Effects of Valence and Arousal on Working Memory Performance in Virtual Reality Gaming

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Emotions & Cognition

- **Affective states** change our attention and memory.
Motivation
The study

Same memory load in every level

Working Memory (WM) capacity: Operation Span Task
The game: Memory Break
Results: Participants

30 participants (15 male - 15 female).

Mean age: 26.43

**Liked** the game:

- VR: 100%
- Desk: 90%

Interaction **difficult to control**:

- VR: 27%
- Desk: 87%
Results: Questionnaires

In which interaction mode did you feel most...?
Results: Questionnaires

Difficulty levels

Desktop

VR
Results: Affective States

Desktop Vs VR

AROUSAL

F=12.73 p<0.01

VALENCE

F=19.70 p<0.01
Results: Working Memory

Working Memory (WM) performance

Between difficulty levels

Desktop

F=0.52 p=0.67

VR

F=2.20 p=0.09
## Results: Working Memory

### Correlations

<table>
<thead>
<tr>
<th>WM &amp; Immersion</th>
<th>WM &amp; Valence</th>
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<tbody>
<tr>
<td>Rho = 0.13, p = 0.08</td>
<td>Rho = 0.19, p &lt; 0.01</td>
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</table>

- **VR**
  - Rho = 0.21, p < 0.05

- **Desktop**
  - No correlation
Results: Low vs High WM

2 groups: 13 subjects in Low, 17 in High. (based on the AOSSPAN score.)

- **Low WM** group (<0.83) improved their WM performance in **VR**, specially in Level 2

- **High WM** (>0.83) did **not** significantly improved their WM performance.
Results: Low vs High WM

WM performance

![Diagram showing WM performance for Low and High WM in Desktop and VR environments.](image)
Results: Low WM group

**WM performance**

**Arousal & Valence**

Low WM
Results: High WM group

**WM performance**

![Bar charts showing WM performance for Desktop and VR environments across different levels.](image)

**Arousal & Valence**

![Box plots showing arousal and valence levels for Desktop and VR environments across different levels.](image)
Conclusions

1. Higher **immersion** and **arousal** in **VR**

2. **VR** had a significant **effect** on **WM performance**

3. People with **Low WM** capacity can **benefit more** of **VR affective gaming** for cognitive training than those with **High WM**
THANK YOU!