The Perception of Affordances in Mobile Augmented Reality

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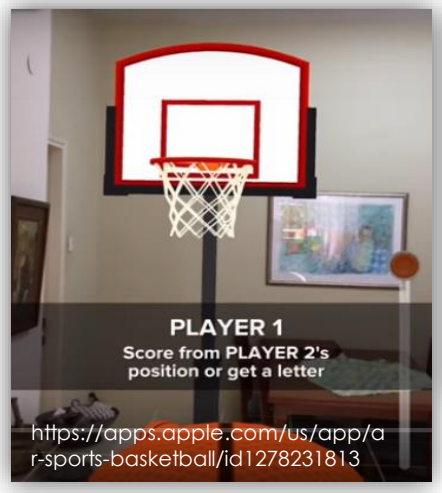
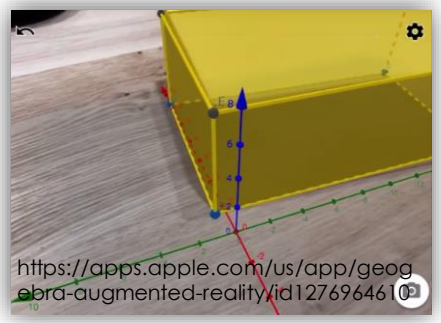
Introduction

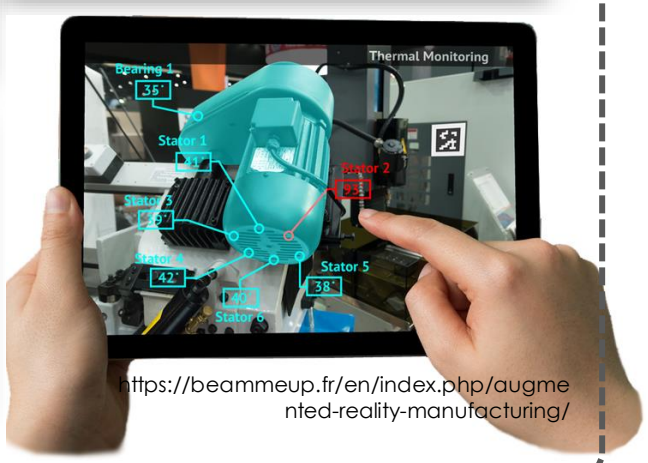
Mobile AR Applications



https://apps.apple.com/us/app/ar-sports-basketball/id1278231813


https://jasoren.com/ar-in-healthcare-education/

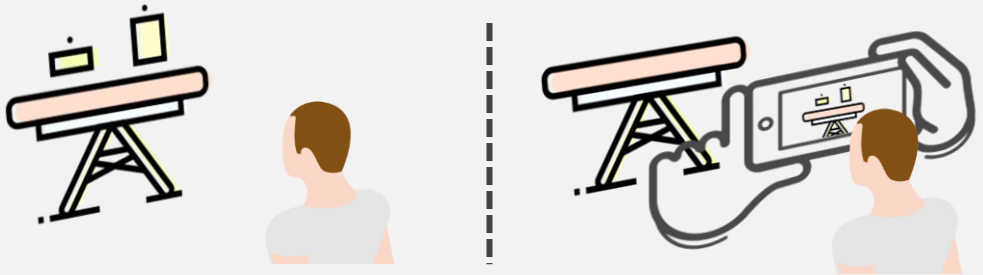

https://apps.apple.com/us/app/geogebra-augmented-reality/id1276964610



https://beammeup.fr/en/index.php/augmented-reality-manufacturing/

Perceptual Fidelity

The degree to which a mediated environment is perceived similarly to the real world



Perception in Real World ≠ **Perception in mobile AR**

Loss of perceptual fidelity

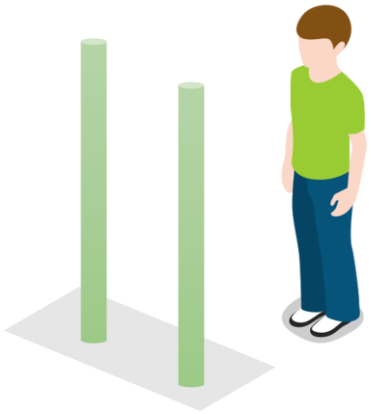
Applications not working as well as intended

Introduction

Affordances

- Possibility for action in environment (J.J. Gibson,1979)
- Body-based: Dependent on relation between observer and environment
- Useful, objective measure of the perceptual fidelity of a virtual or augmented environment

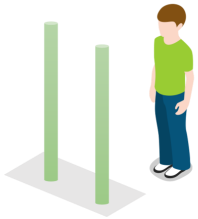
(Bhargava et al. 2020, Creem-Regehr et al. 2019, Gagnon et al. 2020, Guess et al. 2010, Pointon et al. 2018, Stefanucci et al. 2015)



Passing Through

Stepping Over

Introduction



People can scale their judgments to the dimensions of their body

Conservative (≈ 1.16x shoulder width)
Franchak&Adolph 2016, Stefanucci&Geuss 2009, Warren&Wang 1987

Overestimated
Jiang&Mark 1994, Plumert&Schwebel 1997

People can make the judgments about virtual objects effectively ≈ RW
Geuss et al. 2010, Guess et al. 2015, Regia-Corte et al. 2013, Creem-Regehr et al. 2019, Jun et al. 2015, Bodenheimer&Fu 2015, Lin et al. 2013, Lin et al. 2014

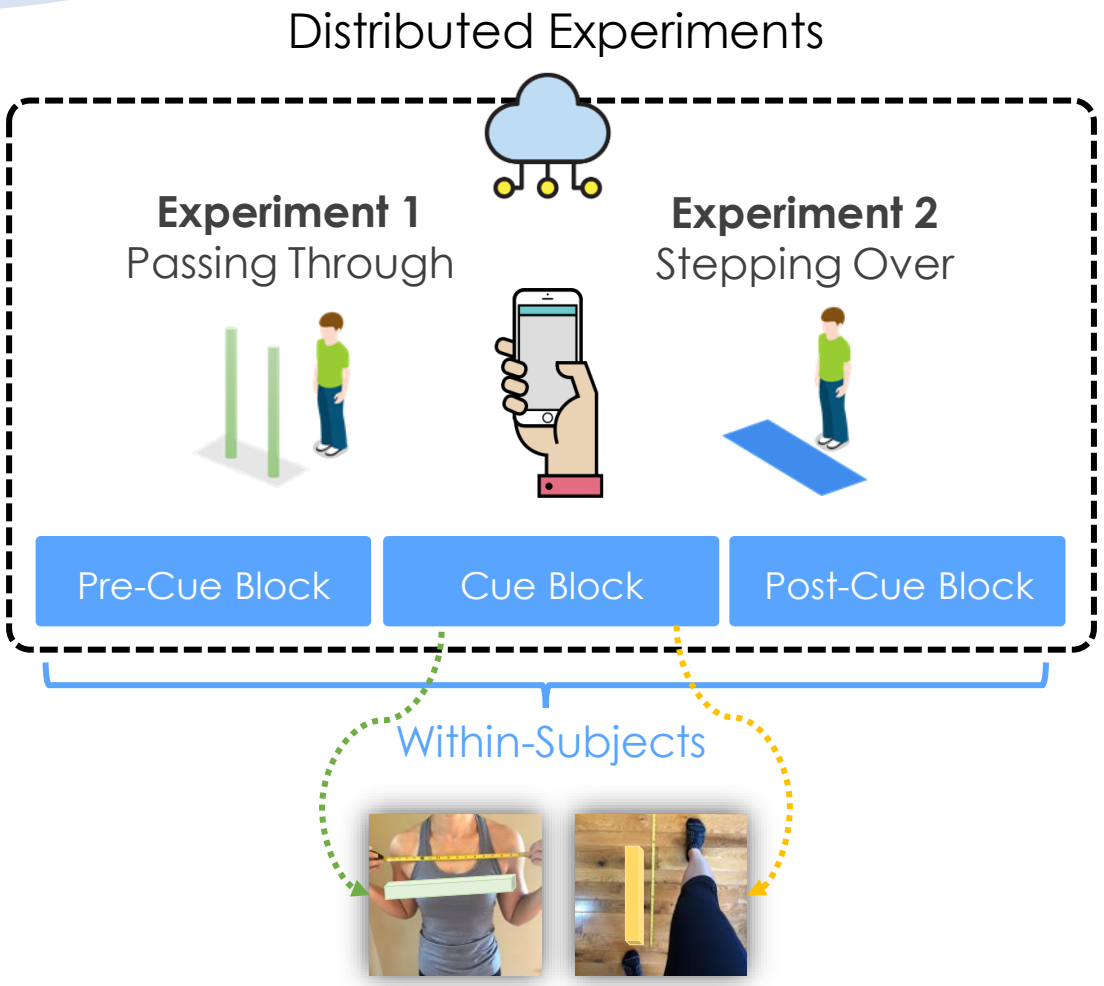
The comparison of AR affordance judgments to the RW is mixed.

≈ RW
(Pointon et al. 2018)


HoloLens 1

< RW
(Pointon et al. 2018, , Gagnon et al. 2021)

Rationale and Hypotheses



Hypotheses

H1 Affordance judgments in mobile AR will have **similar pattern** to judgments in prior **real world** and **VR** studies.

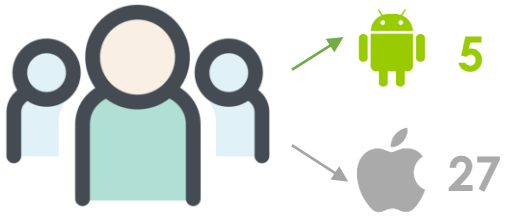
H2 **AR cues** depicting body dimensions will **help** both affordances judgments.

H3 AR cues will cause **training effect** after the cues are removed.

Application Design

Experiments Passing Through

Participants



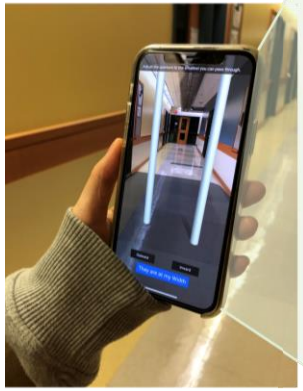
Subjects
N = 32

15 males **17 females**

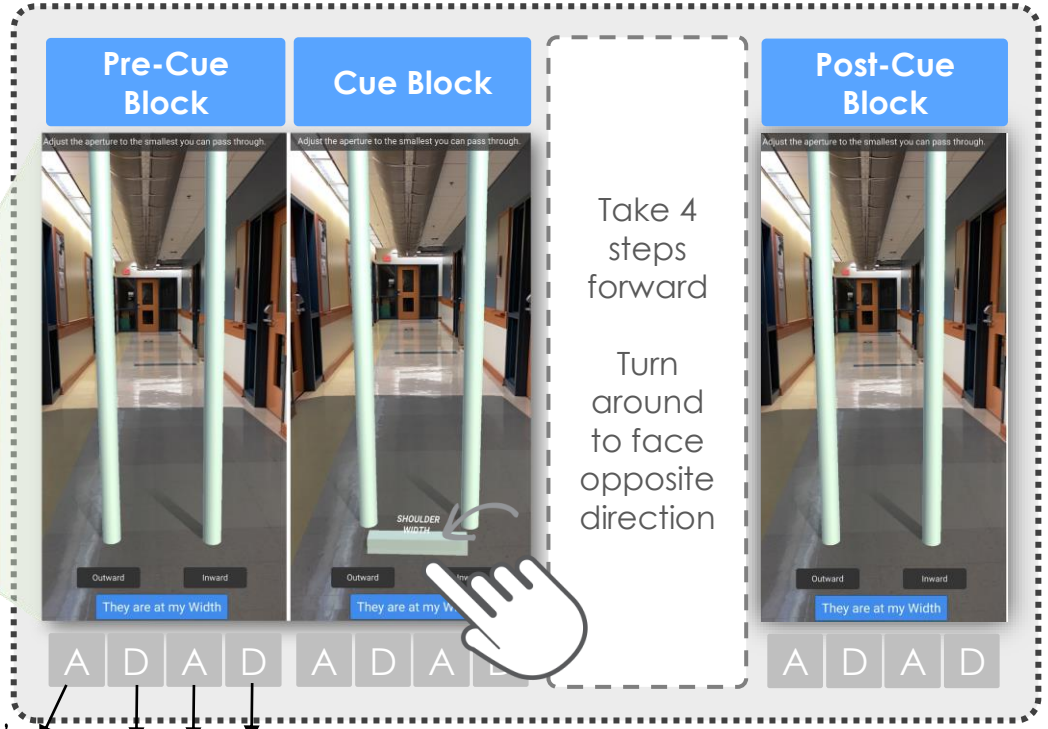
Age 19 – 68
(M = 32.57)

Procedure

Measure the Shoulder Width

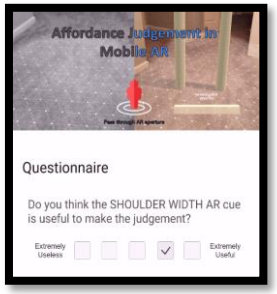


Task : Adjust the width between poles until the minimum users can pass through.



70% participants' input shoulder width: 180% 70% 180%

Rate the Usefulness of AR Cue



Experiments Stepping Over

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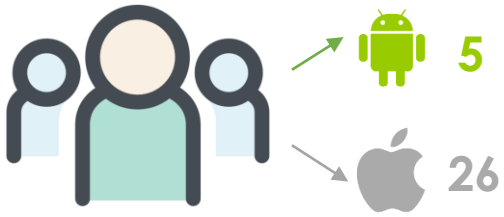


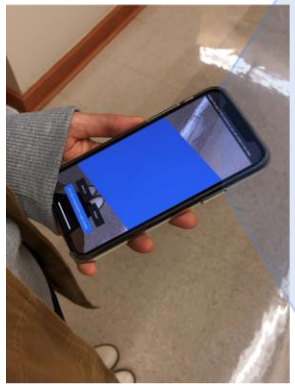
Subjects
N = 31

15 males **17 females**

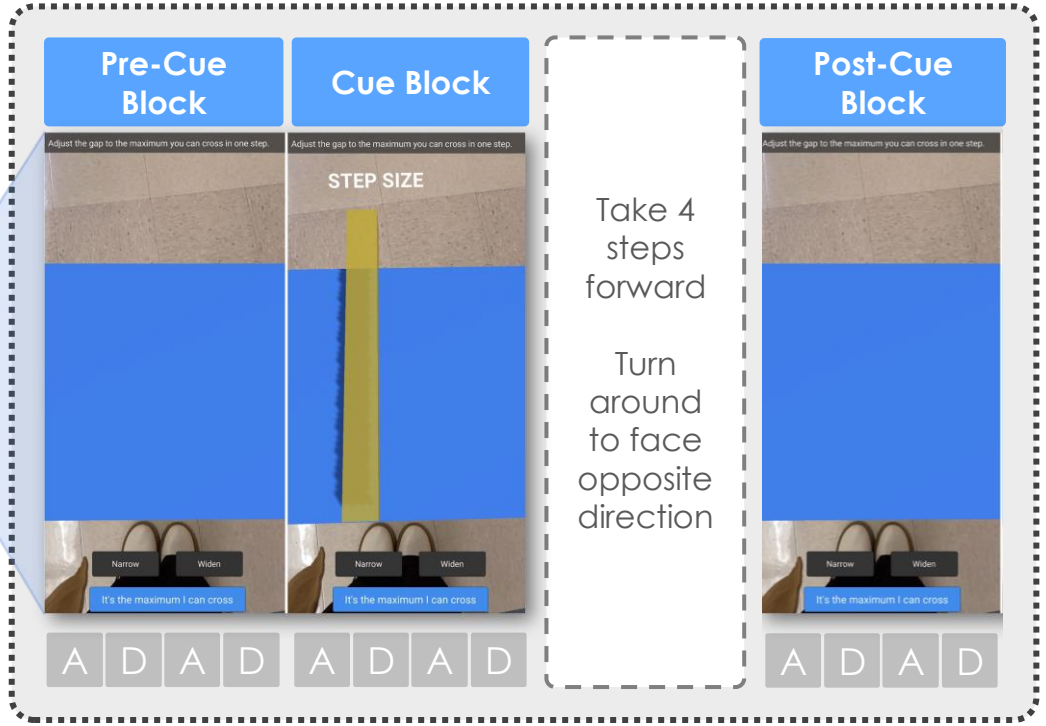
Age 19 – 68
(M = 32.19)

Procedure

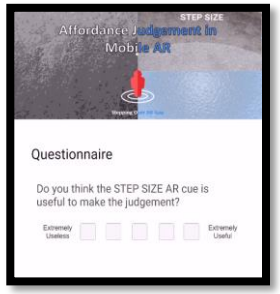
Measure the Max Stride



Task : Adjust the gap until the maximum you can step over in one step.



Rate the Usefulness of AR Cue



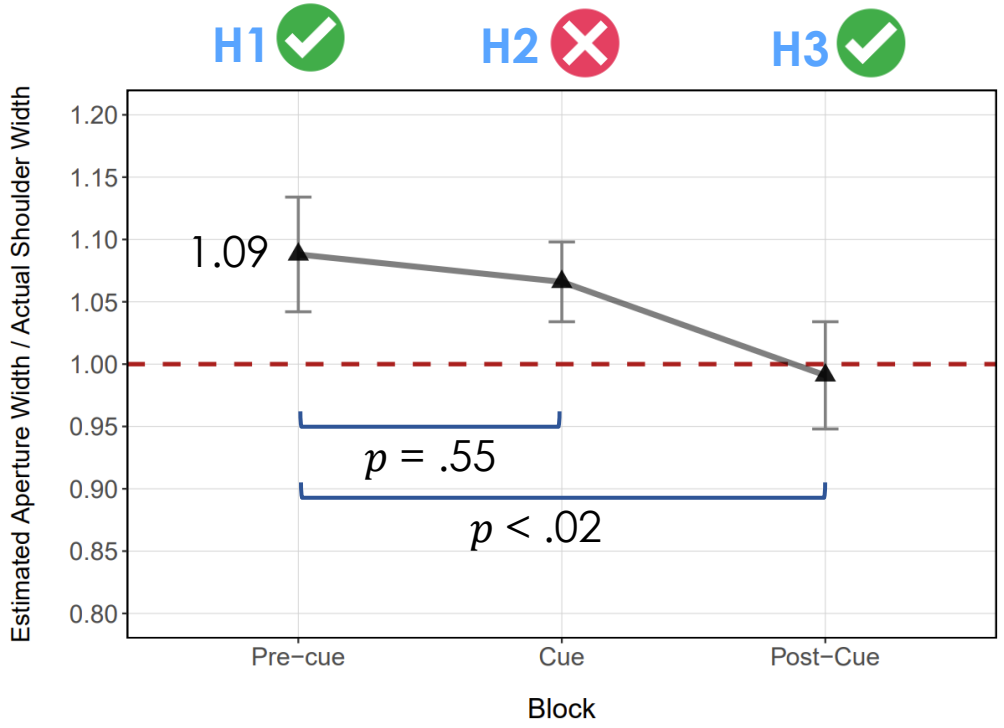
Results

Passing Through

There was a significant effect of block

Ratios were not different in the **cue** (M = 1.07) compared to the **pre-cue** (M = 1.09) block

Ratios were lower in the **post-cue** (M = .99) block compared to the **pre-cue** block,



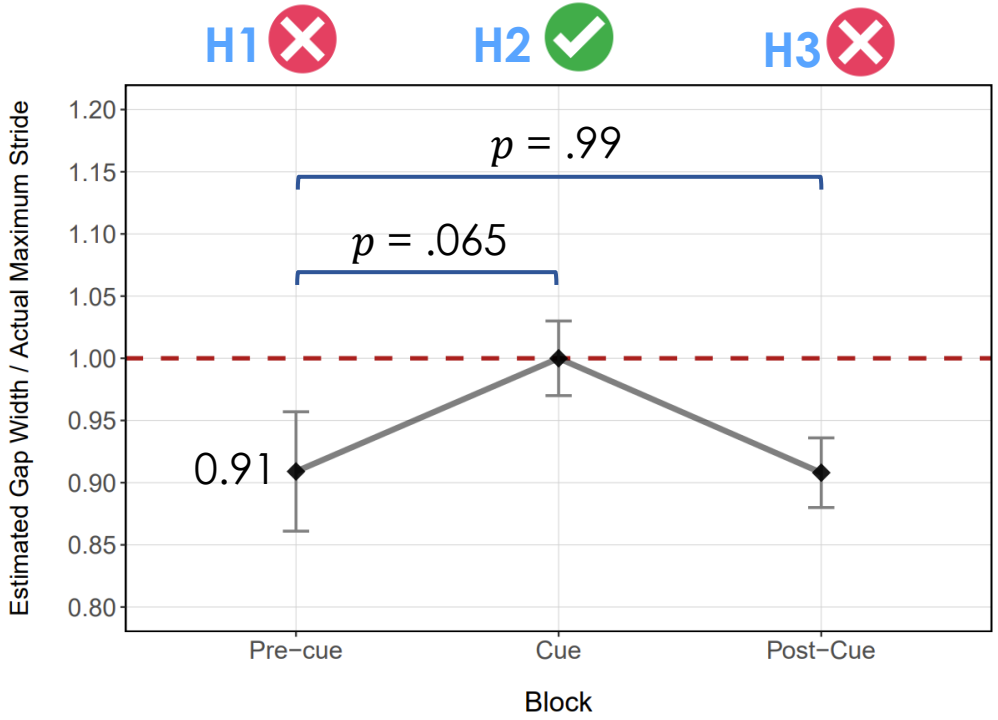
Results

Stepping Over

There was a marginally significant effect of block

Estimates in the **cue** block (M = 1.00) were marginally greater than in the **pre-cue** block (M = .91),

There was no difference between the **post-cue** block (M = .91) and the **pre-cue** block,



Discussion

Hypotheses

H1 Affordance judgments in mobile AR will have **similar pattern** to judgments in prior **real world** and **VR** studies.

consistent with the tendency to overestimate the passable aperture width

conservative than reported in prior work (underestimation of capabilities)

H2 **AR cues** depicting body dimensions will **help** both affordances judgments.

Cues indicating body size in AR have the potential to **influence a user's estimates** of affordances

H3 AR cues will cause **training effect** after the cues are removed.

The persistence of the **training effect** depends on the **task** at hand

Discussion

Why was the effect of the AR cues different in two affordance tasks?

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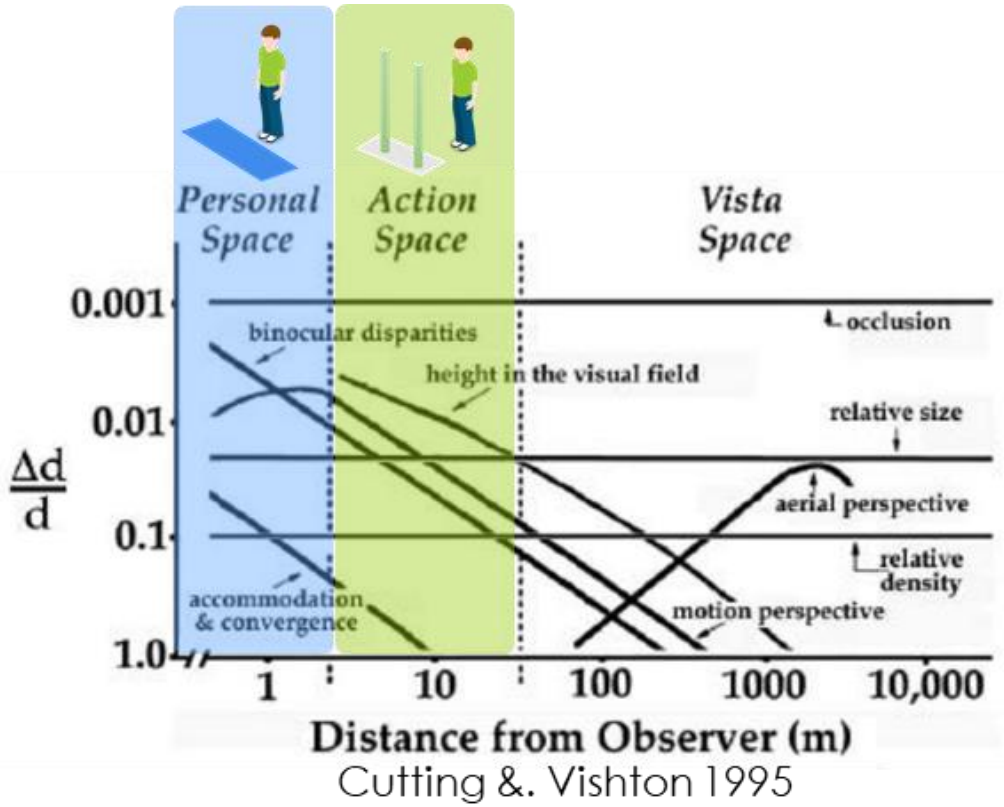
1. The region of space in which the action is performed



Cutting &. Vishton 1995

2. Differences in strategies for how the cue was used in different affordance contexts

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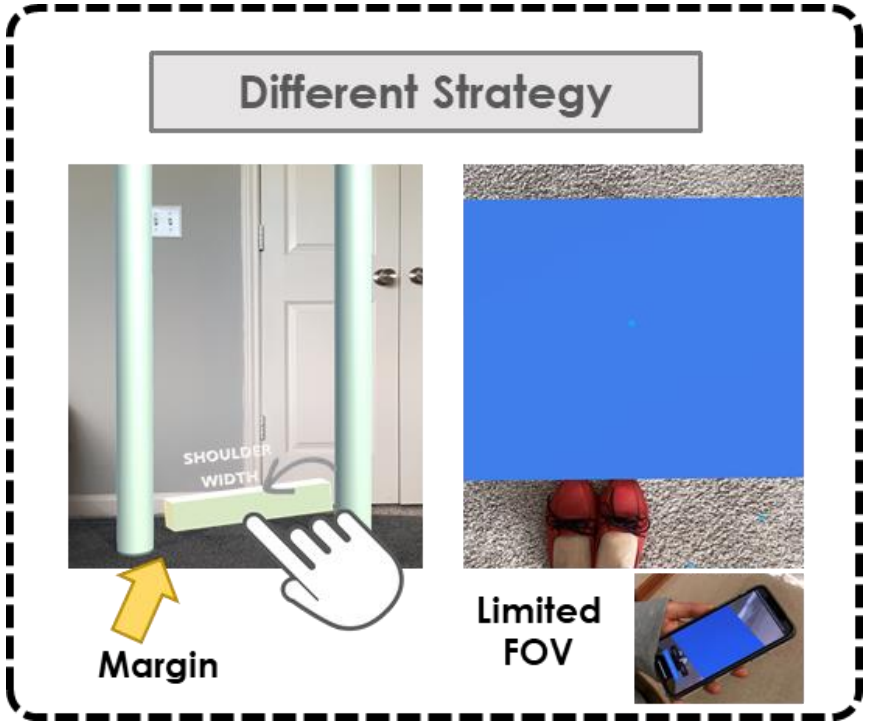
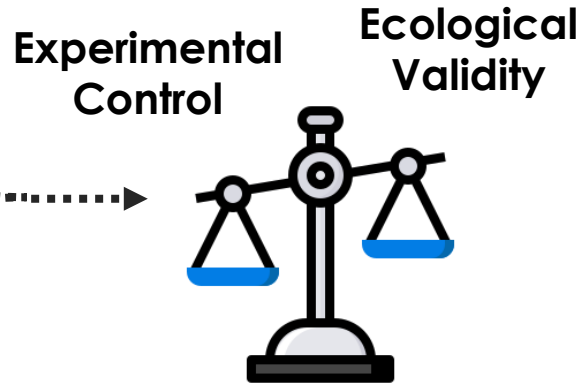


Limitations and Future Work

limitations associated with the distributed data collection approach via smartphones

Limitations	Future Work
Less control over measurement of the body dimension	Submit a photograph of them measuring shoulder width and stride length
Differences among the devices	Generalizations of AR training effects across different devices will be important to assess
No control over the real world environments	Request participants take a photo of their environment Control this variable by requiring a specific type of environment



Advantages of testing in the wild

Conclusion

Users can perceive their action capabilities in mobile AR:

Passability judgments in mobile AR are similar to those observed in real and virtual environments;

Judgments for stepping over were underestimated than reported in prior work.

Effects of providing AR cues for training are found in context of affordance judgments

(even in the face of inherent variability and loss of some experimental control).

We provide a fundamental **framework** for judging perceptual fidelity of mobile augmented reality **in the wild**.

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Q&A

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