

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



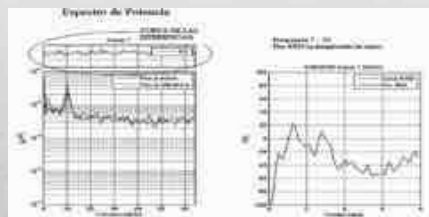
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- BCI in experimental contexts
- Objectives
- Method
 - Participants
 - Procedure
 - Instruments
 - Signal processing
 - Navigation paradigm
 - Virtual environment
- Results
- Conclusions

Training in realistic virtual environments

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- 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

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- 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

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

Objectives

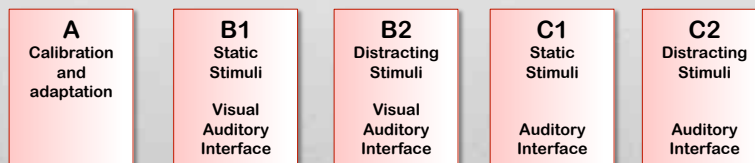
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- **11 naïve voluntary students**
- **Minimum error rate <30% in calibration**
- **Informed consent**
- **Bonus points on grade subject**

Method: Participants

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- 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

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- 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

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- Navigation through a virtual park, making 21 movement commands



Method: Procedure

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



Method: Instruments

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- 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

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- 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

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- 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

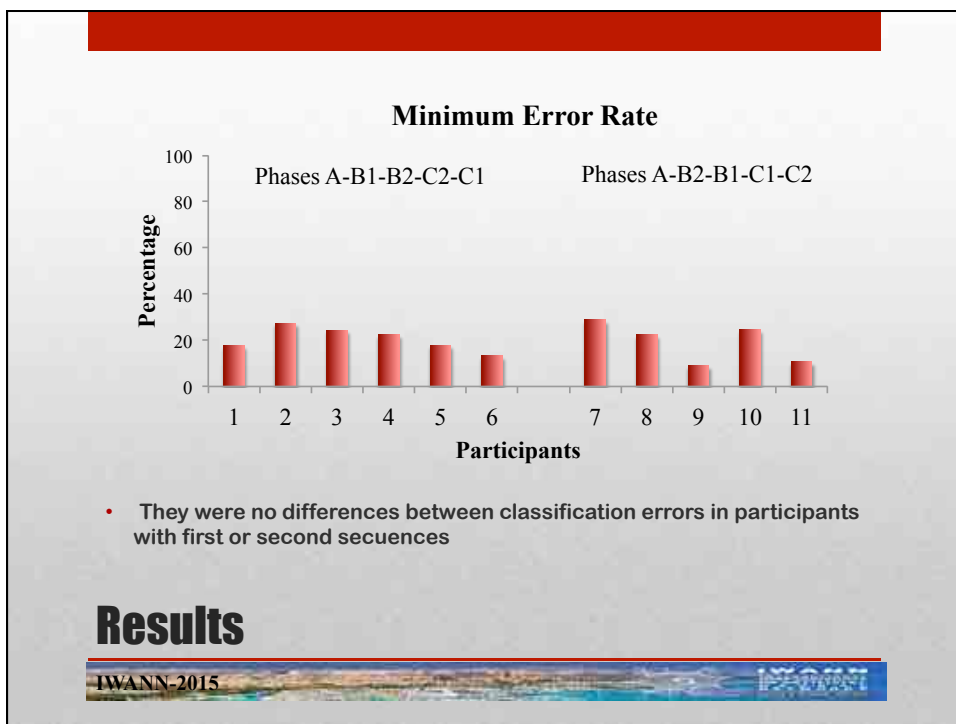
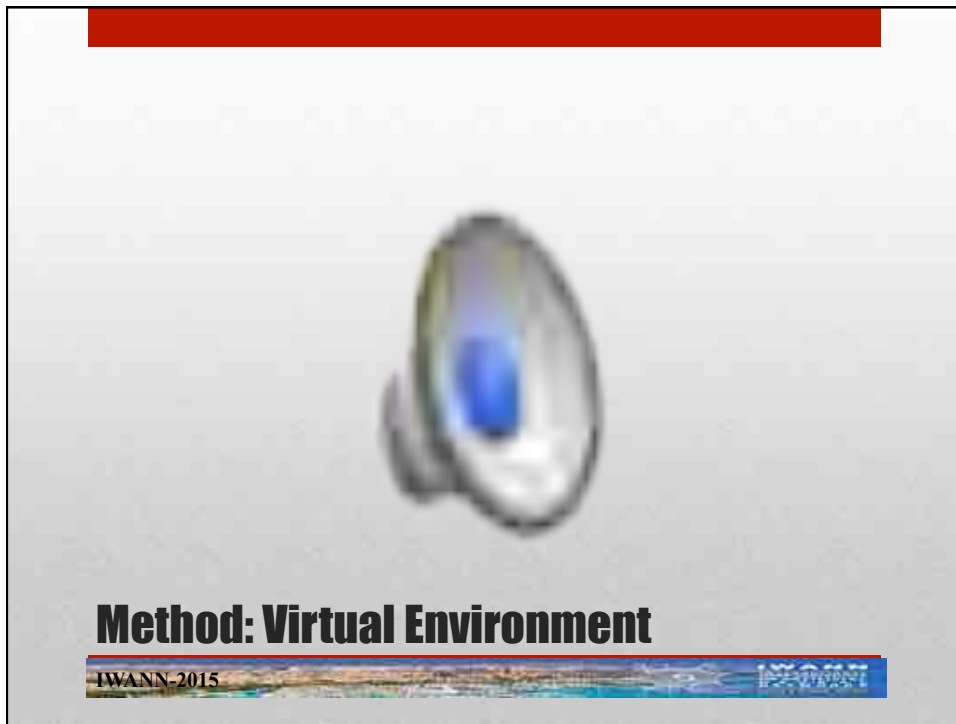
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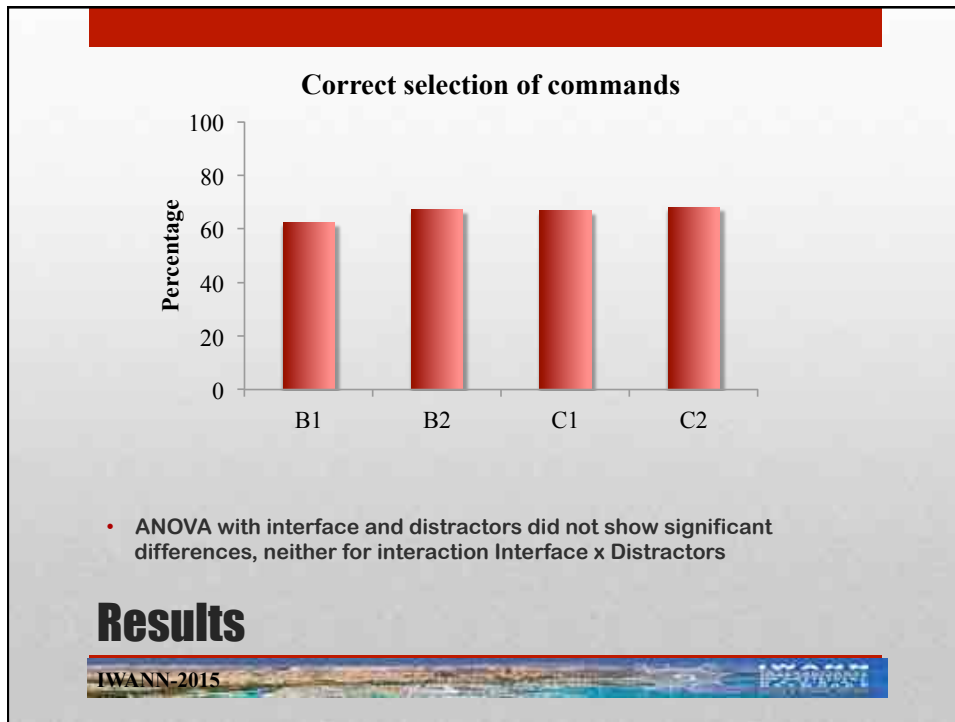
- Virtual Environment with distracting stimuli while navigation and commands
 - *Skater and boxes falling*
 - *Rain*
 - *Wind*
 - *Person reading*
 - *Little boy playing*
 - *Dog*
 - *Snow falling*



Method: Virtual Environment

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

Conclusions


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- 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

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Conclusions

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Training in realistic virtual environments with BCI

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

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