USING ELECTROENCEPHALOGRAPHY (EEG) AND VIRTUAL REALITY (VR) TO UNDERSTAND & IMPROVE COGNITIVE PERFORMANCE.

C. JEUNET

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Rationale of the Approach

Understand & Improve

/ Cognitive Performance
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Understand & Improve
/
Cognitive Performance

NEED FOR
Rationale of the Approach

Understand & Improve
/ Cognitive Performance

NEED FOR

Brain Imaging Technique
Rationale of the Approach

Understand & Improve

/ Cognitive Performance

NEED FOR

Brain Imaging Technique

Controlled Environment
Rationale of the Approach

Understand & Improve
/ Cognitive Performance

NEED FOR

- Brain Imaging Technique
- Controlled Environment

- EEG
  ElectroEncephaloGraphy
- VR
  Virtual Reality
Rationale of the Approach
Rationale of the Approach

Project #1

Understanding Cognitive Performance Using EEG & VR

SENSE OF AGENCY
Rationale of the Approach

Project #1

Understanding
Cognitive Performance
Using EEG & VR

Project #2

Improving
Cognitive Performance
Using EEG & VR

SENSE OF AGENCY

COVERT ATTENTION
Project #1 – SENSE OF AGENCY
Project #1 – Theoretical Background

SENSE OF EMBODIEMENT

Sense of Self–Location

Sense of Body–Ownership

Sense of Agency
Project #1 – Theoretical Background

SENSE OF EMBODIEMENT

Sense of Self–Location

Sense of Body–Ownership

Sense of Agency
Our approach: Rely on theories from psychology & philosophy

Sense of Agency
Project #1 – Theoretical Background

Our approach: Rely on theories from psychology & philosophy

Sense of Agency

Relies on
3 principles
Priority Principle
Exclusivity Principle
Consistency Principle

Includes
2 components
Feeling of Agency
Judgement of Agency
Assess the relevance of our approach to manipulate and measure the Sense of Agency in Virtual Environments.
Do you feel in control?: Towards Novel Approaches to Characterise, Manipulate and Measure the Sense of Agency in Virtual Environments

VIDEO
see HERE
Project #1 – Sense of Agency

III – Discussion

- Our approach enabled us to manipulate and measure the SoA
- Questions currently investigated:
  - Can we measure variations of the SoA in real-time?
  - Do all the principles impact equally the SoA?

Project #2 – **COVERT ATTENTION**
Project #2 – Context
Project #2 – Context

[Biomechanics]
Project #2 – Context

[Biomechanics] [Physiology]
Project #2 – Context

Biomechanics

Physiology

Social

Cognition

Psychology

Neurophysiology
Project #2 – Context

[Biomechanics] [Physiology] [Mental State] [Social] [Cognition] [Psychology] [Neurophysiology]
Project #2 – Context

How to train athletes’ mental state?
Project #2 – Context

How to train athletes’ mental state?

Using Neurofeedback
Project #2 – Context

Learning to self-regulate their brain activity in order to improve motor or cognitive functions…

Central Florida biofeedback
Project #2 – Context

How to train athletes’ mental state?

Using Neurofeedback

[Biomechanics] [Physiology] [Mental State] [Social] [Cognition] [Psychology] [Neurophysiology]
Project #2 – Context

What ability should be trained?
Project #2 – Context

What ability should be trained?

Covert Visuo-Spatial Attention (CVSA)
Project #2 – Approach

Neurofeedback Training of CVSA
Project #2 – Approach

Neurofeedback Training of CVSA

*Using Virtual Reality*
Project #2 – Approach

Neurofeedback Training of CVSA

Using Virtual Reality

1. Does CVSA have specific neurophysiological correlates?
Project #2 – Approach

Neurofeedback Training of CVSA

Using Virtual Reality

1. Does CVSA have specific neurophysiological correlates?
2. Are the characteristics of these correlates related to performance?
Investigating the neurophysiological correlates of CVSA & the relationship between these correlates and performance.
Project #2 – CVSA – Soccer Goalkeepers

II – Protocol

VIDEO
Project #2 – CVSA – Soccer Goalkeepers

III – Results

\[ \text{Lateralisation Index} = \text{Power}_{\text{right}} - \text{Power}_{\text{left}} \]
Lateralisation Index = Power_right – Power_left

III – Results

2-way ANOVA for repeated measures

Time * Class interaction – p < 0.001

N = 12

Project #2 – CVSA – Soccer Goalkeepers
Project #2 – CVSA – Soccer Goalkeepers

III – Results

N = 12

Alpha (8–14Hz) power – task vs. rest
Replication of results from the literature [Schmidt et al., 2010; Tonin et al., 2013]

Questions currently investigated:
- Is this marker (LI) suitable for a neurofeedback training procedure?
  - Is it measurable on a single trial basis?
  - Does it correlate with performance or expertise?

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