

14/6/15

## Training in realistic virtual environments:

### Impact on user performance in a motor imagery-based Brain-Computer Interface

Leando da Silva-Sauer, Luis Valero-Aguayo, Francisco Velasco-Álvarez, Sergio Varona-Moya, Ricardo Ron-Angevin

*Depto. Tecnología Electrónica*

*Depto. Personalidad, Evaluación y Tratamiento Psicológico*

*Universidad de Málaga*

*Málaga (Spain)*

TEC-2011-26395



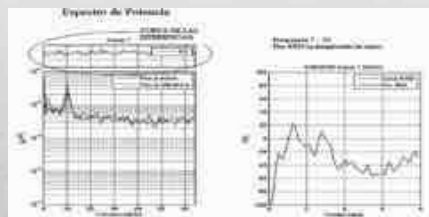
IWANN-2015

- BCI in experimental contexts
- Objectives
- Method
  - Participants
  - Procedure
  - Instruments
  - Signal processing
  - Navigation paradigm
  - Virtual environment
- Results
- Conclusions

## Training in realistic virtual environments

IWANN-2015

- Component of EEG (8-13 Hz)
- Event Related Desynchronization
- Navigation with ERD into VR (car, wheelchair)
- Imagination Responses:
  - *Hand movement*
  - *Cognitive relax*



## BCI in experimental contexts

IWANN-2015

- Experimentation context, virtual reality
- Lab tasks, artificial, non-natural
- Generalization to natural context
- Training more realistic spaces
- Virtual space with distracting situations
- Breaks in real situations on wheelchair

## BCI in experimental contexts

IWANN-2015

- **Studying the effects**
  - Realistic VR in a park scenario
  - Distracting situations (visual, movements, lights, auditory, surprise)
  - Application interface (visual, auditory)

## **Objectives**

IWANN-2015



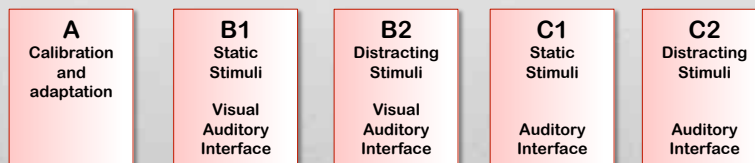
- **11 naïve voluntary students**
- **Minimum error rate <30% in calibration**
- **Informed consent**
- **Bonus points on grade subject**

## **Method: Participants**

IWANN-2015



- Intra-group with repeated measurements
- Phases counterbalanced between participants
- A – B1 – B2 – C2 – C1 (six participants)
- A – B2 – B1 – C1 – C2 (five participants)



## Method: Design

IWANN-2015

- 3 days or sessions, 1 hour approx
- First, calibration, mental imagination right hand and relax, no feedback
- Second, navigation task B1 or B2
- Third, navigation task C1 or C2

## Method: Procedure

IWANN-2015

- Navigation through a virtual park, making 21 movement commands



### Method: Procedure

IWANN-2015

- Soundproof 4x2.4m room
- Stereoscopic overhead projector screen
- Polarized glasses
- Sound system 5.1 surround



### Method: Instruments

IWANN-2015

- EEG bipolar channels
- c3 and c4 positions (hand sensorimotor areas)
- Biosignal g.BSAMP (Guger Technologies)
- NI-USB-610 National Instruments amplifier and digitalization (128 Hz and 12 bit)



## Method: Instruments

IWANN-2015

- Non-Control Command:
  - Semi-transparent vertical blue in center screen
- Control Command:
  - Circle with three parts of quadrants, three navigation commands (forward, right, left)
- Bar computer each 62.5 ms with classifier
- If correct right-hand imagination task 1 s, bar extended
- Audio cues for each quadrants
- In C1 and C2 only auditive cues



## Method: Navigation Paradigm

IWANN-2015

- Virtual Environment simulating a static park with or without distracting stimuli
- 21 commands of a forced path in the park
- Taks and time process:
  - Auditive cue indicating command (forward, right, left)
  - 1 second later, interface comand
  - Selection of a command
  - Feedback visual and auditory (positive or negative)



## Method: Virtual Environment

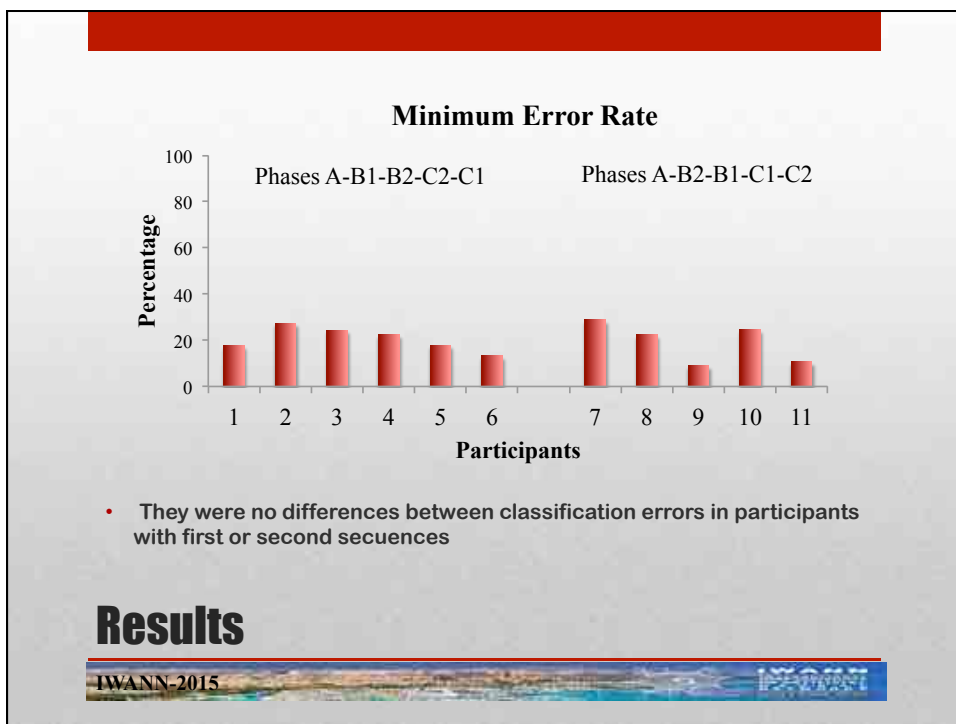
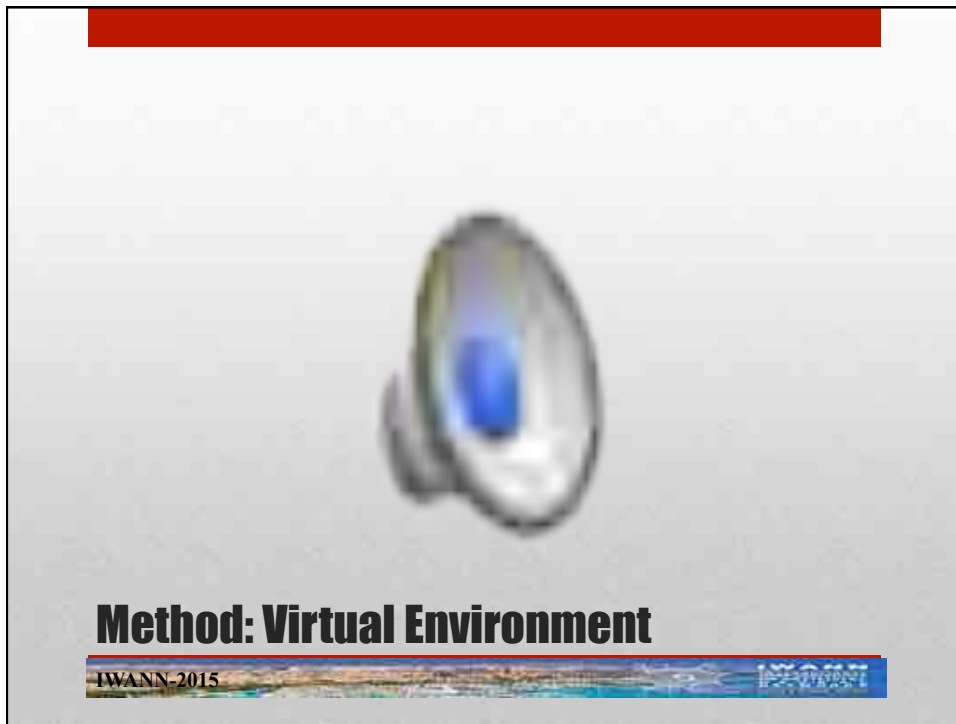
IWANN-2015

- Virtual Environment with distracting stimuli while navigation and commands
  - *Skater and boxes falling*
  - *Rain*
  - *Wind*
  - *Person reading*
  - *Little boy playing*
  - *Dog*
  - *Snow falling*

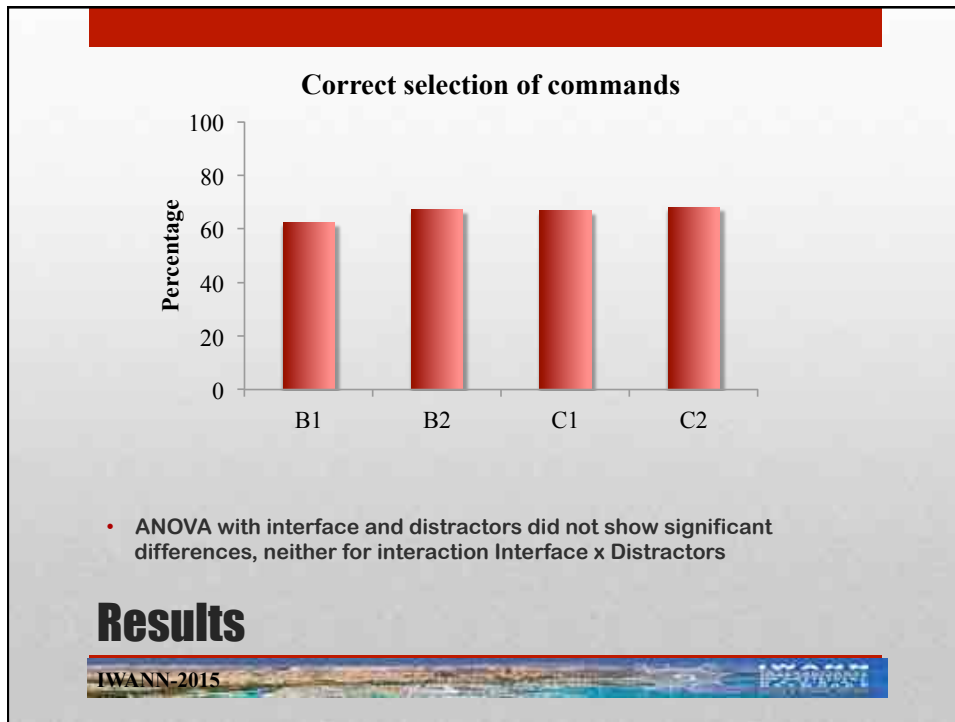


## Method: Virtual Environment

IWANN-2015







- Control of navigation from participant did not depend on the type of interface they used
  - Control of navigation did not depend of distracting stimuli
- Results**
- IWANN-2015

- Relatively small sample size
- Could be used more distracting stimuli
- Study the influence of stressfull or emotional stimuli

## Conclusions


IWANN-2015

- Control achieved in a virtual reality could be generalized to real environment
- Training with BCI should be done more similar to real world
- We plans to apply this navigation control to a weelchair in severe physical disability persons (Amiotrophic Lateral Sclerosis)



## Conclusions

IWANN-2015



**Conclusions**

IWANN-2015

**Training in realistic virtual environments with BCI**

<http://www.diana.uma.es/brains>  
<http://www.incadi.uma.es>

Leandro da Silva-Sauer, Luis Valero-Aguayo, Francisco Velasco-Álvarez, Sergio Varona-Moya, Ricardo Ron-Angevin

*Depto. Tecnología Electrónica*  
*Depto. Personalidad, Evaluación y Tratamiento Psicológico*  
 Universidad de Málaga  
 Málaga (Spain)

[lvalero@uma.es](mailto:lvalero@uma.es)  
 TEC-2011-26395



IWANN-2015