Gameplay in Mixed Reality: How It Differs from Mobile Gameplay

Weerachet Sinlapanuntakul, William J. Shelstad, Jessyca L. Derby, & Barbara S. Chaparro
Department of Human Factors and Behavioral Neurobiology

Introduction

What is Mixed Reality?
- Mixed Reality (MR) expands a user's physical environment by overlaying the real-world with interactive virtual elements
- Magic Leap 1 is an MR wearable spatial computer that brings the physical and digital worlds together (Figure 1).

Figure 1. Magic Leap 1

Mixed Reality Gameplay
- Compared to Virtual Reality and Augmented Reality, MR video games are new and have not been deeply investigated.
- Angry Birds game was used for comparison between mobile (Figure 4) and MR (Figure 5) versions.

What is the GUESS-18?
- GUESS-18 is a shorter version of GUESS, which is used to assess nine dimensions measuring video game satisfaction.
- The Social Connectivity dimension was eliminated in this study due to the nature of the game being single player.

Current Study
This study investigates the impact of mixed reality on video game satisfaction, enjoyment, and performance when compared to its mobile version.

Method

Participants
16 participants (9 male, 7 female); ages 18-24 (M = 20.5, SD = 1.51)
- 75% reported prior experience playing Angry Birds
- 56.3% reported prior experience with virtual reality (VR)
- 12.5% reported prior experience with augmented reality (AR)

Procedure
1. Participants were randomly assigned to which device to complete first.
2. Participants were asked to complete a tutorial of the game.
3. Participants then spent 20 minutes playing the Angry Birds game starting from level 1 on a given device.
4. Once the time was over, they completed the survey, including:
   - **GUESS-18** (what aspects of a game contribute to satisfaction).
   - **ENJOY** (the enjoyment while playing the game).
   - **SSQ** (any symptoms of simulator sickness a person is feeling, completed only when the device given was the Magic Leap).
5. After completing the first device, they would complete the other type of display device with the exact same tasks.
6. Participants also gave any comments and thoughts about the overall experience with the gameplay on each of the device.

Results

Game User Experience Satisfaction Scale (GUESS-18)
The overall satisfaction scores (out of 56) indicated a statistically significance between:
- Magic Leap (M = 42.31, SD = 5.61) and mobile device (M = 38.31, SD = 5.49)
- With α = 0.05, Magic Leap was rated with higher satisfaction, $t(15)$ = 3.09, p = 0.007.
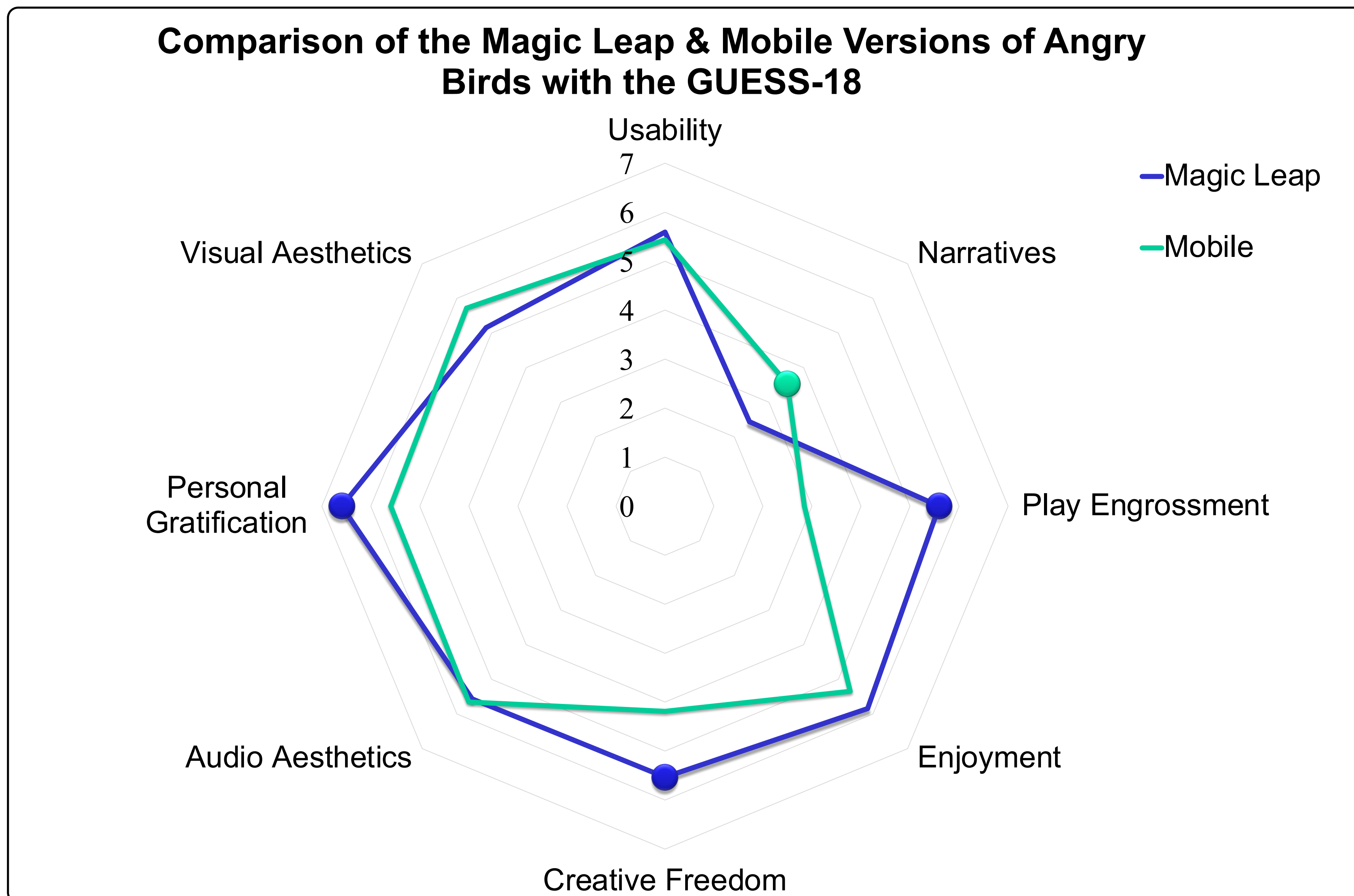- A comparison of GUESS-18 subscales is shown below (Figure 2).

Figure 2. Comparison of GUESS subscales scores of the MR and mobile versions of Angry Birds (7 = strongly agree, 1 = strongly disagree). A highlighted point for a subscale indicates significant difference between devices.

Enjoyment Scale (ENJOY)
The overall results (out of 28) were not statistically significant, $t(15)$ = 1.10, p = 0.29:
- Magic Leap (M = 20.81, SD = 2.85) and mobile device (M = 19.6, SD = 3.46)
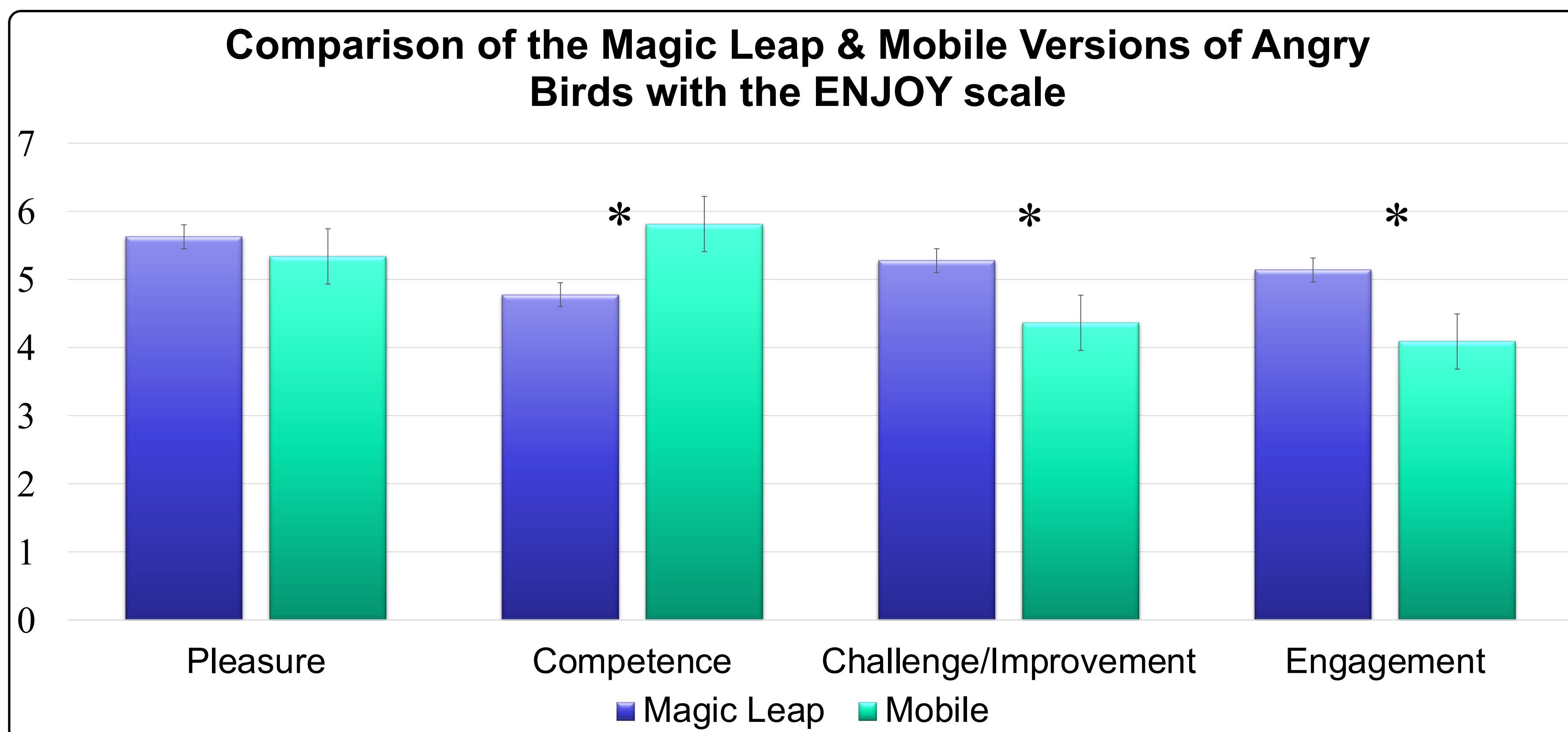- A comparison of ENJOY subscales is shown below (Figure 3).

Figure 3. Comparison of ENJOY subscales scores of the MR and mobile versions of Angry Birds (7 = strongly agree, 1 = strongly disagree). An asterisk (*) for a subscale indicates a significant difference between devices.

Results (continued)

Simulator Sickness Questionnaire (SSQ)
In this study, the 20-minute use of Magic Leap is resulted with concerning symptoms (M = 16.83, SD = 15.51):
- Nausea is considered minimal (M = 9.54, SD = 12.07)
- Oculomotor is considered concerning (M = 17.53, SD = 16.31)
- Disorientation is considered concerning (M = 16.53, SD = 17.02)

Total scores can be associated with negligible (< 5), minimal (5 – 10), significant (10 – 15), concerning (15 – 20), and bad (> 20) symptoms.

User Performance
The stars (out of 3) collected from each level played represented a statistically significant difference in performance outcomes:
- Magic Leap (M = 2.49, SD = 0.30)
- Mobile device (M = 2.93, SD = 0.09)
- Mobile version showed better performances, $t(15)$ = 6.03, p < 0.001
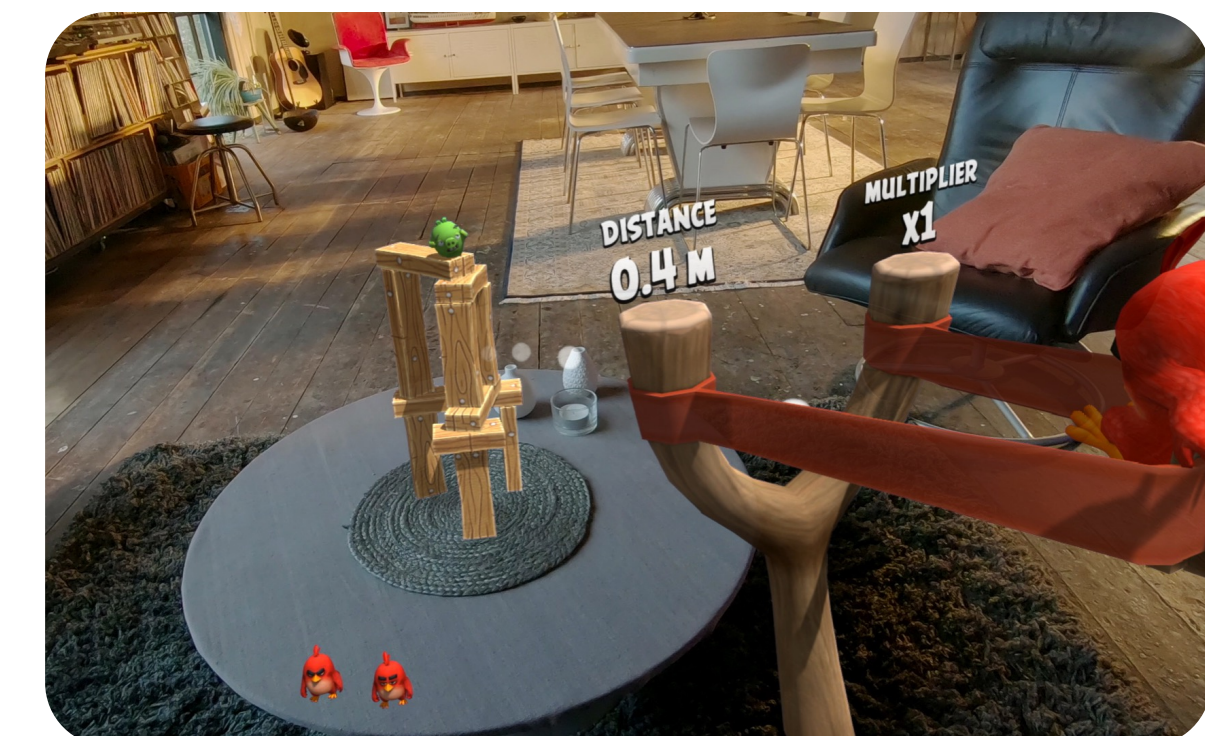

Figure 4. Angry Birds on mobile

Figure 5. Angry Birds on Magic Leap

Discussion

- Overall, participants were more satisfied with Angry Birds on the mixed reality device than the mobile version.
- The lack of differences across GUESS subscales (Visual, Audio, Enjoyment, and Usability) could be due to the gameplay's nature.
- Performance outcomes had no relationship to user satisfaction.
- Some participants had difficulty concentrating and experienced headache and eye strain after using the Magic Leap for 20 minutes.

Future Research
- Future research should examine if social interactions between players would influence satisfaction and enjoyment.
- Other video game genres should be investigated further.
- Researchers should also investigate whether other MR headsets, such as the HoloLens 2, would provide similar results.

References

- Bimberg, P., Weissker, T., & Kulik, A. (2020, March). On the usage of the simulator sickness questionnaire for virtual reality research. In *2020 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops* (pp. 464-467).
- Davidson, S. (2018). *A multi-dimensional model of enjoyment: Development and validation of an enjoyment scale (ENJOY)* (Publication No. 381) [Doctoral dissertation, Embry-Riddle Aeronautical University]. Scholarly Commons.
- Keebler, J. R., Shelstad, W. J., Smith, D. C., Chaparro, B. S., & Phan, M. H. (2020). Validation of the GUESS-18: A short version of the game user experience satisfaction scale (GUESS). *Journal of Usability Studies*, 16(1), 49-62.
- Kennedy, R. S., Lane, N. E., Berbaum, K. S., & Lilienthal, M. G. (1993). Simulator sickness questionnaire: An enhanced method for quantifying simulator sickness. *The International Journal of Aviation Psychology*, 3(3), 203-220.
- Phan, M. H., Keebler, J. R., & Chaparro, B. S. (2016). The development and validation of the game user experience satisfaction scale (GUESS). *Human Factors*, 58(8), 1217-1247.
- Shelstad, W. J., Smith, D. C., & Chaparro, B. S. (2017, September). Gaming on the rift: How virtual reality affects game user satisfaction. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 61, No. 1, pp. 2072-2076). Sage CA: Los Angeles, CA: SAGE Publications.