

Abstract

Perceived **Affordances** - judgements of action capabilities - are an effective way to determine if users' experiences in virtual reality (VR) settings are similar to real-world perception. Abundant research has been conducted on the step over affordance with adult participants, yet limited data has been used to explore affordances in children, whom are generally less compatible with current VR devices due to their smaller interpupillary distance and head size. Therefore, this study aims to study step over affordances of children under conditions where the participants are with/without an avatar and the object to be stepped over is dangerous/non dangerous,. By asking the participants to adjust the height of the obstacle being stepped over and carrying out the action of stepping over, we expect to see affordance judgement ratios similar to reality for the non dangerous obstacle and with avatar conditions, and more careful judgement ratios for the dangerous obstacle and no avatar conditions.

Method

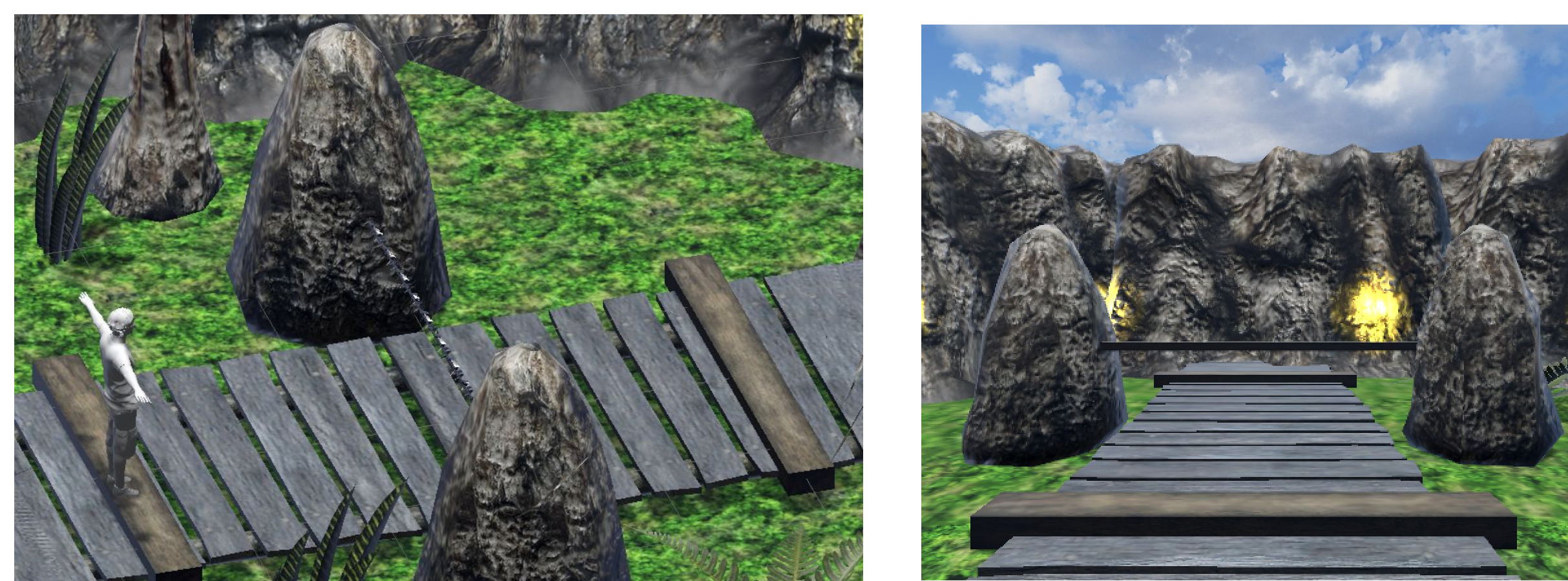


Fig 1, 2. Experiment Environment

The Pretest measured the initial step over affordance judgements of participants in virtual reality. Participants were asked to adjust the height for the hovering obstacle to a position where they predict they could just step over with an upright posture and without stretching their body. There were 2 trials for each condition



Fig 3, 4, 5. Non dangerous (Wooden Bar) and Dangerous (Rotating Blade) Obstacles; Avatar Condition

	No Avatar	Avatar
Non Dangerous	Condition 1	Condition 3
Dangerous	Condition 2	Condition 4

Fig 6. Matrix for Non dangerous/dangerous and No Avatar/Avatar conditions

Method (Continued)

The Calibration Phase tested how participants responded to affordance judgements when they were able to physically experience the step over action. Participants were asked to carry out the step over action after making affordance judgements. There were 4 trials for each condition

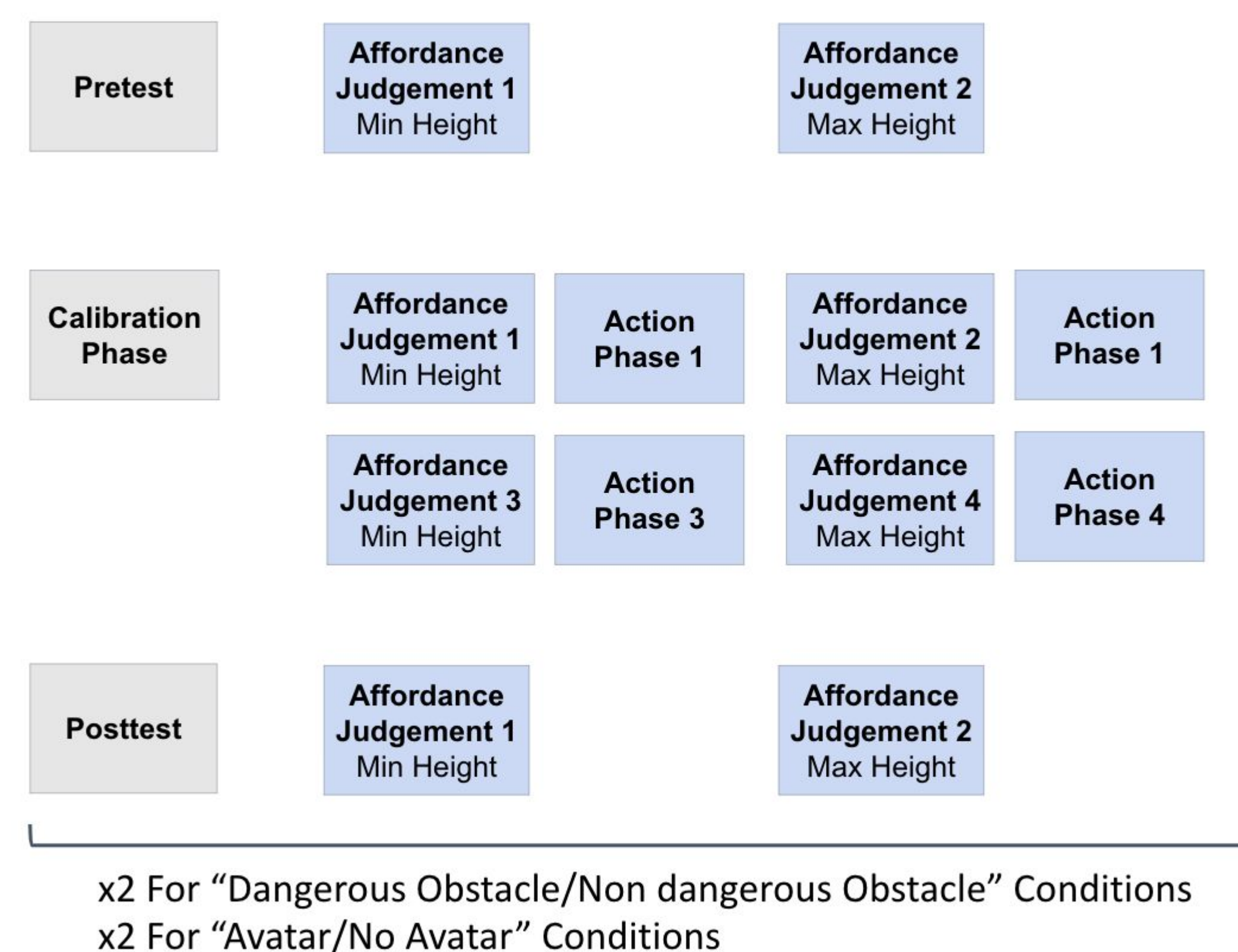


Fig 7. Procedure overview

The Posttest replicated the procedures of the pretest to measure how taking actions during the calibration phase possibly influenced the affordance judgements of the participants. There were 2 trials for each condition.

Pilot Results

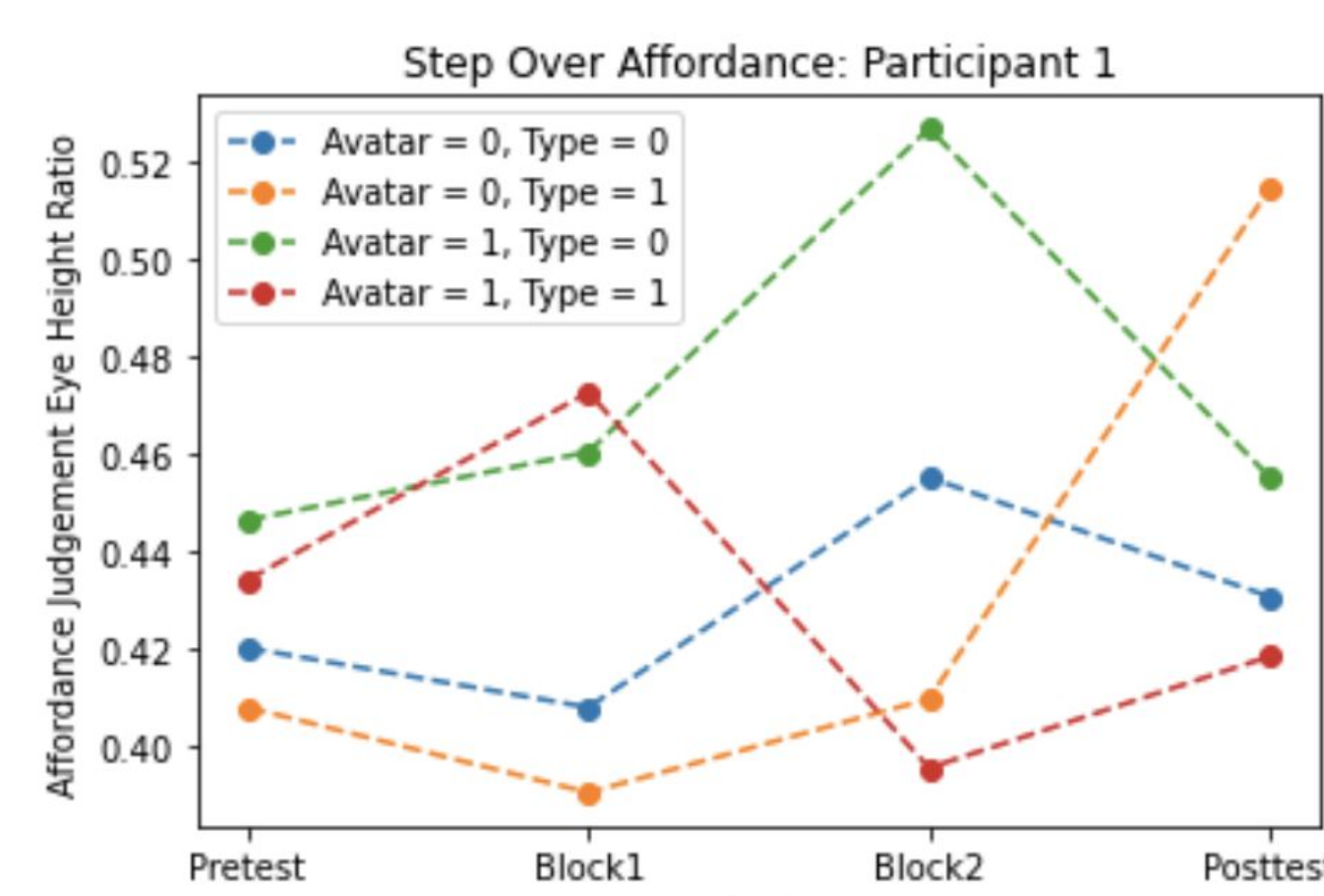


Fig 8. Step Over Affordance Judgements for Participant 1

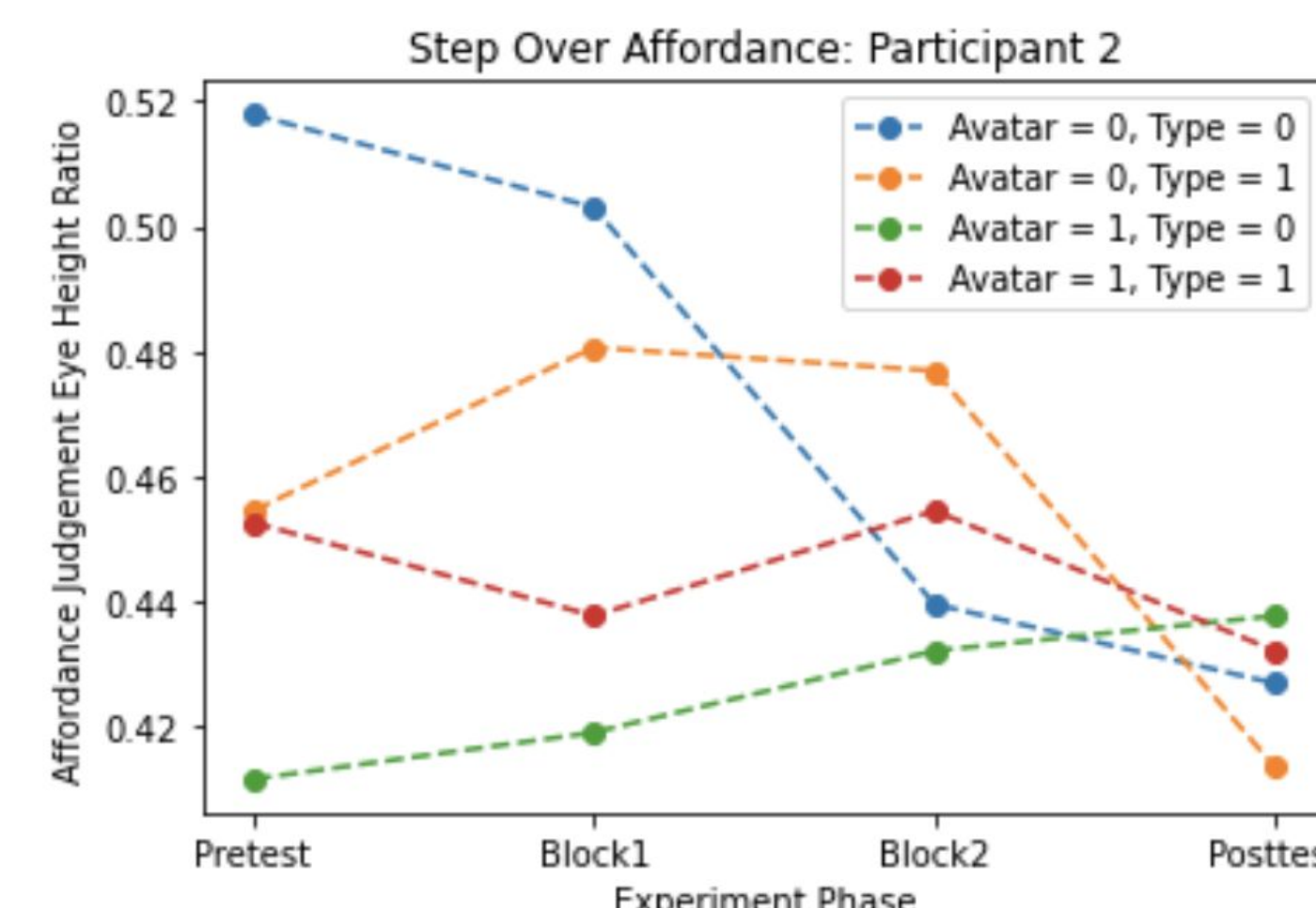


Fig 9. Step Over Affordance Judgements for Participant 2

The experiment was piloted with two 11-year-old female participants with eye heights of 1.45m and 1.43m respectively. Results were collected, averaged, plotted, and analyzed as above. While there is no significant generalizable trend for each participant, we can preliminary state that the two blocks in the calibration phase did have an effect on the affordance judgements of the participants, which resulted in an overall upshifting affordance eye height ratio or a converging affordance ratio.

Acknowledgements

This work was supported by the National Science Foundation under grant number 1763966

Pilot Results (Continued)

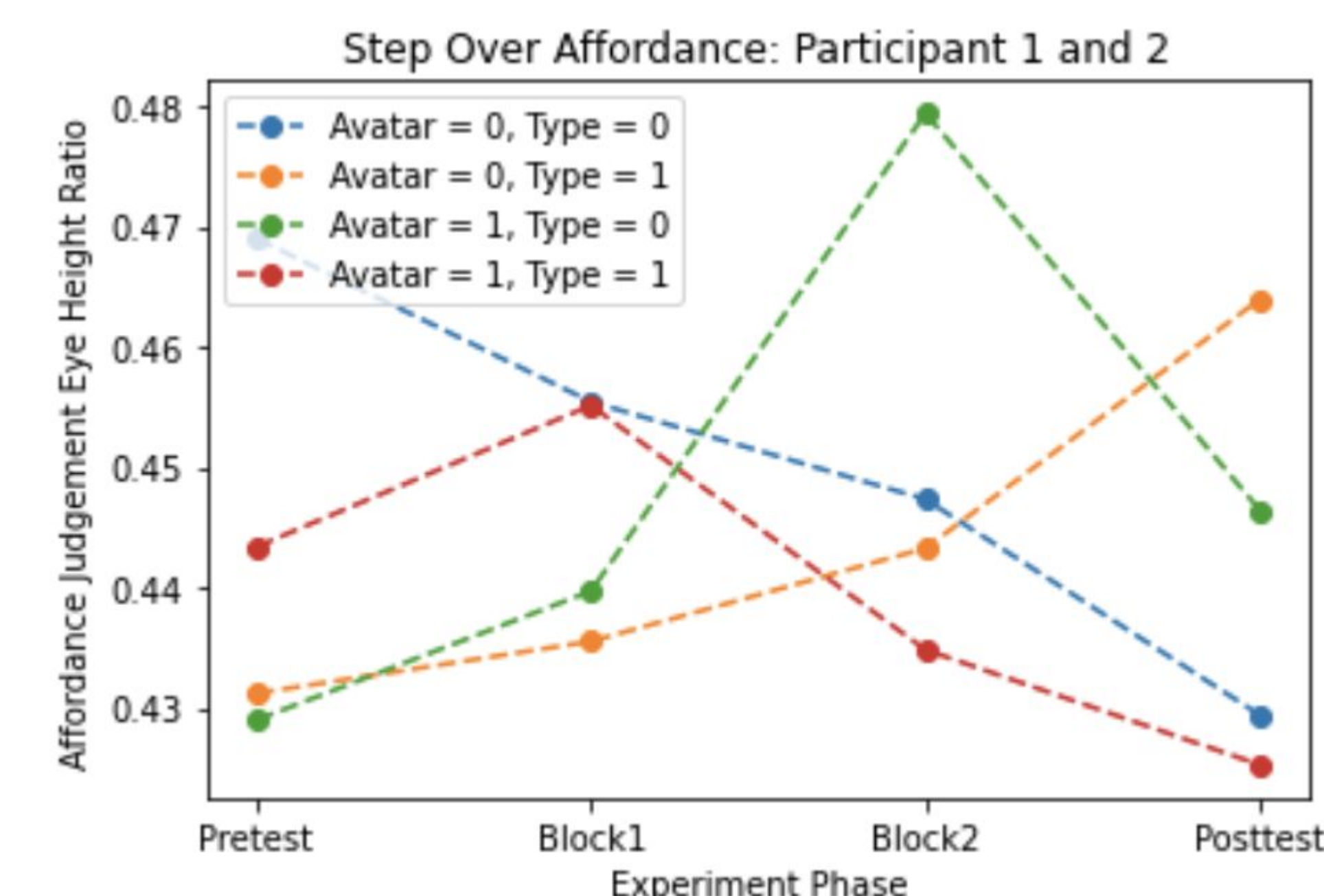


Fig 10. Step Over Affordance Judgements for Participants 1 and 2

Average results of the two participants similarly showed that no general trend is extractable from the pilot results. The average affordance judgements for each participant at all phases are lower than the baseline step over height of 0.52 of eye height. The dangerous obstacle conditions (red and orange lines) seem to have overall lower affordance judgement eye height ratios in each phase compared to the non dangerous conditions. The effect of the avatar is undeterminable.

Discussion and Conclusion

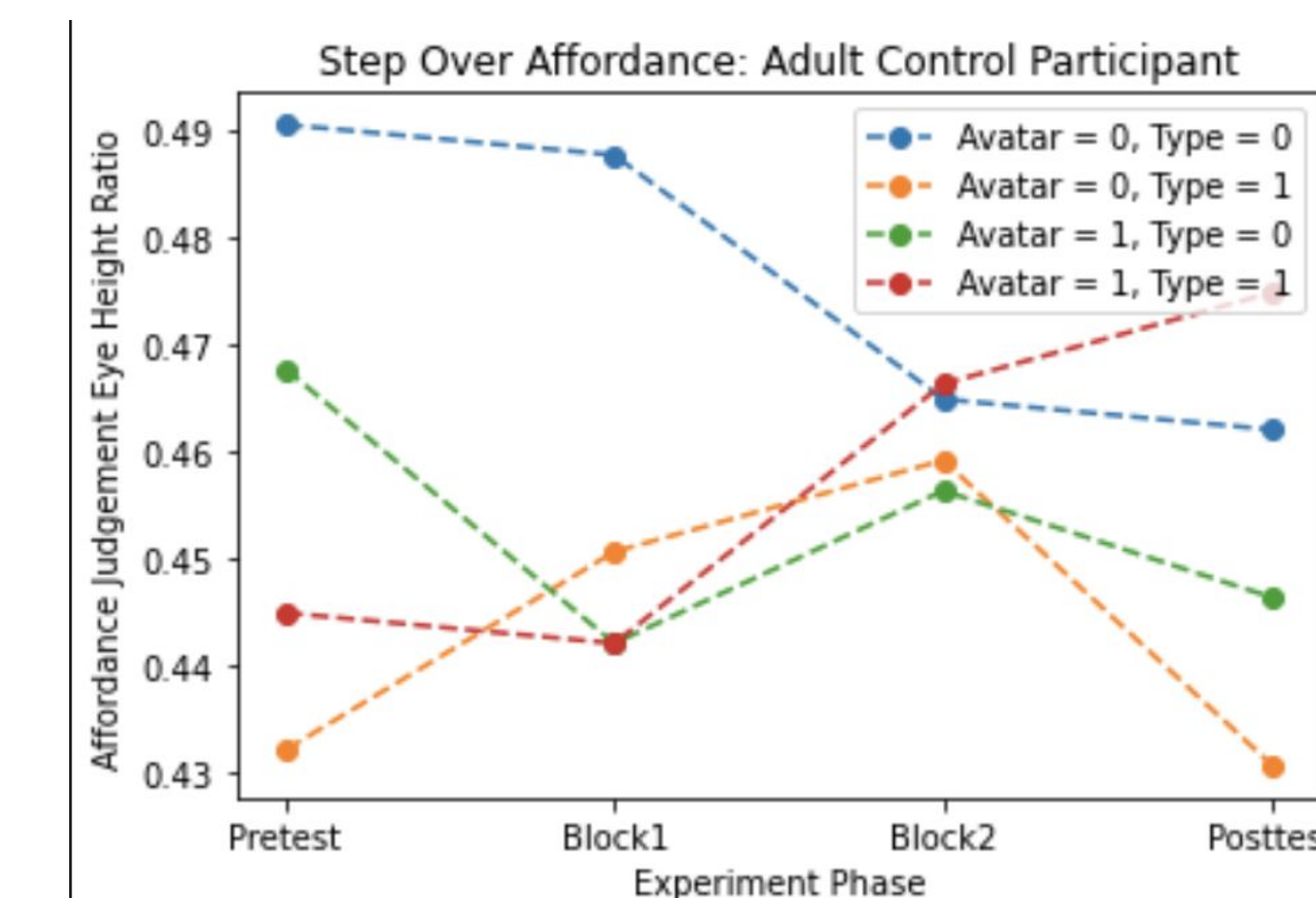


Fig 11. Step Over Affordance Judgements for Adult Control Participant

An adult participant was invited to pilot the experiment to serve as a control. The trend for the affordance judgements at each experimental phase remains unclear. Effects of avatar and obstacle type are also undeterminable. More data with standard error measurement analysis is required to extrapolate valid trends.

Overall, **no conclusion regarding the change in affordance judgement trends or the effects of avatars and obstacle types can be draw from the pilot data.** More data from different children age groups and different children eye heights with be collected for further analysis.

References

- [1] Q. Lin, J. Rieser, and B. Bodenheimer, "Affordance Judgments in HMD-Based Virtual Environments: Stepping over a Pole and Stepping off a Ledge," ACM Trans. Appl. Percept., vol. 12, no. 2, pp. 1–21, Apr. 2015, doi: 10.1145/2720020.
- [2] H. C. Gagnon et al., "The Effect of Feedback on Estimates of Reaching Ability in Virtual Reality," in 2021 IEEE Virtual Reality and 3D User Interfaces (VR), Lisboa, Portugal, Mar. 2021, pp. 798–806. doi: 10.1109/VR50410.2021.00107.
- [3] H. C. Gagnon et al., "Gap Affordance Judgments in Mixed Reality: Testing the Role of Display Weight and Field of View," Front. Virtual Real., vol. 2, p. 654656, Mar. 2021, doi: 10.3389/frvir.2021.654656.