# TOWARDS AN EEG-BCI BASED COVERT VISUAL ATTENTION TRAINING PROCEDURE FOR SOCCER GOALKEEPERS

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## INTRODUCTION

### DESIGNING INNOVATIVE TRAINING PROCEDURES FOR ATHLETES

Most sport training procedures neglect the cognitive dimension of performance. Using **EEG-BCIs** and **Virtual Reality**, we aim at designing efficient, motivating and ecological cognitive training procedures to improve athletes' performances.

**Target cognitive ability:** Covert Visual Attention (CVA)
**Target population:** Soccer Goalkeepers

WHY? It is essential for soccer goalkeepers to have high CVA abilities, i.e., to be able to covertly commit attention to an object located in their peripheral field of view [1].

### STATE-OF-THE-ART EEG-CORRELATES OF CVA

CVA elicits an **α-synchronisation** over parieto-occipital areas ipsilateral to the attended hemi-field of view [2,3]. This pattern, called **Lateralisation Index (LI)**, reflects an inhibitory process aiming to allocate more resources to the target location.

Research question

### DETERMINING RELEVANT EEG CORRELATES OF COVERT ATTENTION, I.E. CORRELATES THAT ARE:

C 1 - specific to the target ability (CVA)
C 2 - measurable on a single-trial basis
C 3 - related to athletes' expertise and/or performance

››› Does the LI satisfy these criteria or would other correlates of CVA be more relevant?

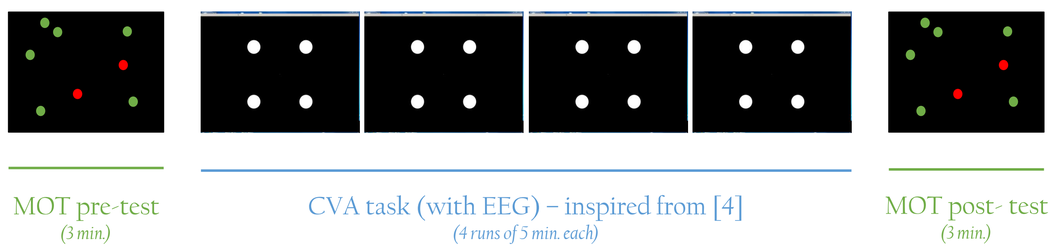
## MATERIALS & METHODS

Participants - 17 soccer goalkeepers, from the lowest to the highest levels of the French championship

Material - EEG: 32 wet ladybird electrodes, g.Amp (g.tec); Eye tracker: EyeTribe

Protocol - 2 sessions of CVA training (4 runs per session) - Multiple Object Tracking (MOT) task as pre- & post-test

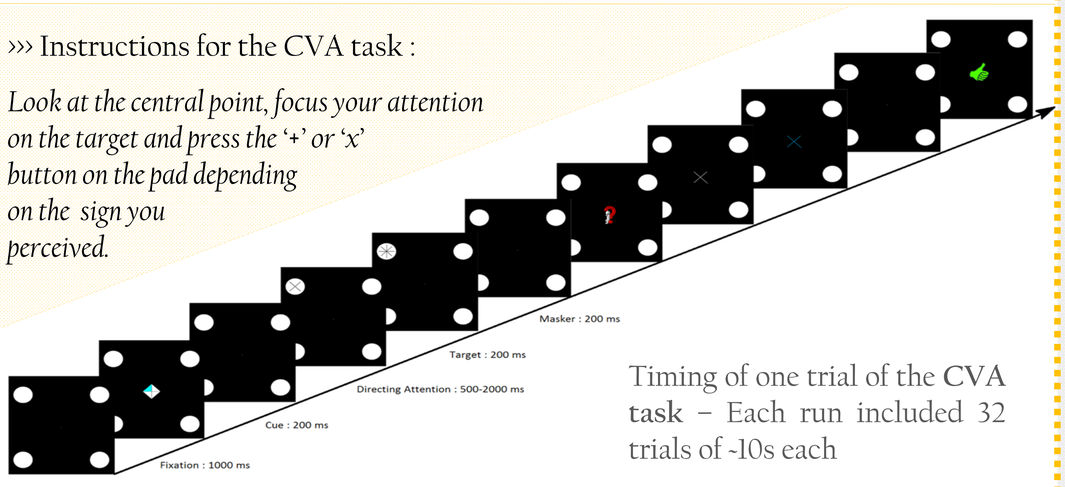
A participant taking part in the CVA task, fixating the central point and waiting for the cue to appear.




Structure of 1 training session – Each participant took part in 2 sessions

››› Instructions for the CVA task :

*Look at the central point, focus your attention on the target and press the '+' or 'x' button on the pad depending on the sign you perceived.*

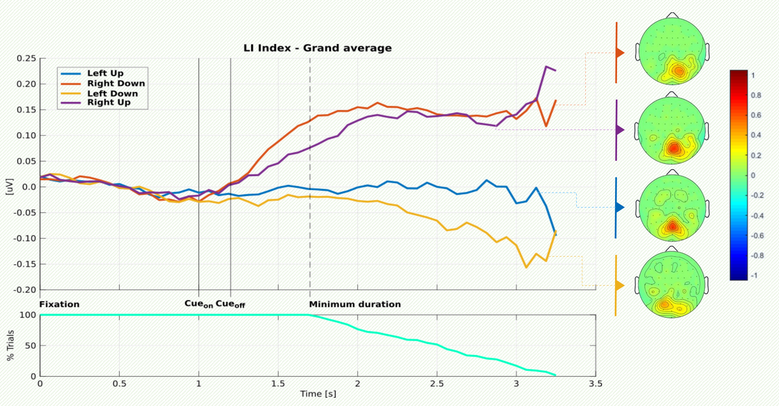



Timing of one trial of the **CVA task** – Each run included 32 trials of ~10s each

## MAIN RESULTS

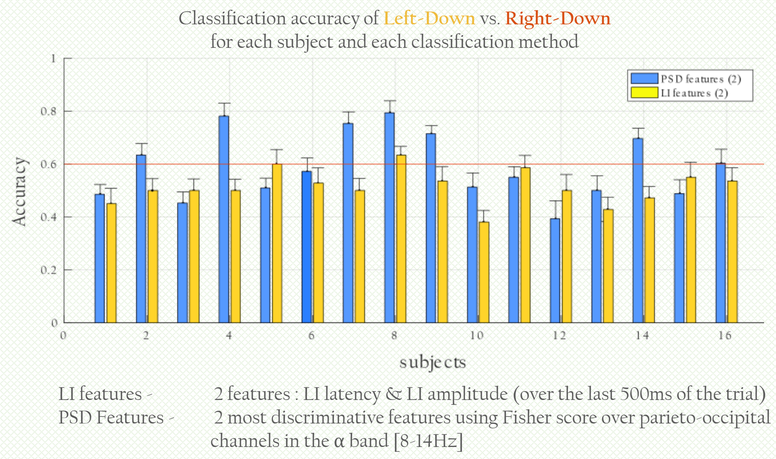
### WE INVESTIGATED EEG CORRELATES OF COVERT VISUAL ATTENTION THAT ARE:

#### C 1 - Specific to the target ability (CVA)




Through grand average analyses, we successfully replicated the state-of-the-art LI (computed as [α-powerRight – α-powerLeft ]), which reflects CVA processes.

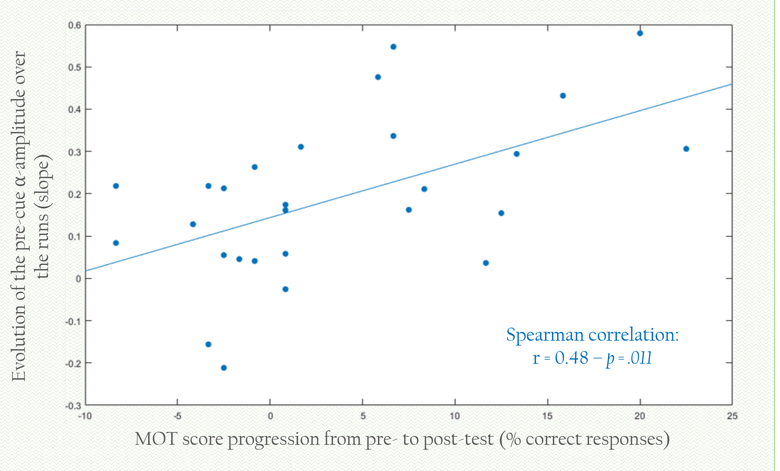
#### C 2 - Measurable on a single-trial basis




LI features - 2 features : LI latency & LI amplitude (over the last 500ms of the trial)
PSD Features - 2 most discriminative features using Fisher score over parieto-occipital channels in the α band [8-14Hz]

LI appeared not to be a reliable marker on a single-trial basis. We used a machine learning approach (PSD-Fisher score) to reach higher classification accuracy.

#### C 3 - Related to athletes' expertise or perf




Athletes' MOT progression correlated with (1) the evolution of the pre-cue α-amplitude and (2) the evolution of the CVA task performance ($r = 0.52$, $p = .006$).

## DISCUSSION & FUTURE WORK

1. The state-of-the-art LI is not suitable to be used for an online BCI CVA training.
2. Reliable EEG correlates of CVA, measurable on single-trials, remain to be determined.
3. The evolution of the pre-cue α-amplitude seems to reflect athletes' covert visual attention progression. The specificity of this marker remains to be assessed [5].

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