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Binaural Evoked Potentials in Young Normal Hearing Adults: Objective Measures of the Binaural System

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University of Leuven

Scope

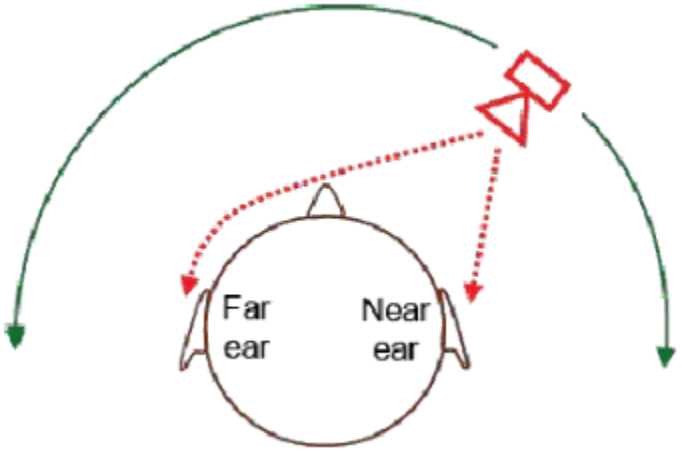
- Introduction
  - Binaural Hearing
  - Auditory Evoked Potentials
- Methodology
- Results
- Conclusion

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Introduction Binaural Hearing

- Binaural hearing: central auditory processing

- (1) Sound localization (horizontal plane)



(Dillon 2012, Hearing aids)

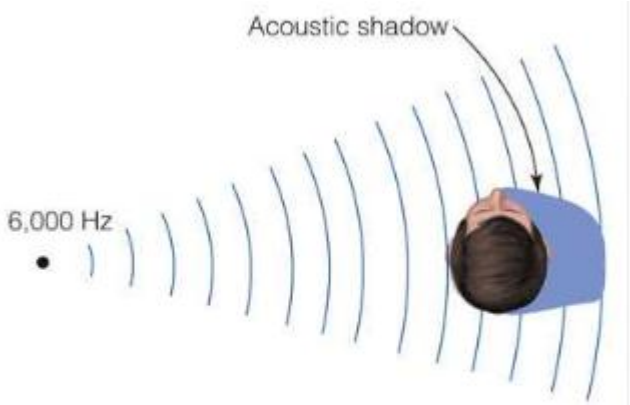
Introduction Binaural Hearing

- Binaural hearing: central auditory processing

- (1) Sound localization (horizontal plane)



ITD's/IPD's (low freq's)



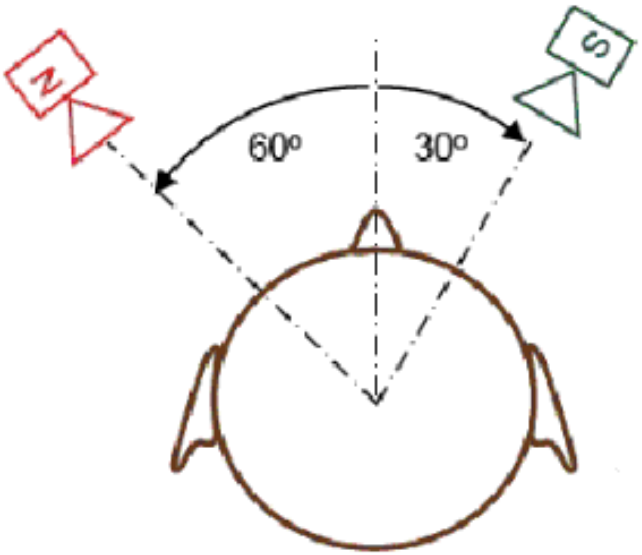
ILD's (high freq's)

(Thomson Higher Education 2007)

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Introduction Binaural Hearing

- (2) acoustically challenging conditions

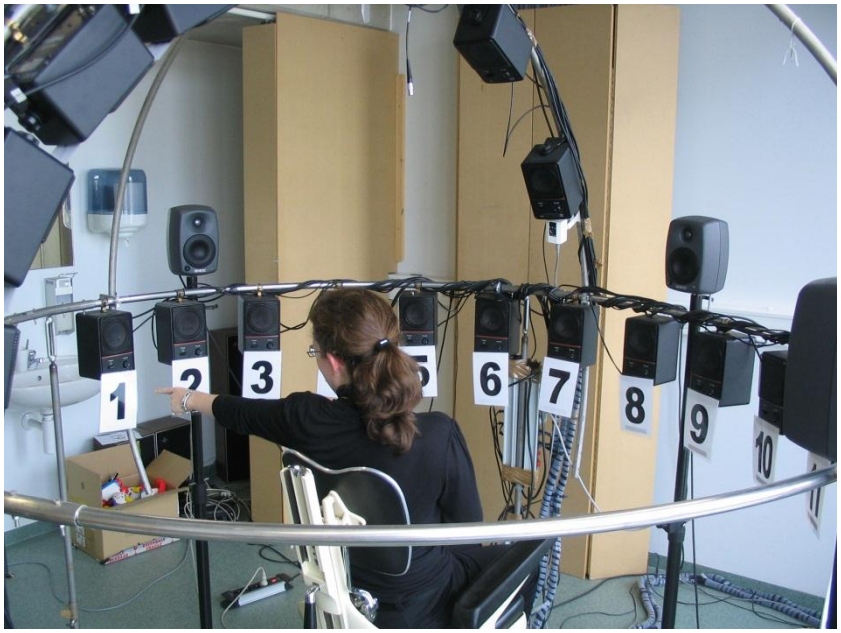


Head diffraction
Binaural squelch
Binaural redundancy

(Dillon 2012, Hearing aids)

Introduction Auditory Evoked Potentials

- Behavioral vs. electrophysiological measures





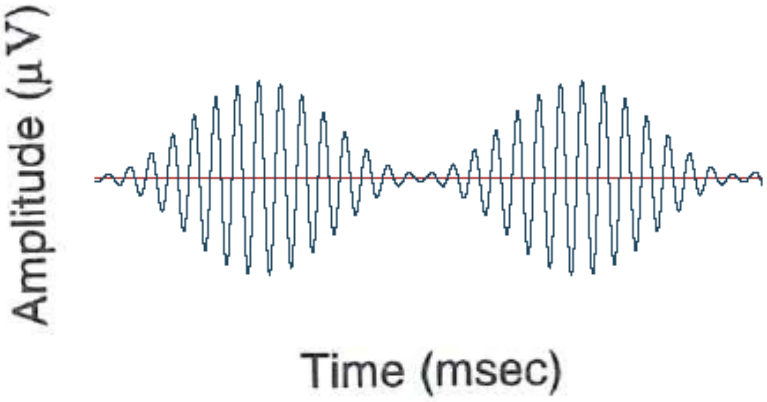
- Relevance electrophysiological measures:

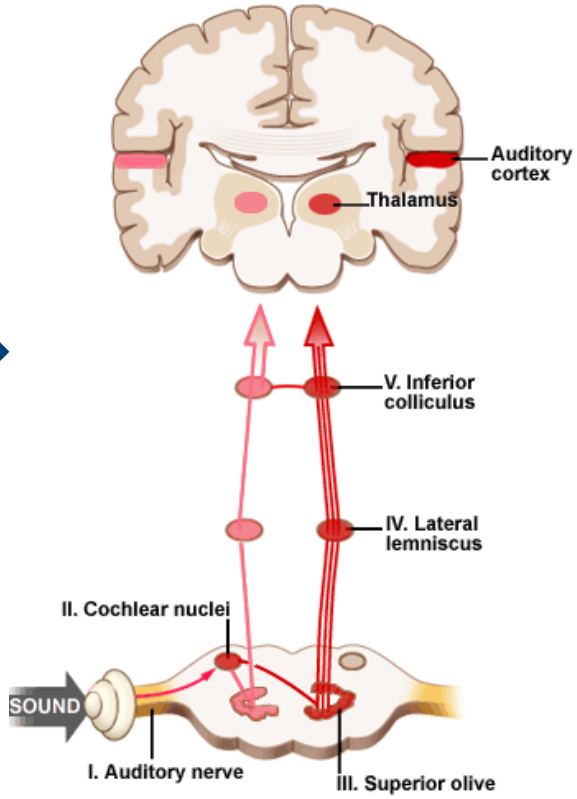
  hearing aids > optimizing binaural hearing
  peripheral vs. central auditory processing (cfr. Aging Project)

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Introduction Auditory Evoked Potentials

- Auditory Evoked Potentials (AEP's)
  > Auditory Steady-State Responses or ASSRs



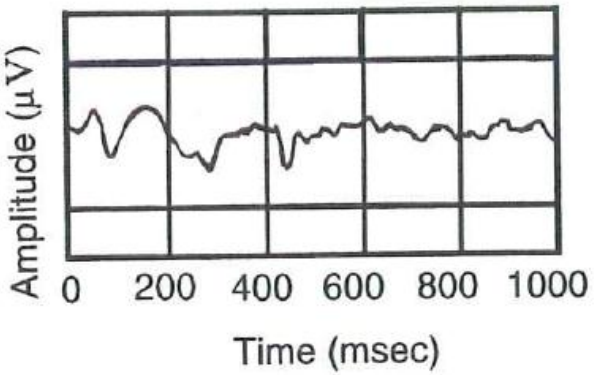


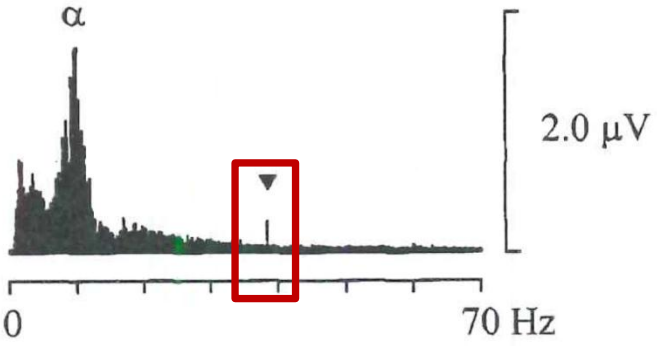
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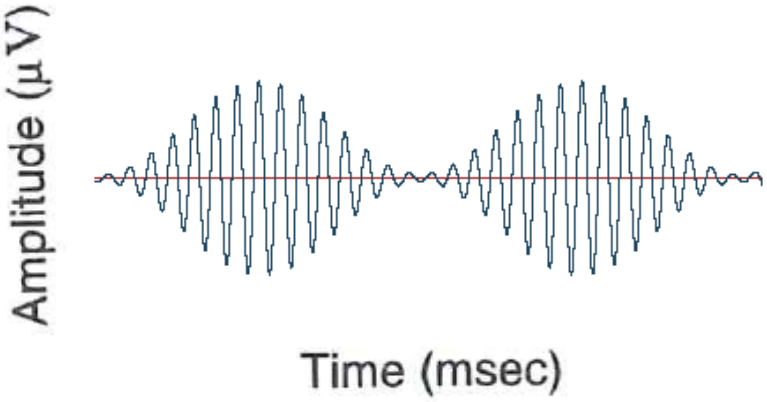


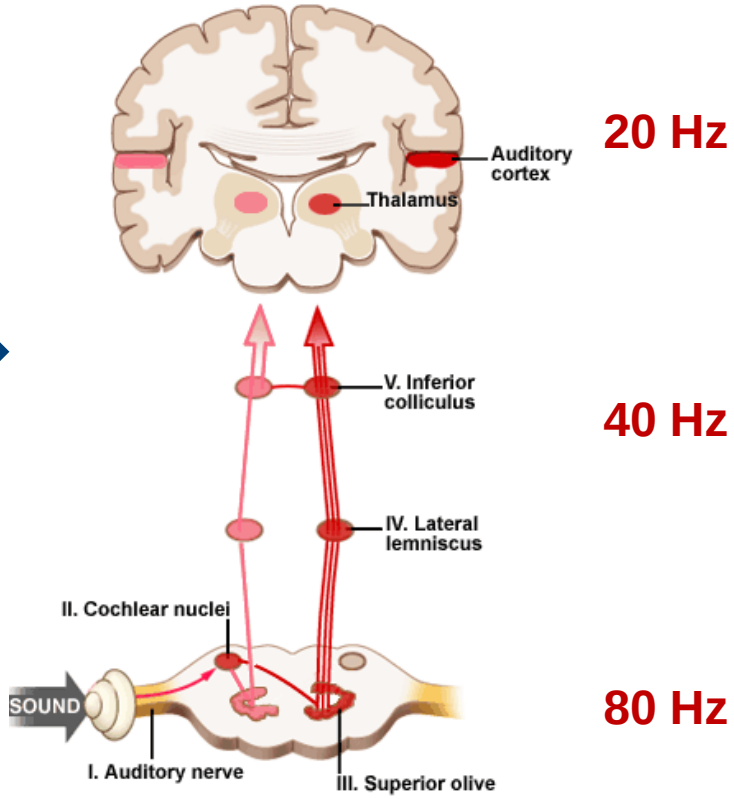


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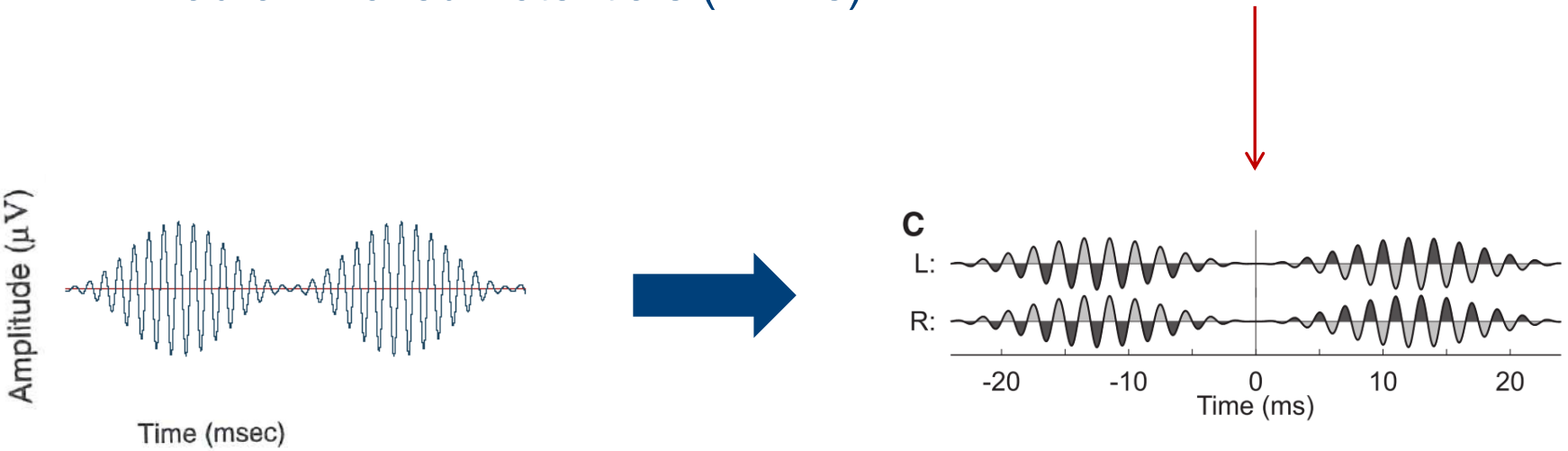




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  > Binaural Evoked Potentials (BEP's)



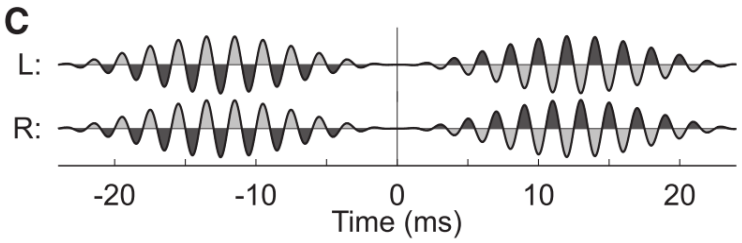
(Ross 2008)

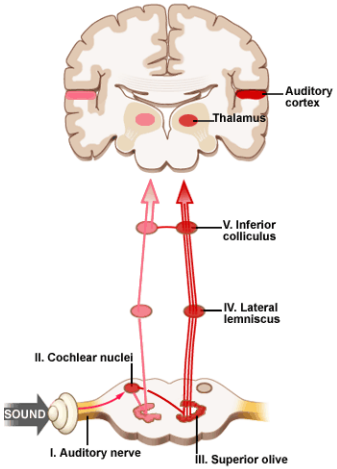
IPD change: +90° [L], -90° [R]

Introduction Auditory Evoked Potentials

- Auditory Evoked Potentials (AEP's)
  > Auditory Steady-State Responses or ASSRs
  > Binaural Evoked Potentials (BEP's)

f_m = 20, 40, 80 Hz (ASSRs)





20 Hz

40 Hz

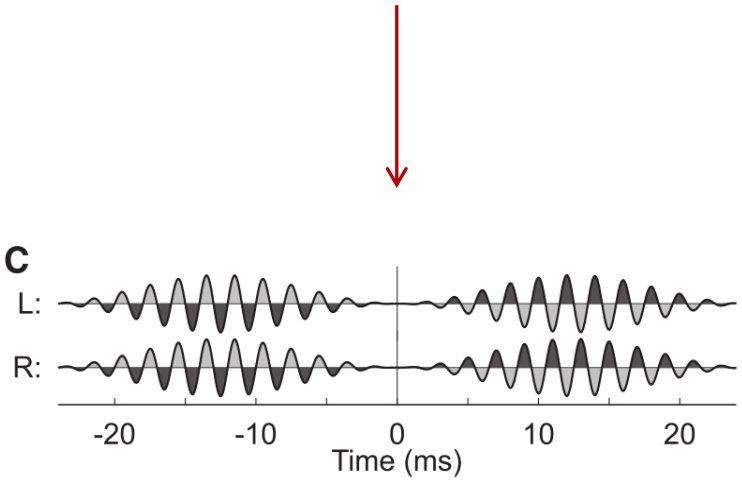
80 Hz

(Ross 2008)

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Introduction Auditory Evoked Potentials

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f_m = 20, 40, 80 Hz (ASSRs)

IPD change → change response

f_c = 500, 1500 Hz

(Ross 2008)

Methodology

- Goal = determine objective measures for binaural processing.
- Pilot study – 7 young NH participants
- Slow protocol vs. fast protocol



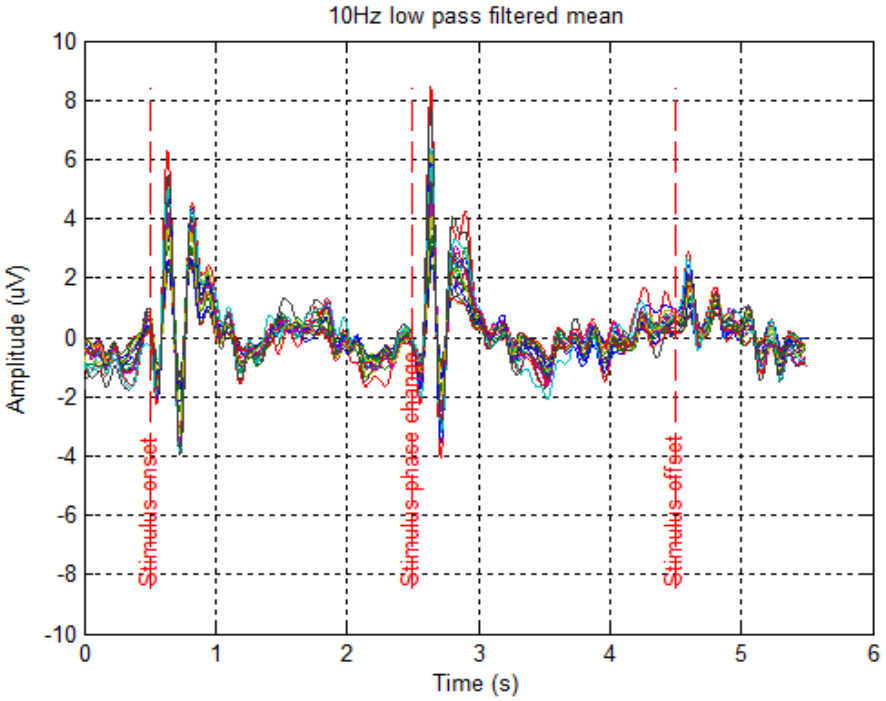
IPD change after 2s

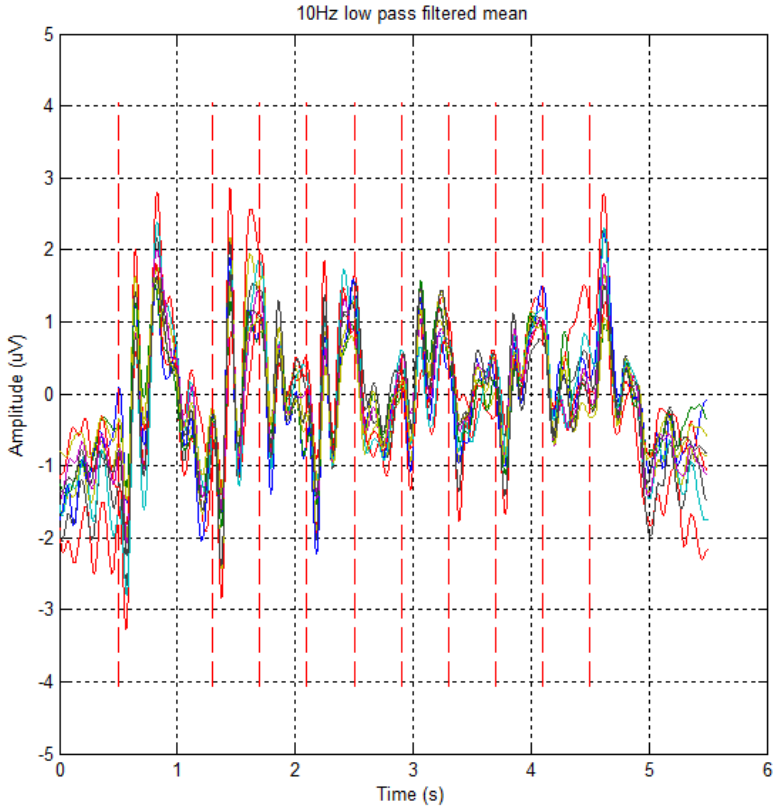
IPD change after 800ms
recurring every 400ms
8 IPD changes in total

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Methodology – responses (1)

time domain → onset – change – offset response





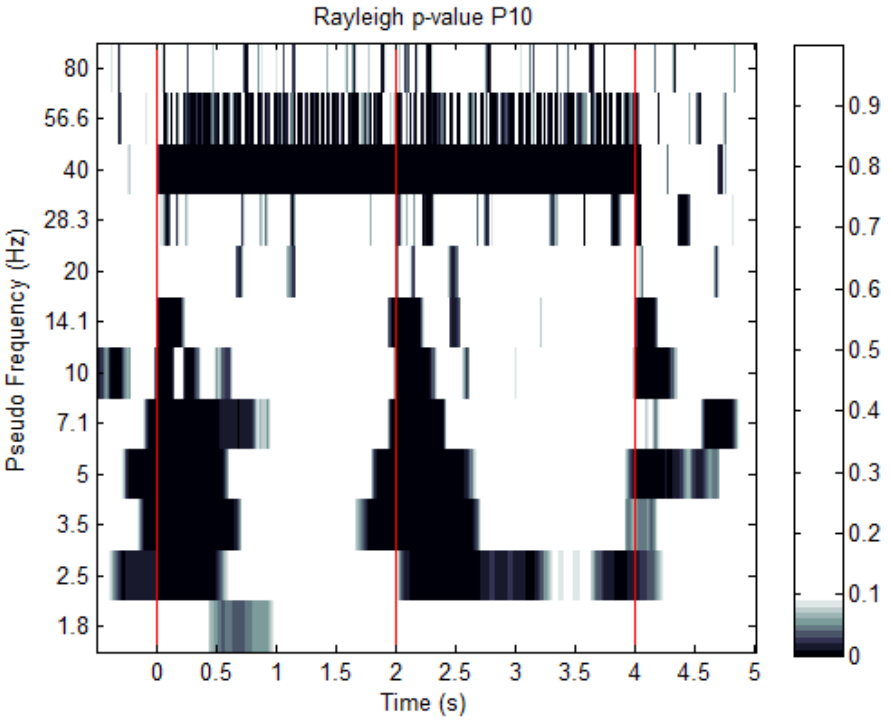
slow protocol – f_c = 520 Hz – f_m = 40Hz

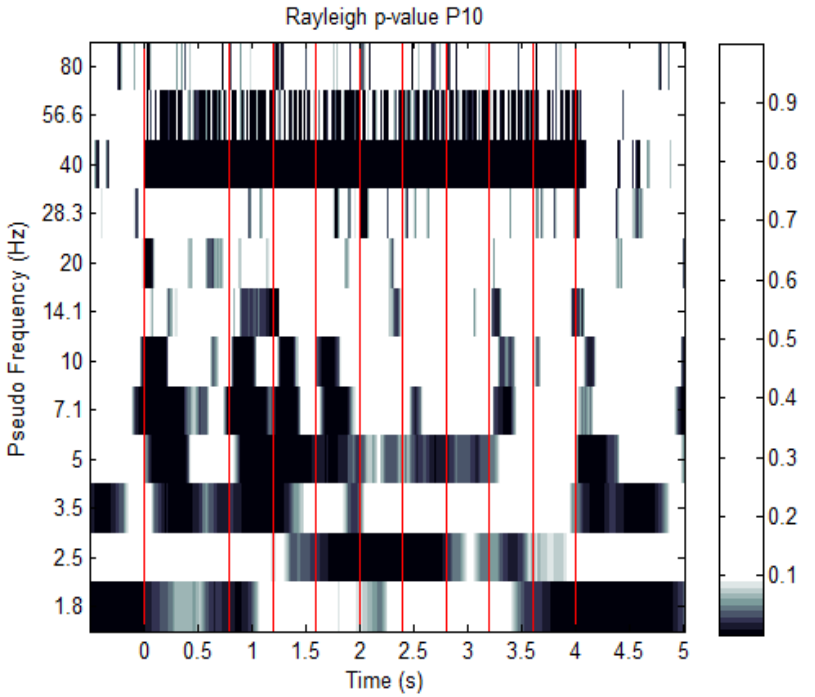
fast protocol – f_c = 520 Hz – f_m = 40Hz

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Methodology – responses (1)

Frequency domain → onset – change – offset response – ASSRs





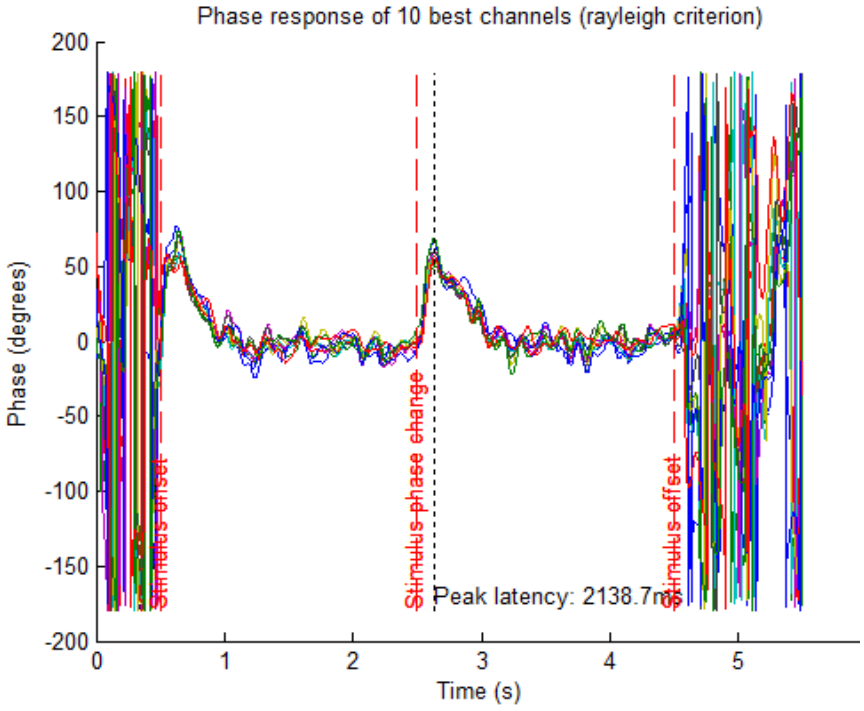
slow protocol – f_c = 520 Hz – f_m = 40Hz

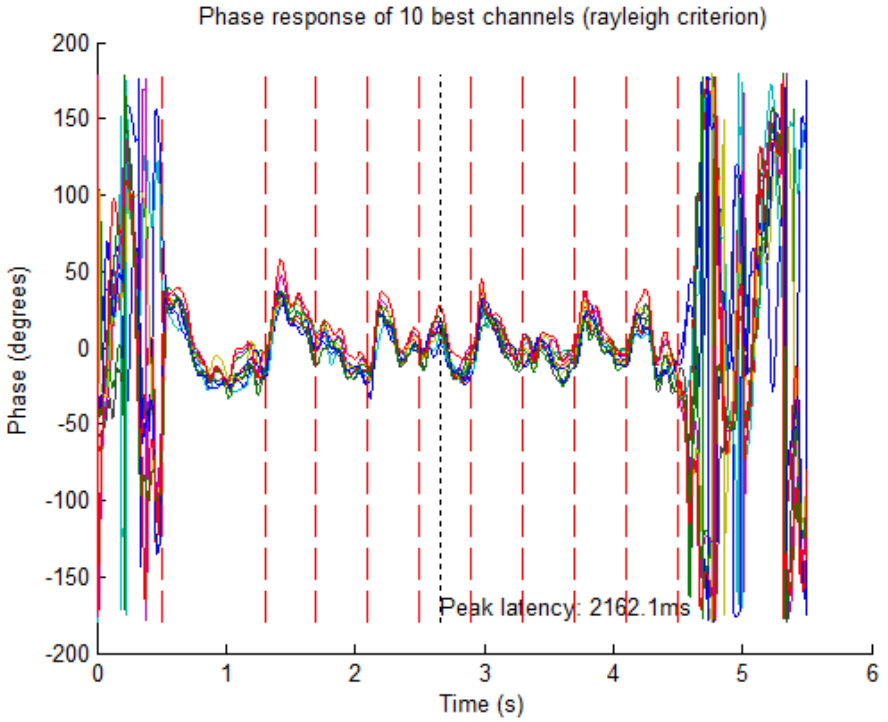
fast protocol – f_c = 520 Hz – f_m = 40Hz

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Methodology – responses (1)

Time domain → phase deviation





slow protocol – f_c = 520 Hz – f_m = 40Hz

fast protocol – f_c = 520 Hz – f_m = 40Hz

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Results

- Slow protocol:

(Ross 2008)

f_m	20 Hz	40 Hz	80 Hz
ASSRs	1/1	5/5	1/1
IPD change	0/1	5/5	0/1

- Fast protocol:

f_m	20 Hz	40 Hz	80 Hz
ASSRs	2/2	6/6	?/2
IPD change	2/2	5/6	0/2

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Conclusions

- f_m = 40 Hz (Ross 2008) → replicated
- f_m = 20 Hz (cortical) → ASSRs + change response (fast protocol)

  f_m = 80 Hz (brainstem) → no ASSRs or change response
- More data should be collected
  → only 2 participants tested with the new conditions.
  → increase testing time
- These results can be found on an individual level
  → no averaging over subjects is needed.

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Thank you for your attention.



For questions please contact:
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