

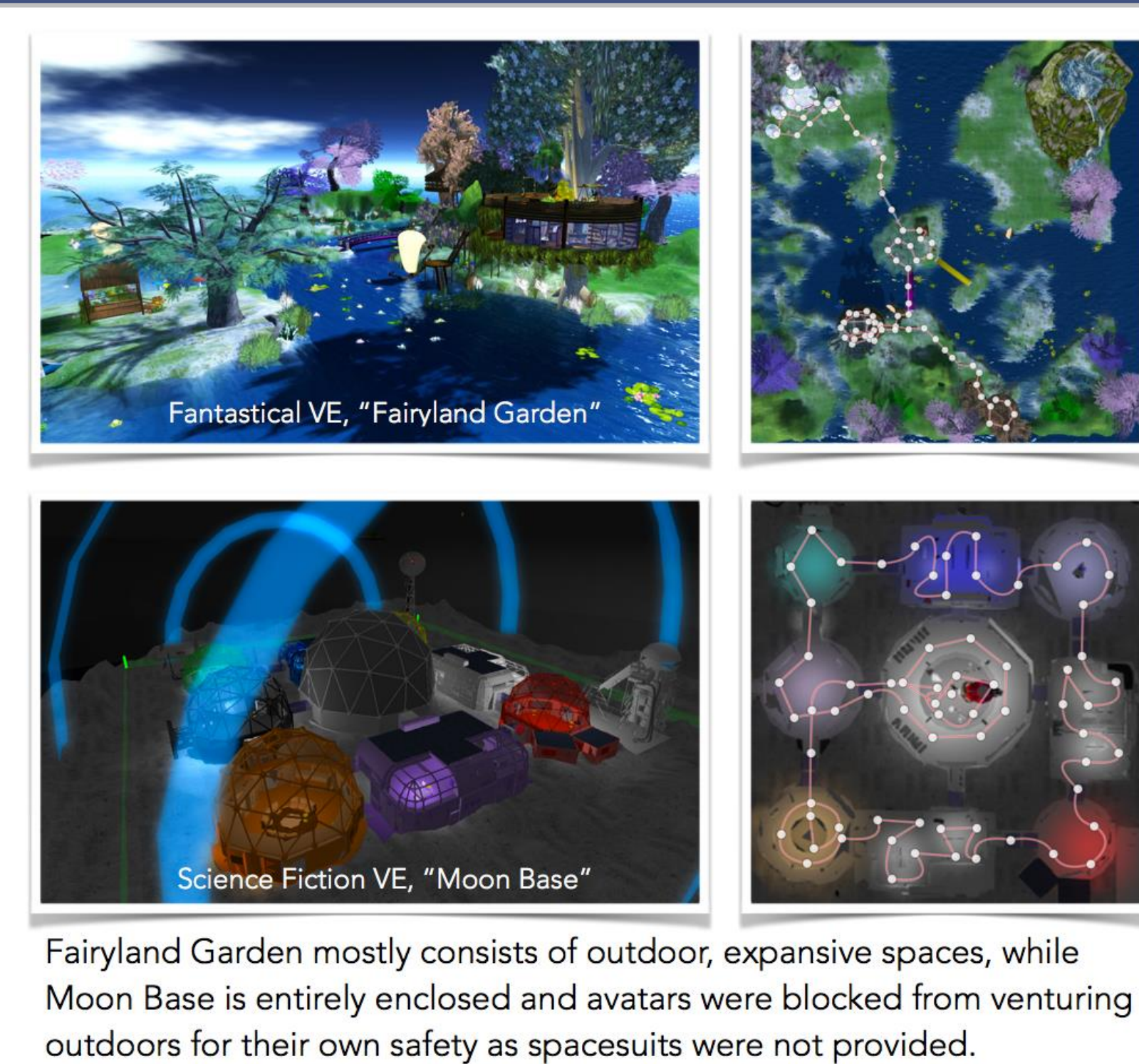
Introduction

- As virtual reality becomes increasingly utilized as a pedagogical tool, it will be valuable to determine what factors impact the likelihood that information learned in a virtual environment (VE) will later be accessible in real world contexts.
- While considerable resources have been devoted to making VEs more immersive, it is unclear how immersion and presence affect learning outcomes.
 - *Immersion*: the sense of oneself being within a VE.
 - *Presence*: the sense of oneself "being" one's avatar.
- Some studies reported that increased presence/immersion resulted in better recall (e.g., Lin, Duh, Parker, Abi-Rached, & Furness, 2002; Mania & Chalmers, 2001), while others reported the opposite (e.g., Bailey et al., 2012).
- Most of these studies examined visuospatial memory, testing recall of visual details about the VE itself. Since both memory and presence/immersion measures were based on the VE, it was difficult to disentangle the relationship between the two.
- The present experiment studied the effects of presence/immersion on verbal memory, thereby isolating the memory task from the VE upon which presence/immersion measures were based.

Participants

- Participants were 12 right-handed UCLA undergraduates.
- All were monolingual native English speakers, and reported no extensive VE experience nor previous exposure to the languages.

Figure 1. Custom VEs



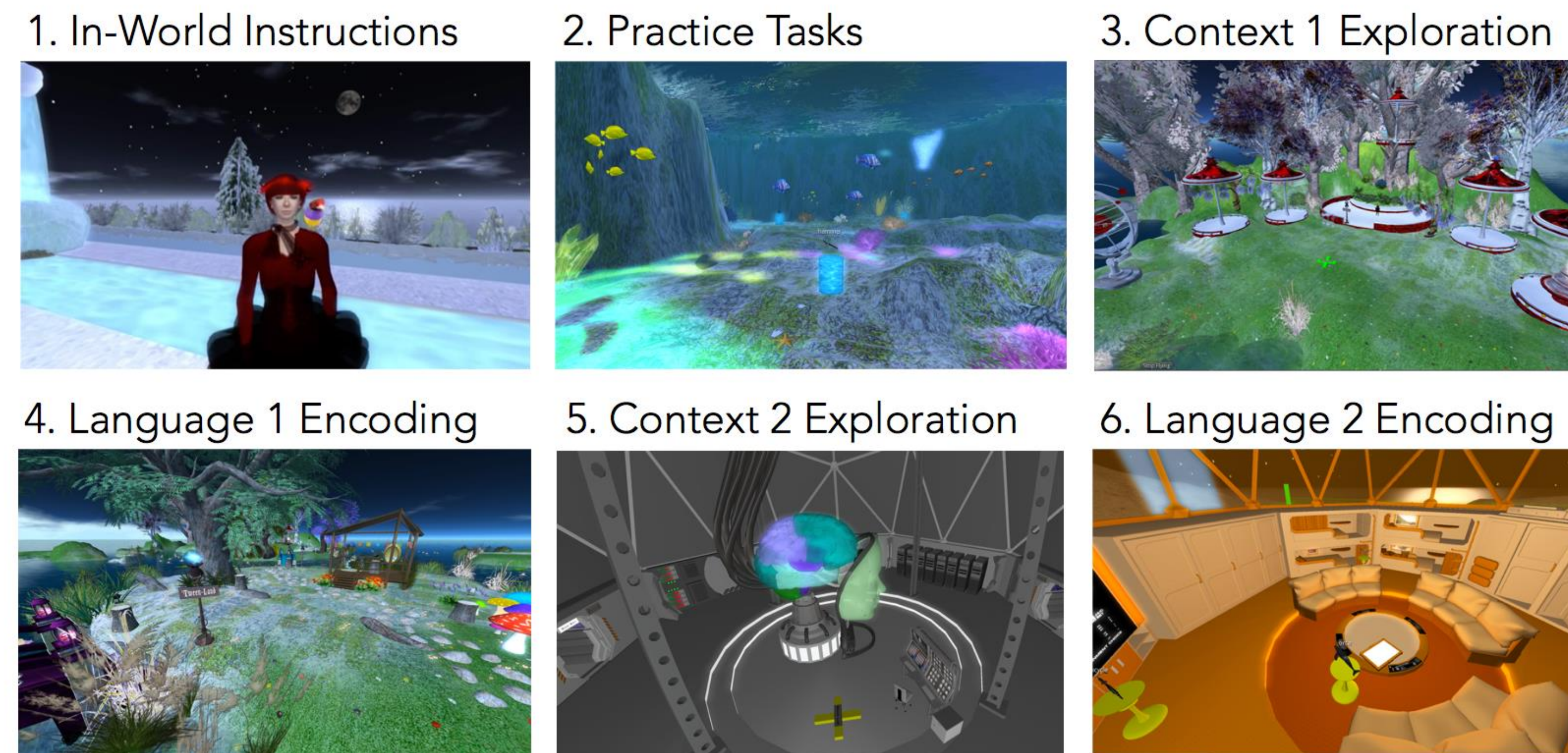
Procedure Overview

Figure 2. Experimental Design

Virtual Environment Learning

Day 1: Encoding 1-3 interleaved with Tests 1-2

Day 2: Test 3, Encoding 4



Language Task

50 English words studied with foreign translations (10 in Swahili only, 10 in Chinyanja only, and 30 in both languages).

Encoding 1: click on object to hear foreign word, speak it back each time (repeat 3x).
Encoding 2-4: attempt to recall the foreign word (T1-3) before additional encoding.



Real-World Testing

End of Day 2: Test 4



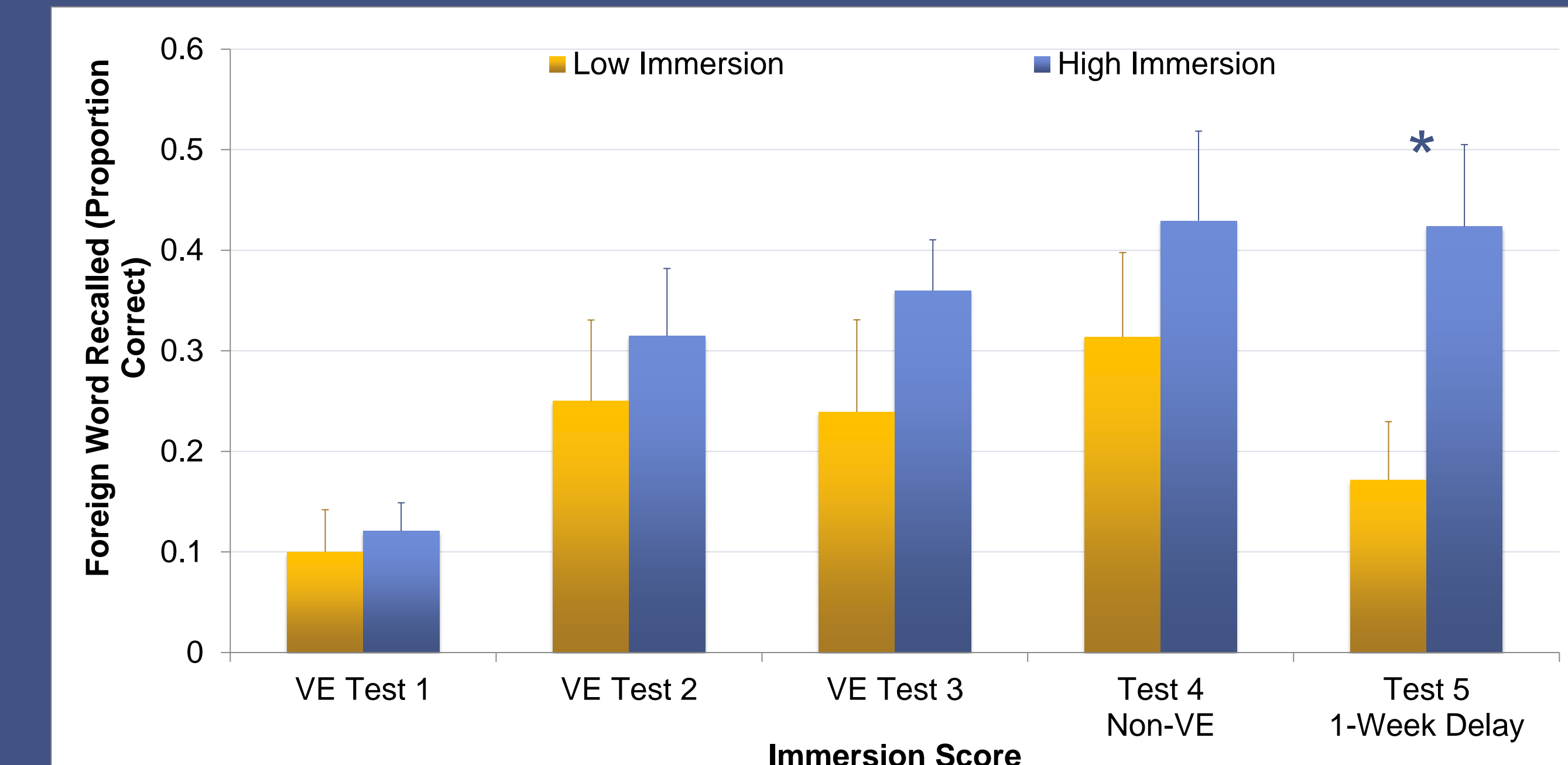
Day 8: Test 5



- On Day 1 and Day 2, participants learned 40 Swahili and 40 Chinyanja words in four encoding sessions in two richly featured VEs, one VE for each language (Figure 1).
- Memory was tested within the VE (cued by English translations of the foreign words) during each study-test cycle, outside the VE at the end of Day 2, and again by phone on Day 8 (Figure 2).
- Participants explored each VE before the first encoding-testing session, for each language, to build VR immersion.
- Presence score was measured using the Fox, Bailenson, and Binney (2009) survey, and immersion was measured with the Witmer and Singer (1998) instrument.
- Memory scores: Verbal recalls were recorded and then scored offline by two different scorers, and averaged when scorers disagreed. Recall was counted as correct when both pronunciation and the order of the syllables were correct.

Results

Figure 3. Immersion and Recall



An independent samples *t*-test revealed that individuals who reported higher levels of immersion showed significantly greater recall on Day 8, as compared to those who reported low immersion. No significant differences were found between high and low presence groups.

Immersion (Test 5)

- High immersion: $M=.42, SD=.18$
- Low immersion: $M=.17, SD=.15$
- $t(10)=2.597, p=.027$

Presence (Test 5)

- High Presence: $M=.27, SD=.01$
- Low Presence: $M=.28, SD=.23$
- $t(10)=-0.56, p=.957$

Conclusions

- These results demonstrate that increased immersion during VE learning might facilitate long-term retention. This suggests that the sense of oneself actually being within the VE is a contributing factor to learning and memory within the VE.
- The lack of a presence effect is not conclusive, as only two participants reported high presence. This may be due to the fact that participants used a first-person viewpoint in the experiment and thus had minimal exposure to their avatar.
- We are currently collecting more data to further investigate this phenomenon.

Acknowledgements

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