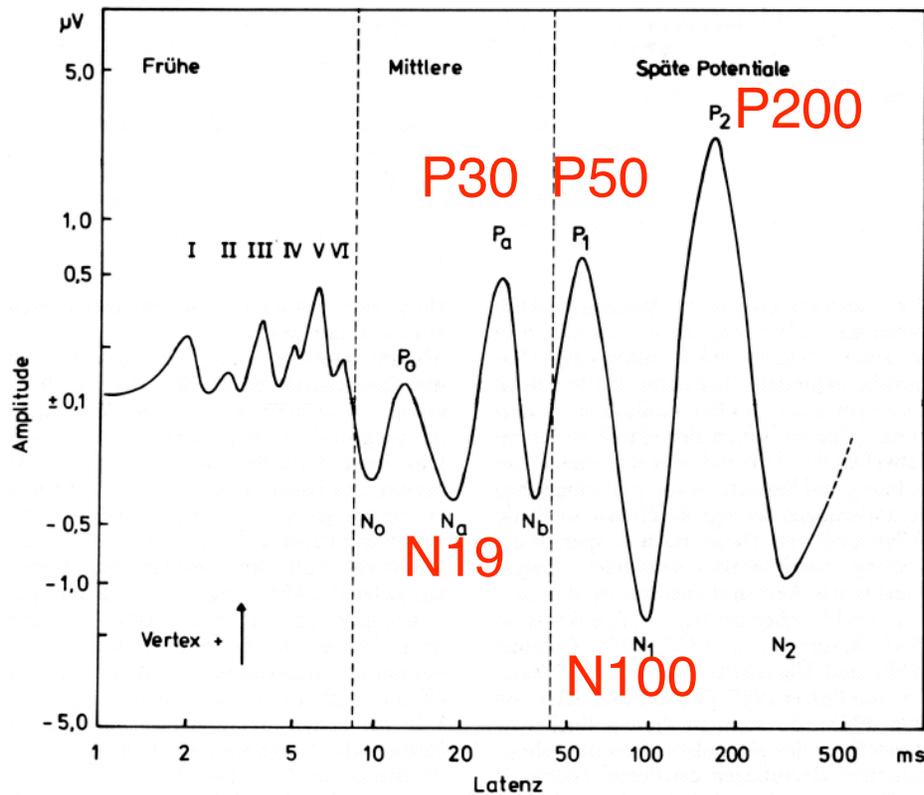
Evozierte Potentiale / Felder







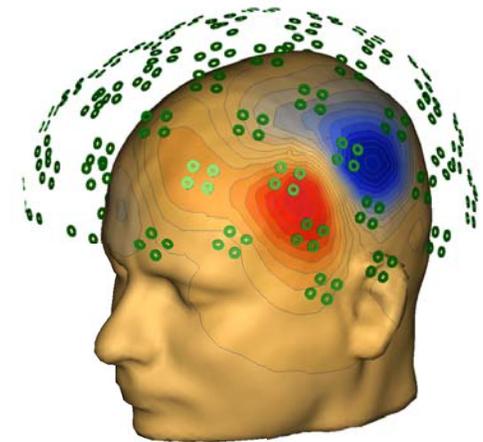
Evozierte Potentiale / Felder





Auditorisch evozierte Felder

frontal



links

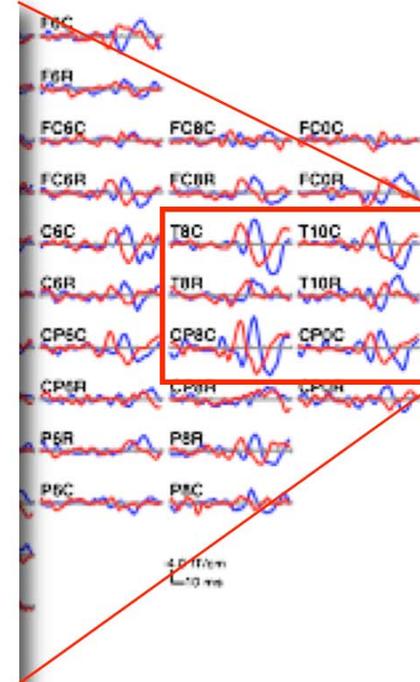
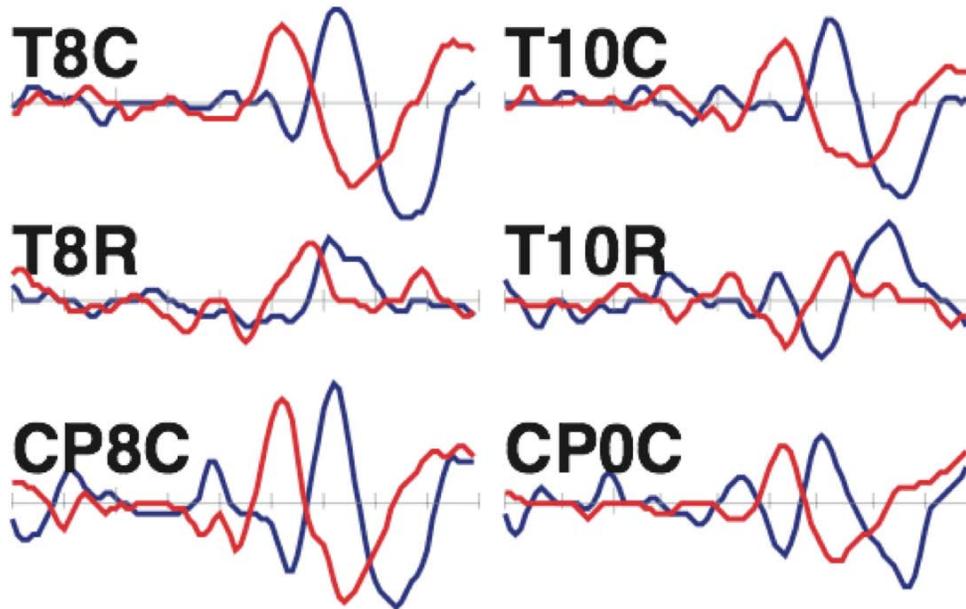
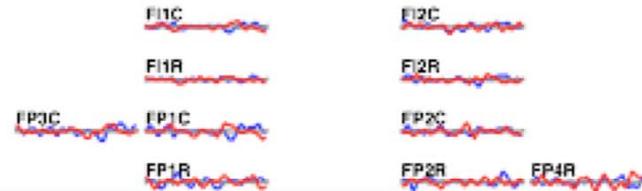
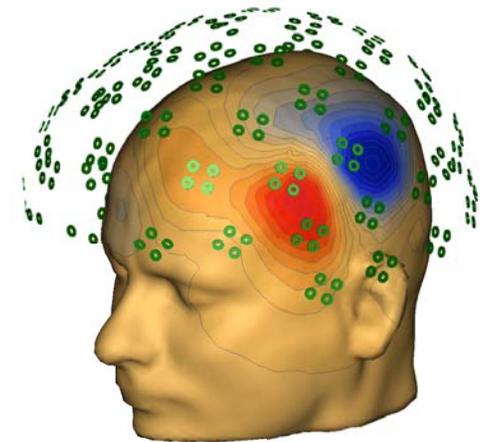
rechts



occipital



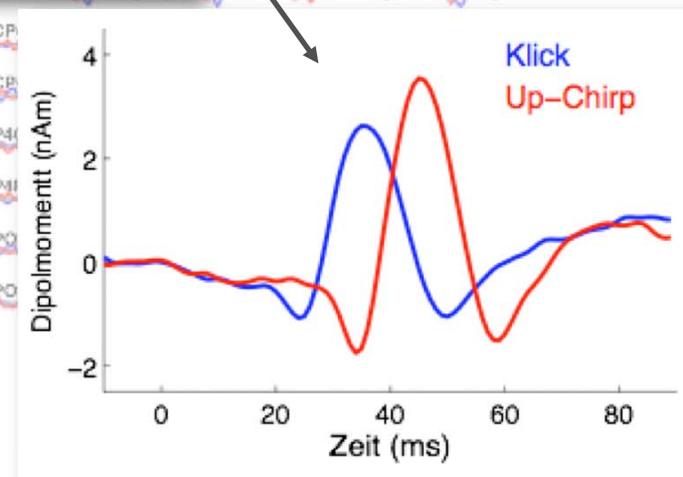
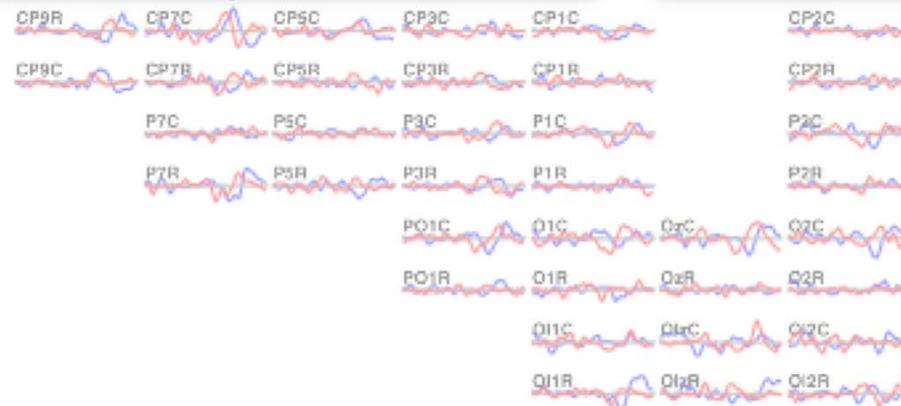
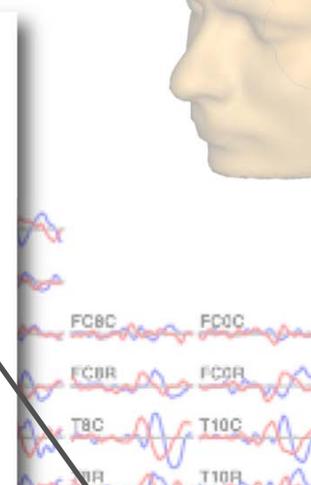
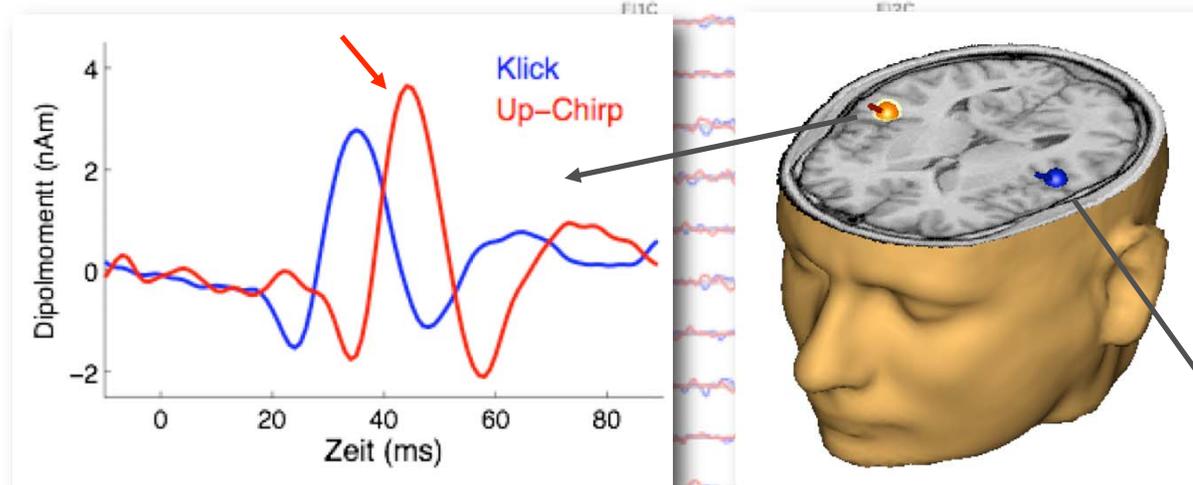
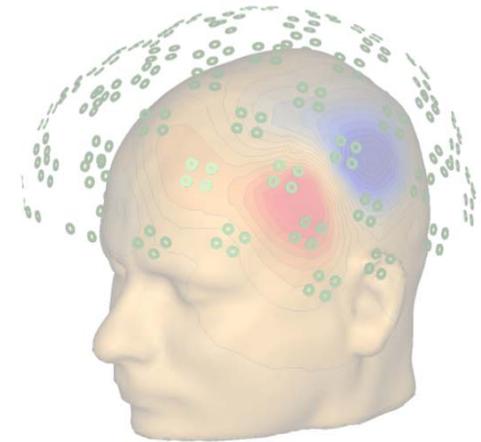
Sensor-Daten





Multiple Quellenanalyse

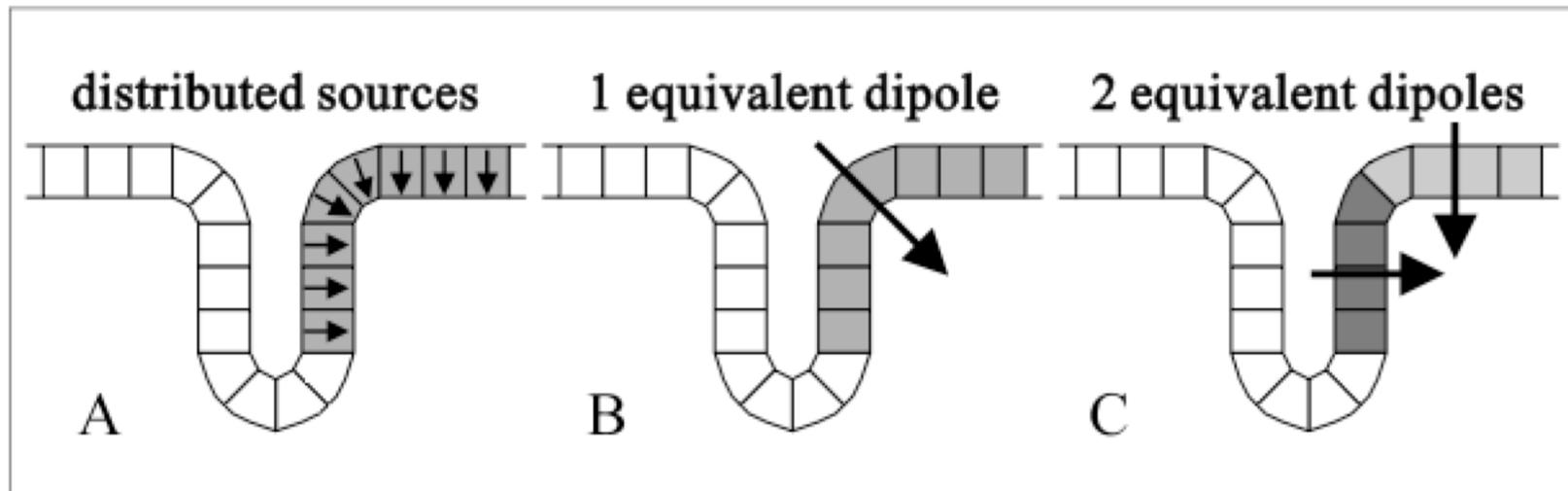
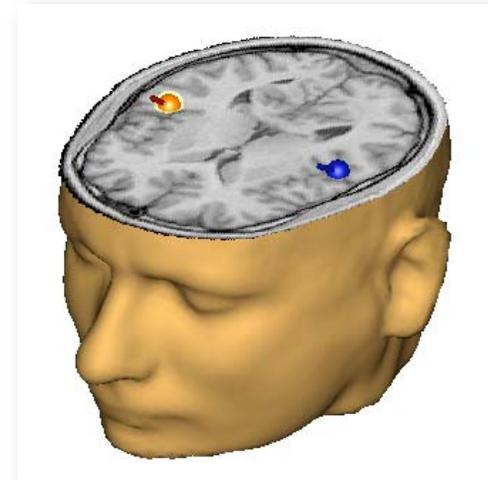
**P30m
oder Pam**





Konzept der Quellenanalyse

Repräsentation des Schwerpunkts
der Aktivierung

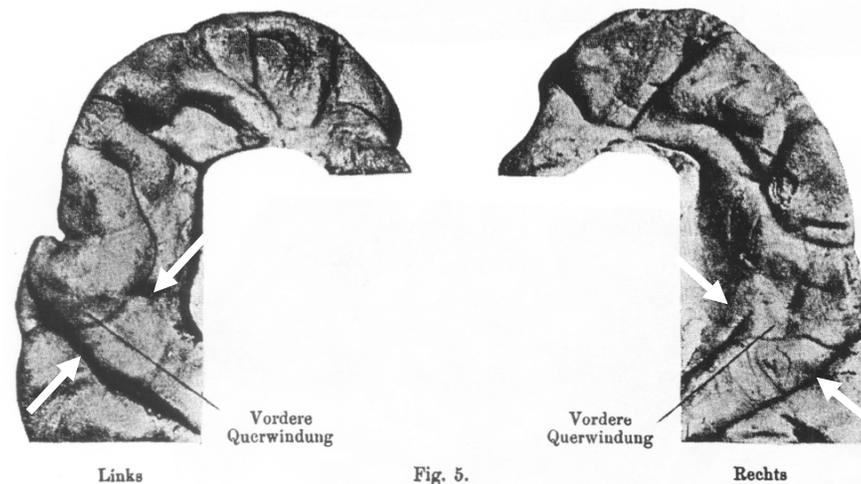




MAEP und Anatomie



Felix Mottl
1856-1911

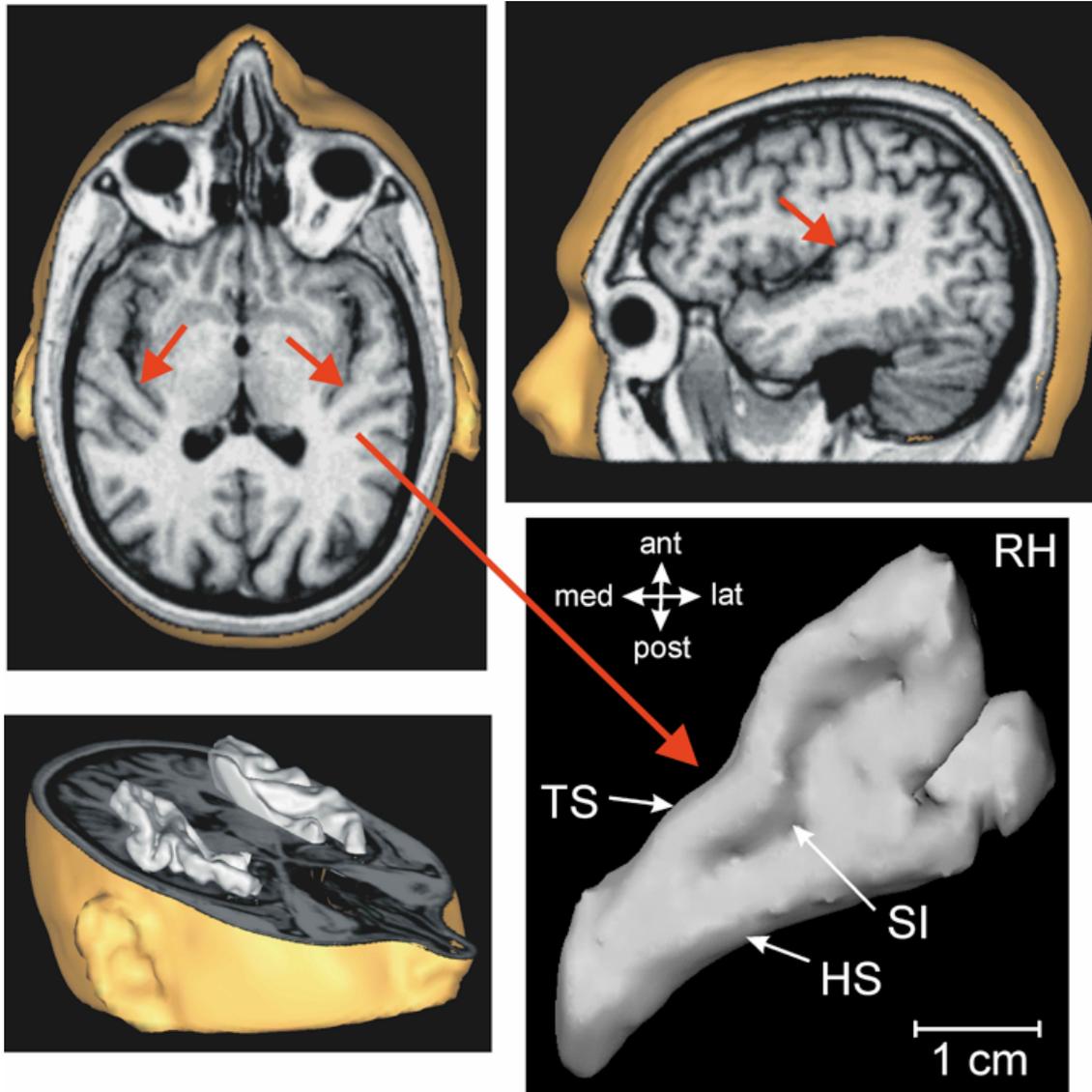


Auerbach, S. (1911): "Zur Lokalisation des musikalischen Talentes im Gehirn und am Schädel",

Archiv für Anatomie und Physiologie – Anatomische Abt., 1-10

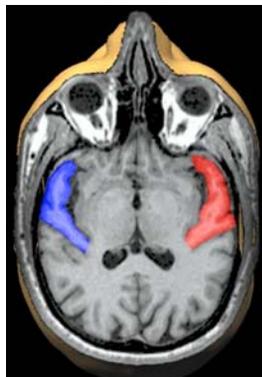


MAEP und Anatomie

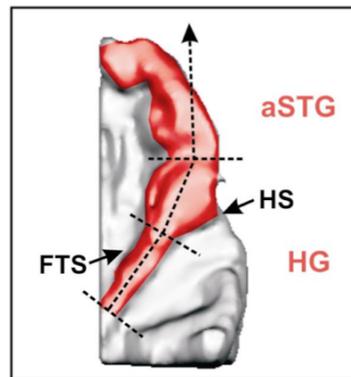




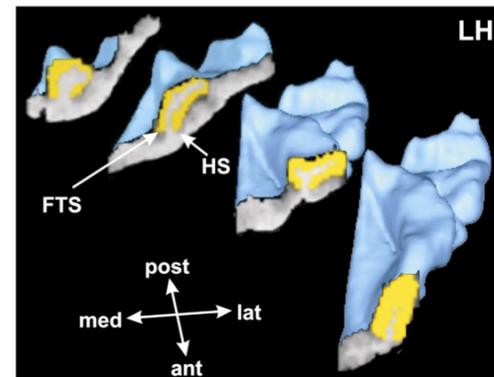
Morphometrie des Auditorischen Cortex



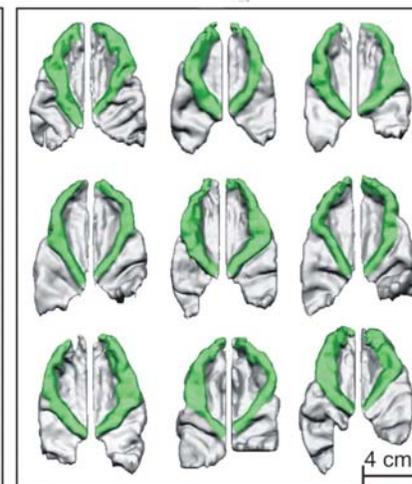
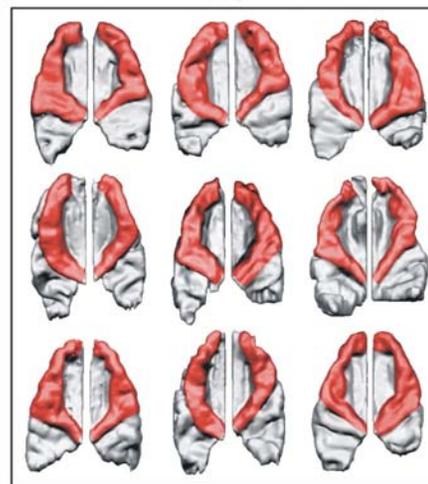
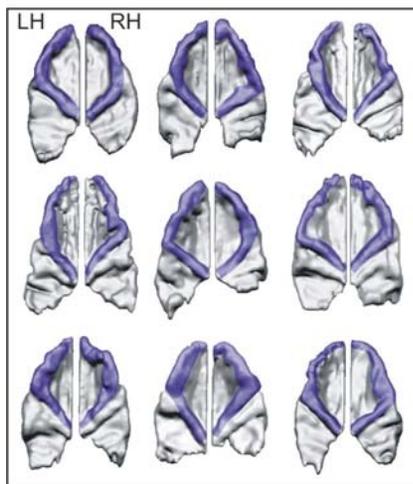
Nicht-Musiker



Profi-Musiker



Amateur-Musiker





Operationalisierung Musikalität



AMMA Test von E.E. Gordon (1989)

first:

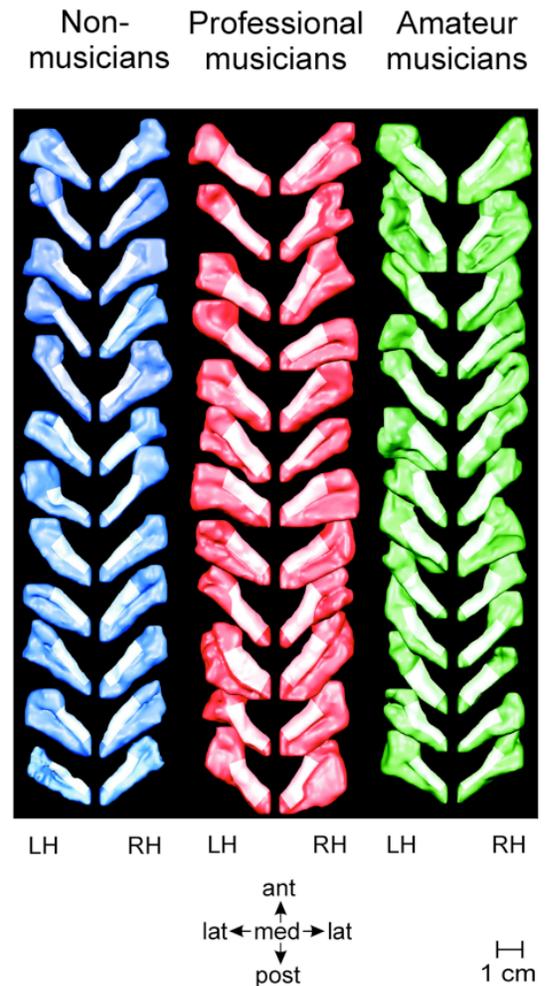
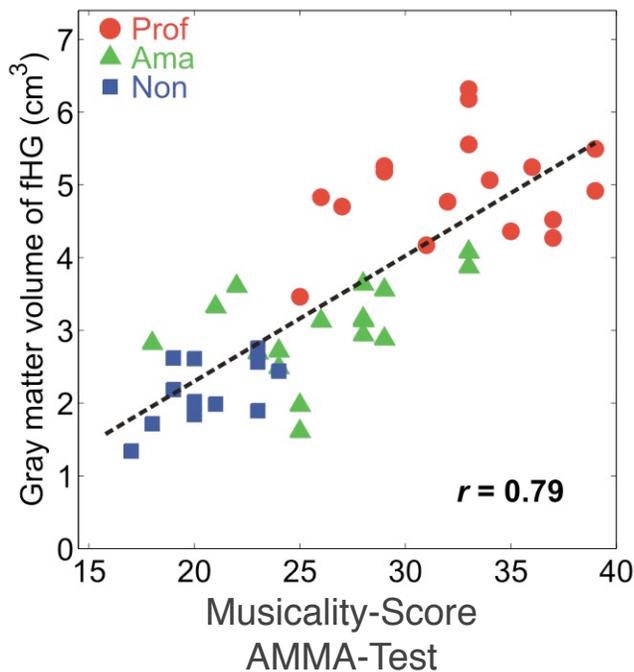
second:

30 kurze Melodiepaare
Die wiederholte Melodie enthält entweder Tonhöhen-
oder Tondauern-Änderungen oder ist unverändert
(3-way AFC task)



Musikalität und Anatomie

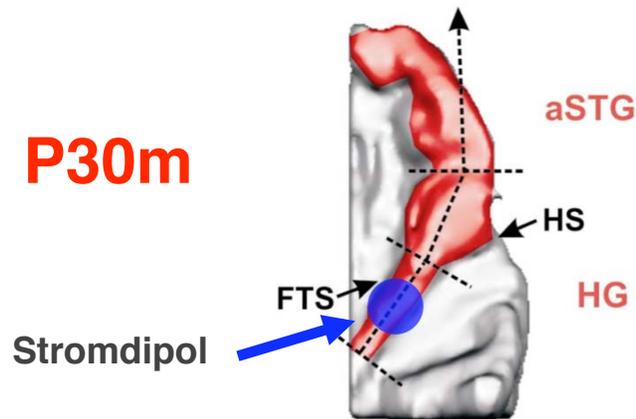
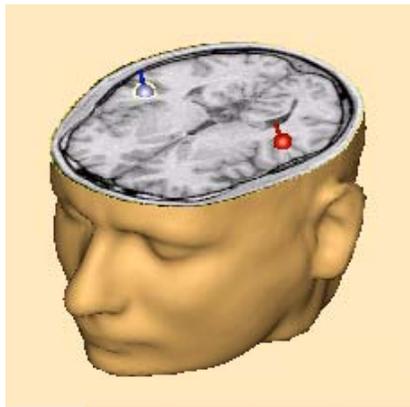
Struktur und Musikalität





Musikalität - Anatomie - Physiologie

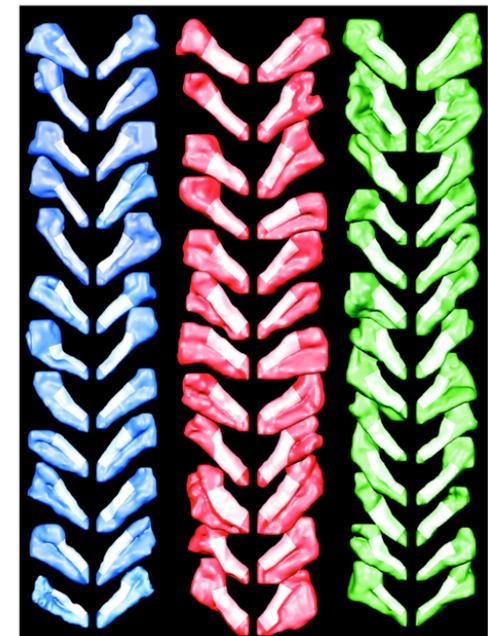
Auditorisch evoziertes Feld
im primären auditorischen Kortex



Schneider et al., 2002

Strukturelles MRT

Non-musicians Professional musicians Amateur musicians



LH RH LH RH LH RH

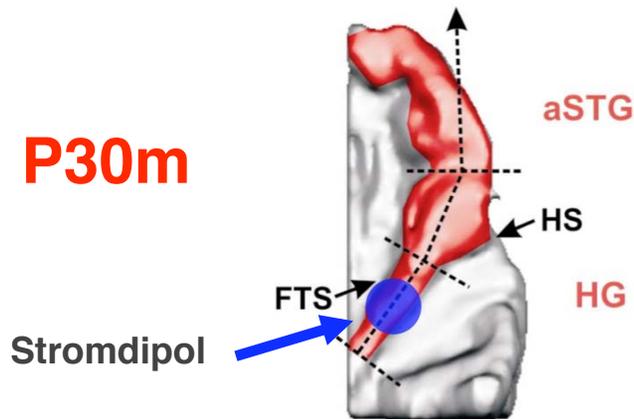
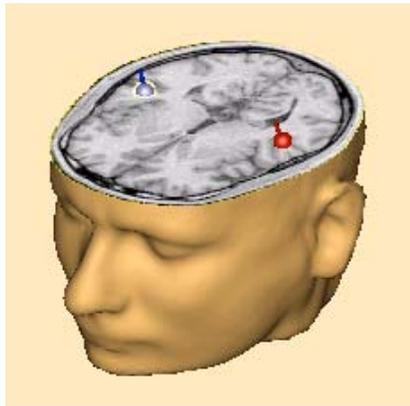
ant
lat ← med → lat
post

1 cm



Musikalität - Anatomie - Physiologie

Auditorisch evoziertes Feld
im primären auditorischen Kortex

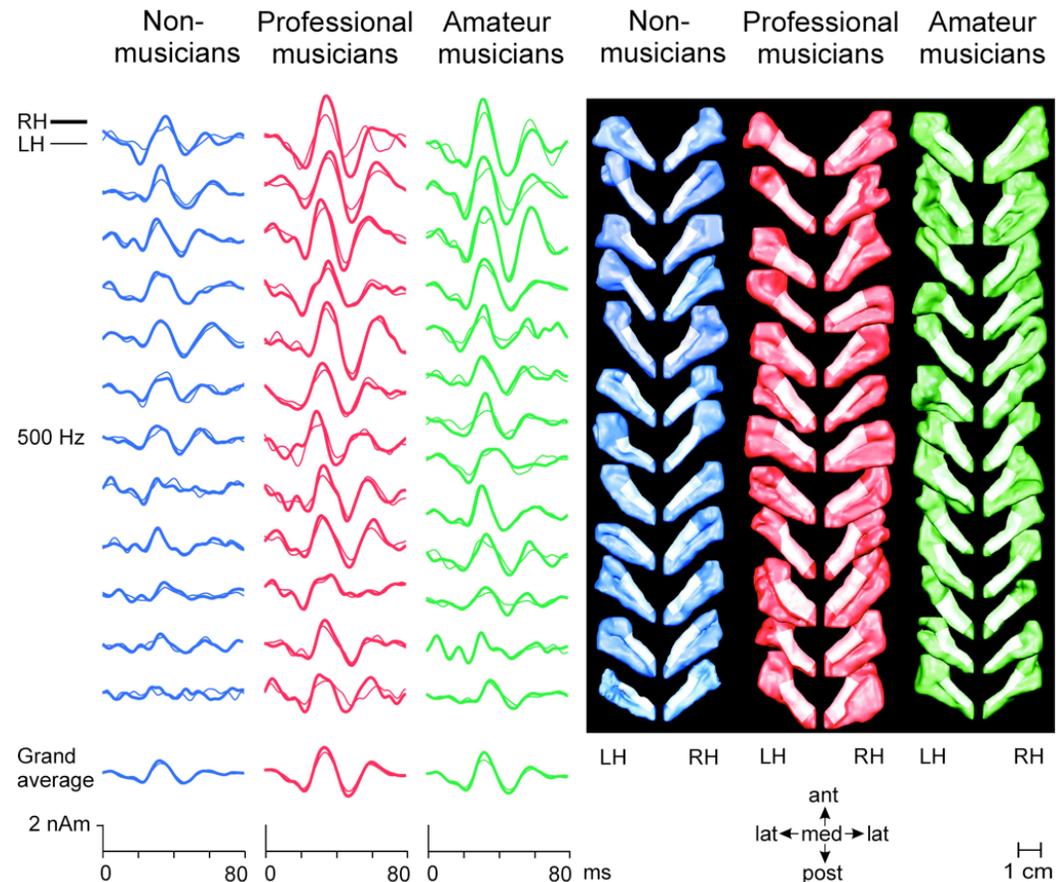


Schneider et al., 2002

Funktion (P30m) und Struktur

Magnetoencephalographie

Strukturelles MRT





Musikalität - Anatomie - Physiologie



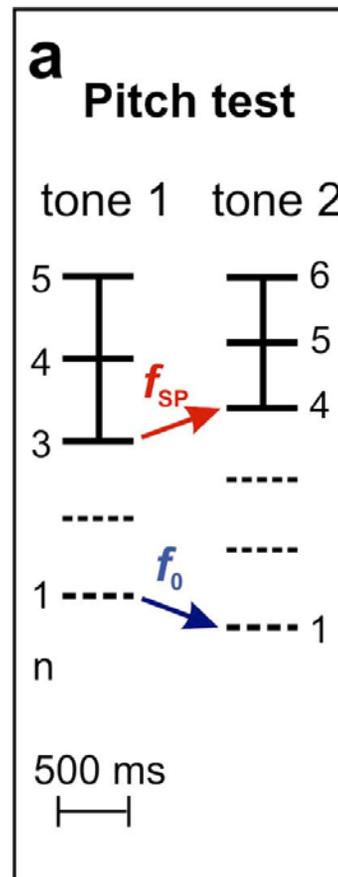
Tonpaar 68:

155 Hz (4-6)

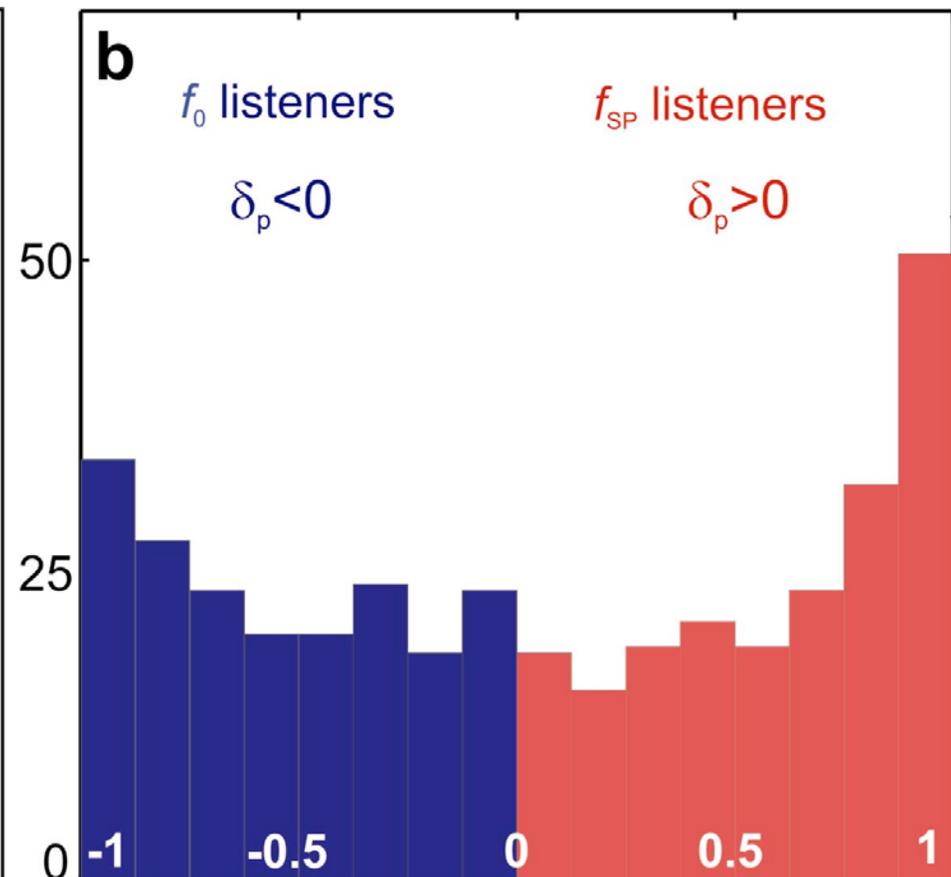
116 Hz (6-8)

Aufwärts: 57 %

Abwärts: 43 %



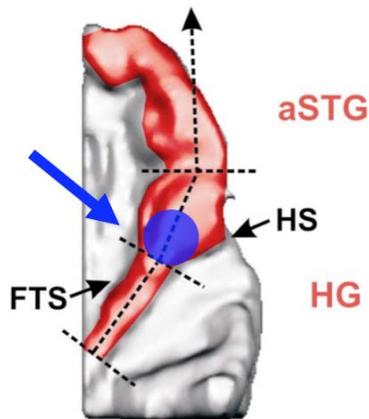
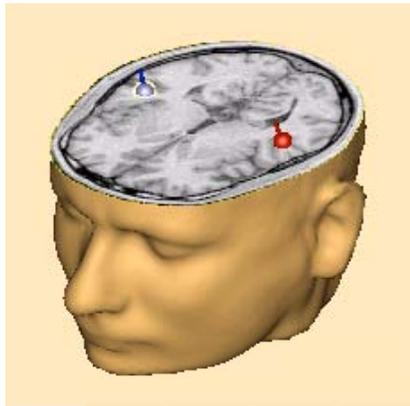
Complex tones





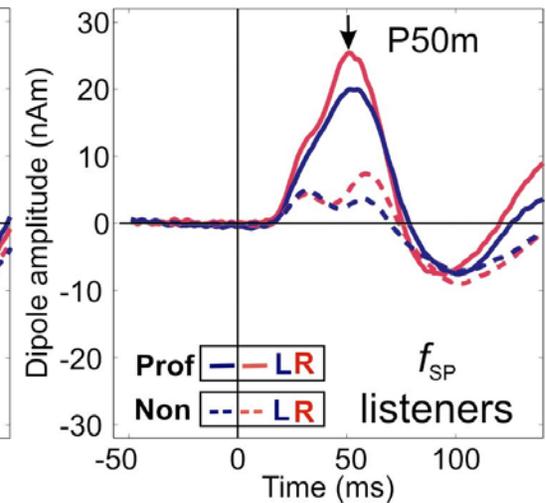
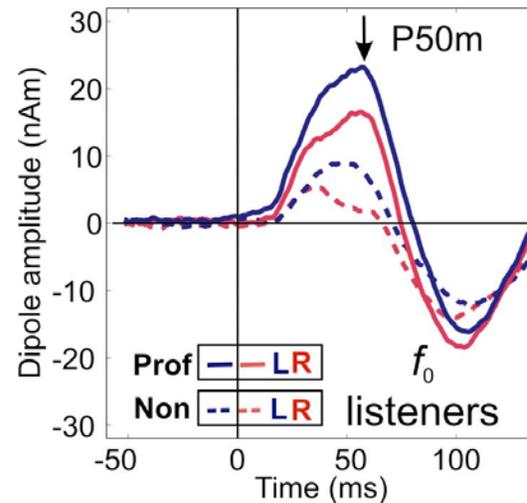
Musikalität - Anatomie - Physiologie

Auditorisch evoziertes Feld
im sekundären auditorischen Kortex



P50m

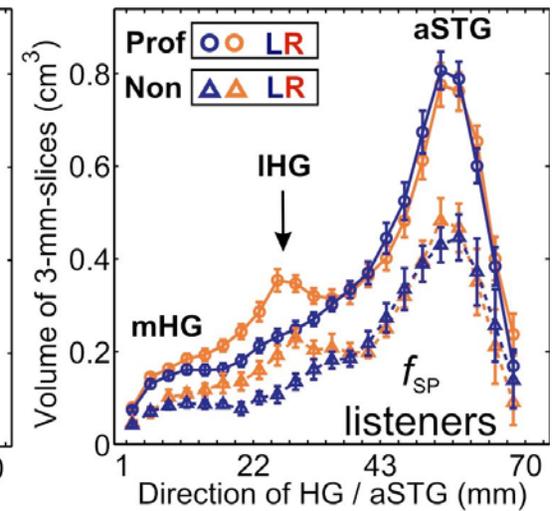
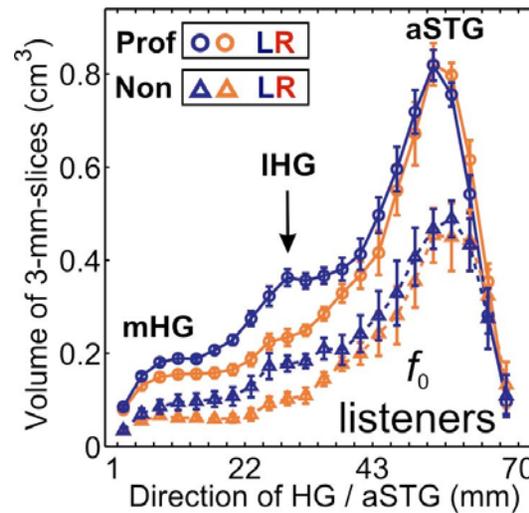
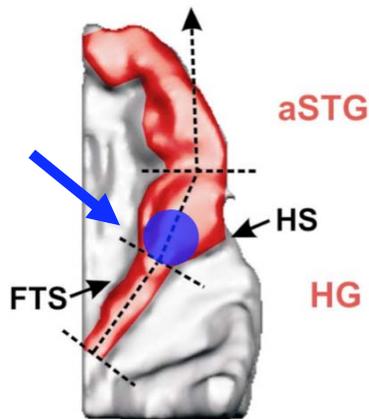
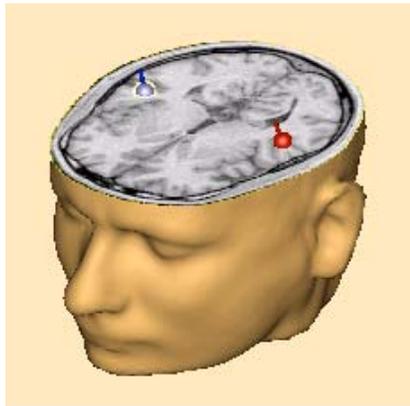
Stromdipol





Musikalität - Anatomie - Physiologie

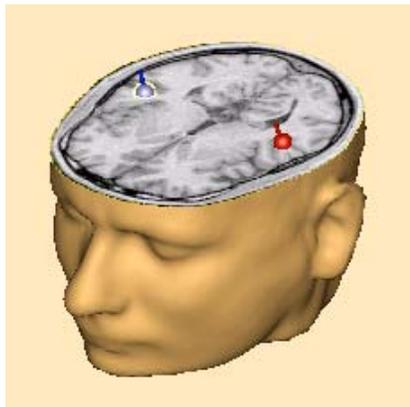
Auditorisch evoziertes Feld
im sekundären auditorischen Kortex





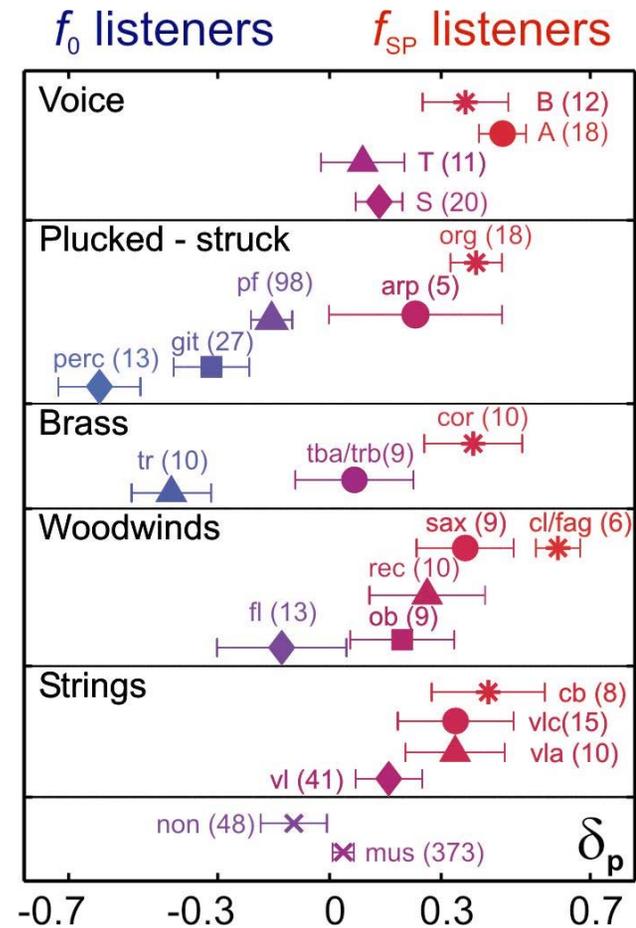
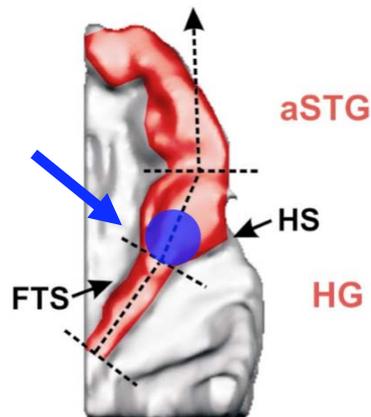
Musikalität - Anatomie - Physiologie

Auditorisch evoziertes Feld
im sekundären auditorischen Kortex



P50m

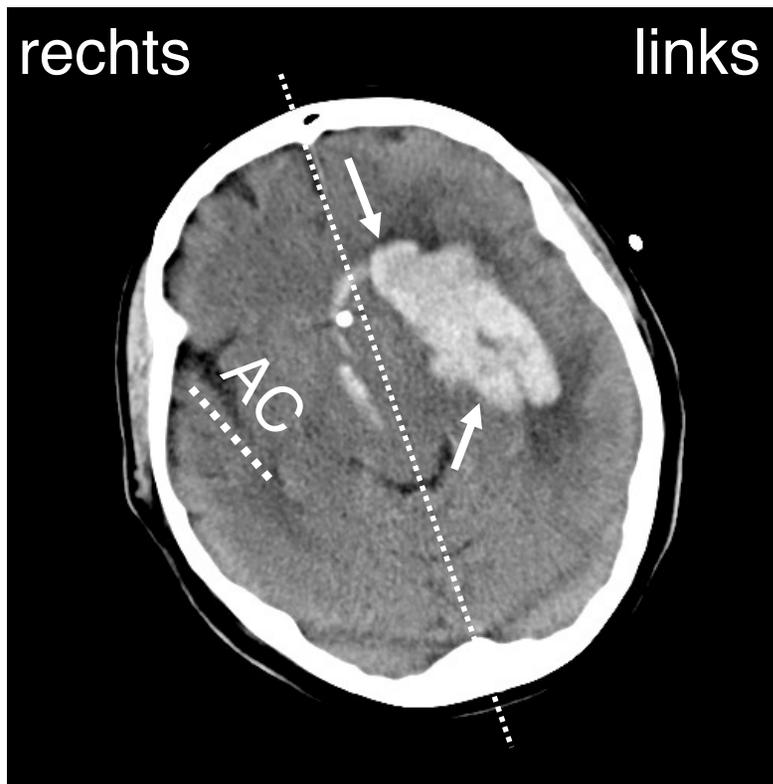
Stromdipol





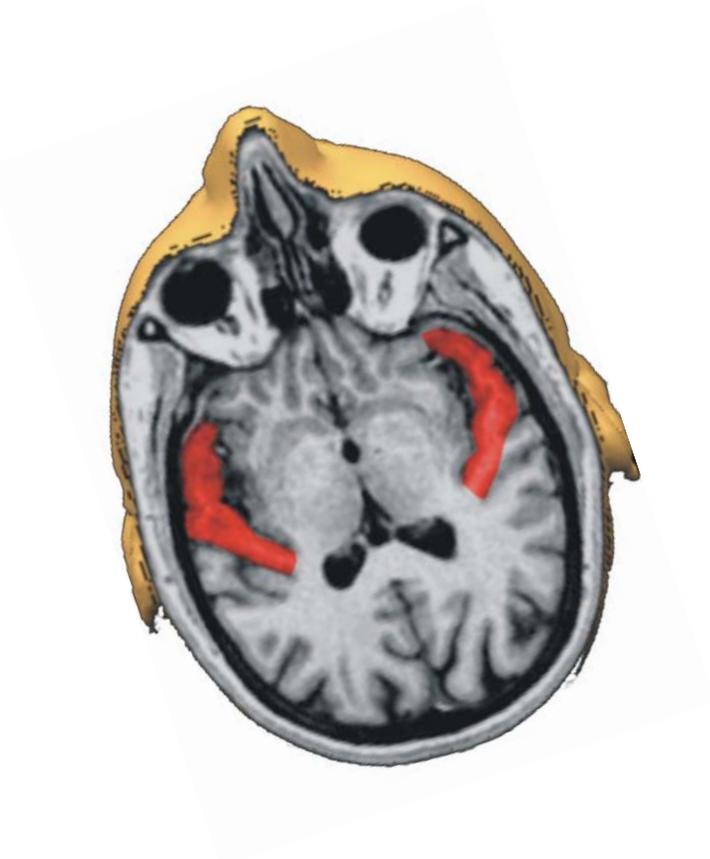
MAEP in Narkose

Patient nach Blutung



Computer-Tomographie

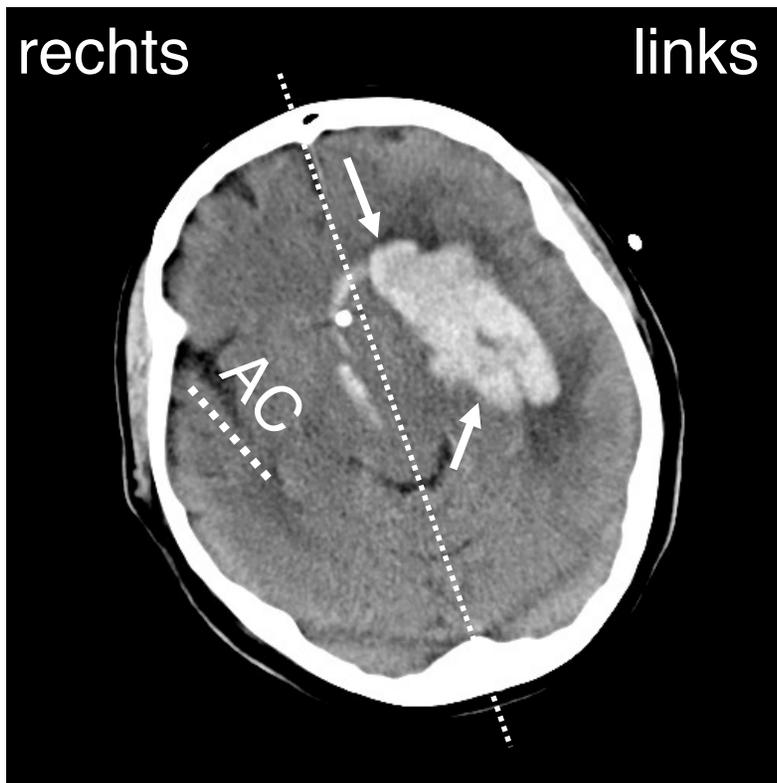
Proband



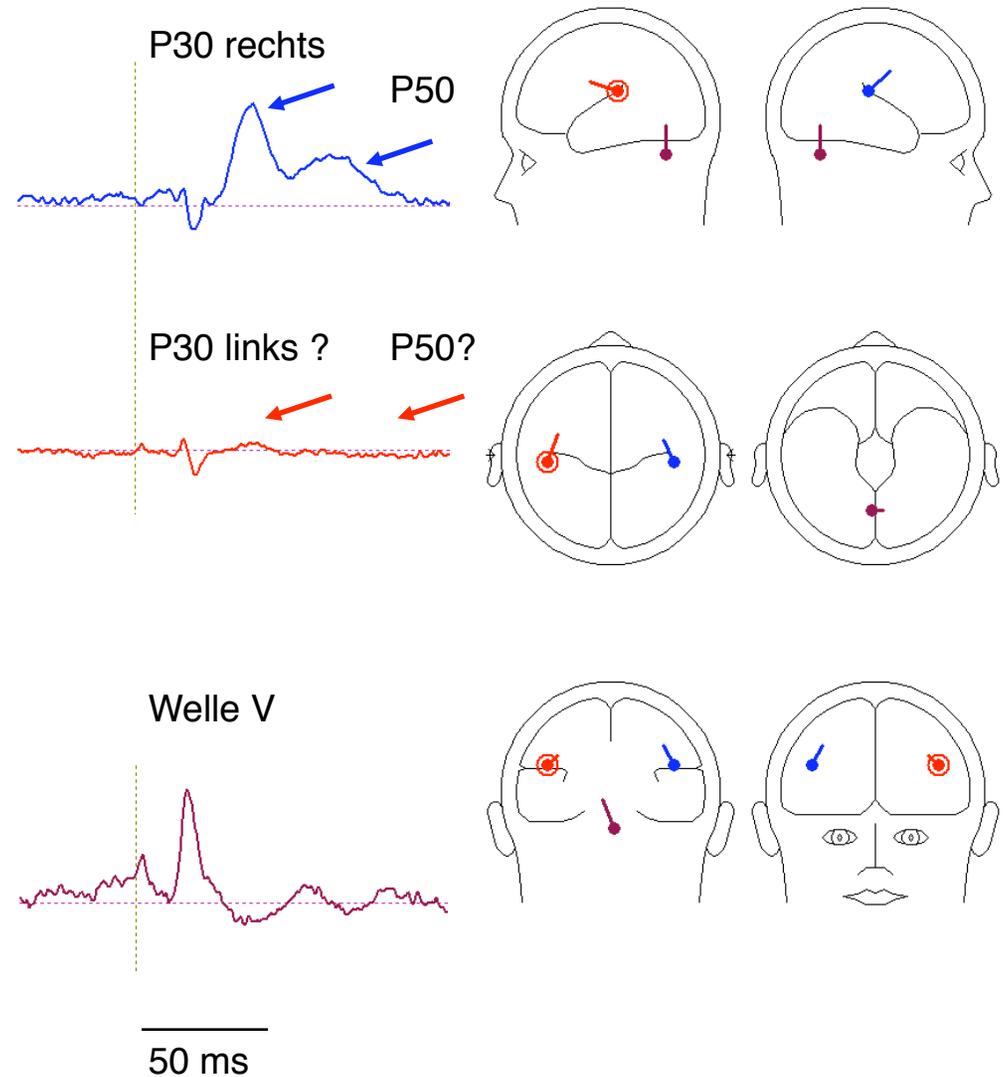


MAEP in Narkose nach Blutung

Patient nach Blutung



Computer-Tomographie





3. Aufmerksamkeitseffekte



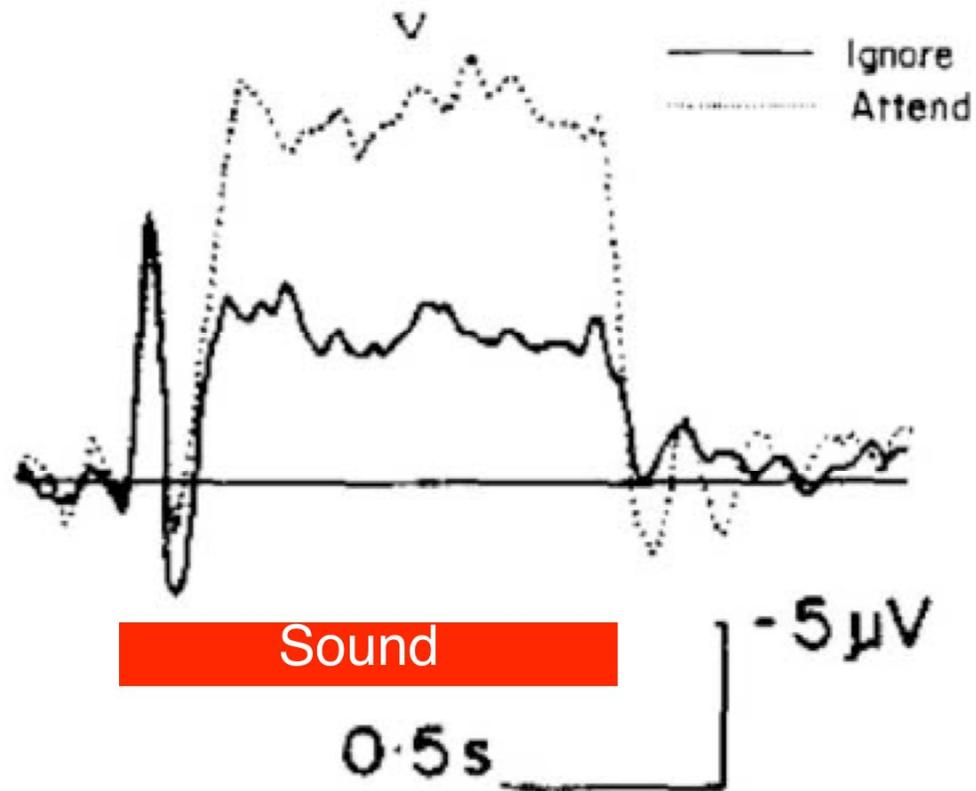
Aufmerksamkeitseffekte des Hörens

oddball Paradigma





Aufmerksamkeitseffekte des Hörens



passiv

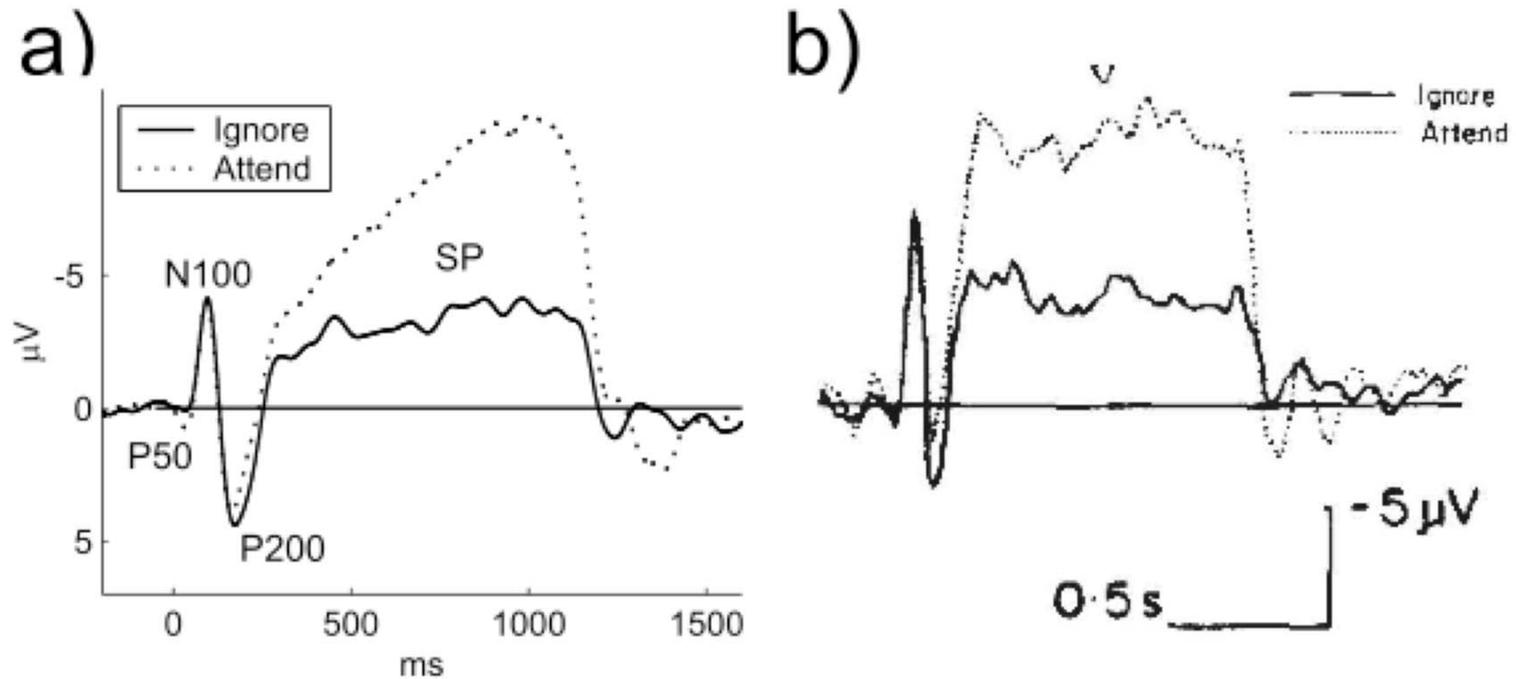


aktiv - Mausclick



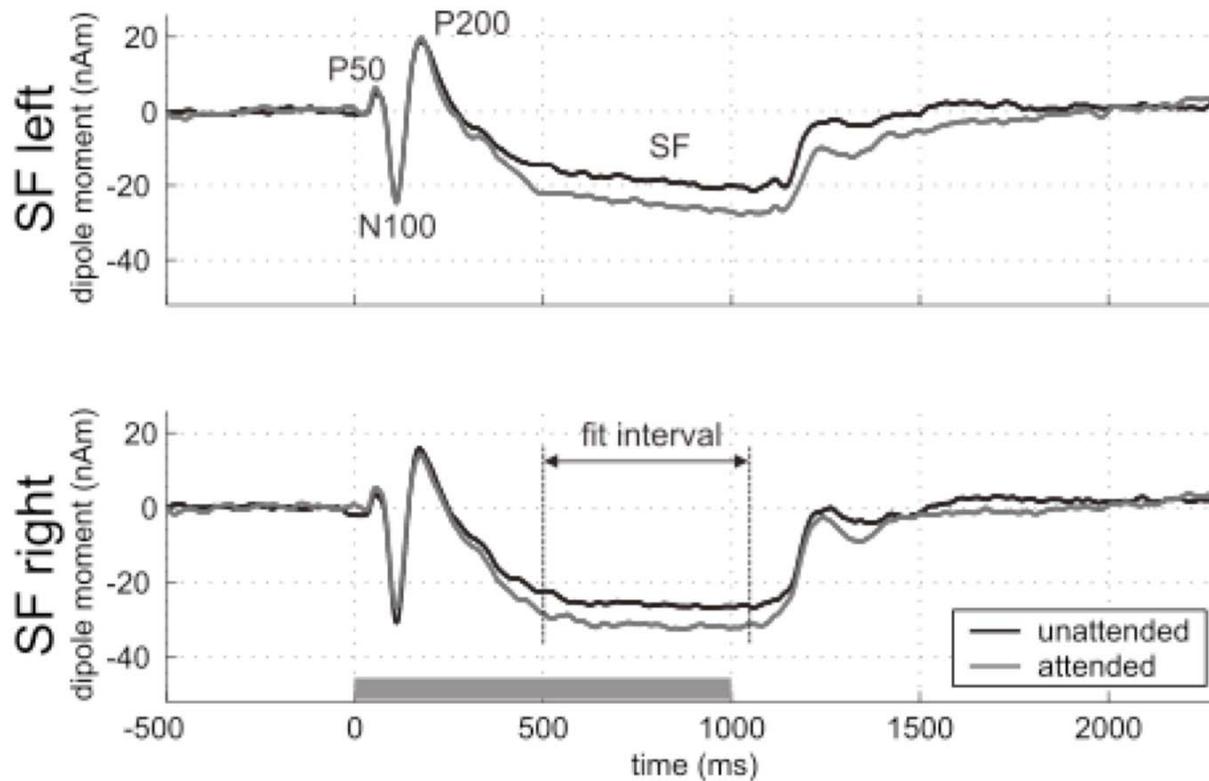
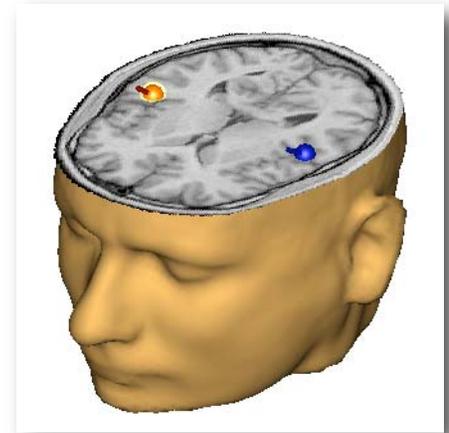


Aufmerksamkeitseffekte des Hörens



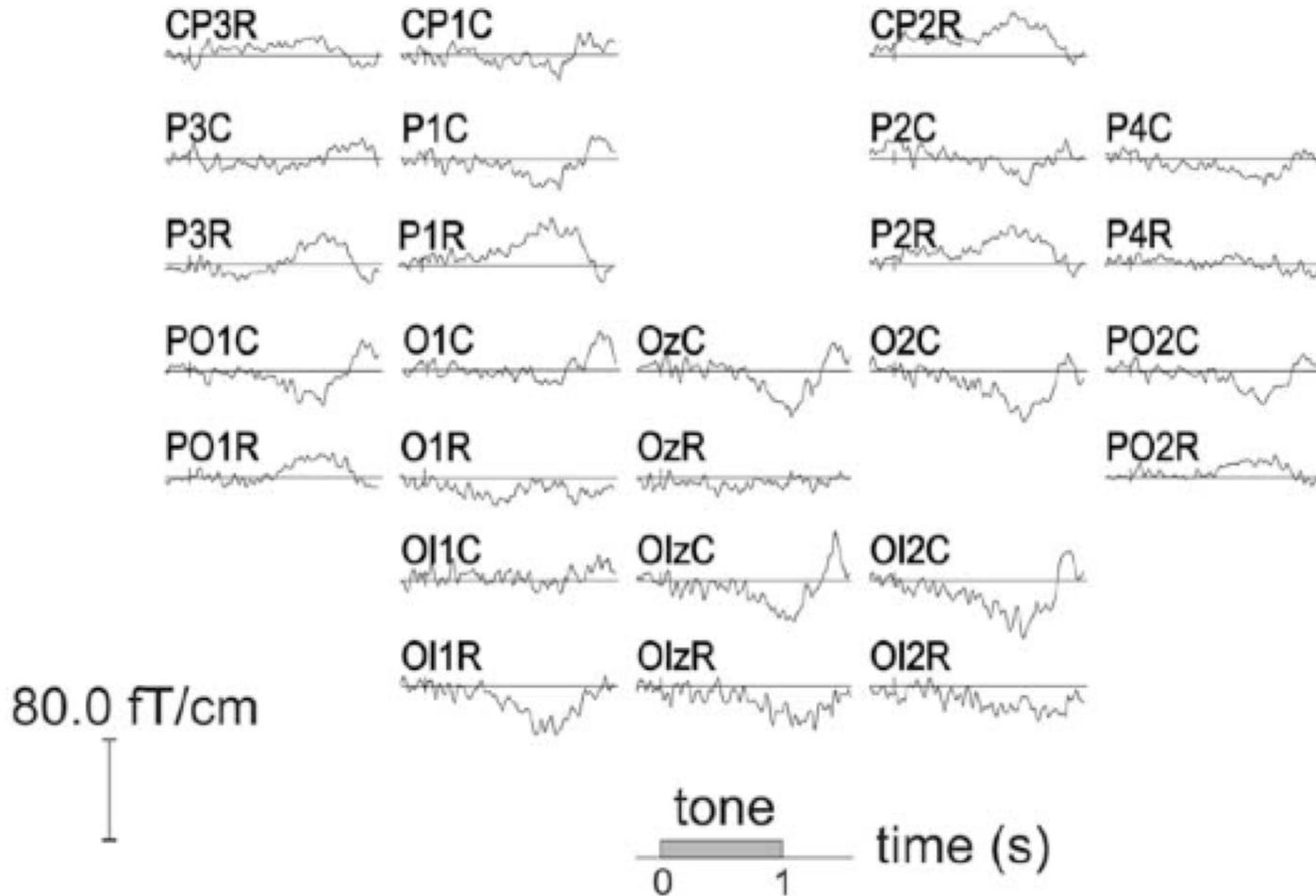


MEG-Ableitung



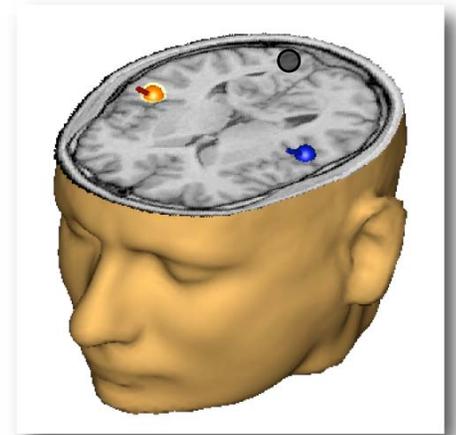
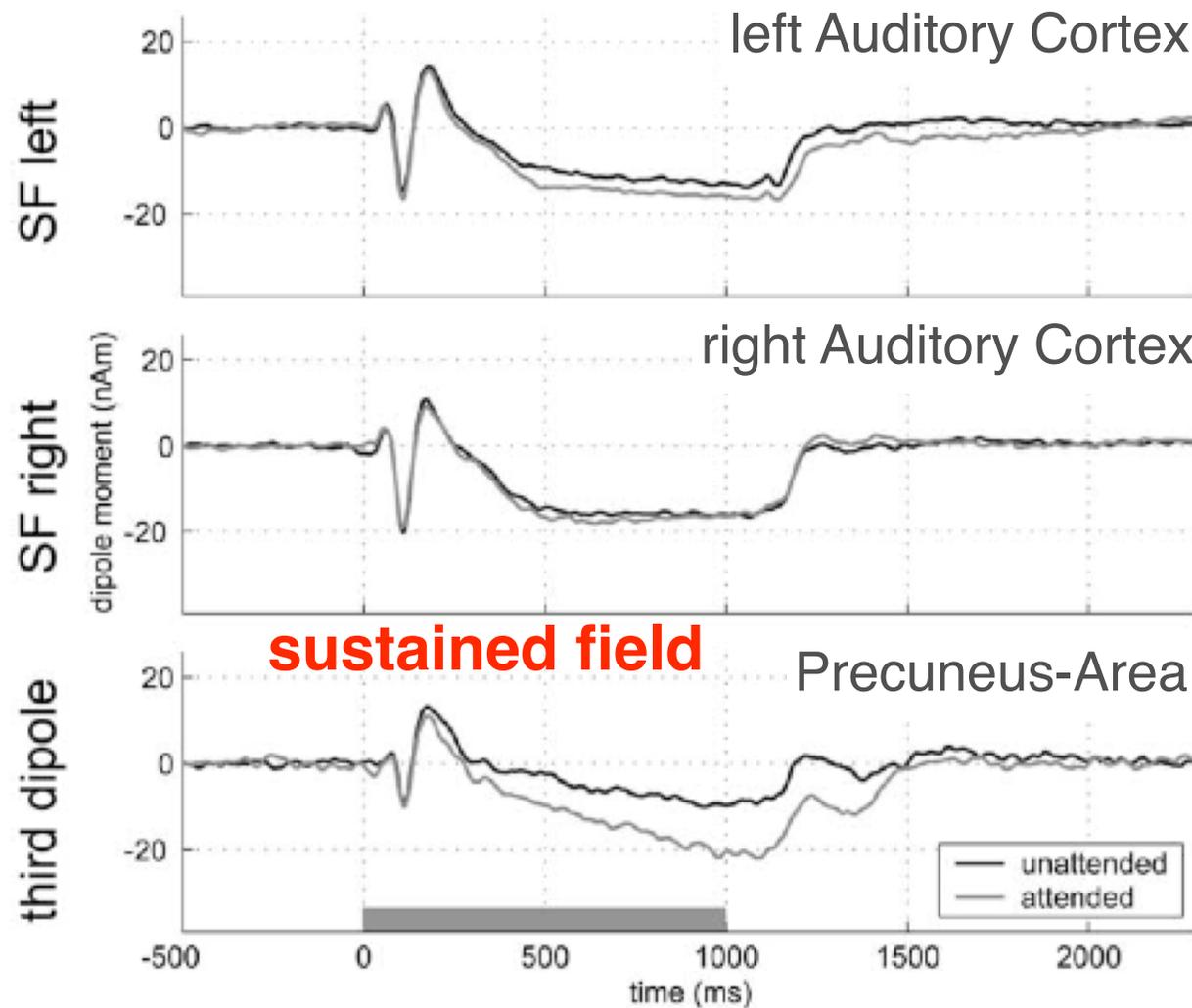


Residual-Aktivität attend-unattend



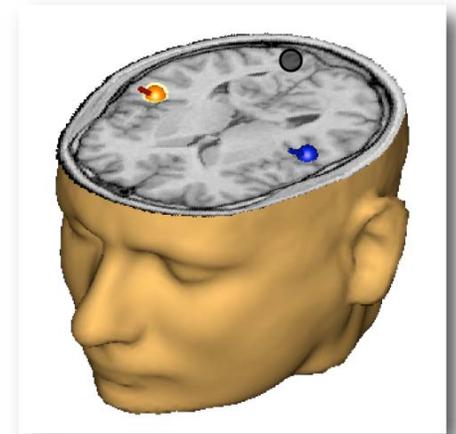
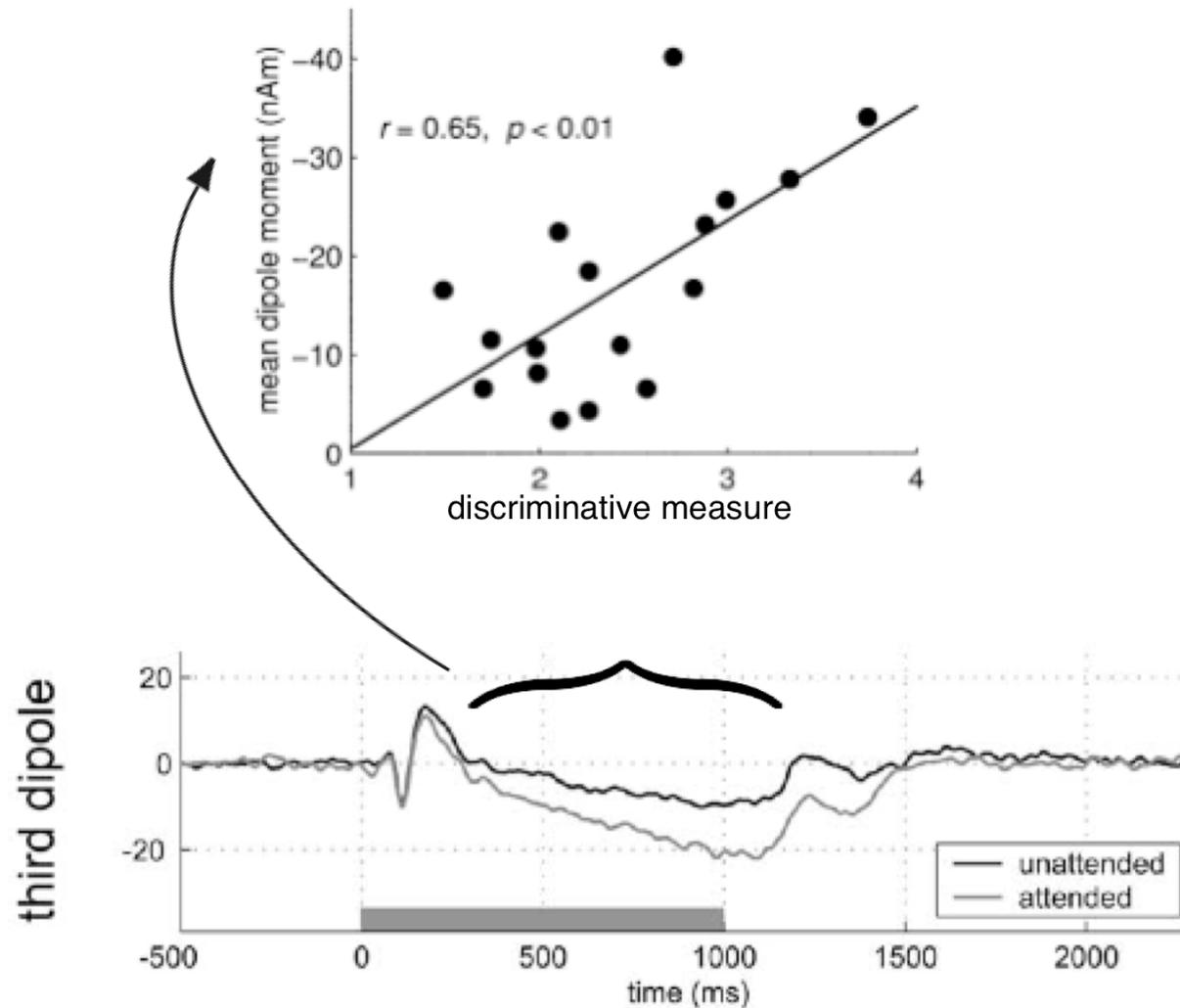


Aufmerksamkeitsabhängiger Generator



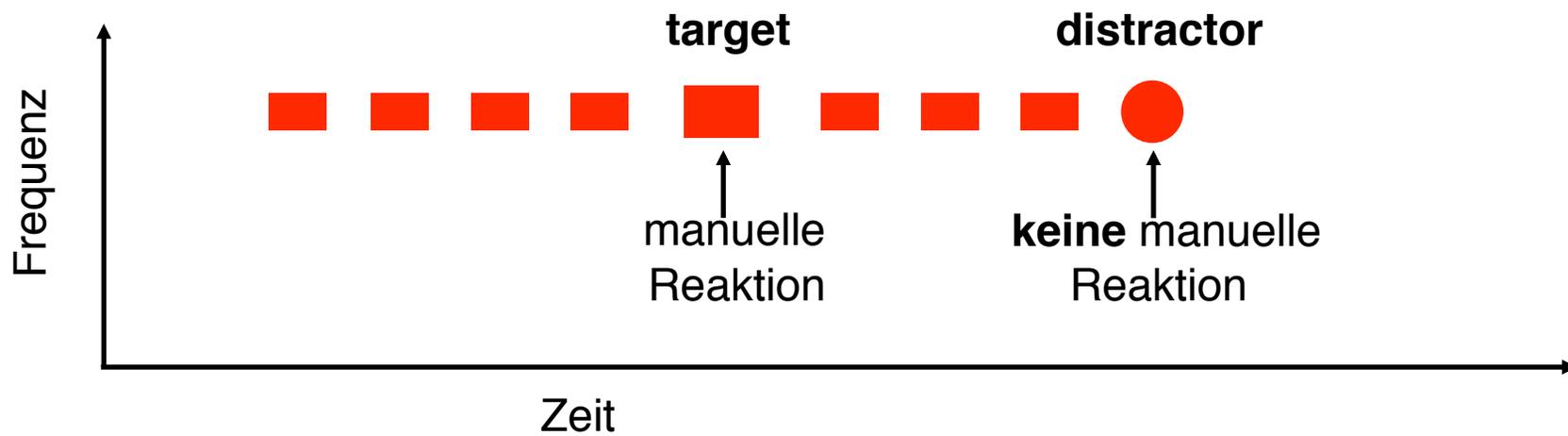


Aufmerksamkeitsabhängiger Generator



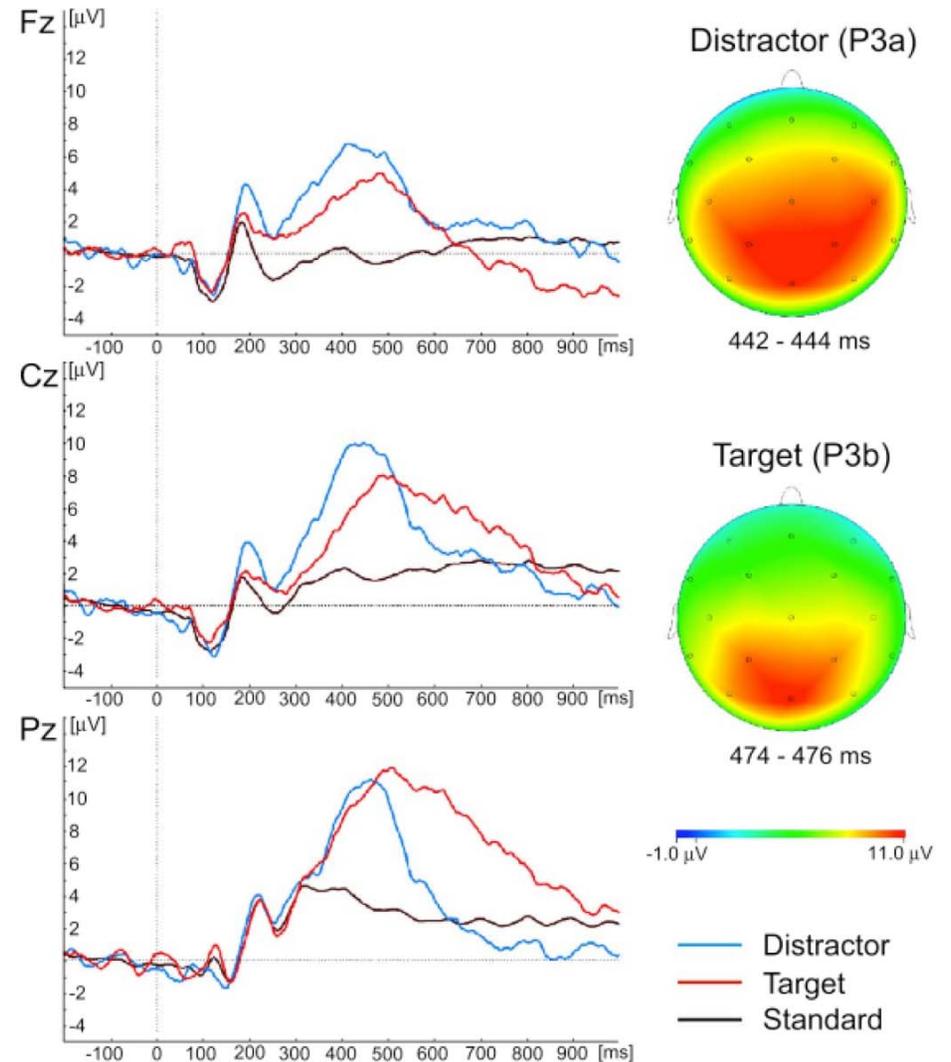
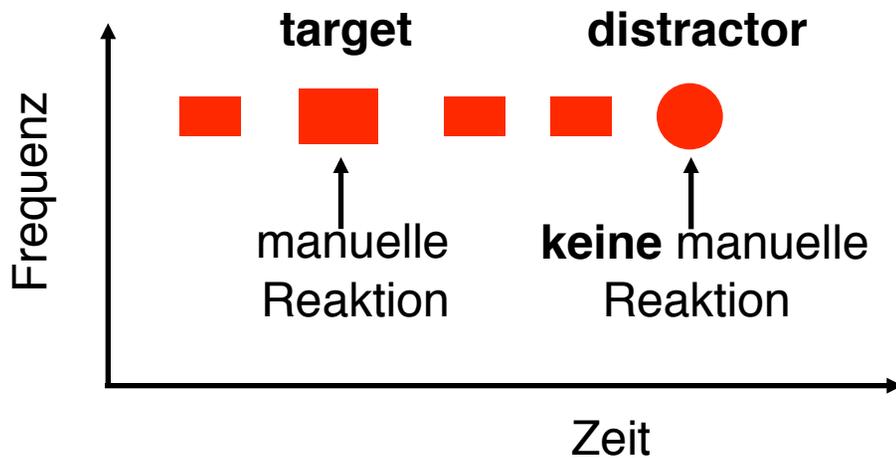


Reizklassifikation





Reizklassifikation

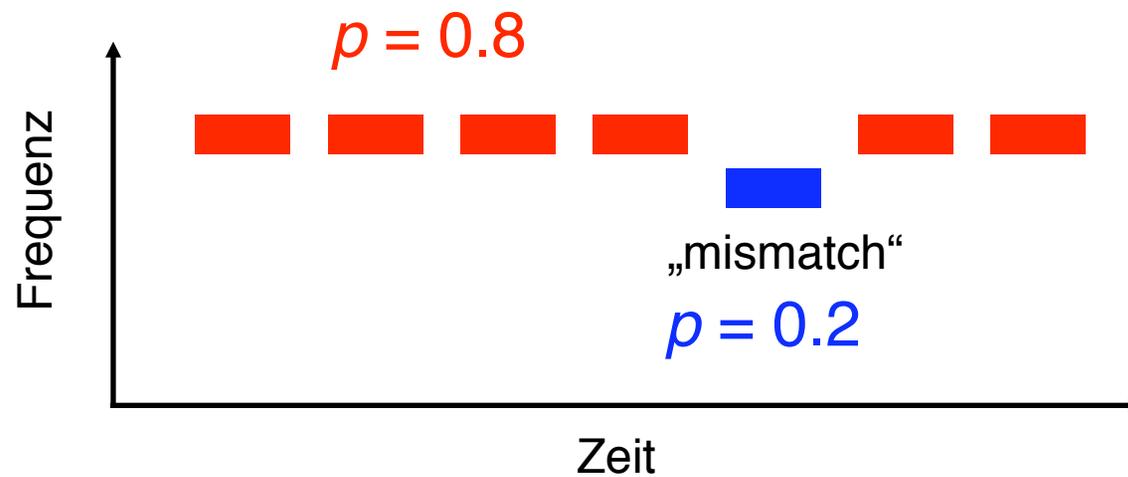




4. Prä-attentionale Effekte

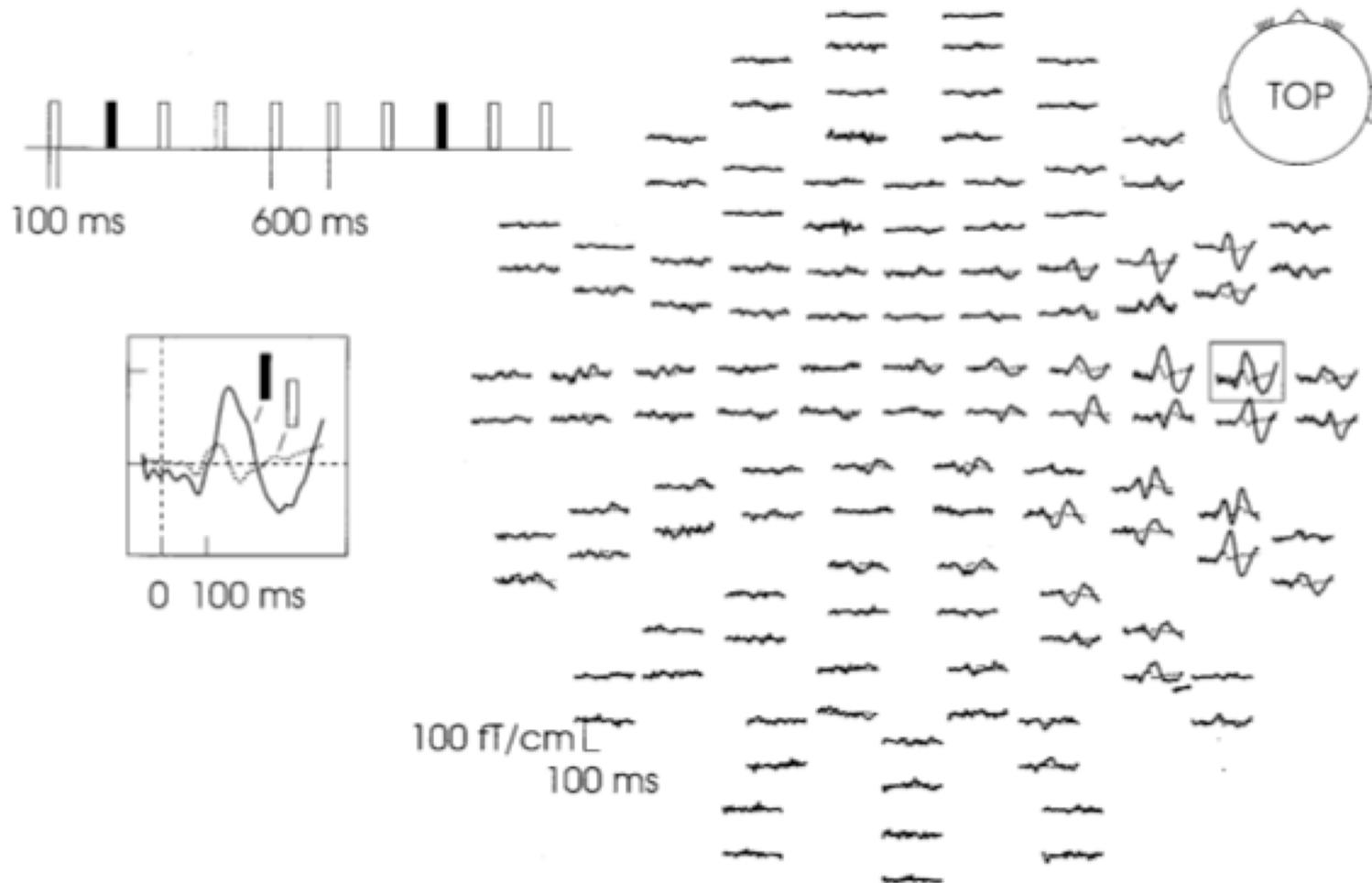


Vorbewusste Verarbeitung im Hörsystem



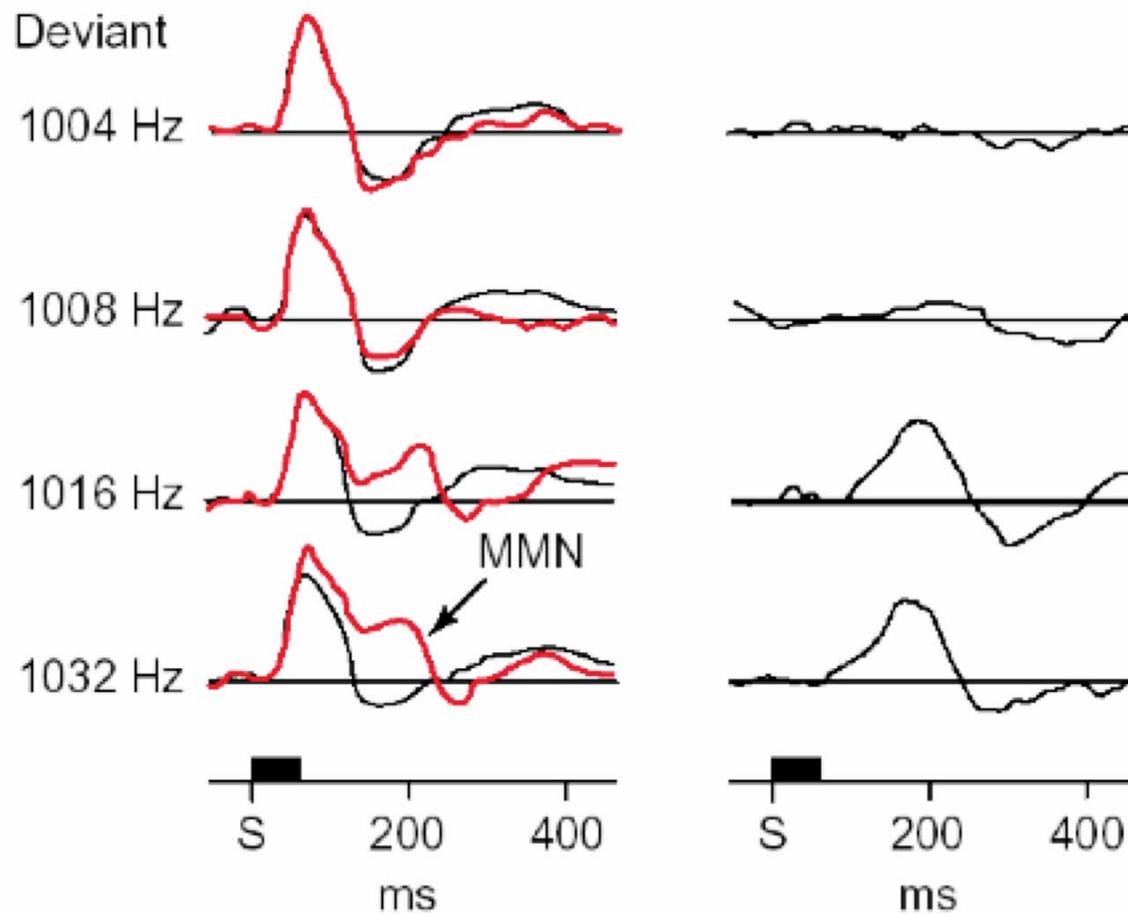


Mismatch Negativity



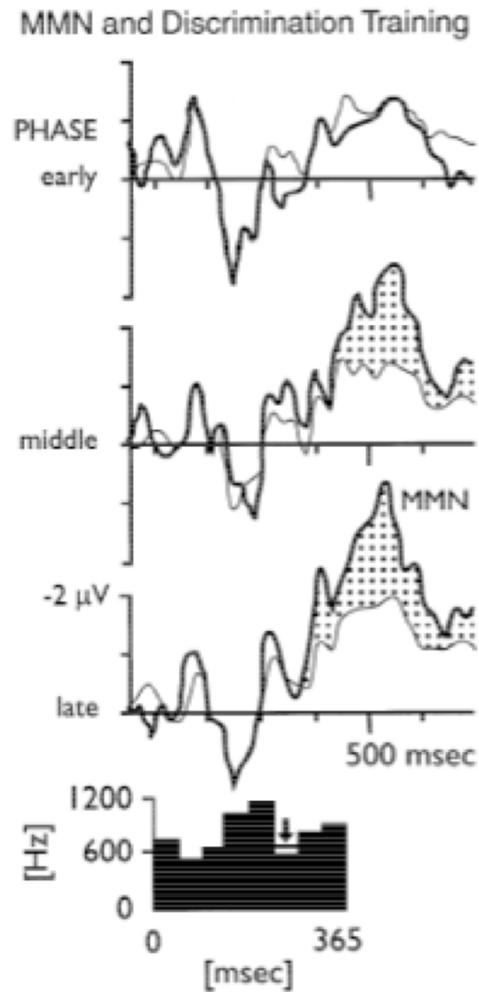


Mismatch Negativity





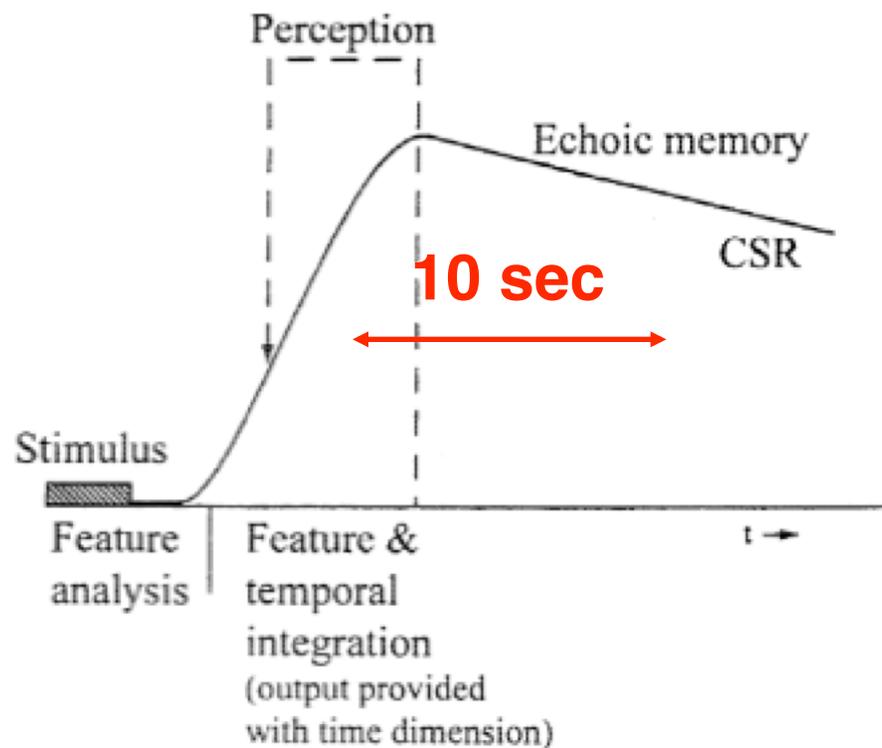
Mismatch Negativity





Mismatch Negativity

Emergence of Central Sound Representation



**automatisch
&
nur auditorisch**



5. Cocktail-Party Effekt



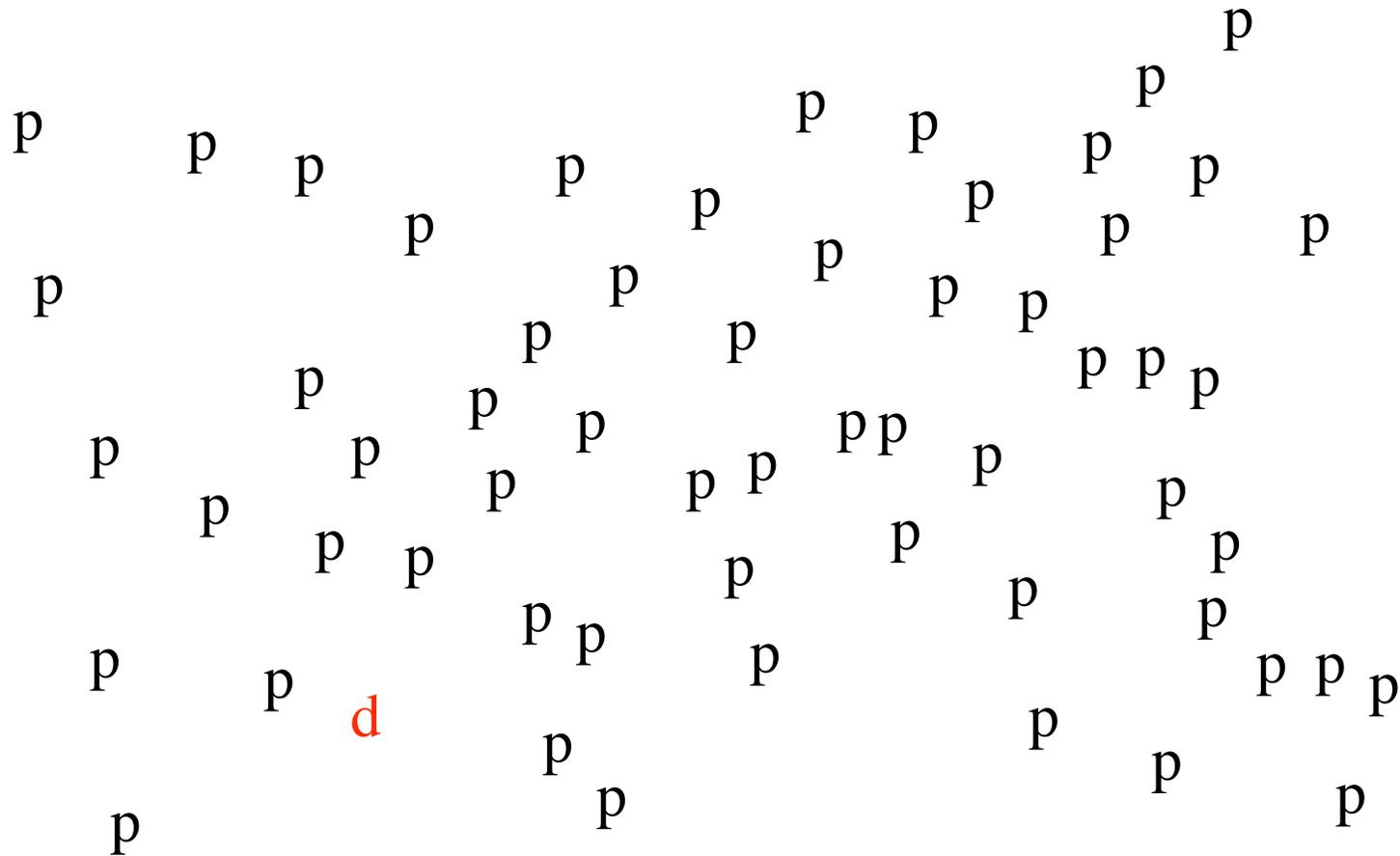
Cocktail-Party-Effekt

d

p



Cocktail-Party-Effekt



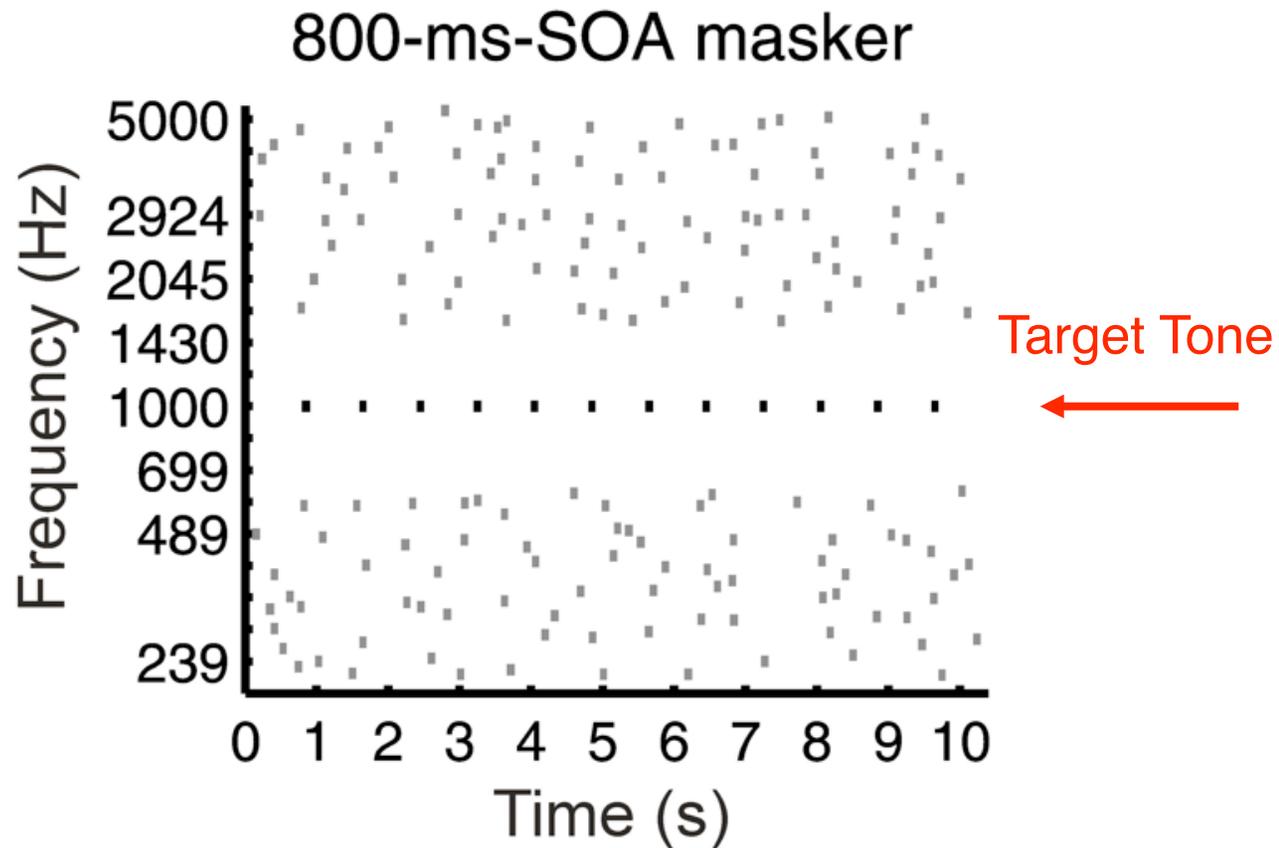


Informational Masking



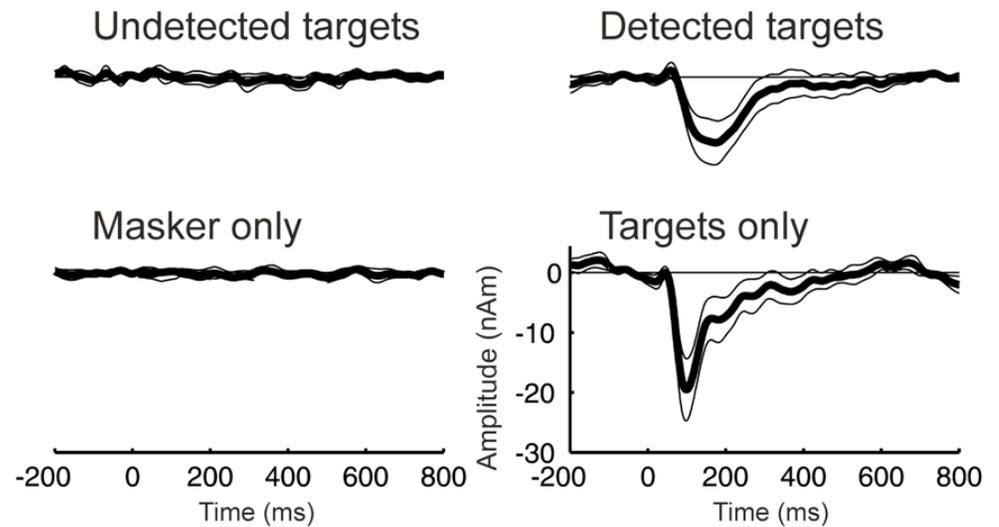
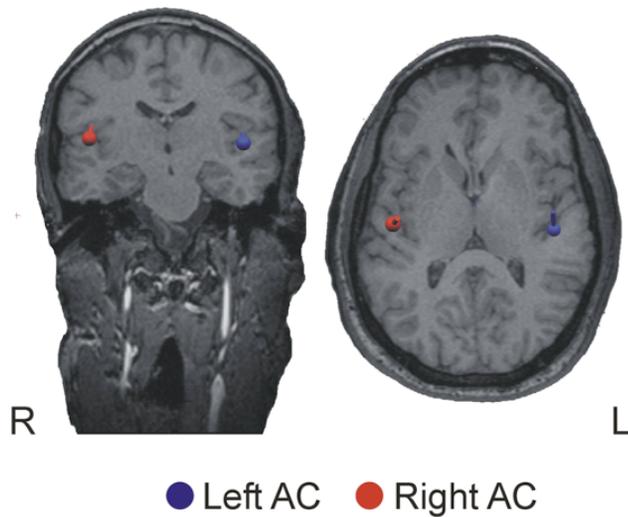


Informational Masking



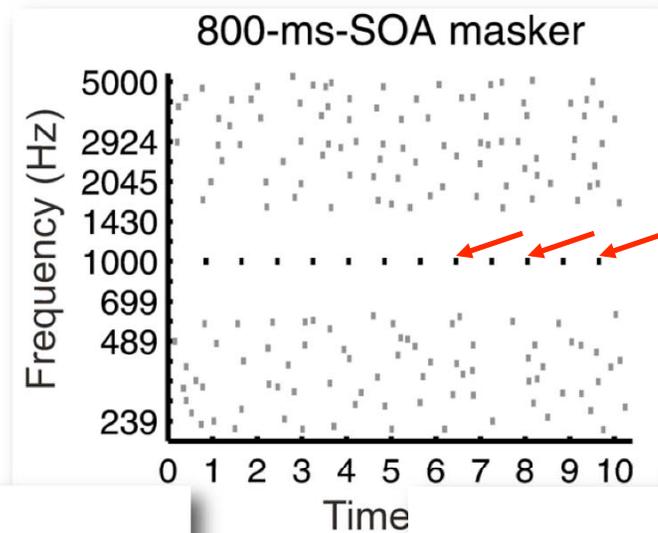


Informational Masking

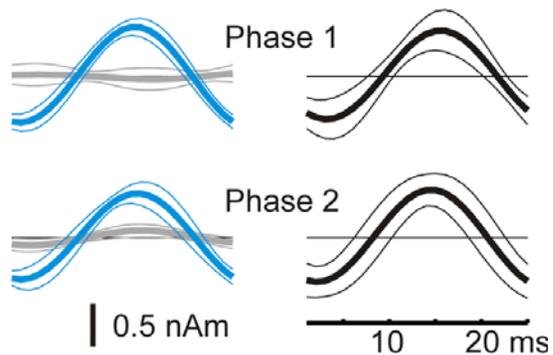




Informational Masking

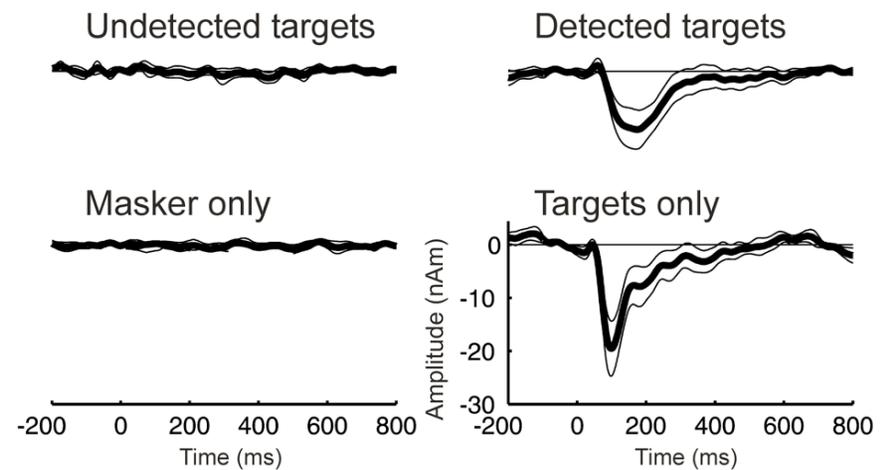


Early Responses



- Detected in phase 2
- Undetected in phase 2
- Masker only

Late Responses





Zusammenfassung

- EEG/MEG erlaubt nicht-invasive Messung
- Quellenanalyse berechnet Aktivierung von einzelnen Generatoren → Schwerpunkt eines Areals
- Frühe Komponenten sind exogen
- Späte Komponenten unterliegen Aufmerksamkeitseffekten
- Aufmerksamkeit/Aufgabe löst einen weiteren Komplex kognitiver Potentiale aus
- Mismatch-Negativity ist ein später aber vorbewußter Prozeß



Literaturhinweise

- **Lutz Jäncke** (2005). *Methoden der Bildgebung in der Psychologie und den kognitiven Neurowissenschaften*. Stuttgart: Kohlhammer.
- **Michael S. Gazzaniga** (2004). *The Cognitive Neurosciences III*. Cambridge: MIT Press.
- **William James** (1890). *The Principles of Psychology*. online: <http://psychclassics.yorku.ca/James/Principles>



Software

- **MATLAB** freier Clone dieses Numerikprogramms:
- **SCILAB** (INRIA, Lyon) für alle gängigen Plattformen
- www.mathworks.de weitere Pakete zur Analyse physiologischer Daten
- **BrainTutor**: <http://www.brainvoyager.com/> (Win, OSX, LINUX)



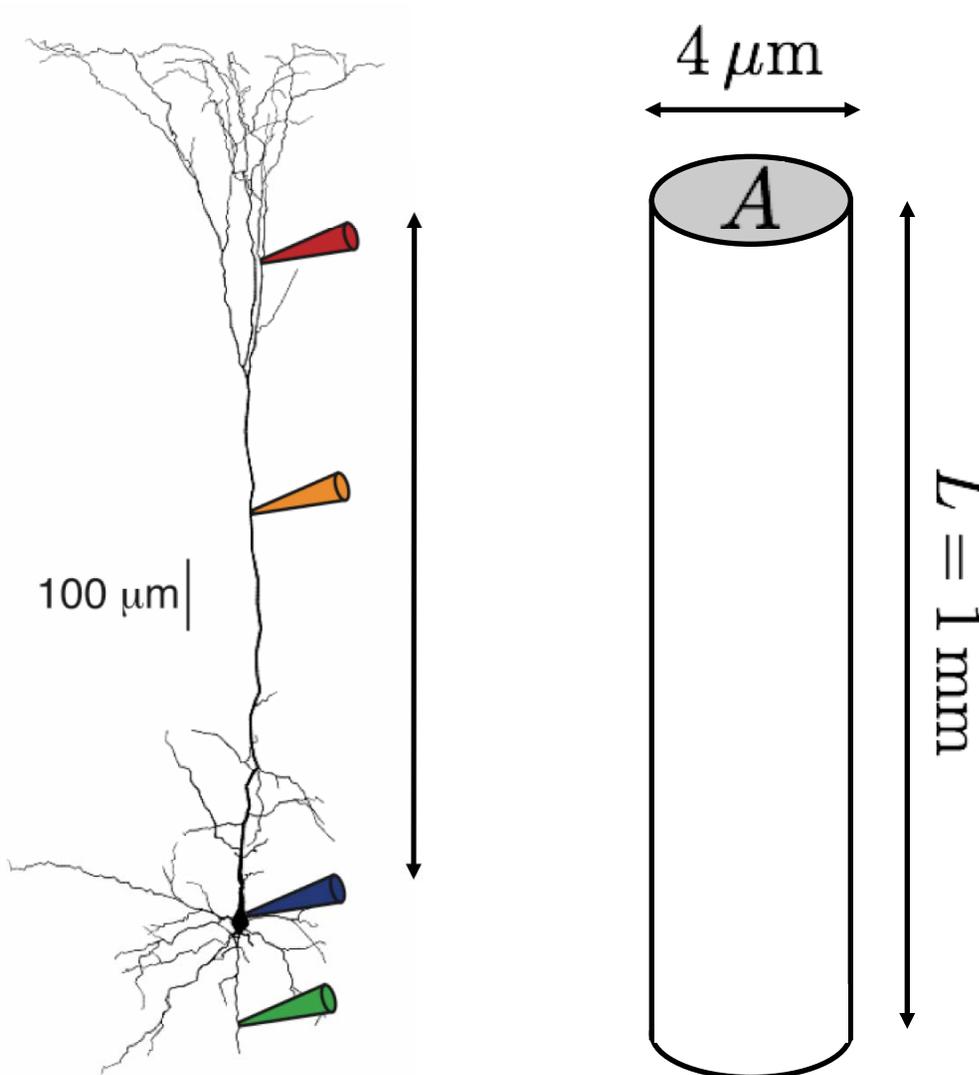
Hardware

- AD Instruments Powerlabs <http://www.adinstruments.com/>





Dipolmoment eines Neurons



Dipolmoment :
 $Q = 3 \cdot 10^{-13} \text{ Am}$

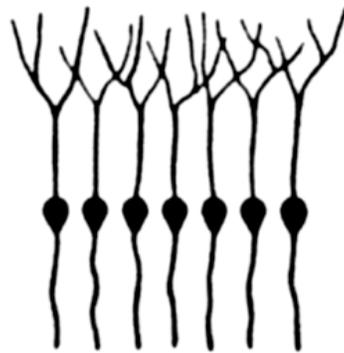
messbares Signal :

5000 ... 1000000 units
 $\sim 40 \text{ mm}^2$ Cortex

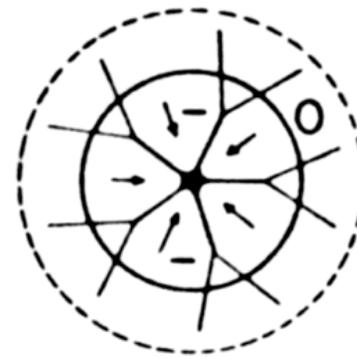
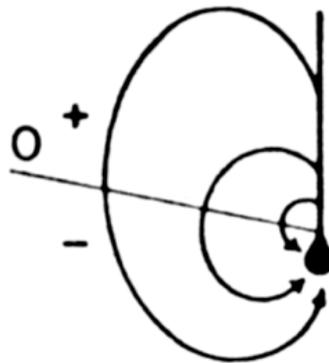


Synchrone und gerichtete Aktivität

OPEN FIELD

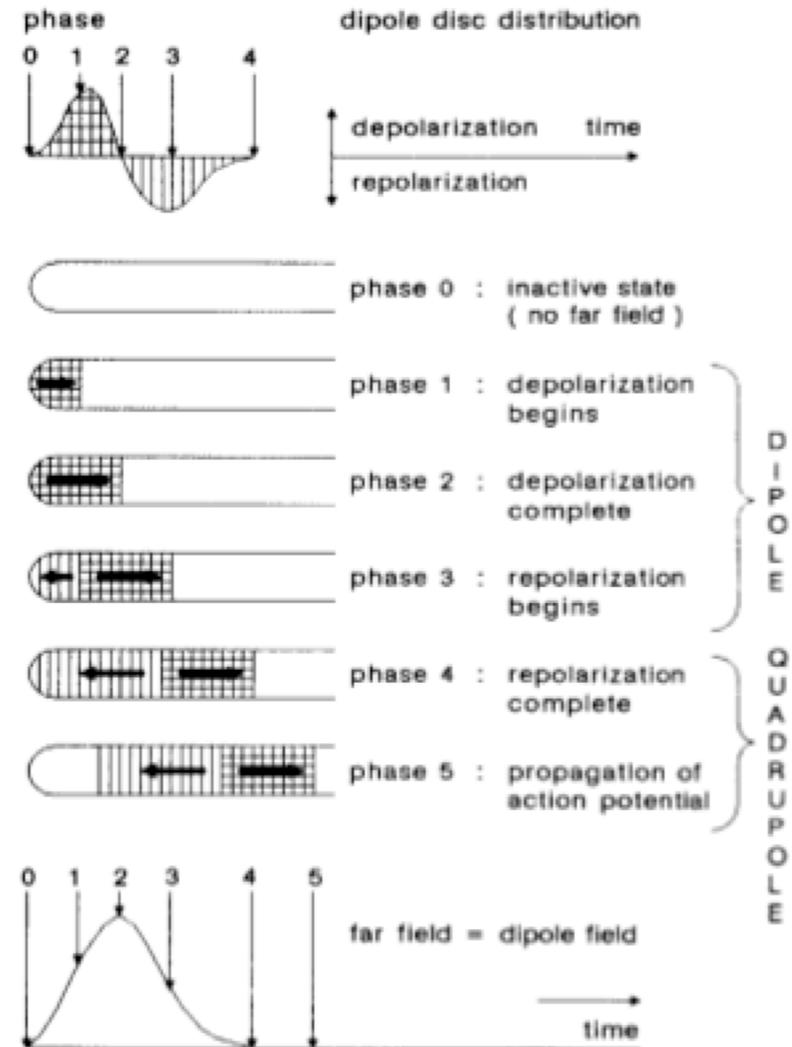


CLOSED FIELD





Aufbau von Dipolfeldern

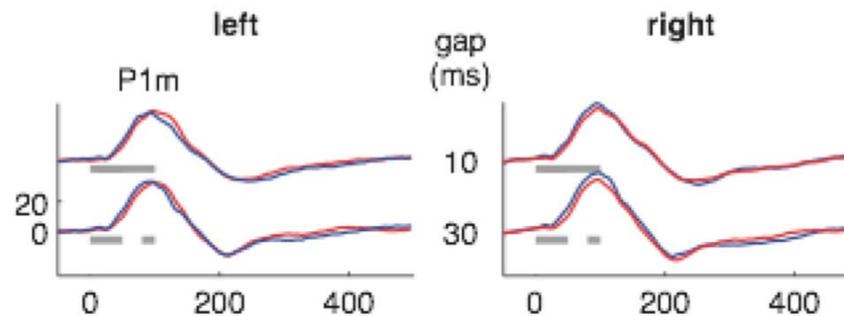


In Phase 1-3 kommt es aufgrund der Asymmetrie der Polarisationsverhältnisse zur Ausprägung eines Dipolfeldes in axialer Richtung.

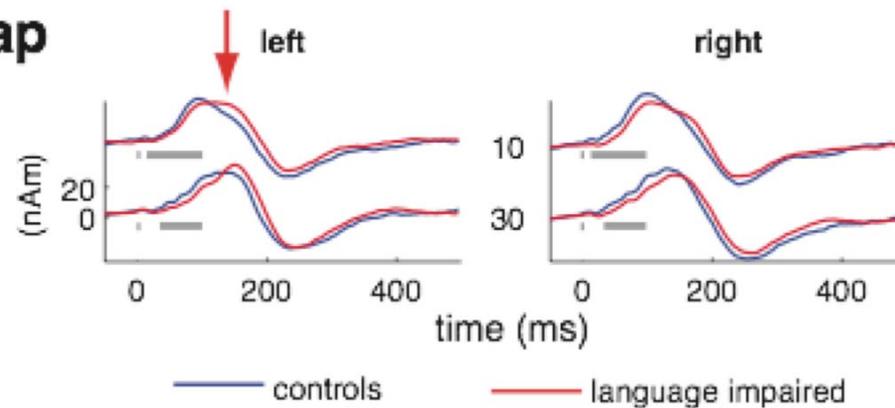


Zeitauflösung - Sprachentwicklung

late gap



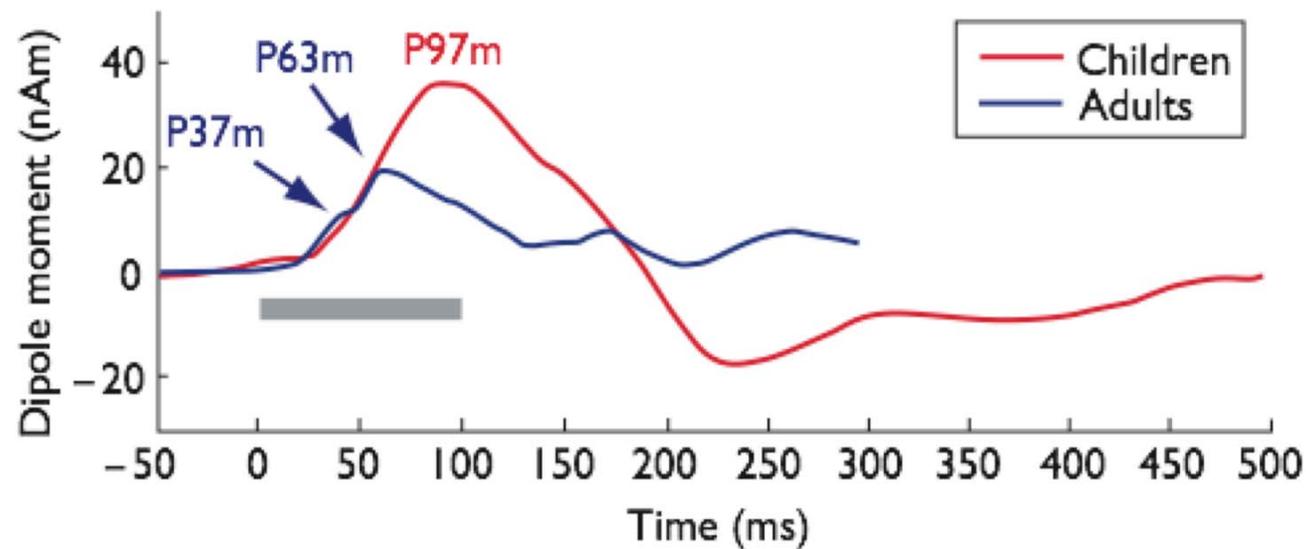
early gap



Diedler et al.
in press



Zeitauflösung - Erwachsene vs Kinder



Diedler et al. (2007)