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Center of Applied Technologies in Neuroscience
PUK, University of Basel, Switzerland

University of Basel, Clinical Psychiatry, COAT

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Overview

Neurophysiological approach in VR:

1. Driving in VR: Study I (Vigilance)

→ **Driving simulator**

2. Conflict in VR Study II (Conflict processing)

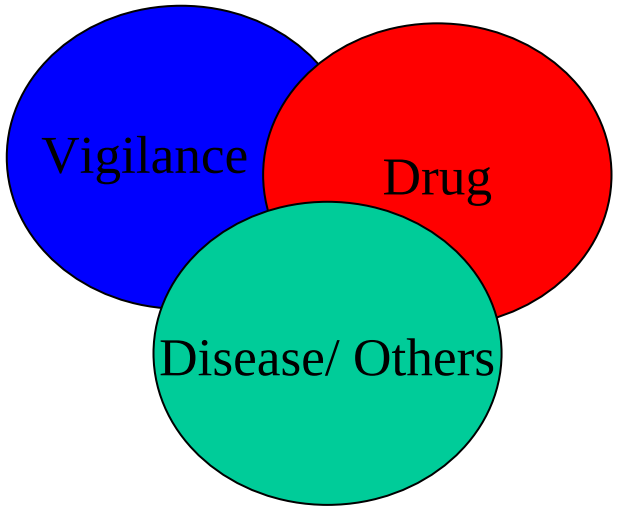
→ **3-Wall VR system**

1. Study I: Driving in VR: facilities

*1. **Setup I**: Driving Simulator*

Test of a driver warning system (DWS)

1. Study I: Driving in VR (*Model*)

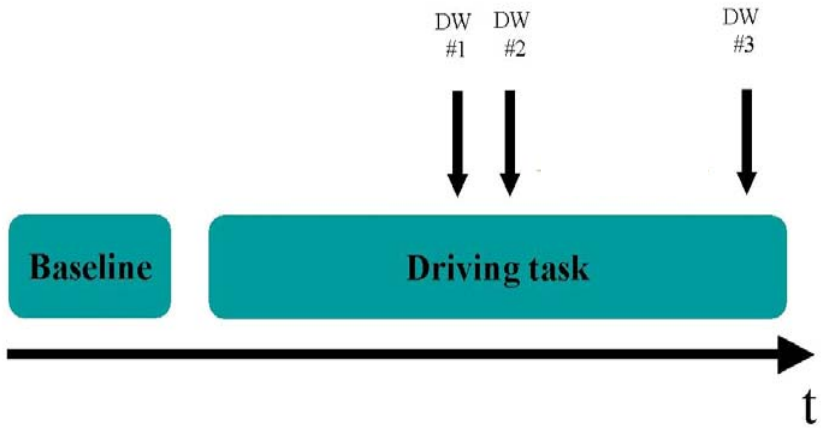


Driving performance

1. Study I: Driving in VR (*Methods*)

Vigilance: Test of a driver warning system (DWS)

- 41 sleep deprived subjects
  (driving novices, standard drivers, professional drivers)
- Test run in a real-car based driving simulator (highway scenario)
- Test duration: about 70 minutes



Questions:

Impact of the drowsiness-warning

Interrelation between physiological and behavioural parameters

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1. Study I: Driving in VR (*Methods*)

A. Parameters (Driving simulator)

Variable	Unit	Range	Sampling
Speed	[km/h]	0-135 km/h	approx 25 Hz
Lateral position	[m]	0 m to lane width (11.9m)	approx 25 Hz
Steering wheel angle	[°]	± 720[°]	approx 25 Hz
Time to line crossing	[s]	used: 0s > TLC < 15 s	approx 25 Hz

B. Parameters (Driver)

Variable	Unit	Range	Sampling
EEG	[uV]	0.3-32 Hz	approx 256 Hz
Skin conductance Respiration/ Cardiovascular	[Ohm]		approx 25 Hz 1024 Hz
KSS/ OSS		0-10/ 0-5	3/ min
Video recording	[s]	2 channels	approx 25 Hz

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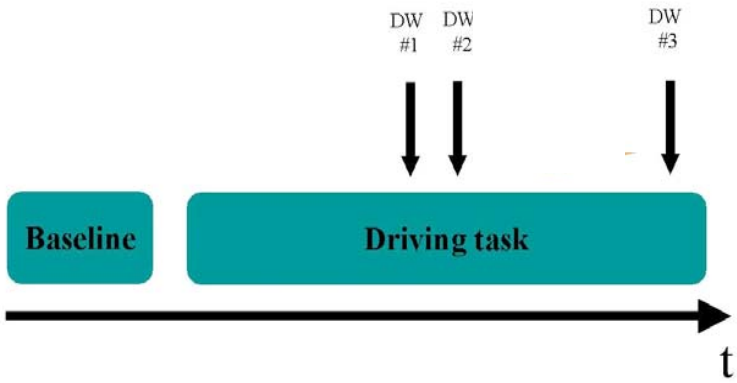
1. Study I: Driving in VR (*Methods*)

1. Study I: Driving in VR (*Results*)

Neurophysiology: EEG

alpha (8-12 Hz)



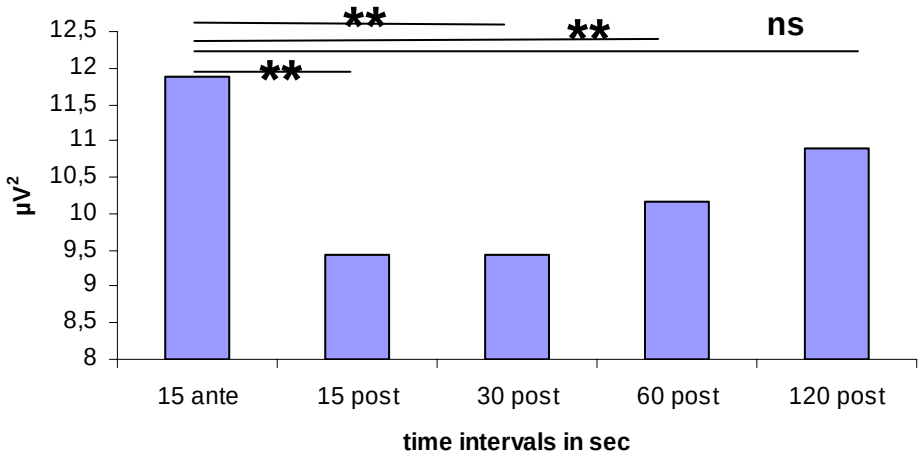


Fig. 1: alpha power values pre- and post-DWS intervention (n=41; ** $p < 0.01$).

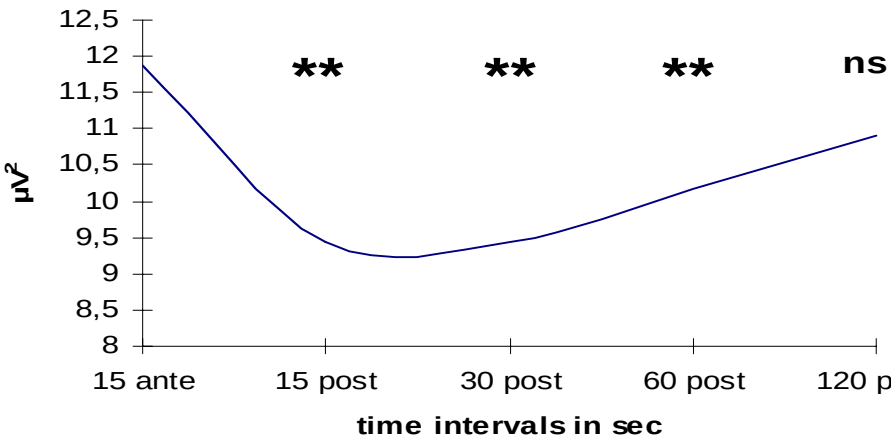
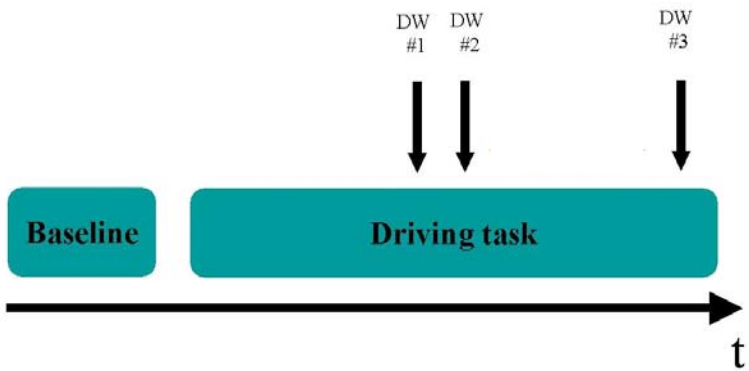


Fig. 2: Fitted curve alpha power (8-12 Hz) changes over time after DWS intervention at (n=41;** $p < 0.01$).

1. Study I: Driving in VR (*Results*)

Neurophysiology: EEG

beta 2 (18-30 Hz)



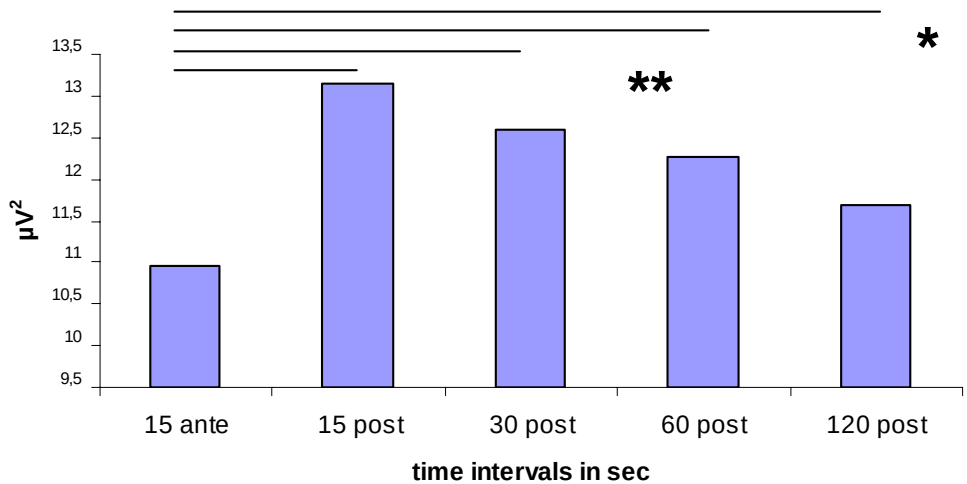
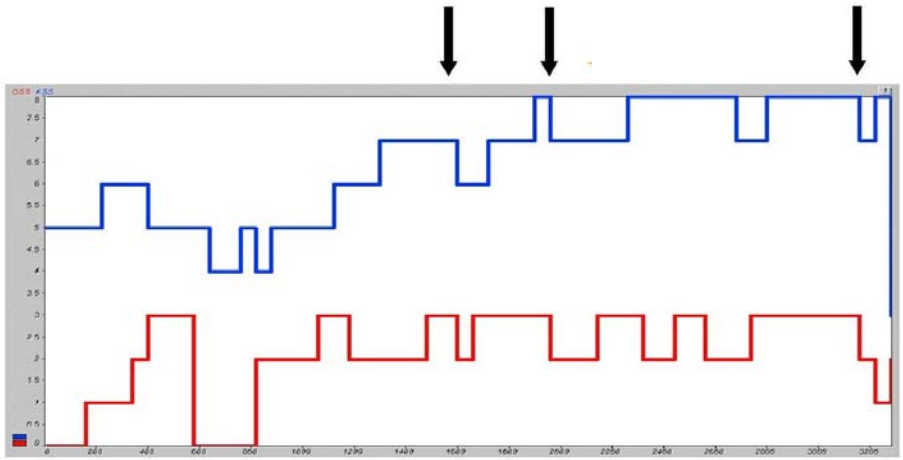


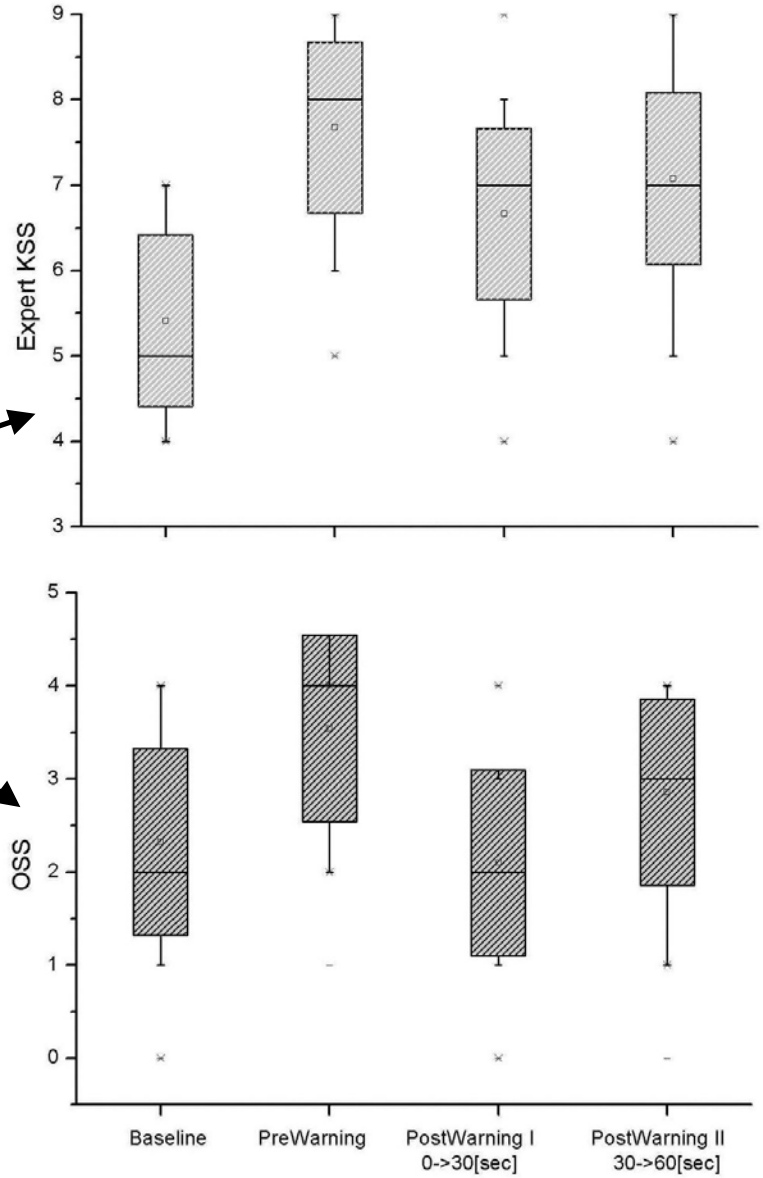
Fig. 3: Development of beta 2 power (18-30 Hz) values after DWS-intervention (n=41;** $p < 0.01$; * $p < 0.01$)

1. Study I: Driving in VR (*Results*)

Offline-scoring-analysis (Video):

Scales: KSS/ OSS





1. Study I: Driving in VR (*Summary*)

- 1. DWS induces a temporary increase of vigilance

  EEG/ Scales (OSS/KSS), skin conductance
- 2. DWS does not affect driving performance (exception: speed)
- 3. No overshooting startling responses (except one subject)
- 4. „Video-based scores“ did not match vigilance in professional drivers → EEG
- 5. DWS has no impact on peripheral physiological parameters

  Exception: skin conductance

↓

A hypovigilance diagnosis module has to be adapted individually

DWS has a short lasting effect

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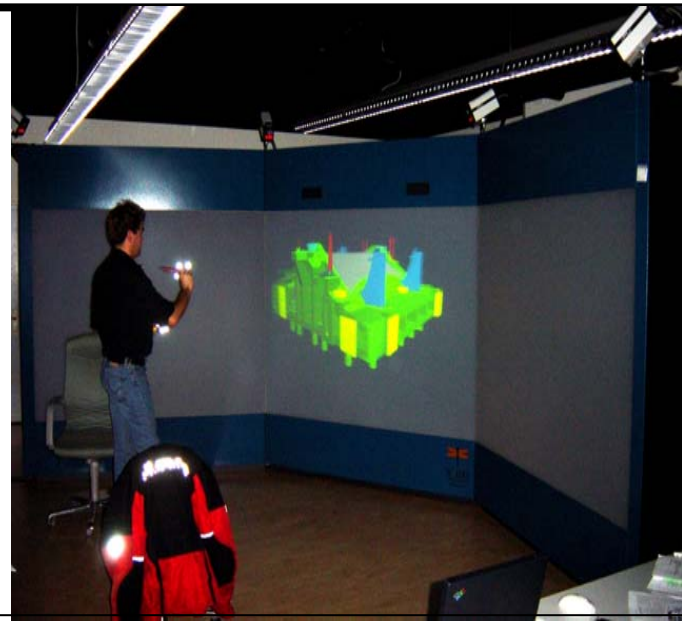
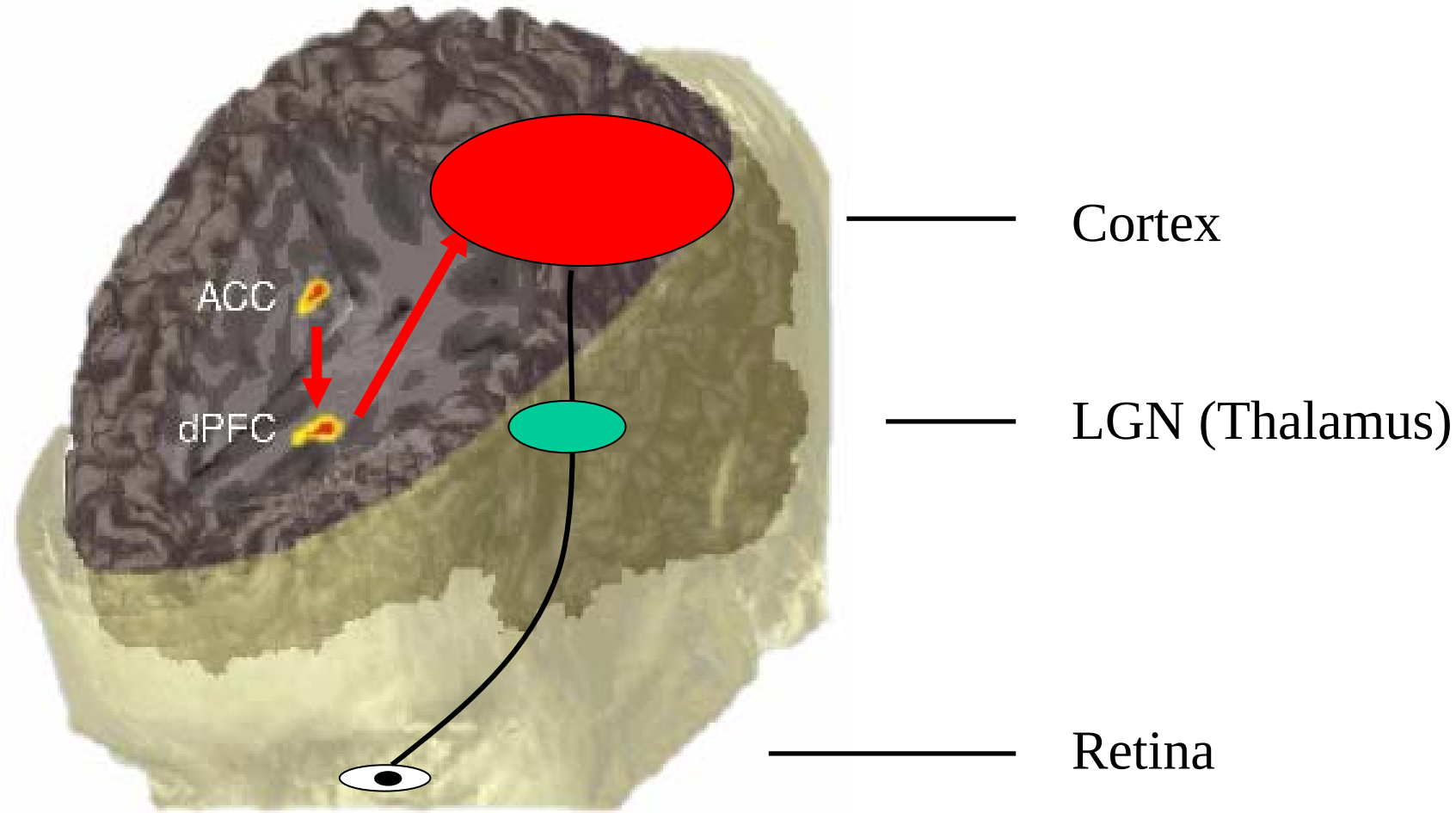
2. Study II: Conflict in VR: facilities

Setup II: *Virtual Environment*



Conflict of stimulus dimensions

2. Study II: Conflict in VR (*model*)



2. Study II: Conflict in VR (*paradigm*)

Stroop (modified):

Example:

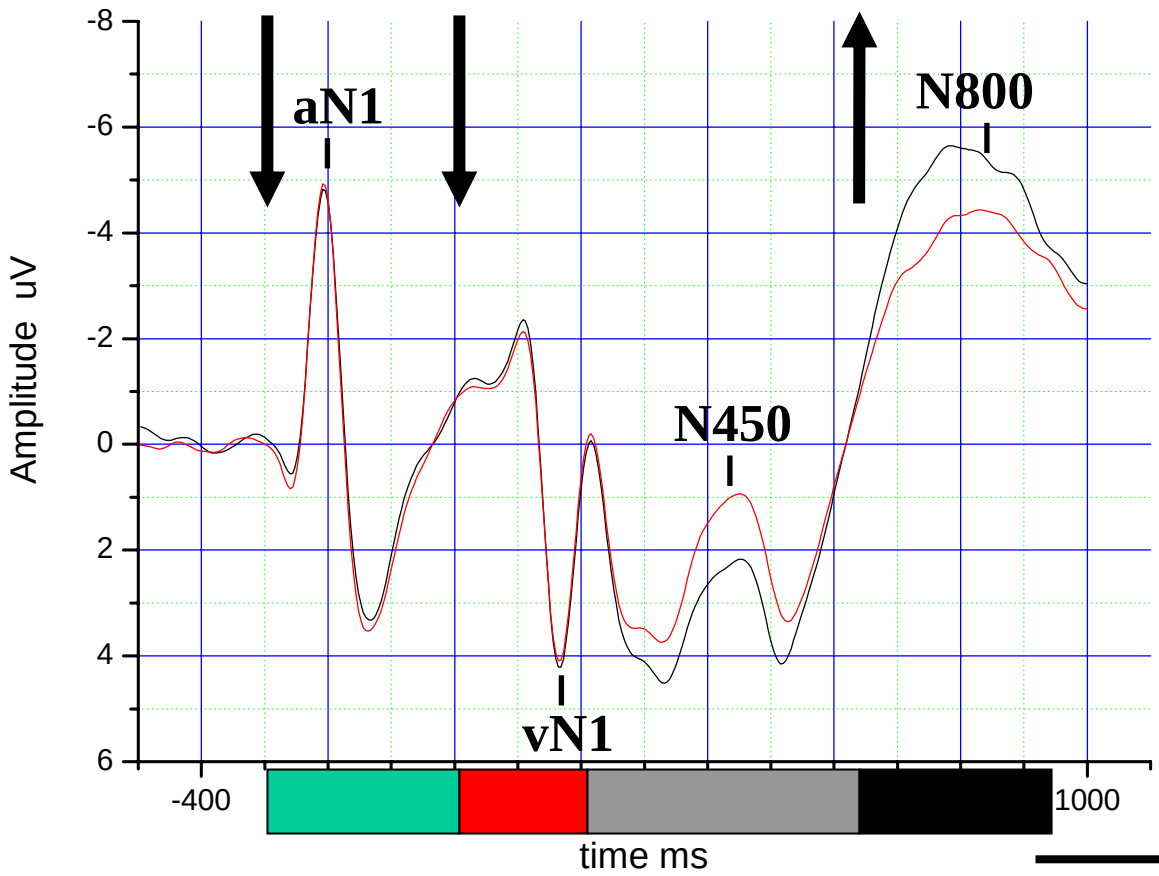
red (no conflict)

blue (conflict)

43 subjects; 480 stimuli each

2. Study II: Conflict in VR (*results*)

Tone red response (button press)

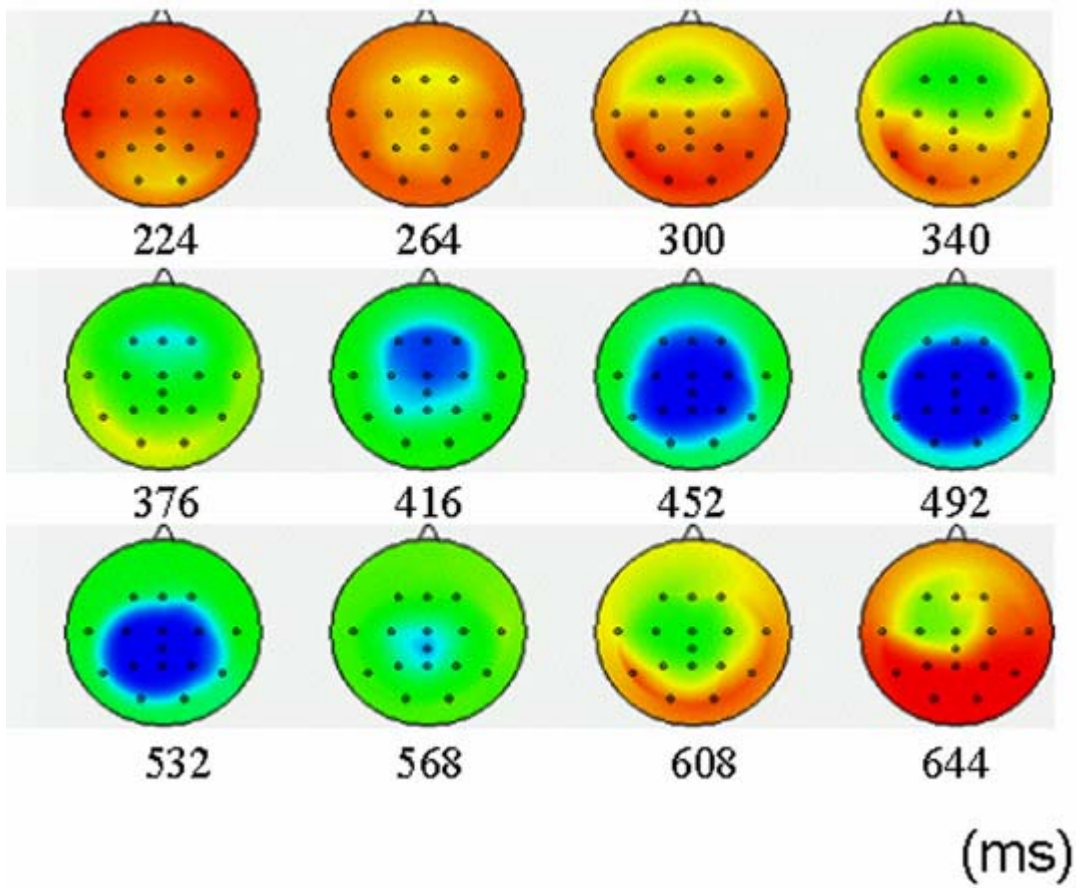


CPz

congruent

incongruent

2. Study II: Conflict in VR (*results*)



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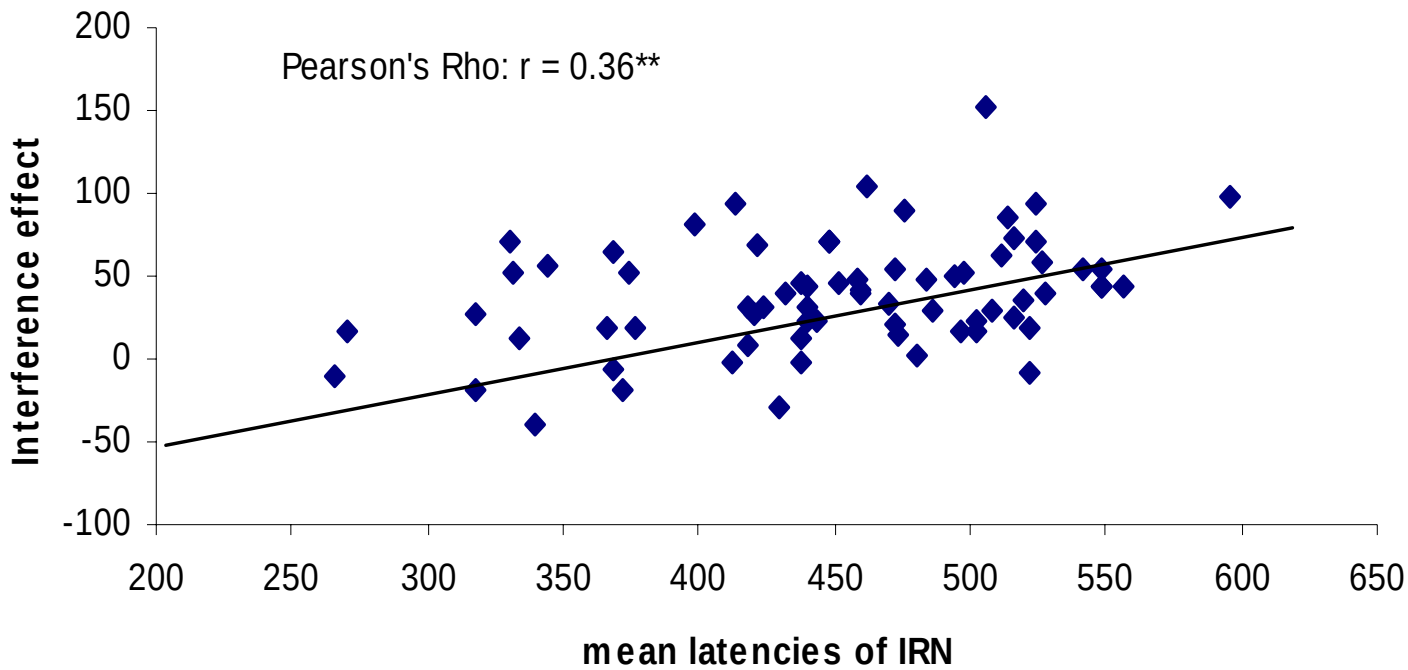
2. Study II: Conflict in VR (*results*)



2. Study II: Conflict in VR (*Summary*)

Findings/ Summary:

- 1. Conflict detection is reflected by an ERP (IRN)
- 2. Conflict detection (IRN) is correlated to performance

Next step: Measurement of conflict of dimensions in VR

Application of prestimuli to improve performance

Team:

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Thank you for your attention