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# Does embodied L2 verb learning affect retention and representation? A VR-EEG study



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## INTRODUCTION

Gesture : observing and performing gestures leads to better vocabulary integration (Kelly, McDevitt & Esch, 2009; Tellier, 2008)

Links between language and sensorimotor structures develop through associative learning (Pulvermuller 2005)

Truly embodied learning involves “self-performed” or “self-generated” action, as opposed to observing or imagining (James and Bose, 2011; James and Swain, 2011; Johnson-Glenberg, 2017, 2018; Johnson-Glenberg and Megowan-Romanowicz, 2017)

Few studies have focused on the neural correlates of learning lexical items in association with motor actions (Macedonia, Muller and Friederici, 2011)

VR experimental paradigms are immersive; the environments provide participants with 3-D visual and auditory stimuli, fully engaging the sensorimotor system (Bohi et al, 2011)

How does performing specific gestures congruent to the new linguistic content in a highly immersive, multimodal, interactive 3D virtual reality (VR) environment enhance fast mapping compared to simply pointing?

Does “embodied learning” using naturalistic physical action, create linguistic representations that produce greater motor resonance?

## METHODS

### LEARNING

40 participants (20 women, age: 20-29)

2 Conditions : Specific action and Pointing (20 participants per condition)

#### 12 auditory verbs

gurni *push*  
zagrebi *scratch*  
pusti *drop*  
baci *throw*  
okreni *pivot*  
premesi *move*  
protresi *shake*  
kucni *tap*  
uhvati *catch*  
podigni *lift*  
lupi *hit*  
obori *tip over*

#### 12 videos of actions



### ACTION



1. Audio presentation of verb
  2. Video of verb action
  3. Participant repeats auditory verb
  4. Participant performs action / points to the object
- 2 consecutive days of learning  
6 repetitions per verb, per day

## EEG Pre and Post Training

### 1. Match-Mismatch

72 trials (36 match and 36 mismatch)  
video -> audio file -> response

Analysis time-locked to the onset of the auditory verb  
Language-related (N400) and motor-related (MP) Erps

### 2. Passive Listening

72 trials (36 target verbs and 36 fillers)

Analysis time-locked to the onset of the auditory verb  
Time-frequency to measure event-related desynchronisation (ERD) in the  $\mu$  (8-13Hz) and beta (20-30Hz) bands

### Behavioral Pre and Post Test

Translation task  
(Serbian → French)

## HYPOTHESES

We expect words learned in the Specific action condition to produce greater motor resonance post-training than those learned in the Pointing only condition, due to a stronger sensorimotor trace

We expect to find an N400 effect for Mismatch versus Match pairs for both conditions, but that it will be stronger for words learned in the Specific action condition due to a richer representation of the learned words

We predict that behavioral learning outcomes to be better for words learned in the Specific action condition

This would provide evidence in favor of theories of embodied cognition and could have important consequences for L2 learning literature