

HoloLens-based Augmented Reality Obstacle Avoidance Training Has Varying Impact on Individuals' Obstacle Avoidance Strategies

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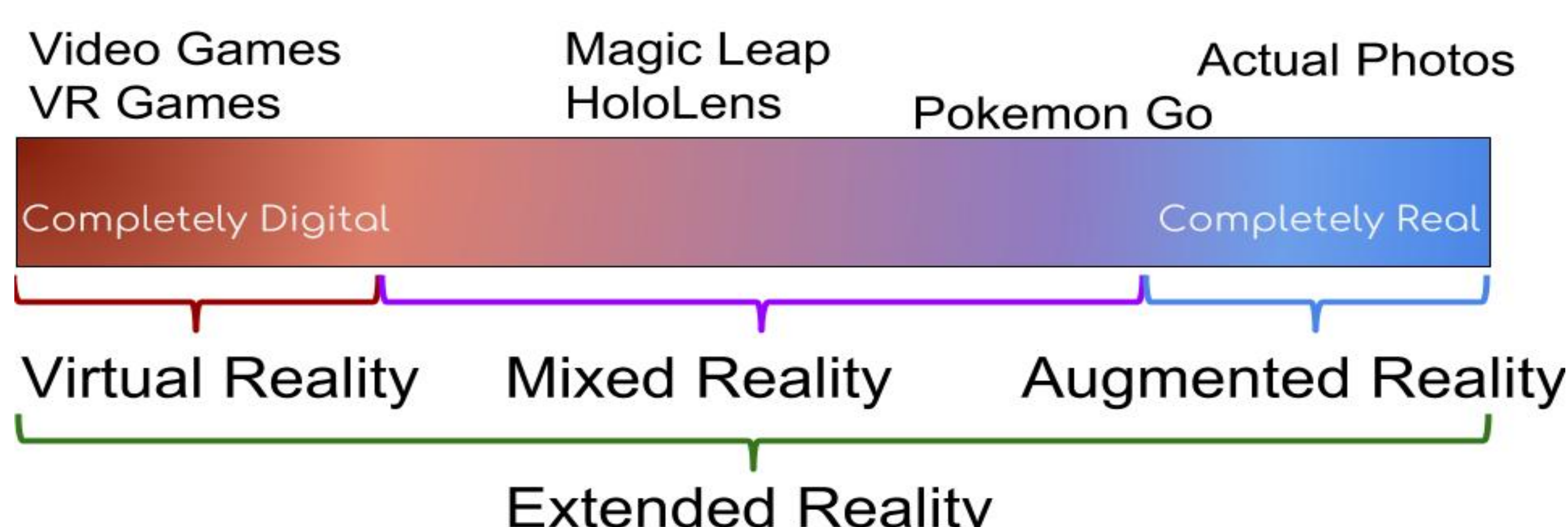


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INTRODUCTION

- Obstacle course training is widely used in the rehabilitation of people with mobility limitations. But, they are limited by resources in rehabilitation centers or laboratories, and potentially dangerous to patients.
- Augmented Reality combines virtual content and reality in a way that the two domains blend together. Users interact with and manipulate both physical and virtual items and environments.



- HoloLens, by Microsoft, is one of the most advanced hardware platforms in AR. Equipped with Spatial Mapping, HoloLens can constantly track its environment and build 3D models of the surroundings to give users an immersive experience.



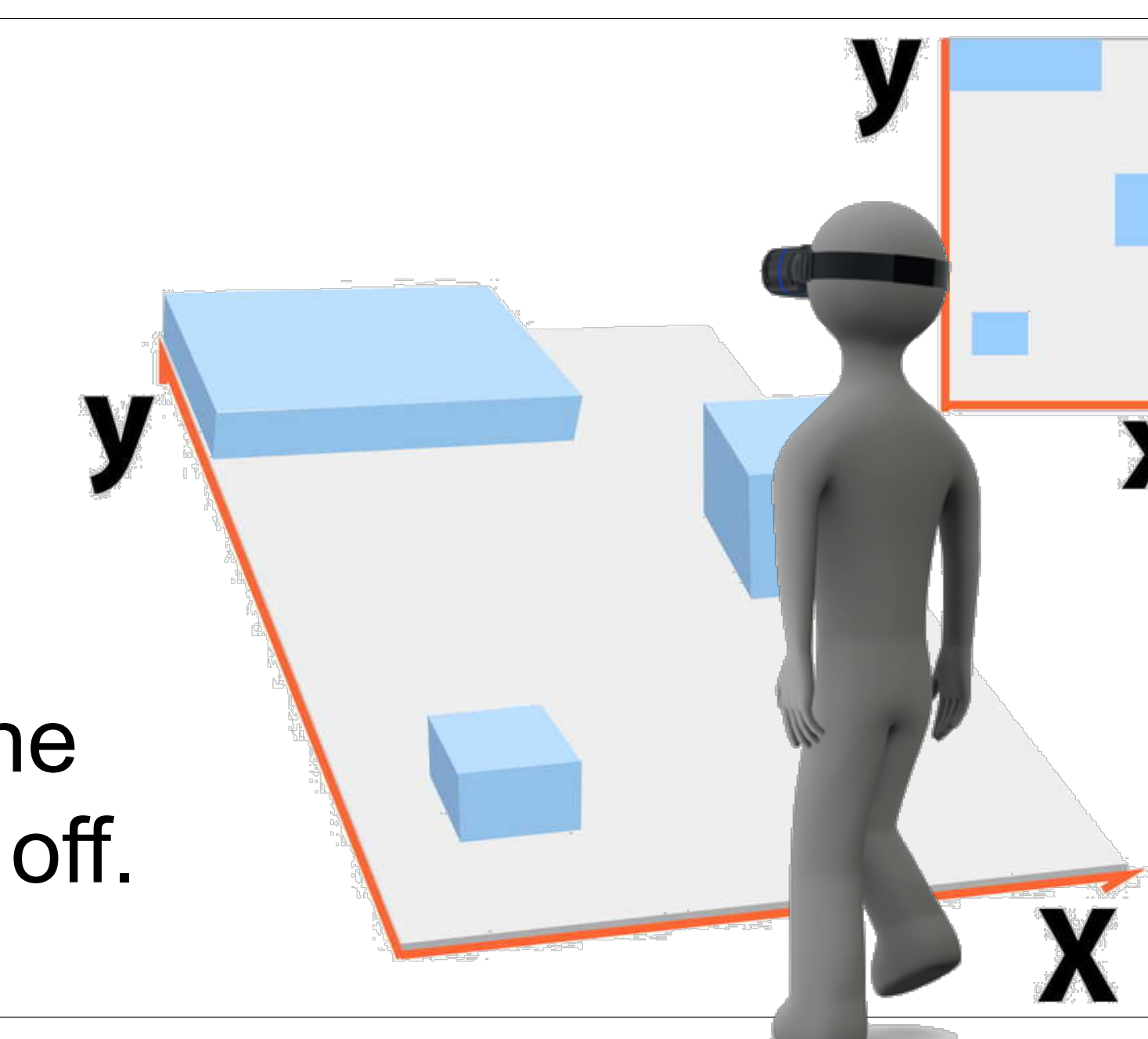
OBJECTIVE

- The purpose of this study is to evaluate immersive AR obstacle avoidance training as an alternative to physical obstacle avoidance training.
- In this study, we want to see if people behave similarly in the AR environment compared to physical environment for obstacle avoidance task.

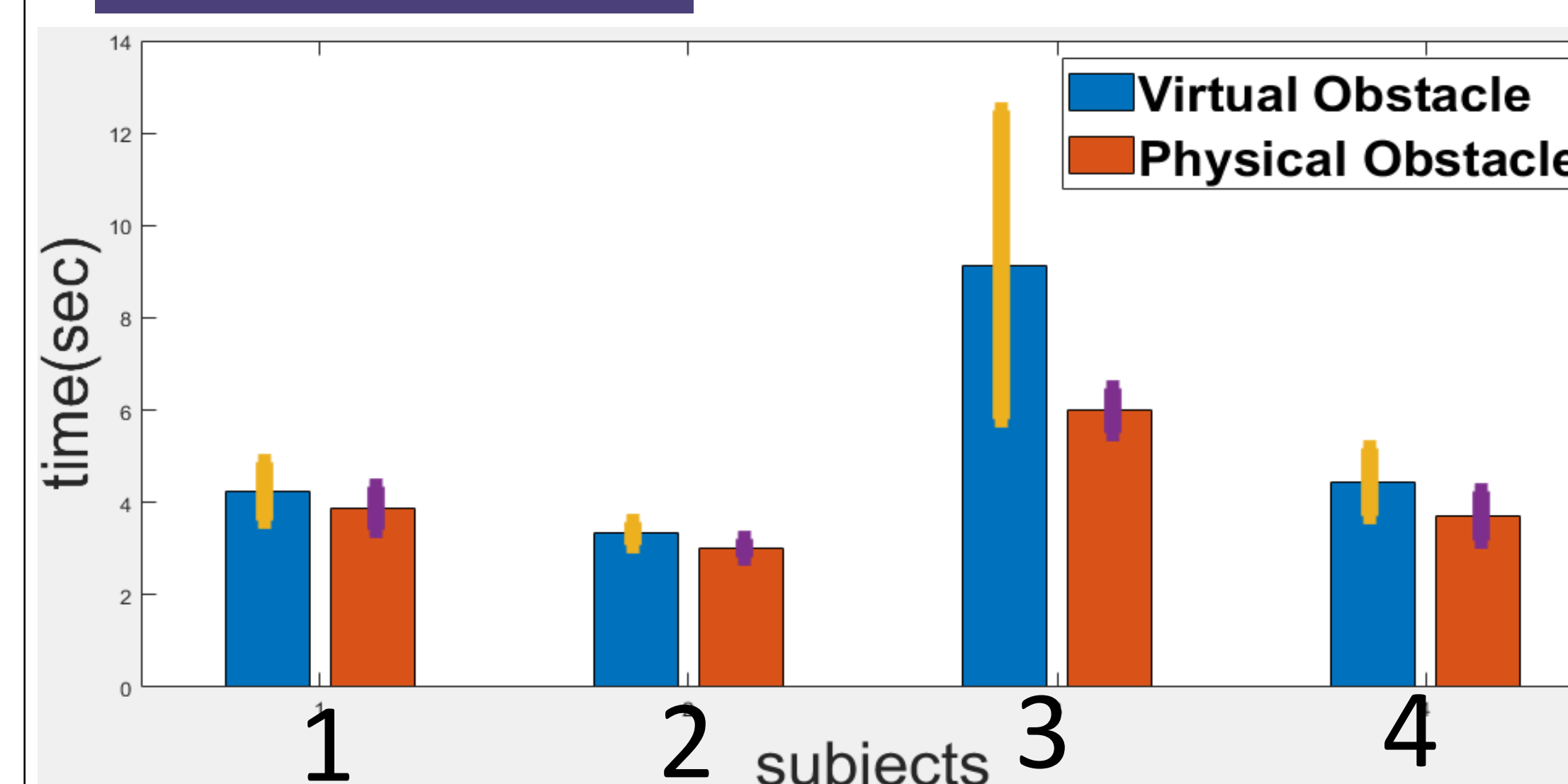
This project was partially supported by NSF #580945 and office of undergraduate research at NC state university.

METHODS

- 6 able-bodied participants were instructed to walk through AR and physical obstacle courses as quickly as possible without hitting or virtually hitting the obstacles. Both AR and physical conditions included 5 trials, and the order of users' experiences in either AR or physical obstacle courses were randomized.
- Subjects wore the HoloLens for both AR and physical test conditions to reduce the effects of wearing a headset. In the physical condition, the HoloLens was turned off.



RESULTS



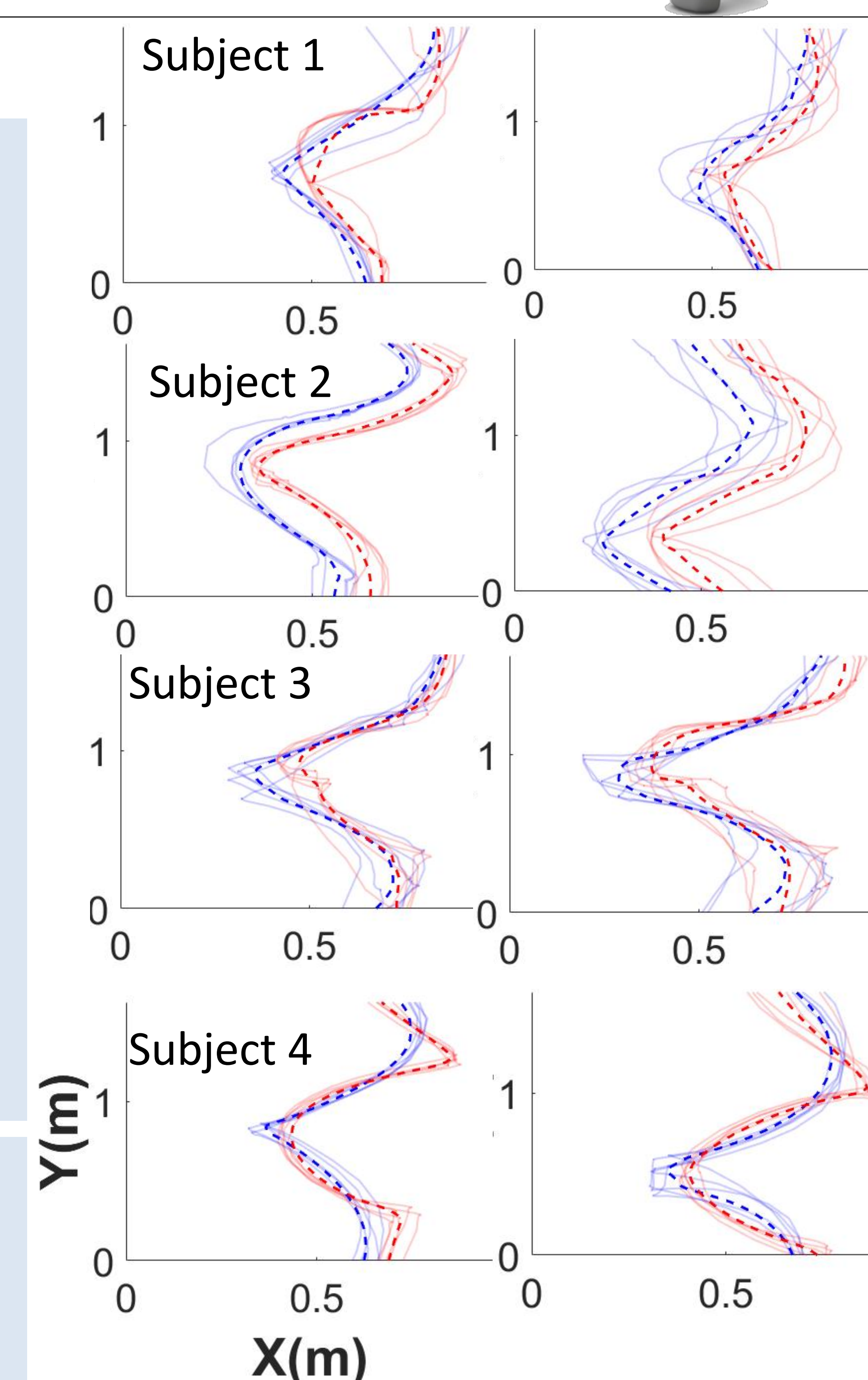
- ▲ Figure 2 Completion time mean and standard deviation for four subjects**
- The completion time of virtual obstacle trails are generally longer than the physical obstacle trails.
 - Some subjects have more variance in completion time.
 - The variance of completion time in AR trails were generally greater.

► Figure 1. Left and Right Foot Trajectories for four subjects, top-down view. Blue presents left foot, red presents right foot. First column shows the physical condition trials, second column shows the AR condition rails.

- Subjects 2 and 4 used similar strategies for obstacle avoidance across AR and physical test conditions
- Subjects 1 and 3 had differing strategies between test conditions

General Observation

- Based on completion time and foot-path trajectory data, subjects tended to walk more consistently across trials for the physical obstacle condition compared to the AR obstacle condition.



CONCLUSION

- Using a HoloLens-based AR obstacle avoidance task has varying impact on individual users' obstacle avoidance strategies.
- Individuals may adapt to AR environments differently, so individual differences should be considered when introducing AR for rehabilitation training.

FUTURE WORK

- Further research is needed to better understand how using AR during rehabilitation training could impact a user's behaviors such as balance, visual perception, and movement consistency.
- Explore other applications of AR in the rehabilitation field.