Dimensionality affects memory for events in immersive virtual reality

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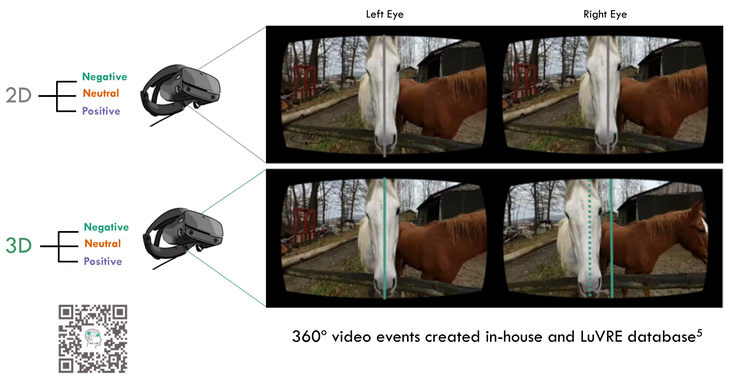
Introduction

- 3D, real-life objects are more memorable than 2D images[1]
- Virtual Reality allows us to manipulate properties of the real-world, such as dimensionality[2]
- 3D experiences are more immersive and linked to an increased sense of presence[3,4]
- More immersive experiences lead to better memory performance[3,4]

Does dimensionality affect how real-world experiences are remembered?

Methods

Immersive Stimuli: 360° videos of real-world events



360° video events created in-house and LuVRE database[5]

1. Encoding of Immersive Real-World Events

Study 1: immediate test
72 360° videos

Study 2: immediate & 24-hr delayed test
48 360° videos

2. Memory Retrieval Cued by Screenshots

Subjective ratings[6]
Emotional Intensity, Emotional Valence, Vividness

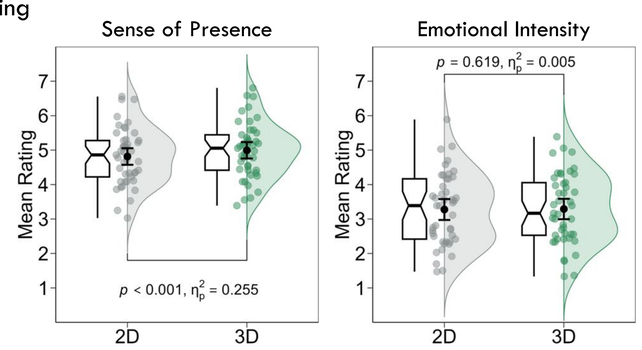
Composite Scene Score

1. **Self-location:** *I can identify* ***where I am*** *in relation to the things I am remembering*
2. **Setting:** ***I experience a scene*** *in which the elements of the setting are located relative to each other in space*
3. **Event Layout:** *I can describe* ***where the actions, objects and/or people are located*** *in the memory*

Study 1: n = 48 (30 women, Mean Age = 20.80 years, SD = 2.74)
Study 2: n = 48 (35 women, Mean Age = 19.32 years, SD = 1.85)

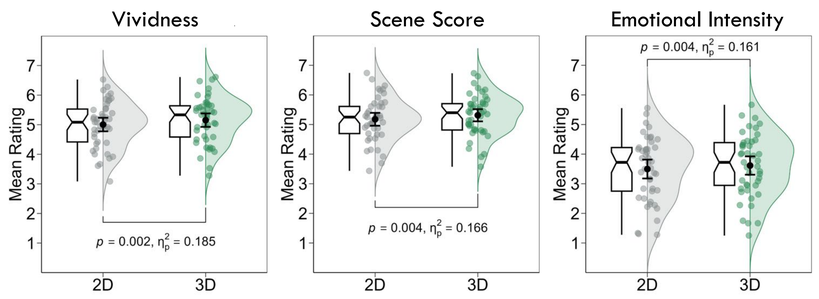
Results: Study 1

Encoding



Higher sense of presence for 3D compared to 2D experiences
No significant differences in dimensionality for emotional intensity

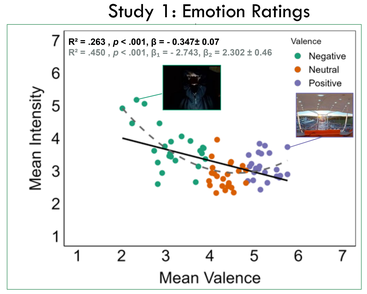
Retrieval



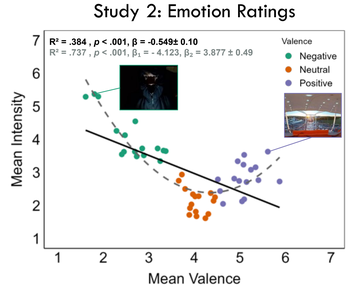
Higher vividness, scene-related memory, and emotional intensity for 3D compared to 2D experiences

Emotionality of 360° Videos

Study 1: Emotion Ratings

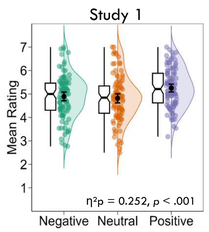


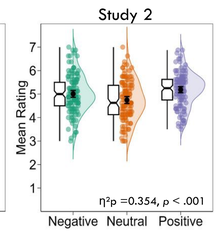
Study 2: Emotion Ratings



Videos with positive or negative content were experienced with greater emotional intensity

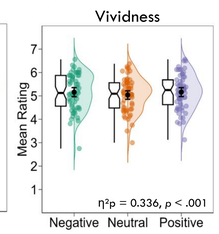
Sense of Presence



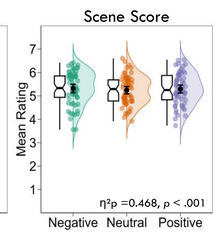


Higher sense of presence for positive than negative or neutral videos

Study 2



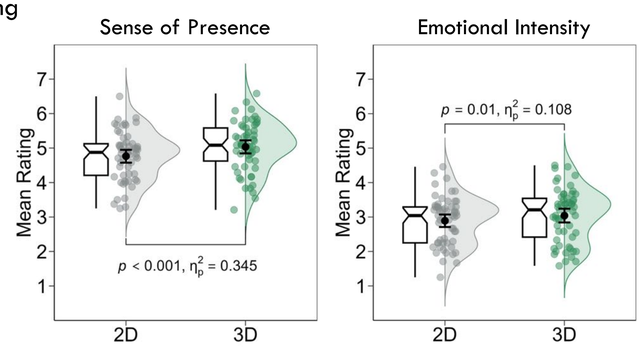
Higher vividness for positive videos



Higher scene score for positive videos

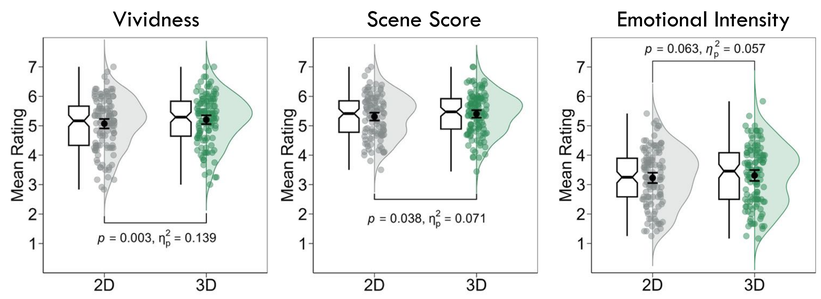
Results: Study 2

Encoding



Higher sense of presence and emotional intensity for 3D compared to 2D experiences

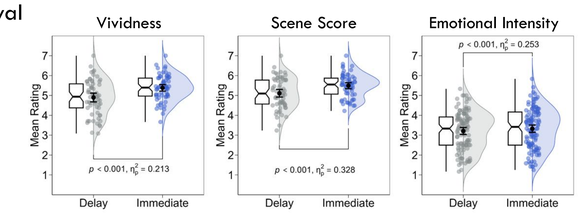
Retrieval



Higher vividness, scene-related memory, and emotional intensity for 3D compared to 2D

Effects of Retention Interval

Memory was better when tested immediately than following a 24-hr delay



Conclusions

- 3D-360° events were more immersive than 2D events [3,4]
- Memories for 3D-360° events were associated with higher vividness, emotional intensity, and better scene-based aspects of memory
- The effect of dimensionality on memory was consistent over time
- These findings indicate the potential of immersive VR for investigating key properties of real-world memories
- An fMRI study in progress will examine how dimensionality affects the neural mechanisms of memory encoding

References

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2. Slater M. (2018). *BJP*, 109(3), 431–433.
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6. Rubin, Deffler, & Umanath. (2019). *Cognition*. 183, 44-56.

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