

VIRTUAL PROXEMICS: LOCOMOTION IN THE PRESENCE OF OBSTACLES IN LARGE IMMERSIVE PROJECTION ENVIRONMENTS

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[1] Sanz, Ferran Argelaguet, et al. "Virtual proxemics: Locomotion in the presence of obstacles in large immersive projection environments." 2015 IEEE Virtual Reality (VR). IEEE, 2015.

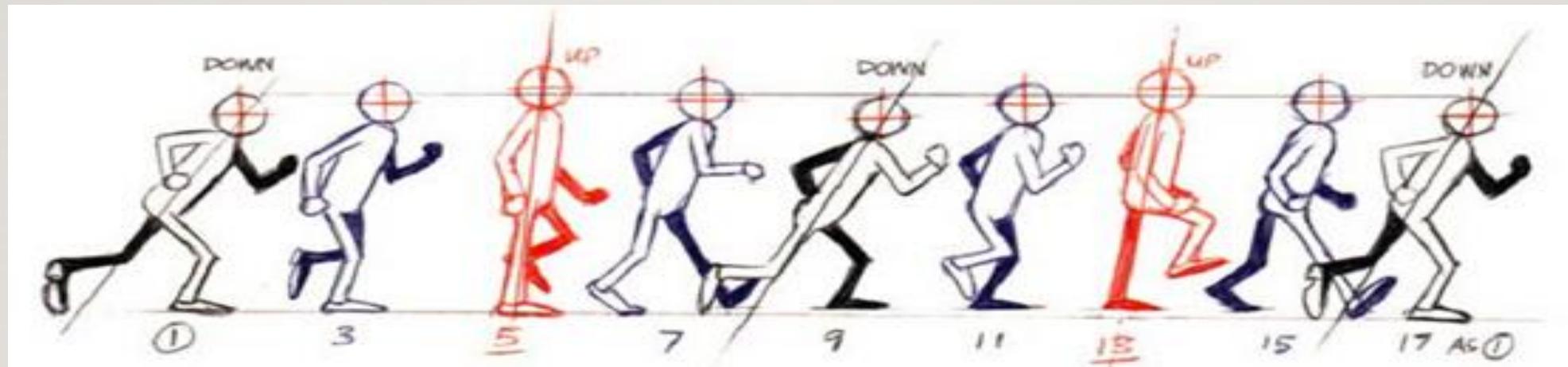
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BACKGROUND

- Research Purpose

- Investigate obstacle avoidance behavior during real walking in a large immersive projection setup.



BACKGROUND

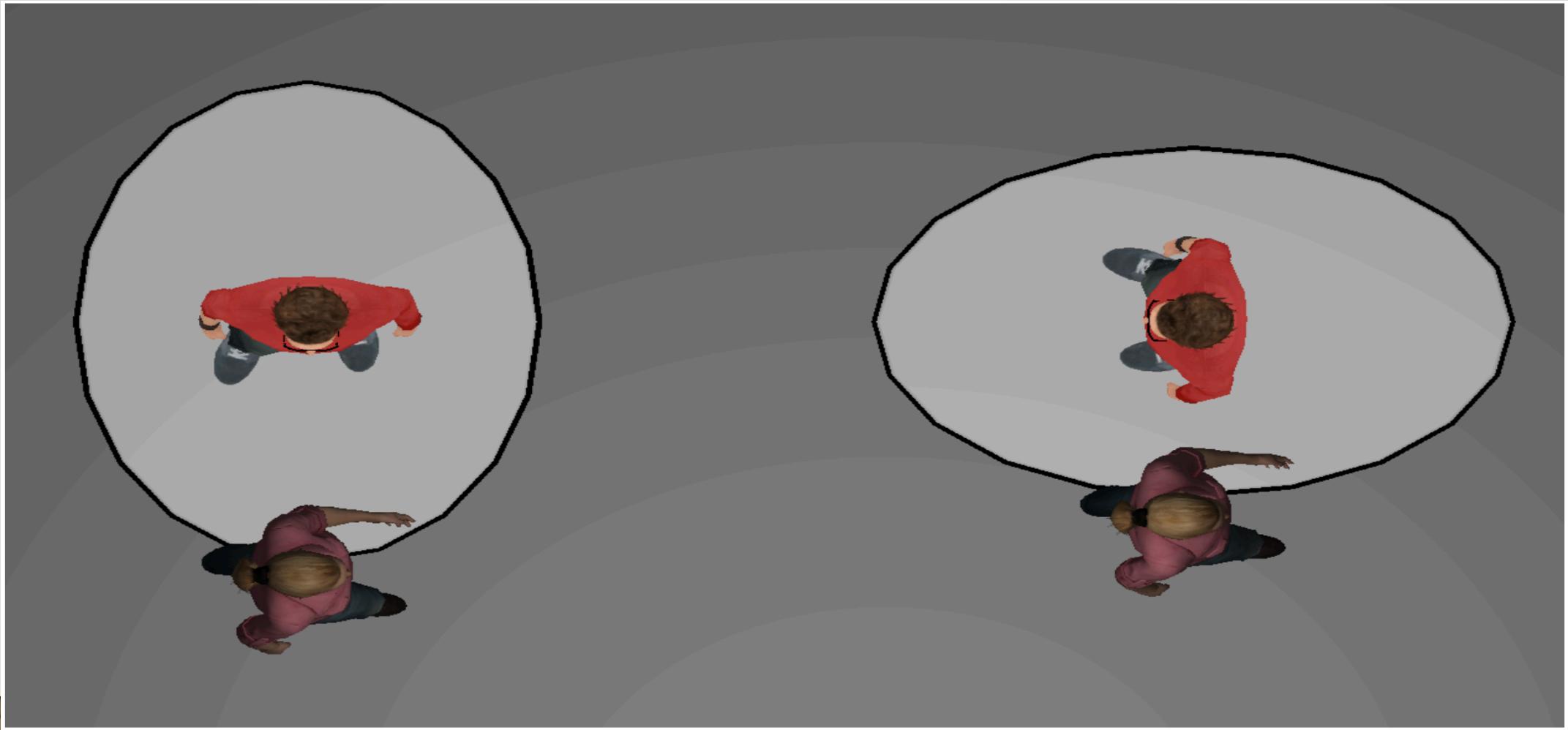
- The Gap



Different feeling and
Behaviors

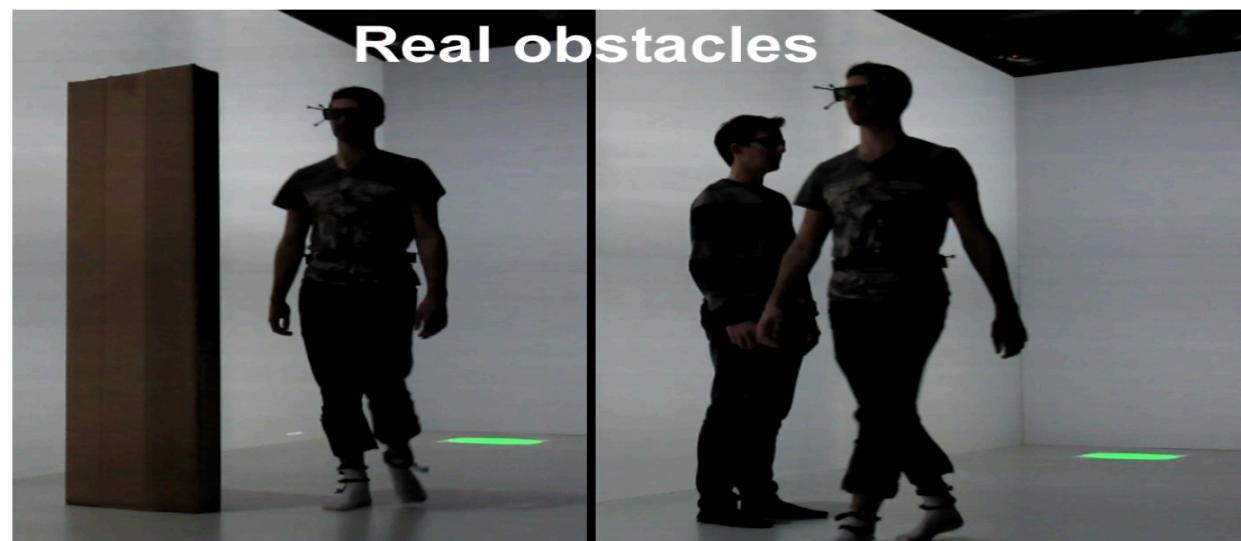
BACKGROUND

- Personal Space



BACKGROUND

- Different Personal Space in V&R World
-



Real obstacles



Virtual obstacles

PREVIOUS WORK

- Fink et al. [2]
 - Non-human obstacles only
- Gerin-Lajoie et al. [3]
 - Do experiment with a static cylinder
- Bailenson et al. [4]
 - Human and Virtual human obstacles



[2] P.W. Fink, P. S. Foo, and W. H. Warren. Obstacle avoidance during walking in real and virtual environments. *ACM Transactions on Applied Perception (TAP)*, 4(1):2, 2007.

[3] M. Gerin-Lajoie, C.L. Richards, J. Fung, and B.J. McFadyen. Characteristics of personal space during obstacle circumvention in physical and virtual environments. *Gait & posture*, 27(2):239–247, 2008.

[4] J. N. Bailenson, J. Blascovich, A. C. Beall, and J. M. Loomis. Interpersonal distance in immersive virtual environments. *Personality & social psychology bulletin*, 29(7):819–33, 2003.

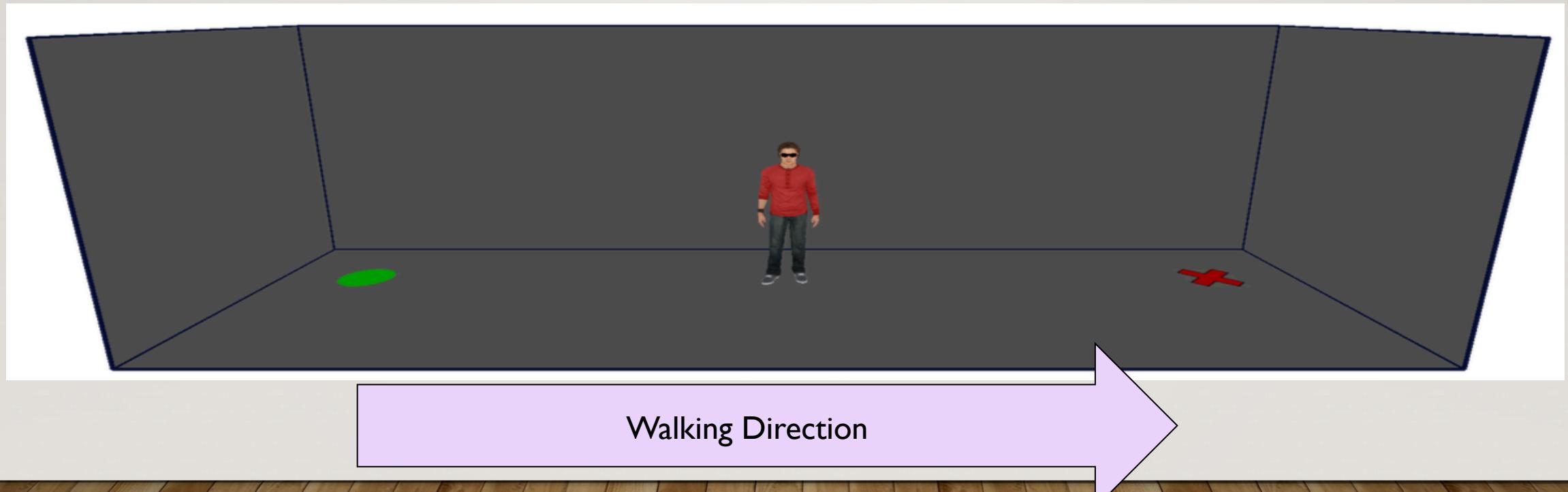
WHAT DIFFERENCE?

- Do study under large immersive virtual environments (IVEs)
- Both human and non-human obstacles are considered.
- More parameters details are set.

EXPERIMENT DESIGN

- Scene Setting

- 9.6m×3m×3.1m (width, depth and height)
- 4-sided immersive projection with 16 projectors



EXPERIMENT DESIGN

- Apparatus

- 16 Barco Galaxy Projectors at 15MPixels resolution in total.
- Shutter Glasses (Volfoni ActivEyes Pro Radiofrequency)

EXPERIMENT DESIGN

- Obstacles

- Human Obstacles
 - Human
- Non-human Obstacles
 - Cardboard Box

EXPERIMENT DESIGN

- Parameters (96 parameters = $(16+8) \times 4$ times)
 - Human Obstacle (16 setting per participants)
 - Orientation $\times 4$
 - {0, 90, 180, 270}
 - Nature $\times 2$
 - {real, virtual}
 - Direction $\times 2$
 - {left-to-right, right-to-left}
 - Cardboard Obstacle (8 setting per participants)



Speed &
Distance

EXPERIMENT DESIGN

- Parameters (96 parameters = $(16+8) \times 4$ times)

- Human Obstacle (16 setting per participants)
- Cardboard Obstacle (8 setting per participants)
 - Orientation $\times 2$
 - {0, 90}
 - Nature $\times 2$
 - {real, virtual}
 - Direction $\times 2$
 - {left-to-right, right-to-left}



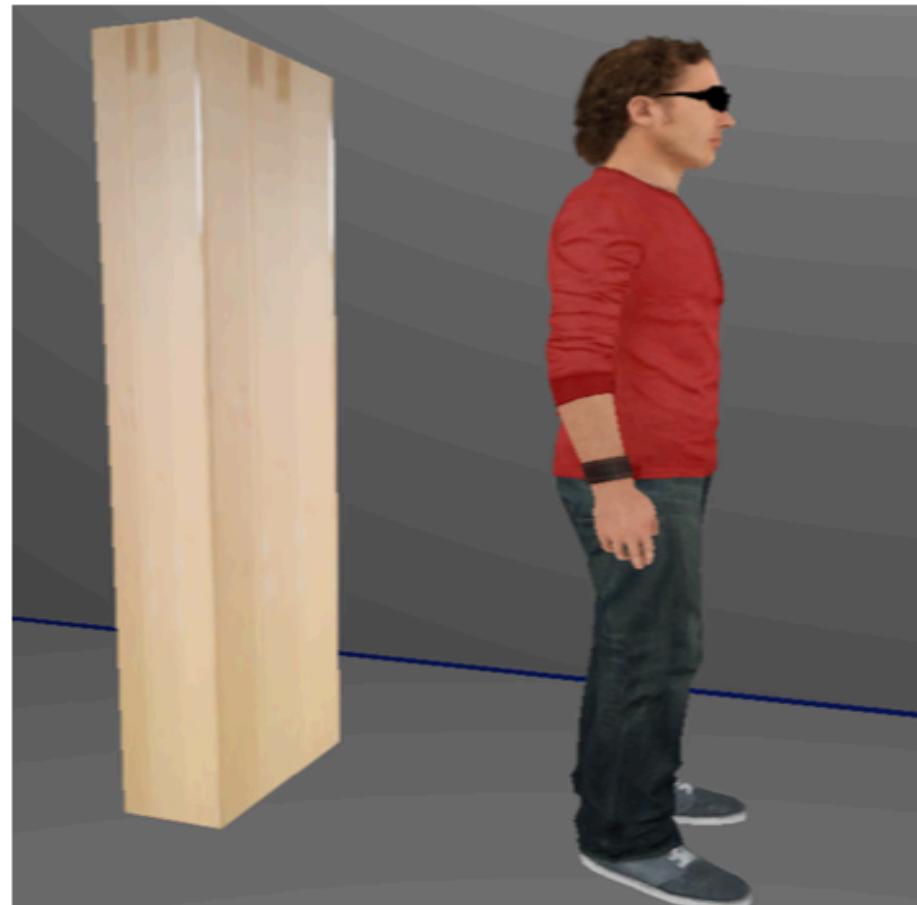
Speed &
Distance

EXPERIMENT DESIGN

- Experiment Method



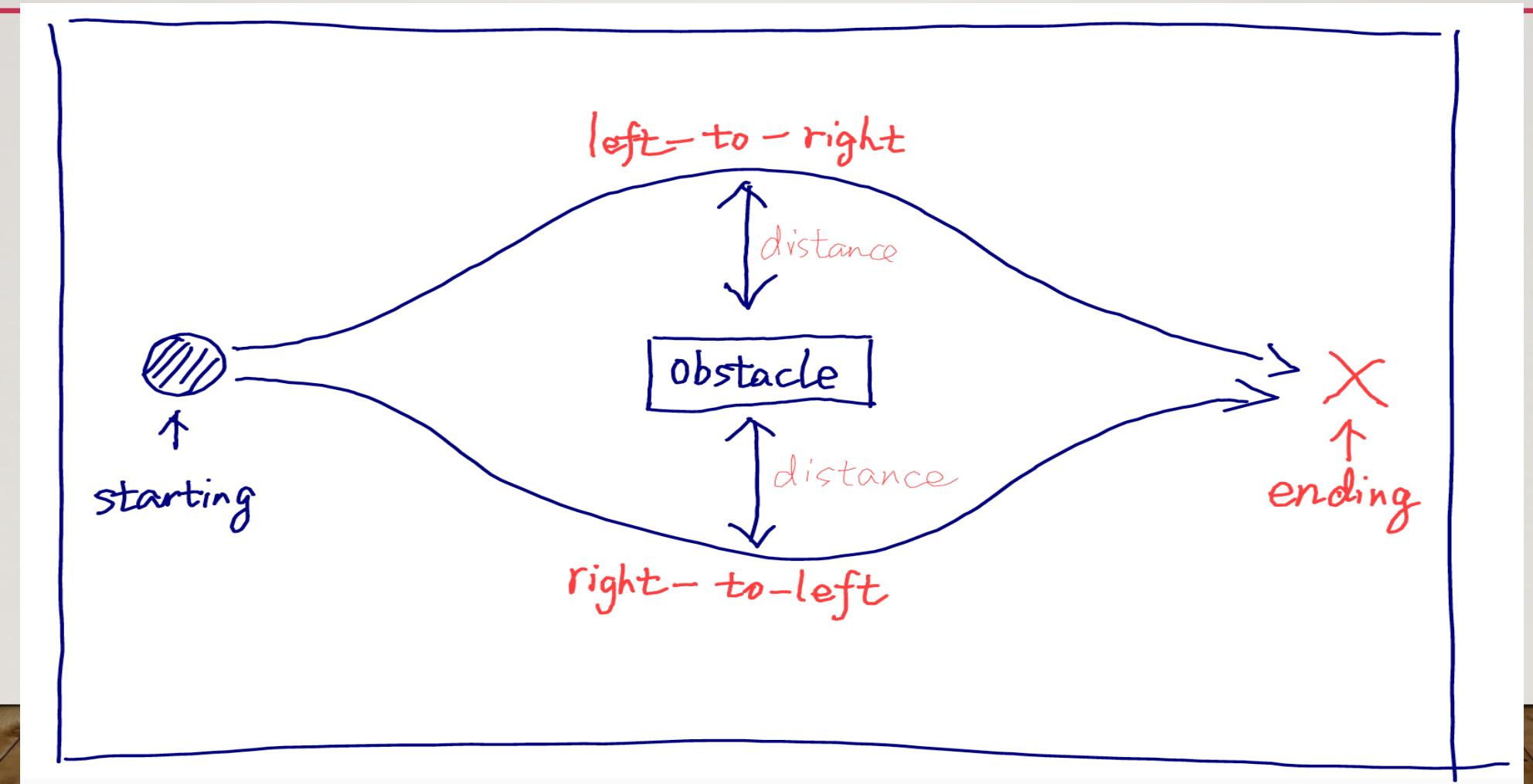
(a) 0°



(b) 90°

EXPERIMENT DESIGN

- Experiment Method



RESULT

- Experiment variable
- 1. the obstacle (cardboard box, human)
- 2. the nature of the obstacle (real, virtual)
- 3. the orientation of the obstacle (0;90;180;270 degrees for human)
(0, 90 degrees for board [symmetric])
- 4. the direction of the trajectory (left-to-right, right-to-left).

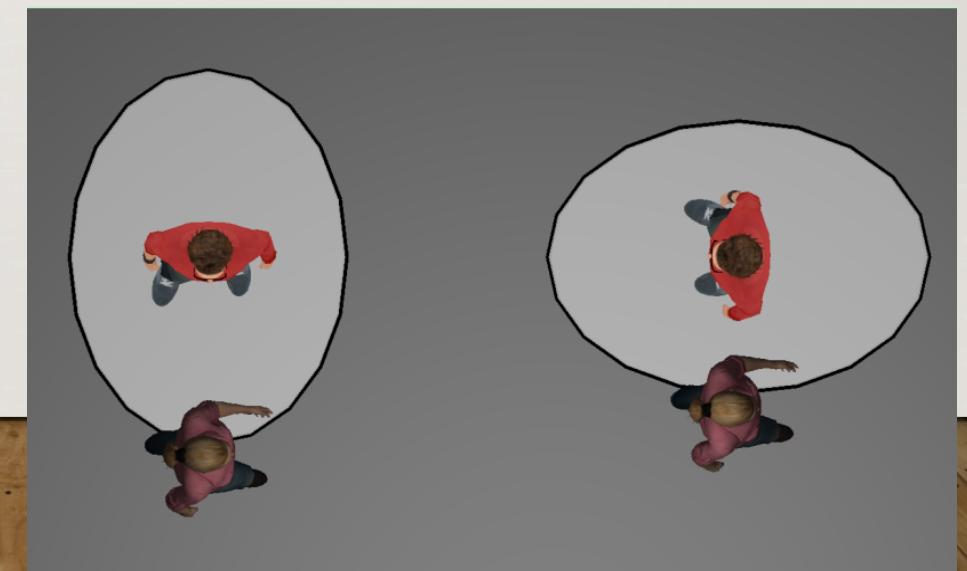
RESULT

	Real	Virtual	Human	Box	Orientation 90	Orientation 0	
Walk Speed	1.17m/s	>	1.13m/s				
Maximal Lateral Deviation	0.66m	<	0.71m	>	0.72m	>	0.65m
Clearance Distance	0.56m	<	0.61m	>	0.62m	<	0.55m

DISCUSSION

- **Virtual VS Real:** Walking speed is slower, and the maximal lateral deviation as well as the clearance are higher when avoiding virtual obstacles than real ones.
- **Human VS Box:** maximal lateral deviation and the clearance distance are higher for human.
- **Orientation:** users consider the personal space of the human obstacle in the collision avoidance task.

Person space



CONCLUSION

- Different in Virtual & Real: large immersive projection (CAVE like) < HDM (head-mounted display).
- Locomotion behavior and the management of users' interaction space is comparable with the ones in real life.
- VR opens the ability to accurately steer the virtual character with respect to the real subject motion.

Q&A

Thanks!