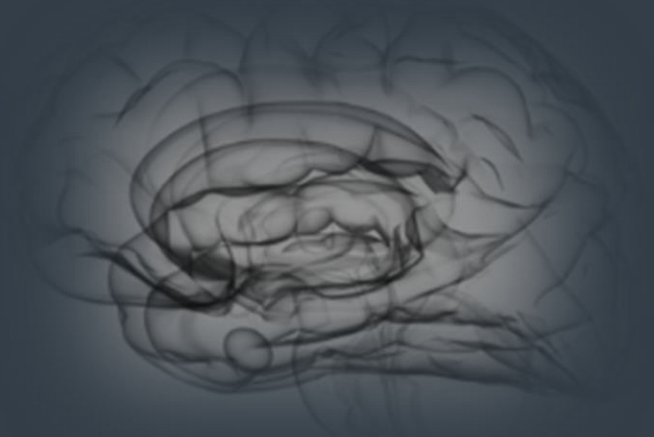


# NEUROPHYSIOLOGICAL DETERMINANTS OF VISUOMOTOR REACTION TIME IN TABLE TENNIS



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# Content

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## **1) The experiment**

Identifying visuomotor performance determinants in the brain

## **2) Table tennis study**

Neurophysiological determinants of visuomotor reaction time in table tennis players

## **3) Visual Training**

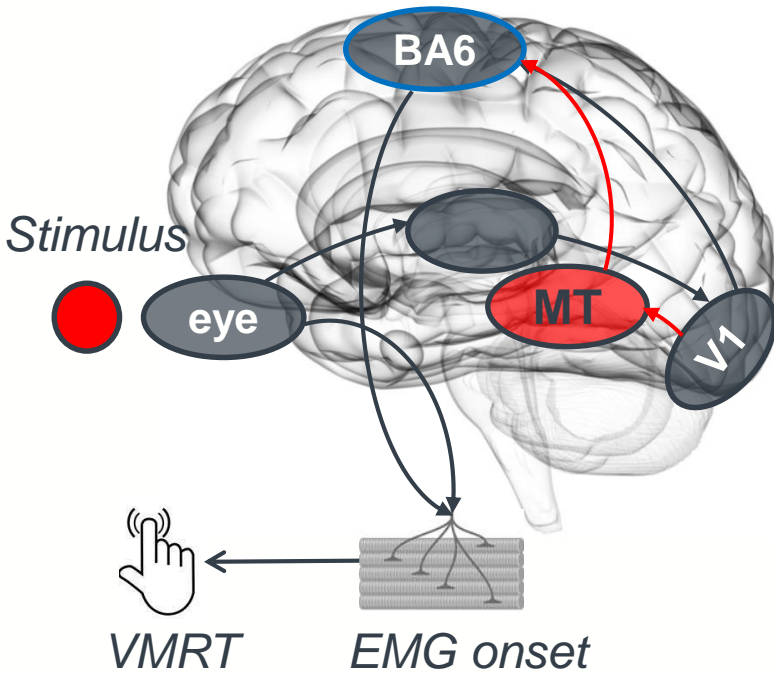
Improving visuomotor performance using stroboscopic training

## **4) And where from here?**

Future perspectives in research and training

# 1) The experiment

## The idea



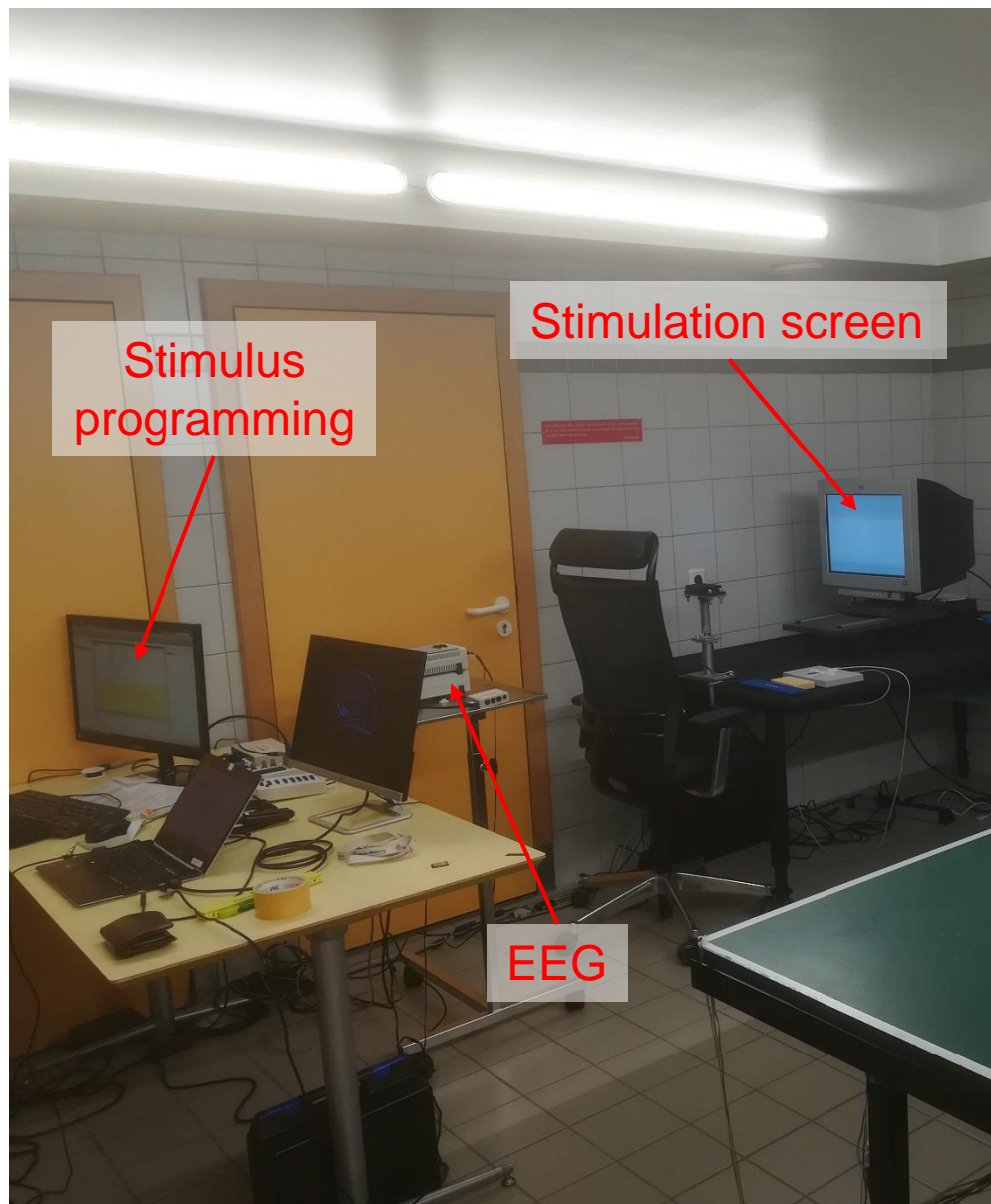
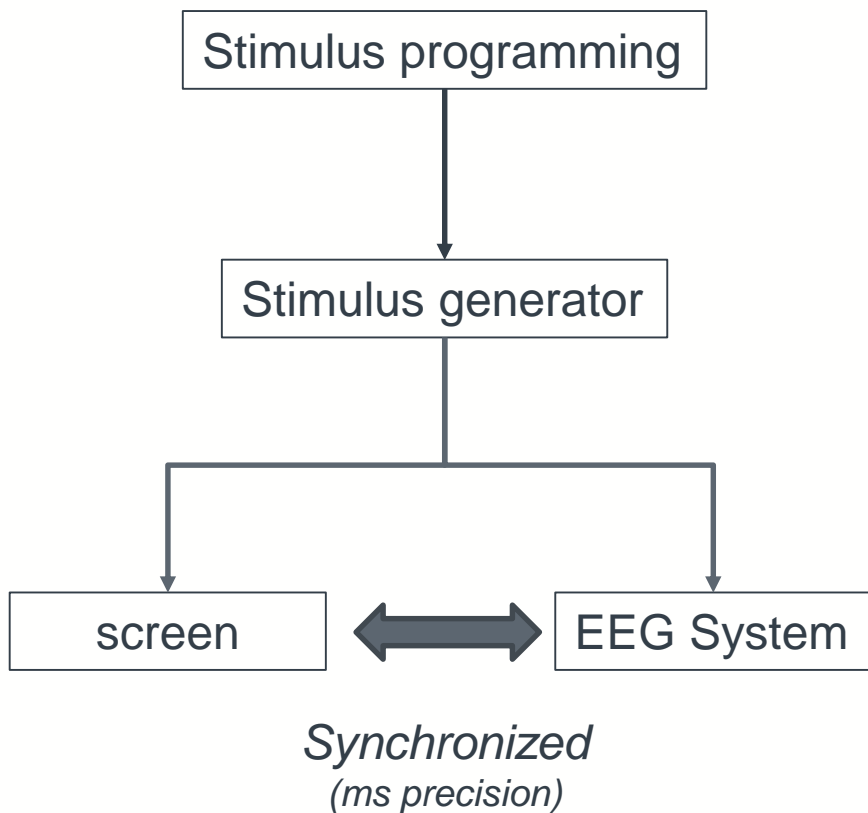
**Step 1:**  
Visuomotor performance **determinants**  
in **table tennis?**



**Step 2:**  
Visuomotor **training** interventions in  
**table tennis?**

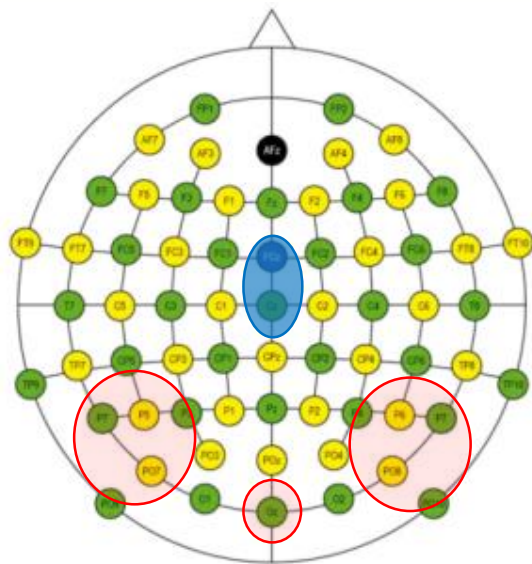
# 1) The experiment

## Experimental setup



# 1) The experiment

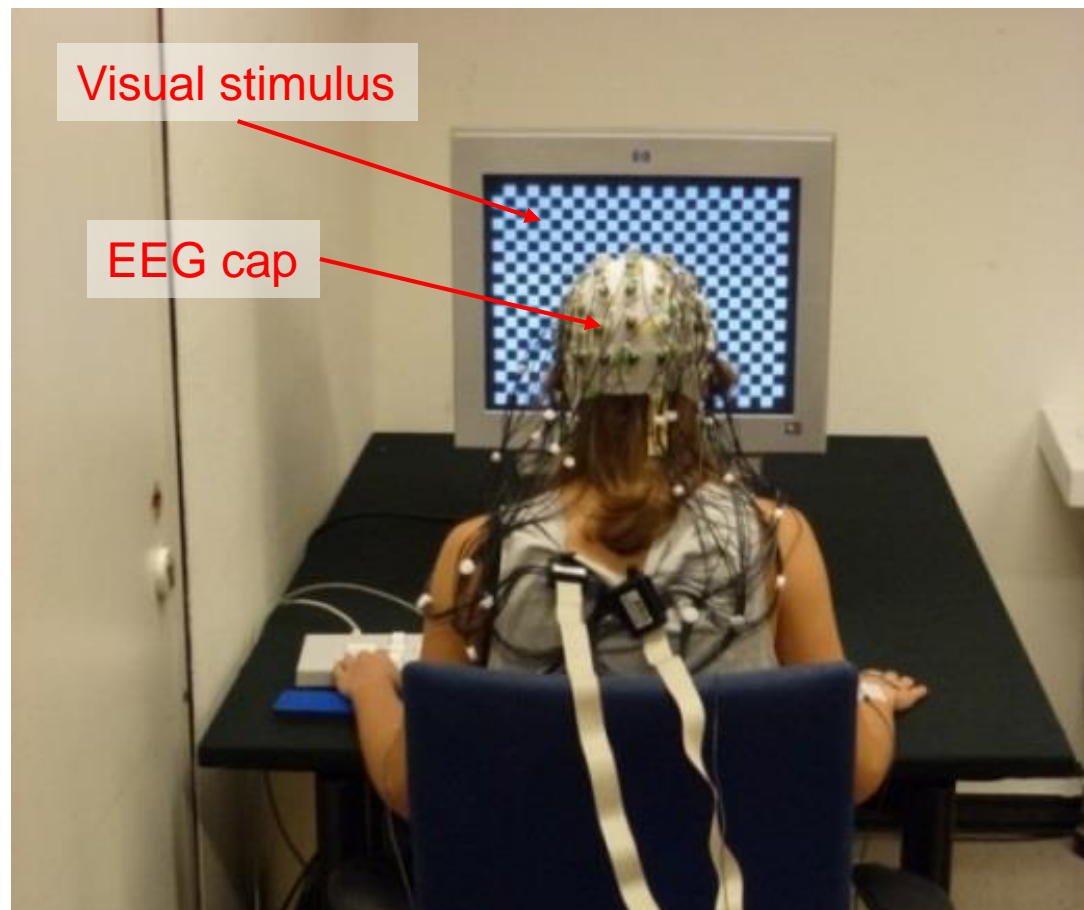
## EEG setup



64 EEG channels



Visual regions (perception)  
Motor regions (transformation)



# 1) The experiment

## EEG preparation

1) Head circumference



2) nasion-inion distance



3) Establish connection



4) Check raw signal

Select cap size



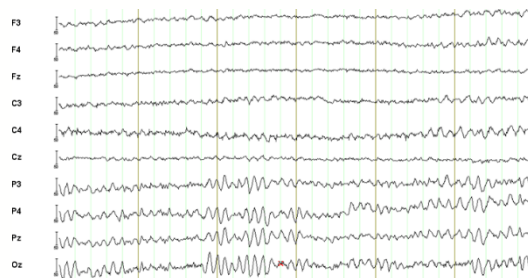
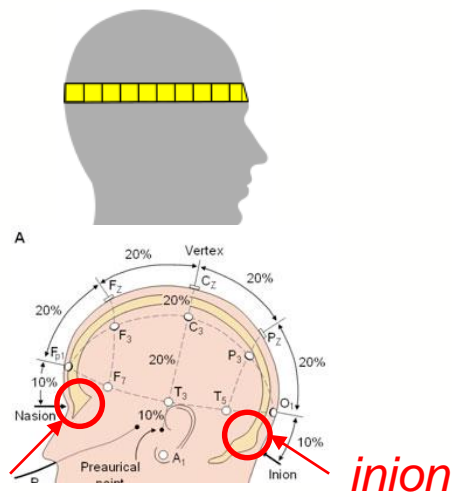
Adjust cap position



Electrode ↔ scalp



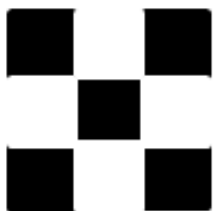
Control signal quality



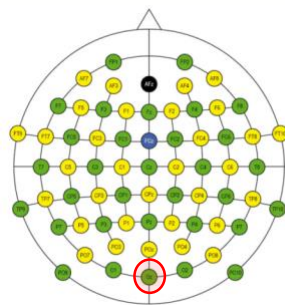
# 1) The experiment

## Experimental protocol

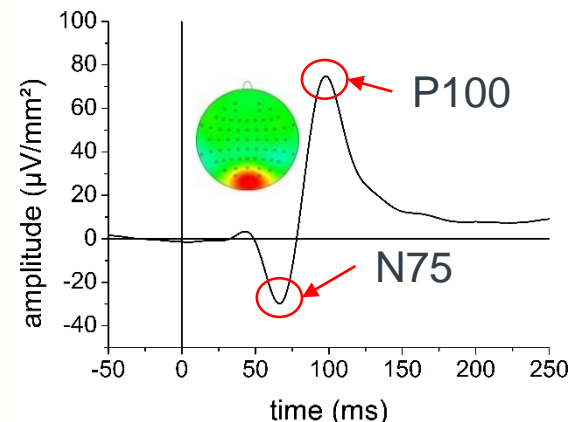
Contrast stimulus



activate V1



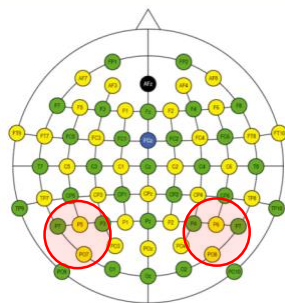
**contrast**  
perception speed



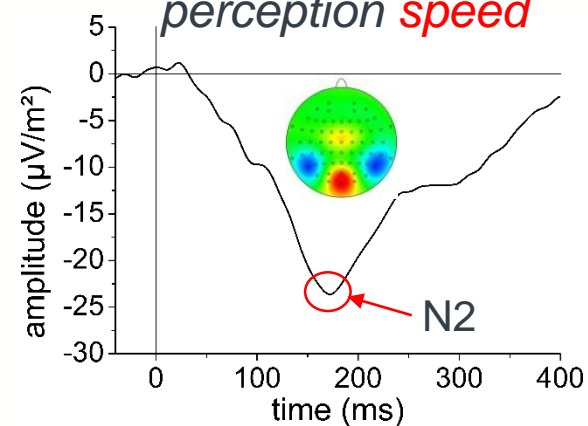
Motion stimulus



activate MT



**motion**  
perception speed





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**LET'S START THE TEST 😊**



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## 2. THE STUDY

*Neurophysiological determinants of visuomotor reaction time in table tennis players*

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**[ LU:NEX ]**

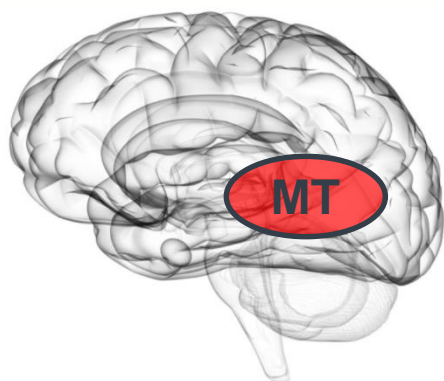
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# 2. Table tennis study

## Badminton



## Table tennis



Reaction time ⇔ visual system



Determinants of reaction time???

## 2. Table tennis study

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### Working title:

*Neurophysiological determinants of visuomotor reaction time in table tennis players*



*INS Luxembourg*

### In cooperation with



*China table tennis  
college Europe*



*German Sport University Cologne*

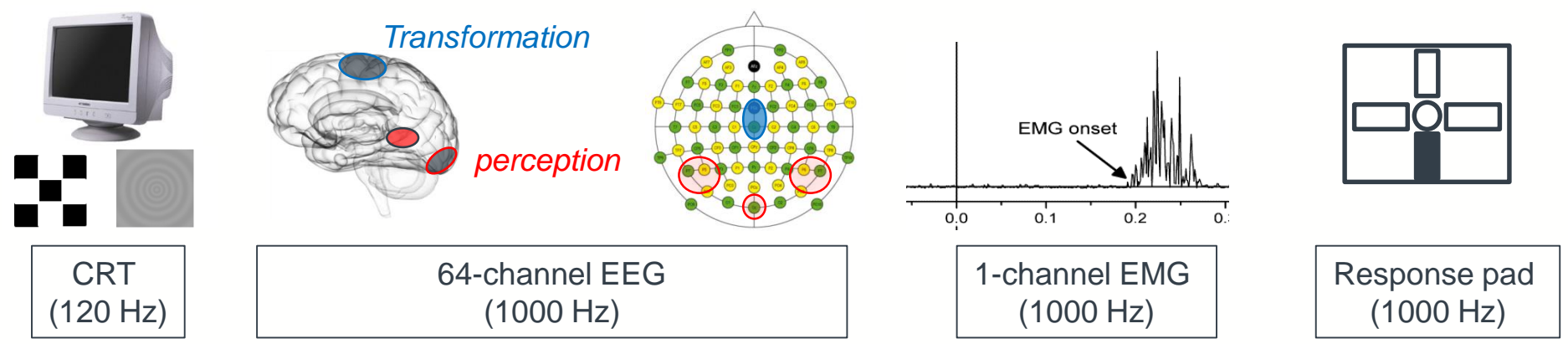
# 2. Table tennis study

**17 participants** (experienced youth table tennis players)  
 13 years of age, 6 years experience, 18h/week

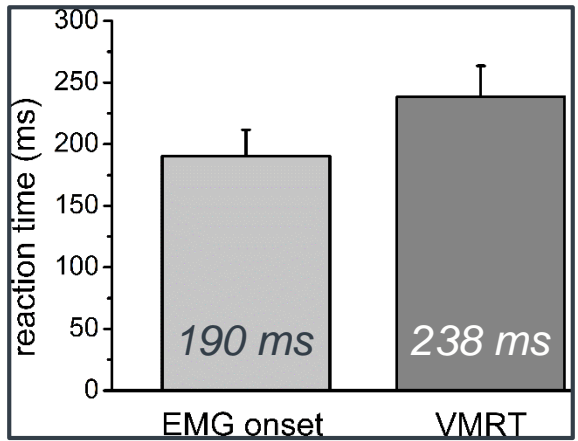
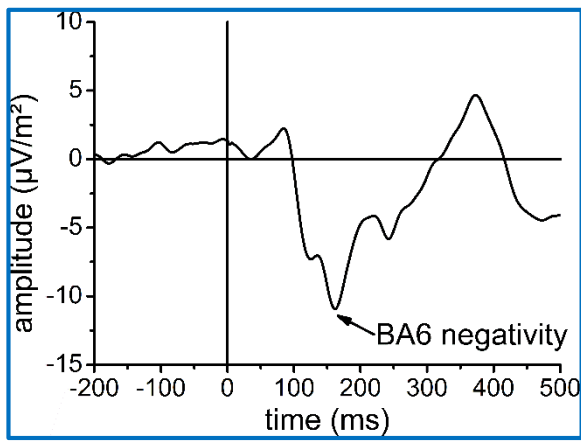
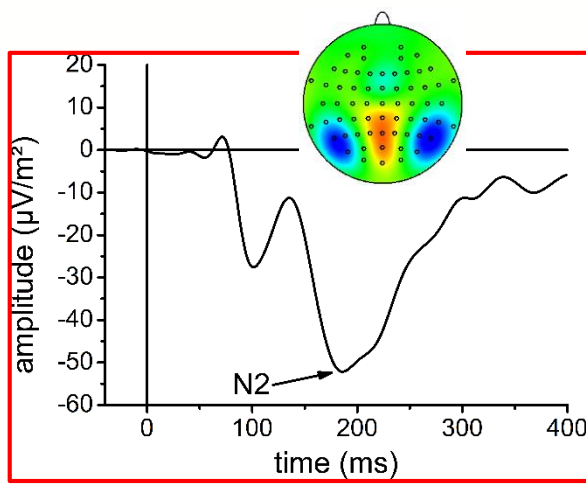
**Experiment 1:** visual *contrast* stimuli

**Experiment 2:** visual *motion* stimuli

**Parameters:** perception/transformation speed, EMG onset, VMRT



# 2. Table tennis study



**Perception:**

identifiable **N2** potential

**Transformation:**

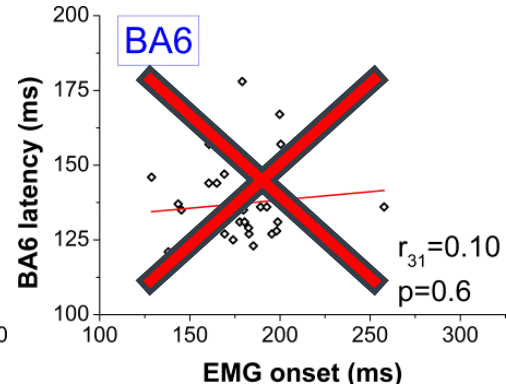
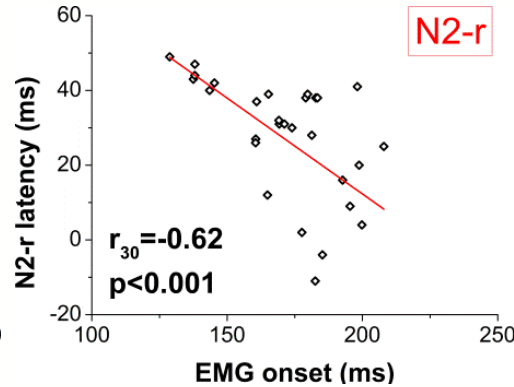
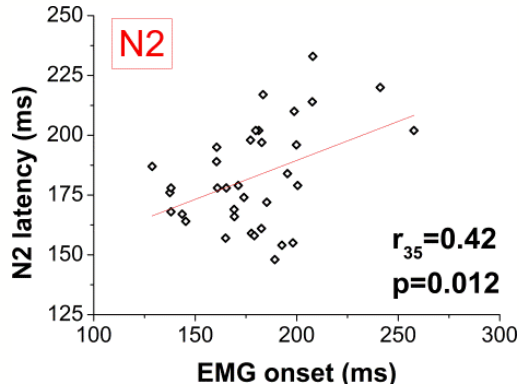
identifiable **BA6** negativity potential



Visuomotor reaction time???

# 2. Table tennis study

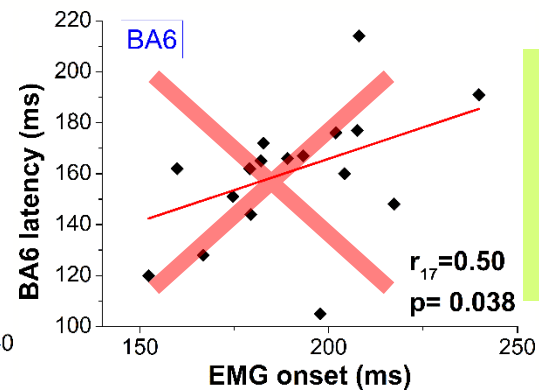
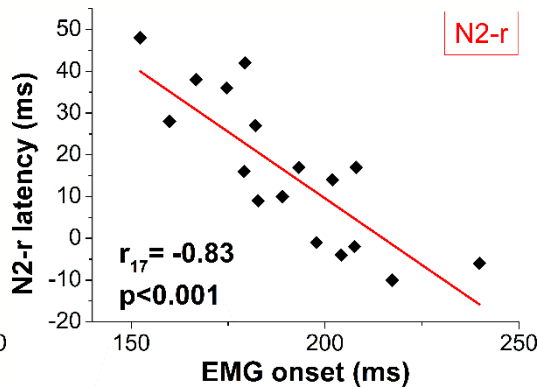
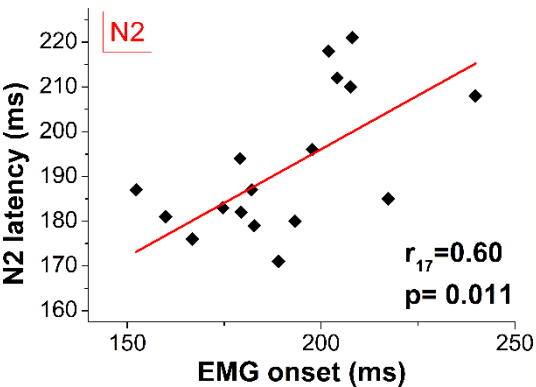
## Badminton



Regression

$R = 0.80$   
 $R^2_{\text{corr.}} = 0.63$

## Table tennis

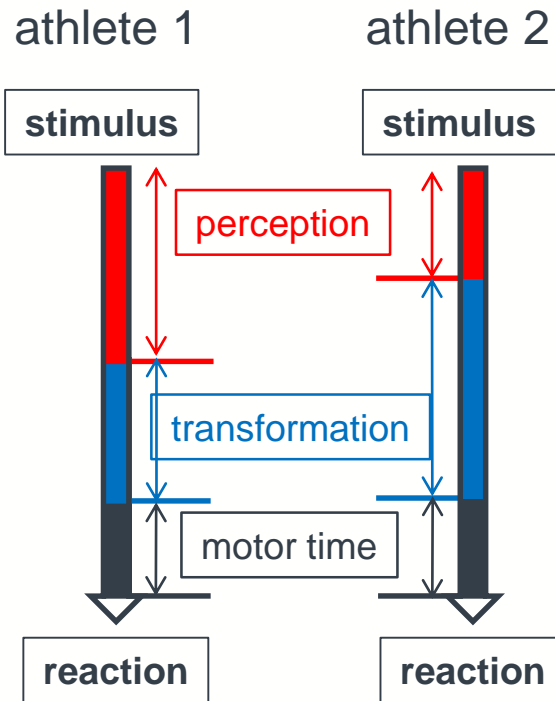


Regression

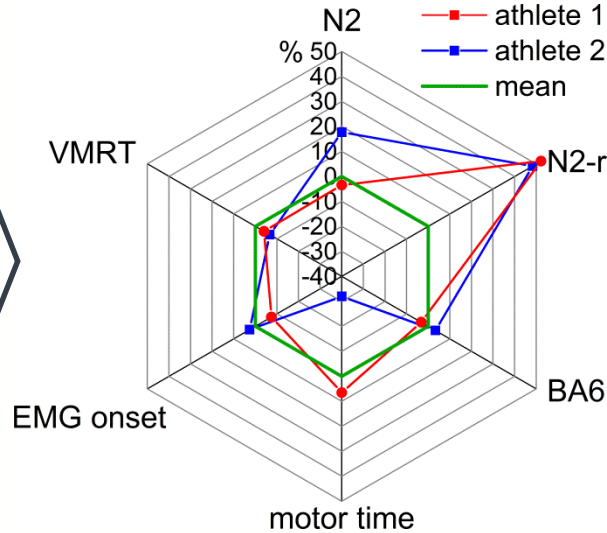
$R = 0.88$   
 $R^2_{\text{corr.}} = 0.73$

# 2. Table tennis study

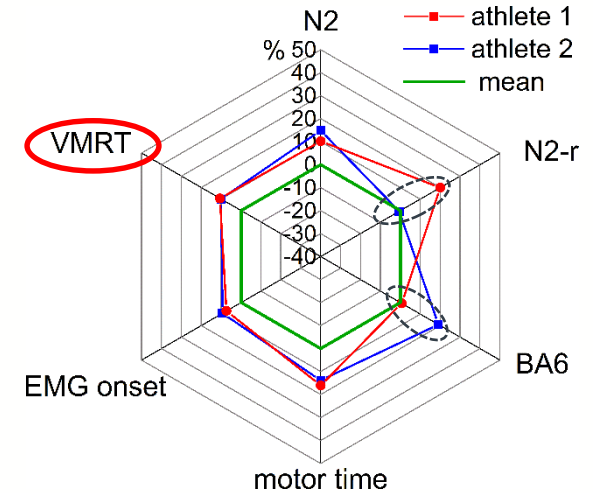
## Practical relevance?



### Badminton



### Table tennis



**Athlete 1: slow visual**

**Athlete 2: slow motor**

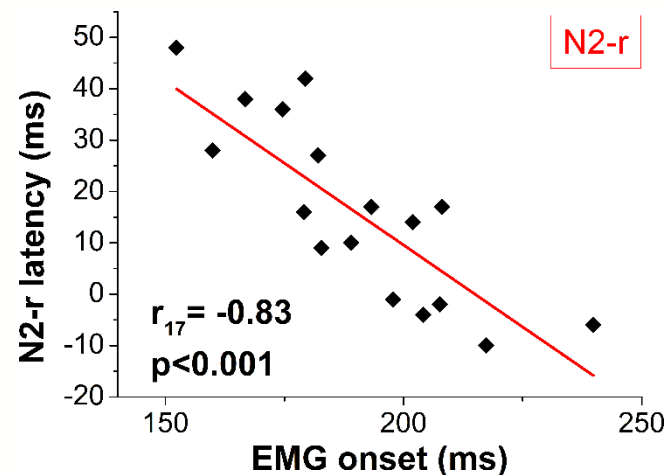
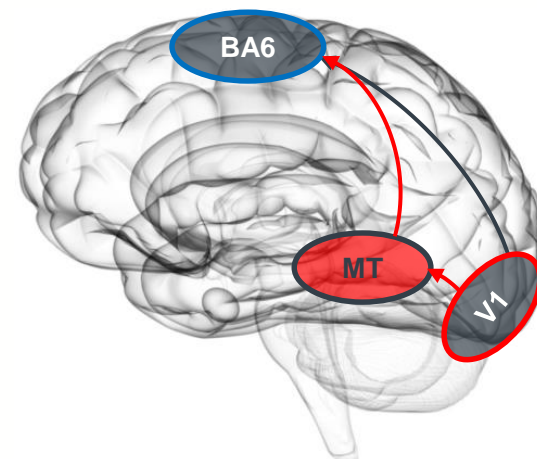
# 2. Table tennis study

## Summary

- 1) Visuomotor reactions activate **visual** (N2) and **motor** regions (BA6 negativity)
- 2) **Neurophysiological** processes determine visuomotor reaction time
- 3) Crucial importance of **visual processes**



Visual training





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# 3.VISUOMOTOR TRAINING

*Improving visuomotor abilities using stroboscopic training*

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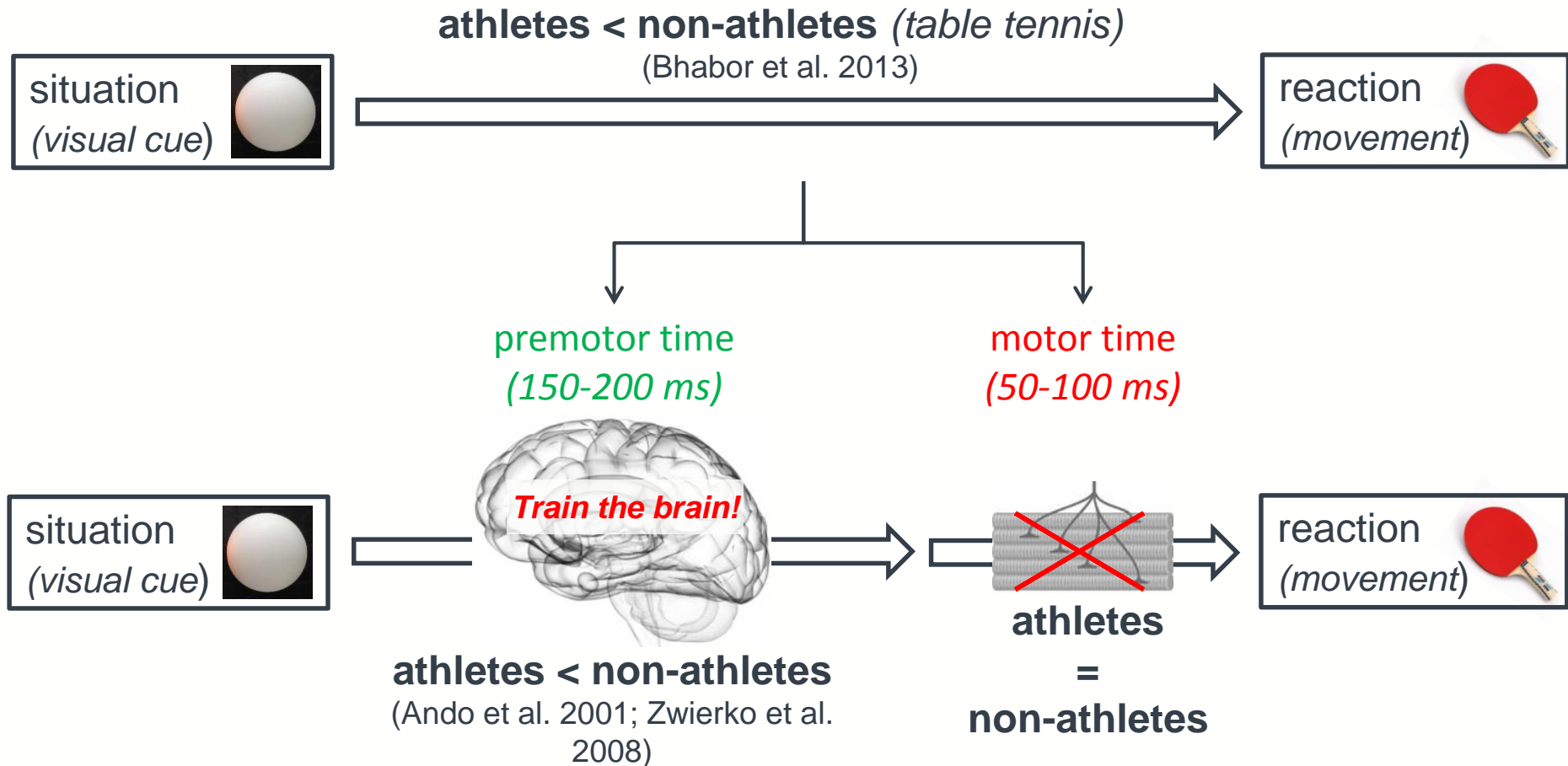


**[ LU:NEX ]**

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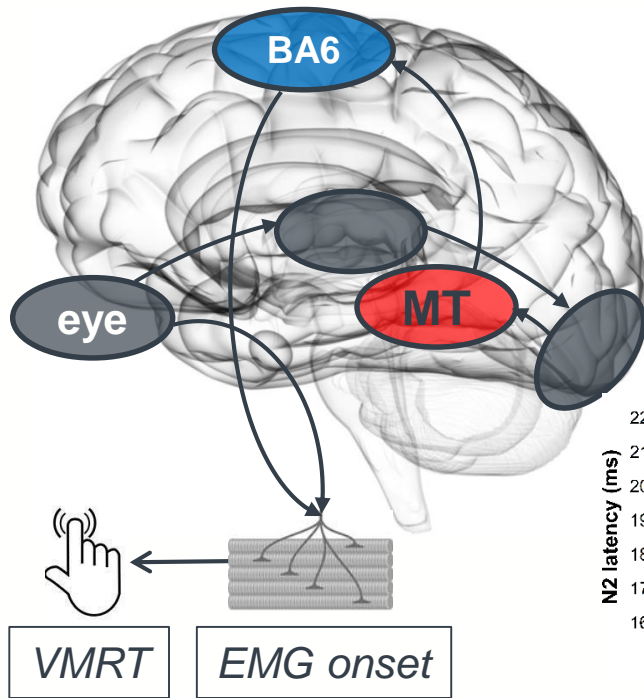
# 3. Visual training

## What we already know...



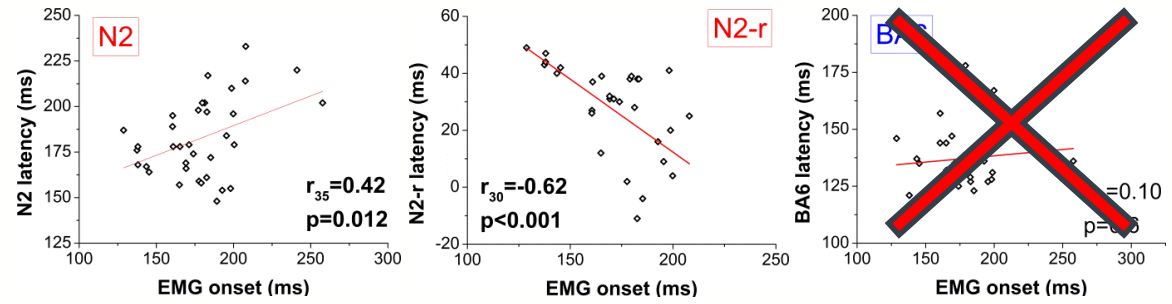
# 3. Visual training

## What we also know...

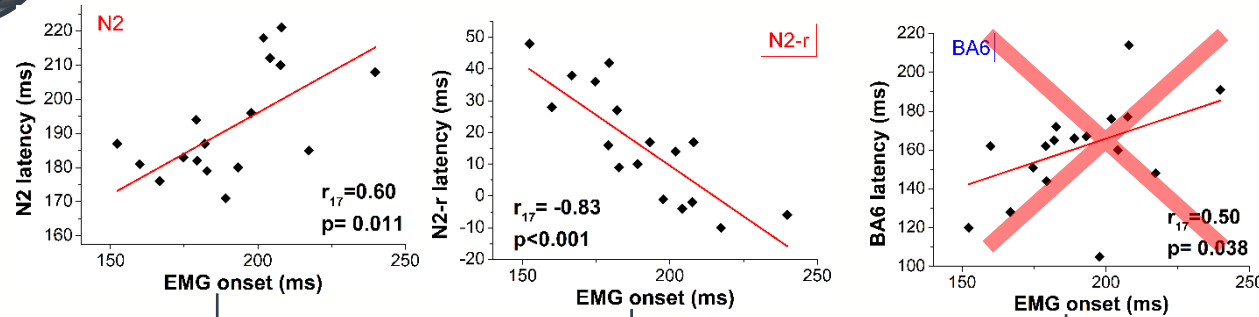


**Perception (MT)**  
**Transformation (BA6)**

### Badminton



### Table tennis



Train the brain



**Train the visual system !**

# 3. Visual training

## How shutter glasses work

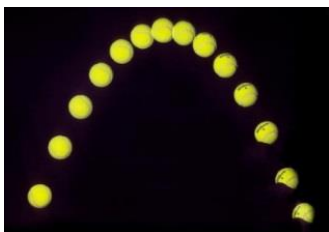


*Shutter glasses*

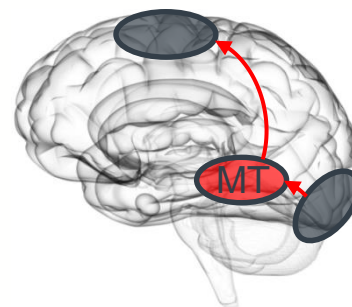


*Stimulation protocol*

## The idea of shutter training



*Stroboscopic effect*



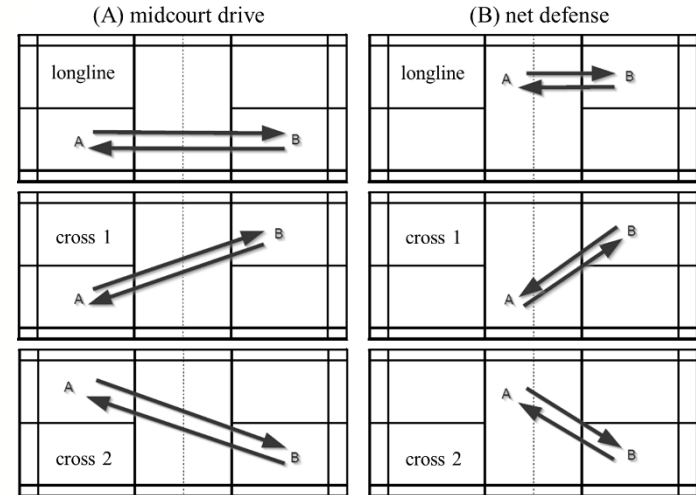
*Visual adaptation!?*

# 3. Visual training

## Why shutter glasses?

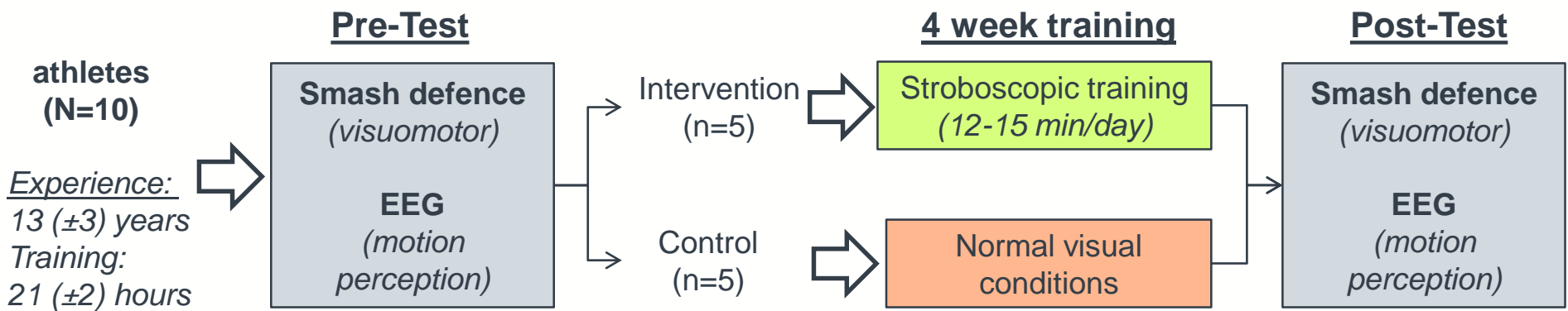
- 1) No extra training time ✓
- 2) Easy to use be athletes and coaches ✓
- 3) Variable training intensity ✓
- 4) Promising research results ✓

***What about training practice?***

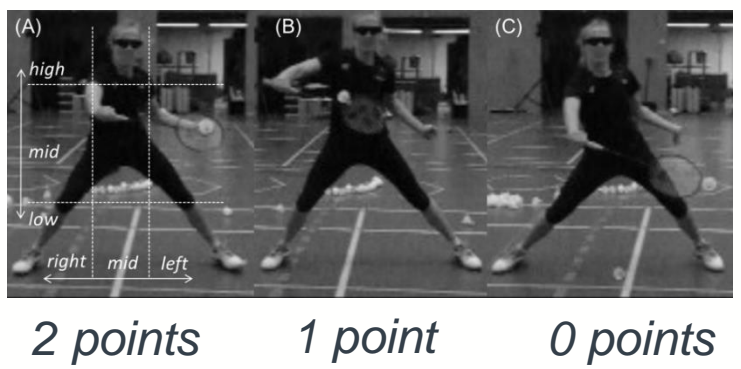


# 3. Visual training

## Training the visual system – a pilot study

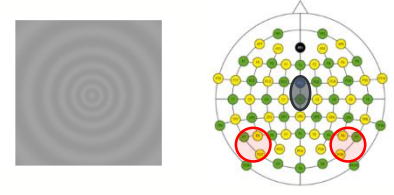


### Smash defence (80 balls)

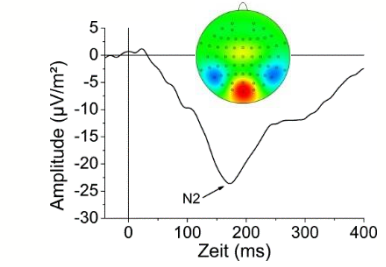


Point score

### Motion perception



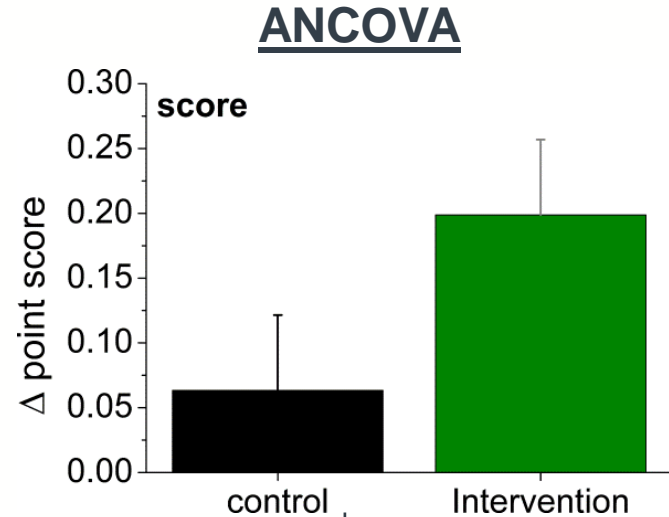
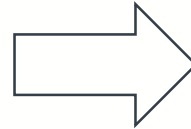
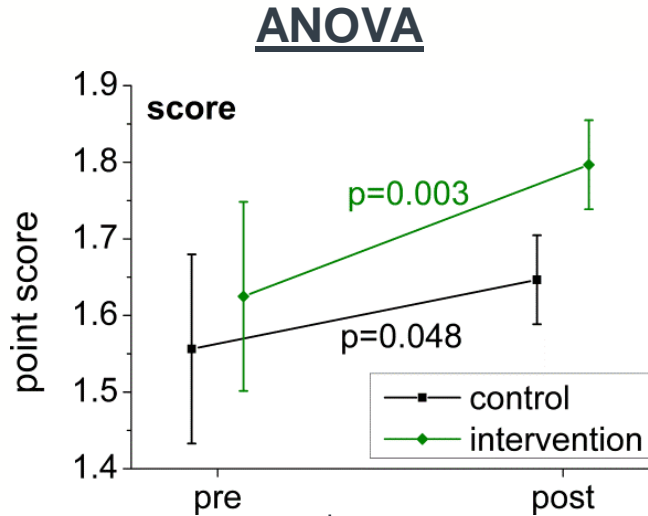
16 channel EEG



N2 potential

# 3. Visual training

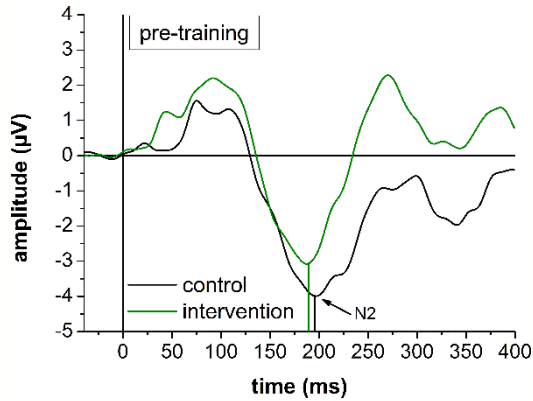
## Training the visual system – a pilot study



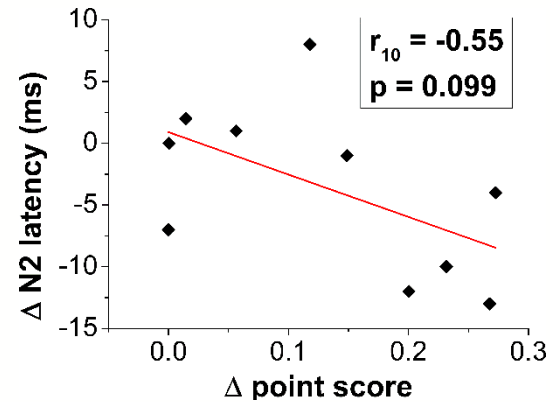
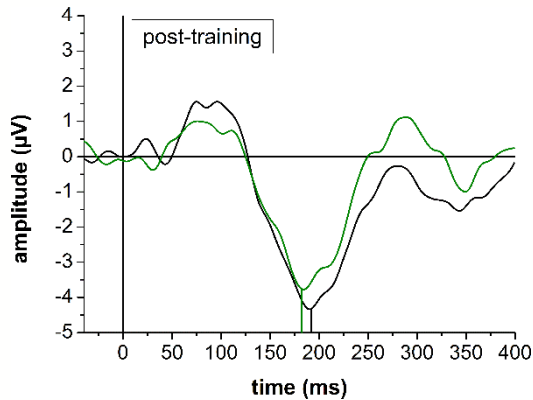
**Stroboscopic training => stronger performance gains**

# 3. Visual training

## Pre-training perception speed



## Post-training perception speed



Visual **perception speed**  
(N2 potential)



Visuomotor **performance**  
(point score)



# 3. Visual training

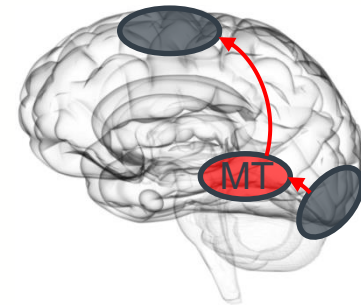
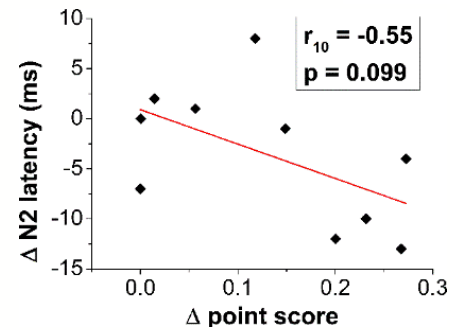
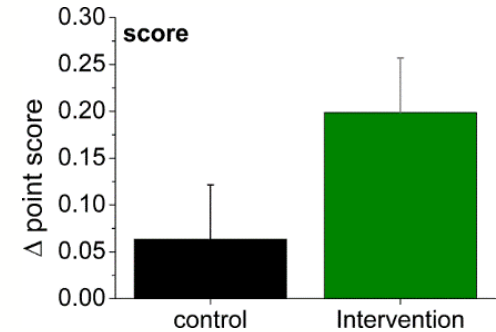
## Summary

- 1) Stroboscopic training improves visuomotor performance
- 2) Visuomotor performance  $\leftrightarrow$  motion perception

Promising training approach for elite athletes in visuomotor demanding sports...

**BUT...**

- Small sample size (n=10)
- Short training duration
- No retention test



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# AND WHERE FROM HERE?

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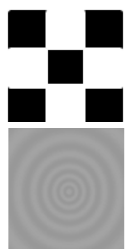
**[ LU:NEX ]**

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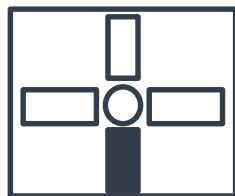
# And where from here?

## Ecological validity

Visuo...



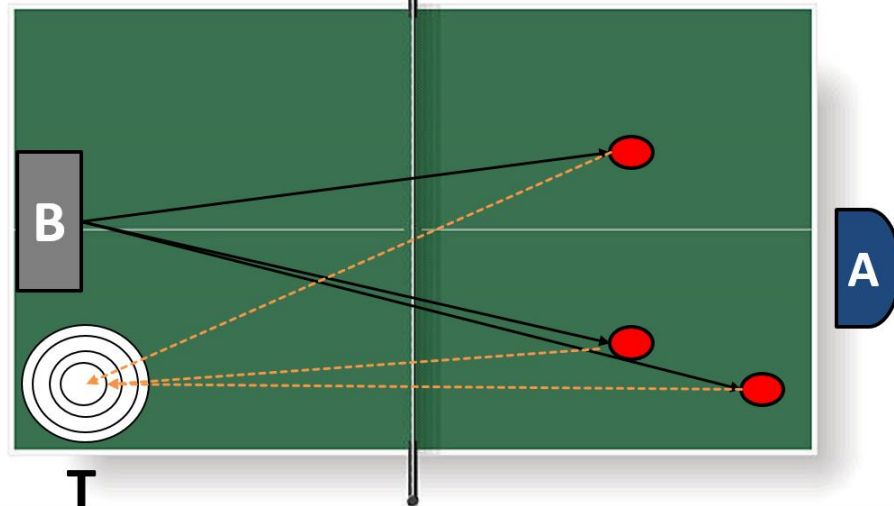
...motor



Visuo...



...motor



Neurophysiological processes  
determining table tennis performance

# And where from here?

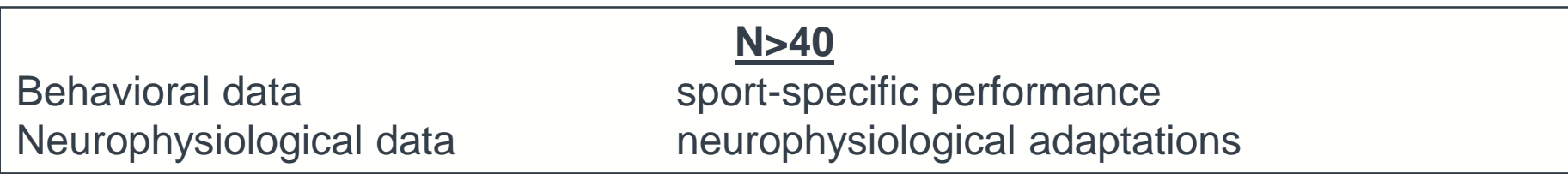
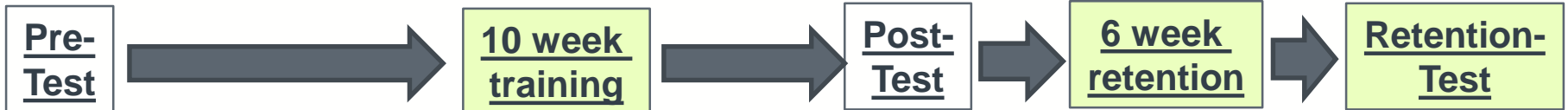
## Longitudinal research

**Pilot study** => visuomotor training using shutter glasses

Small sample size (n=10)

Limited training time (4 weeks)

No retention test

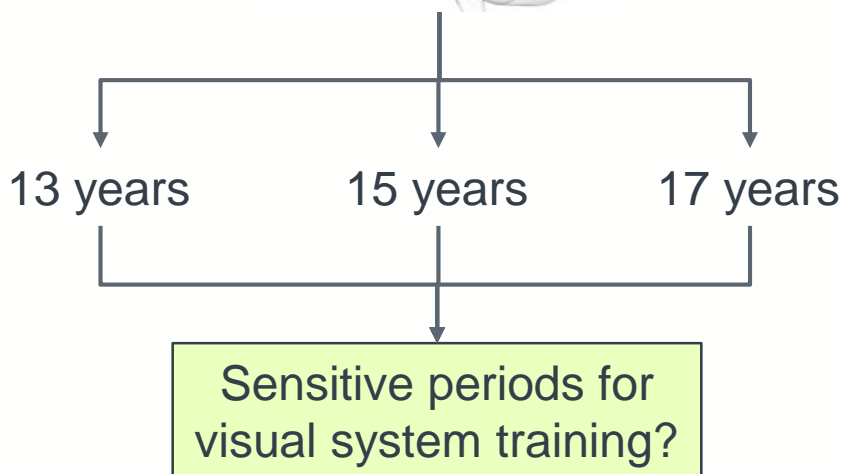
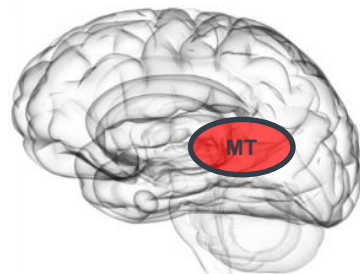


# And where from here?

## Sensitive periods!?

What should be trained? ✓

When should be trained ?



*China table tennis college Europe*



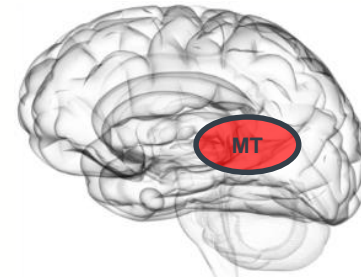
*INS Luxembourg*

# In summary

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## We know...

- 1) Visuomotor reaction time determines table tennis performance
- 2) Visuomotor reactions are determined by the brain and especially the visual system
- 3) Shutter trained seems to be effective to improve visuomotor reactions

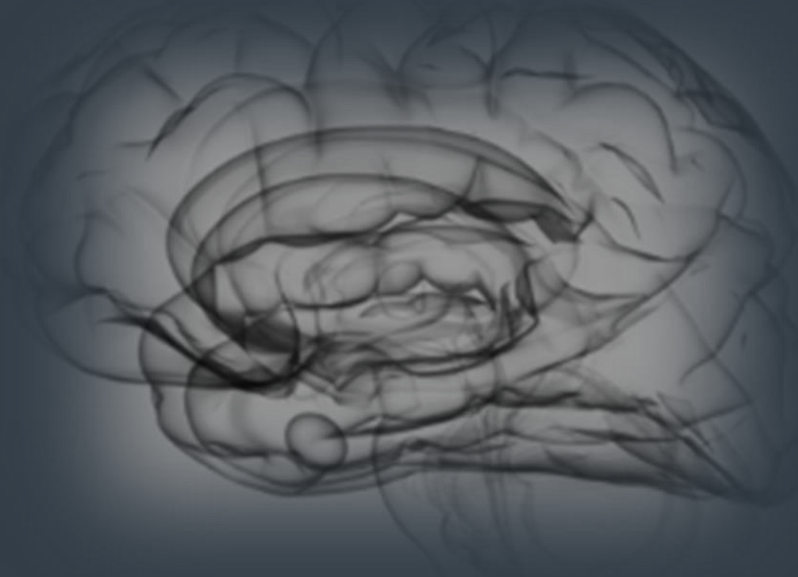


## For the future...

- 1) Improving ecological validity
- 2) Detecting (possible) sensitive periods
- 3) Establish the link between visual training and neural plasticity



THANK YOU 😊



*Dr. Thorben Hülsdünker*  
*thorben.huelsduenker@lunex-university.net*