

IEEE VR



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BUILDING AND REGULATING THE METAVERSE

Embodied Interaction

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EMRNR
The European Metaverse Research Network



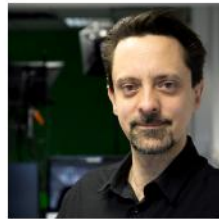
SEE VR Lab

Social, Empathic, and Embodied VR Lab at Goldsmiths, University of London



Prof Sylvia Xueni Pan

Sylvia is a Professor of VR. She is the co-head of the SEE VR Lab.



Prof Marco Gillies

Marco is a Professor of Computing. He is the co-head of the SEE VR Lab.



Clarice Hilton

Clarice is a creative technologist and researcher in immersive artwork.



Fang Ma

Fang is a RA in the IIIE project and a PhD student focusing on virtual humans.



Tara Collingwoode-Williams

Tara is a Lecturer in VR, and a final year PhD student in VR Embodiment.



Nima Jamalian

Nima is a Lecturer in VR, and a final year PhD student in VR hand tracking.



Georgiana Cristina Dobre

Cristina is a PhD student in AI-driven Character for immersive experiences such as gaming and training.



Carlos Gonzalez Diaz

Carlos is a PhD student in interactive machine learning and movement interaction design VR.



Janet Gibbs

Janet is a PhD student in sensori-motor contingency and presence.



Nicky Donald

Nicky is a PhD student in virtual performance and 3D projection.



Claire Yuke Pi

Claire is a RA in the Child Embodiment project and a PhD student in Embodied interaction



Chaojing Li

Chaojing is a PhD student on VR for interactive narrative experiences.

Goldsmiths
UNIVERSITY OF LONDON



@panxueni @marcogillies

Why bother with the metaverse when we have zoom?

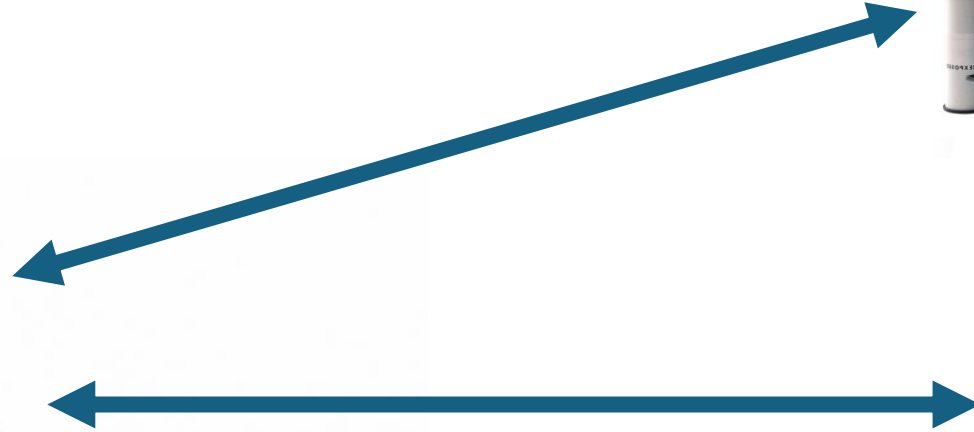


Non-Verbal Cues

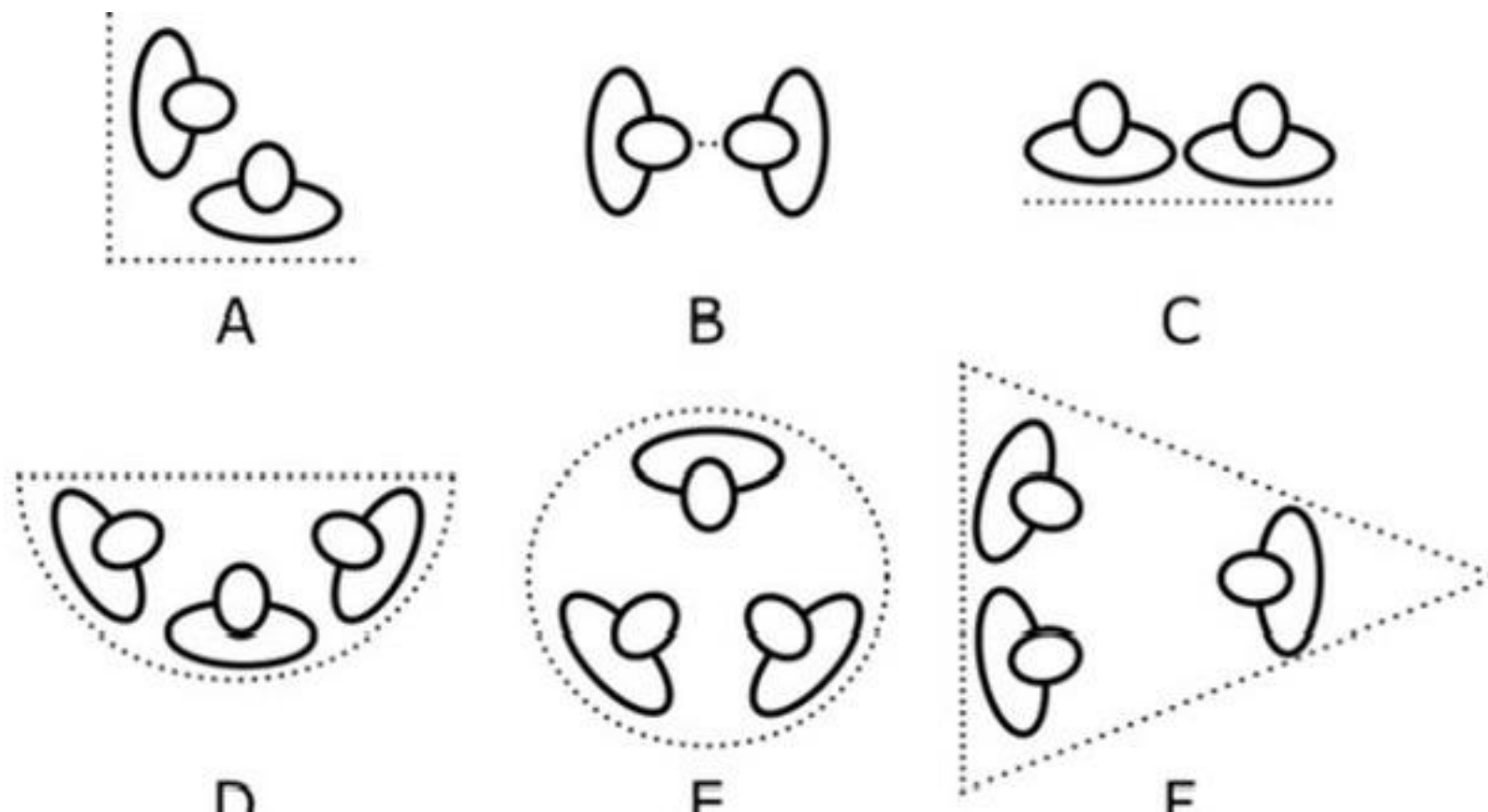
- Gestures
- Posture
- Facial Expression
- Eye Gaze



Eye Contact Doesn't work



Social Interaction is Spatial



2 types of “people” in the Metaverse



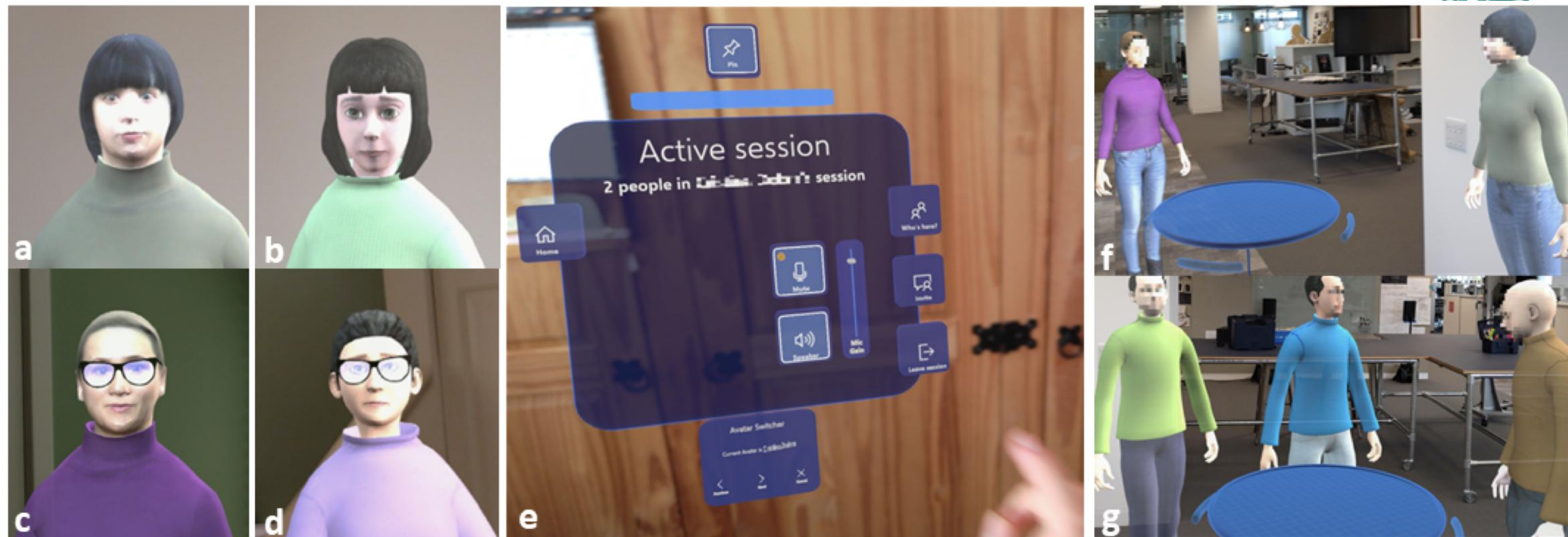
Avatars

- 3D representations of people
- Directly controlled by the person

Agents

- Computer Controlled Characters
- “AI” Controlled

Avatars



Dobre, Georgiana Cristina; Wilczkowiak, Marta; Gillies, Marco; Pan, Xueni and Rintel, Sean. 2022. 'Nice is Different than Good: Longitudinal Communicative Effects of Realistic and Cartoon Avatars in Real Mixed Reality Work Meetings'. In: CHI Conference on Human Factors in Computing Systems Extended Abstracts.

Expressive Self-avatar



Ma & Pan IEEE VR 2022



Study 2
47 blendshapes
Realistic avatar



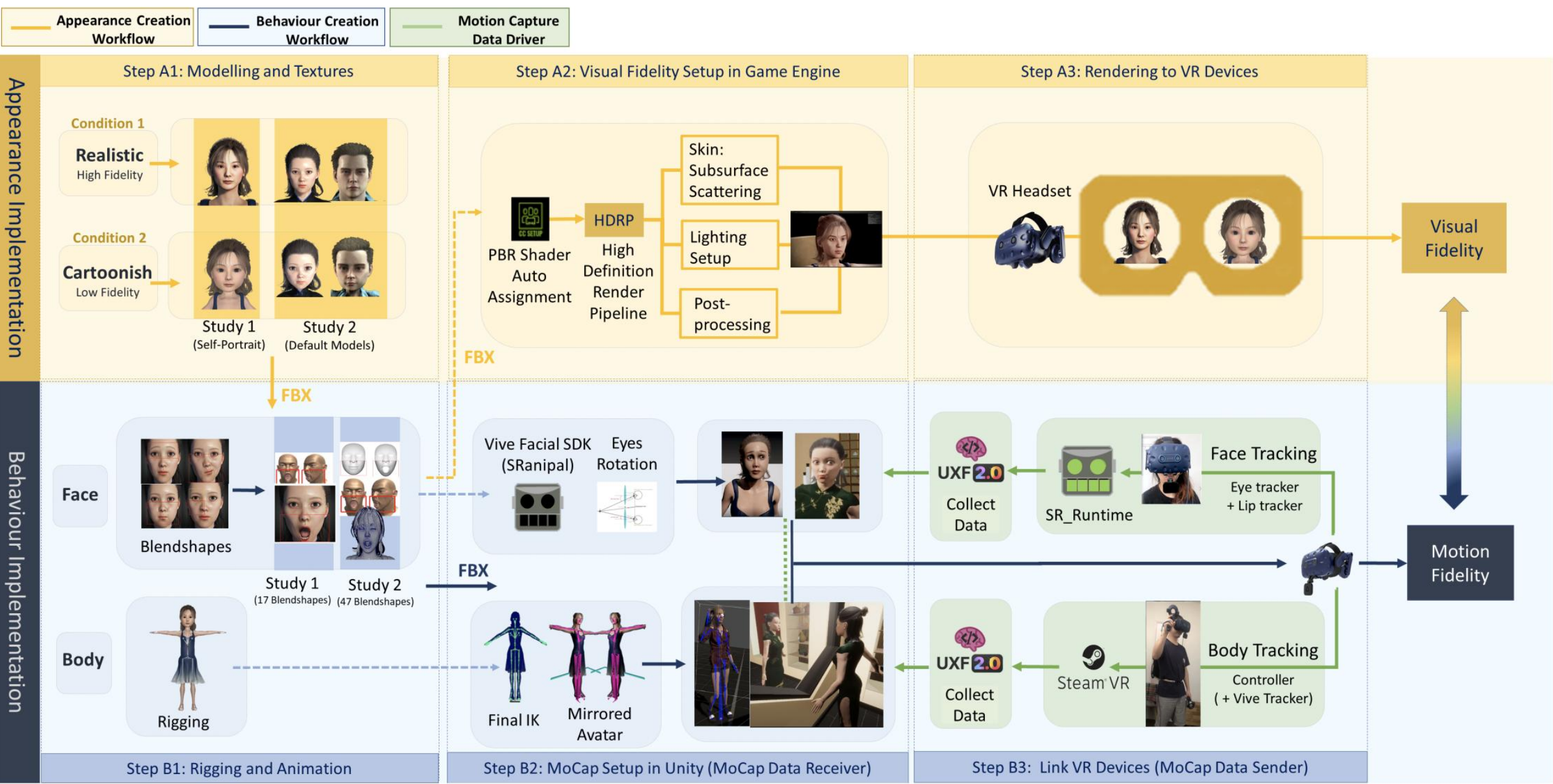
Study 2
47 blendshapes
Cartoonish avatar



Study 1
23 blendshapes
Realistic avatar

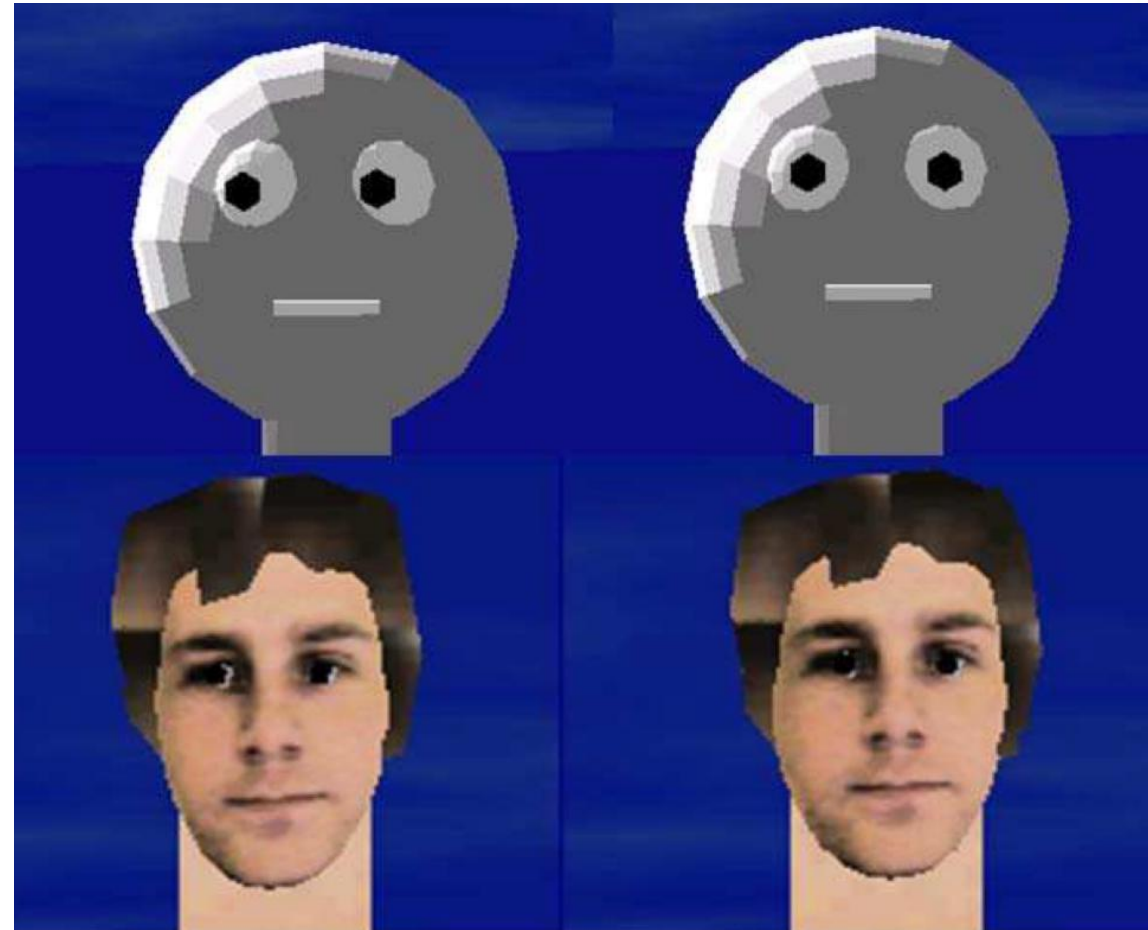
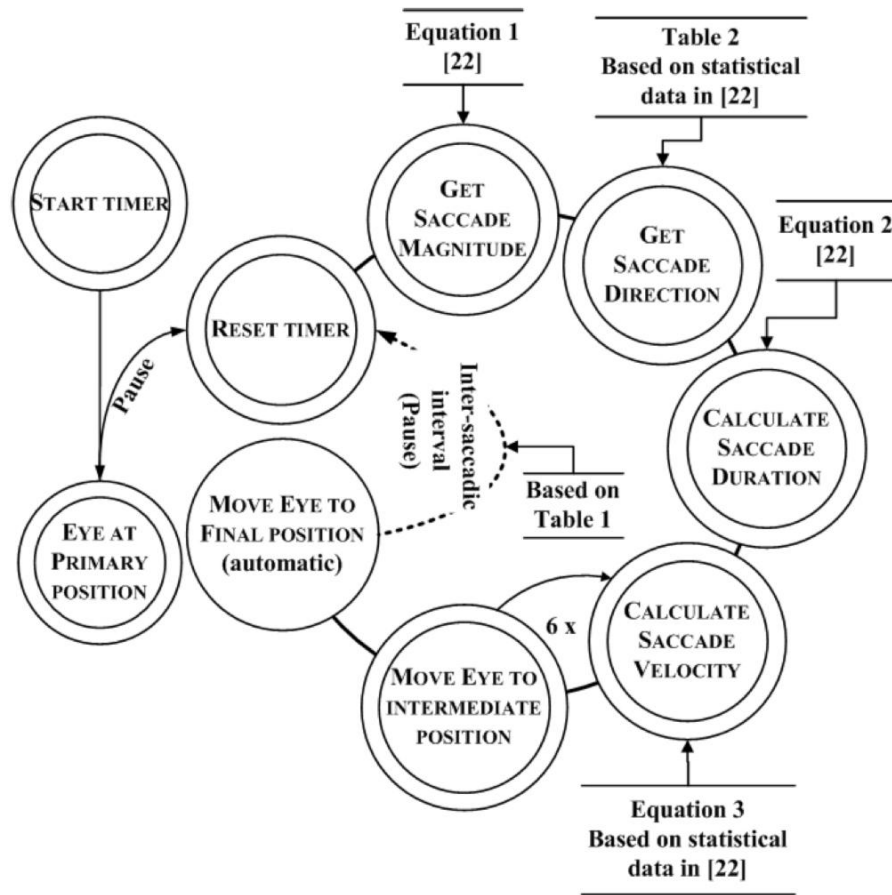


Study 1
23 blendshapes
Cartoonish avatar



So LLMs have solved agents, right?

Eye Gaze Model



Vinoba Vinayagamoorthy, Maia Garau, Anthony Steed, Mel Slater 2004. [An eye gaze model for dyadic interaction in an immersive virtual environment: Practice and experience](#). In: Computer Graphics Forum

Social Interaction is
2-way

Hard part is
sensing users



AI-Driven Characters In Virtual Reality

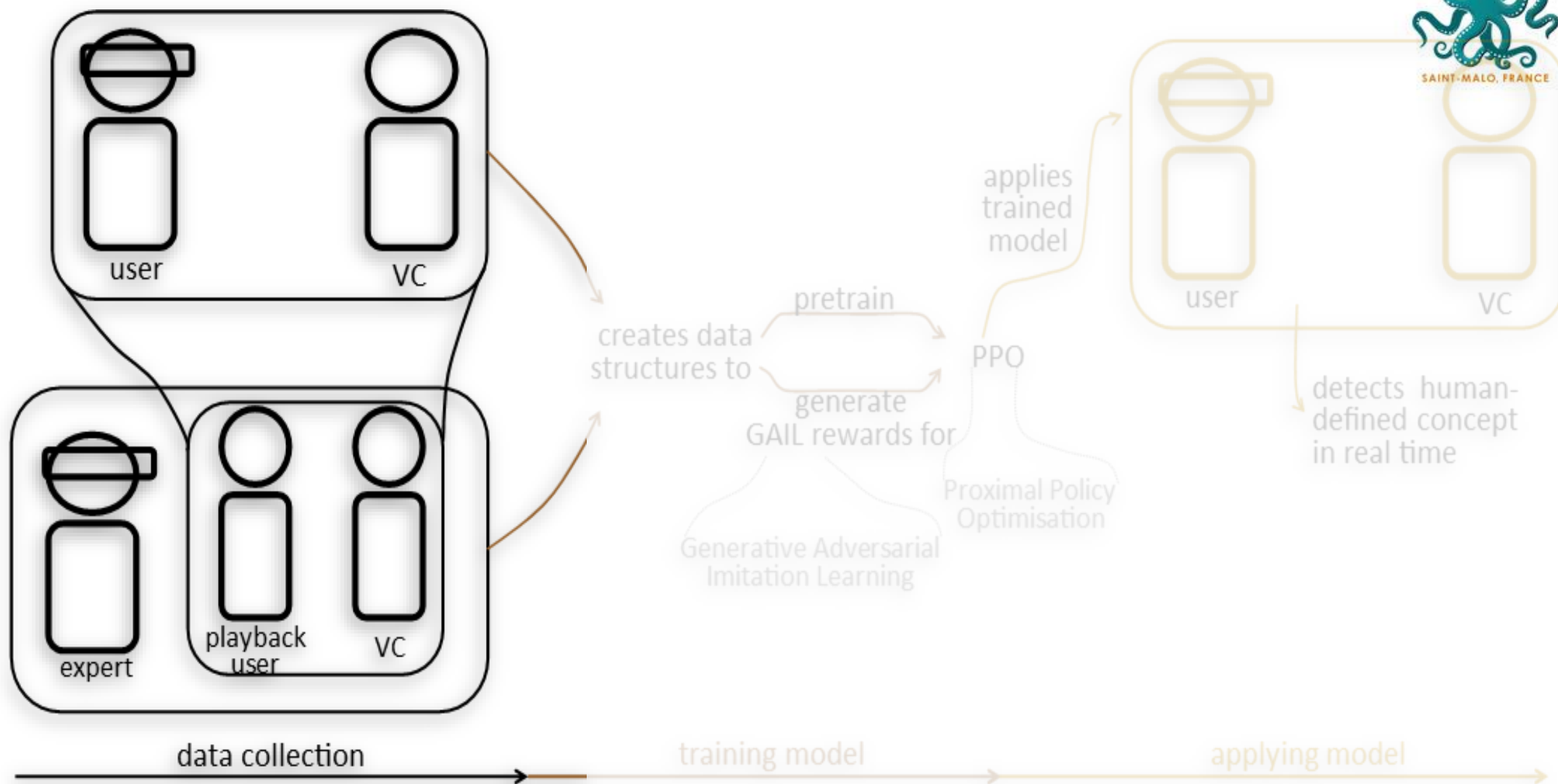


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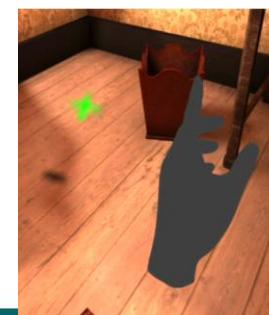
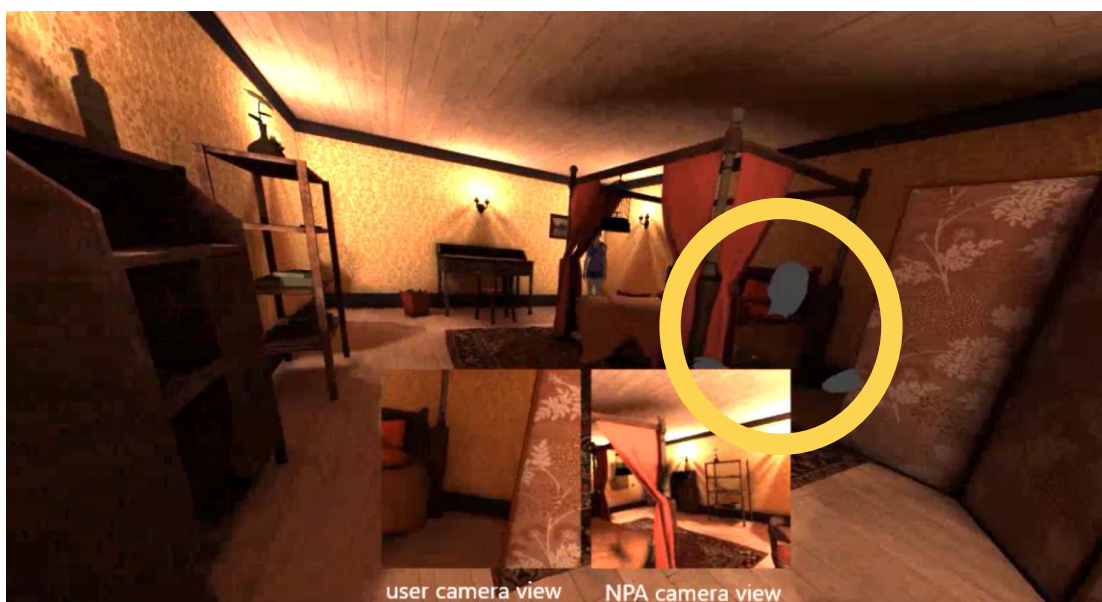
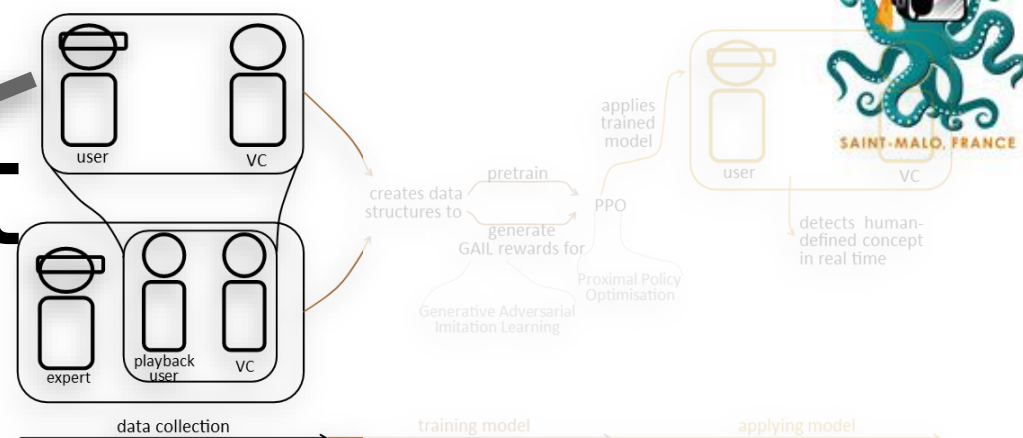
Innovate UK



Pipeline



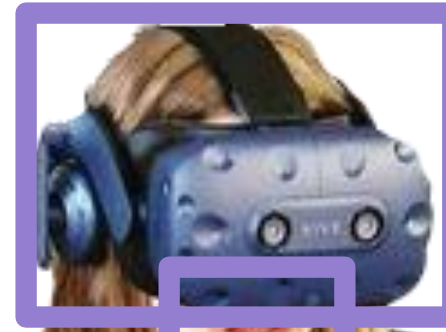
Applied Pipeline: player engagement



Is this just for Agents?

- Tracking cues are imperfect
- Missing many aspects of body language
- Infer and generative

Head
Tracking

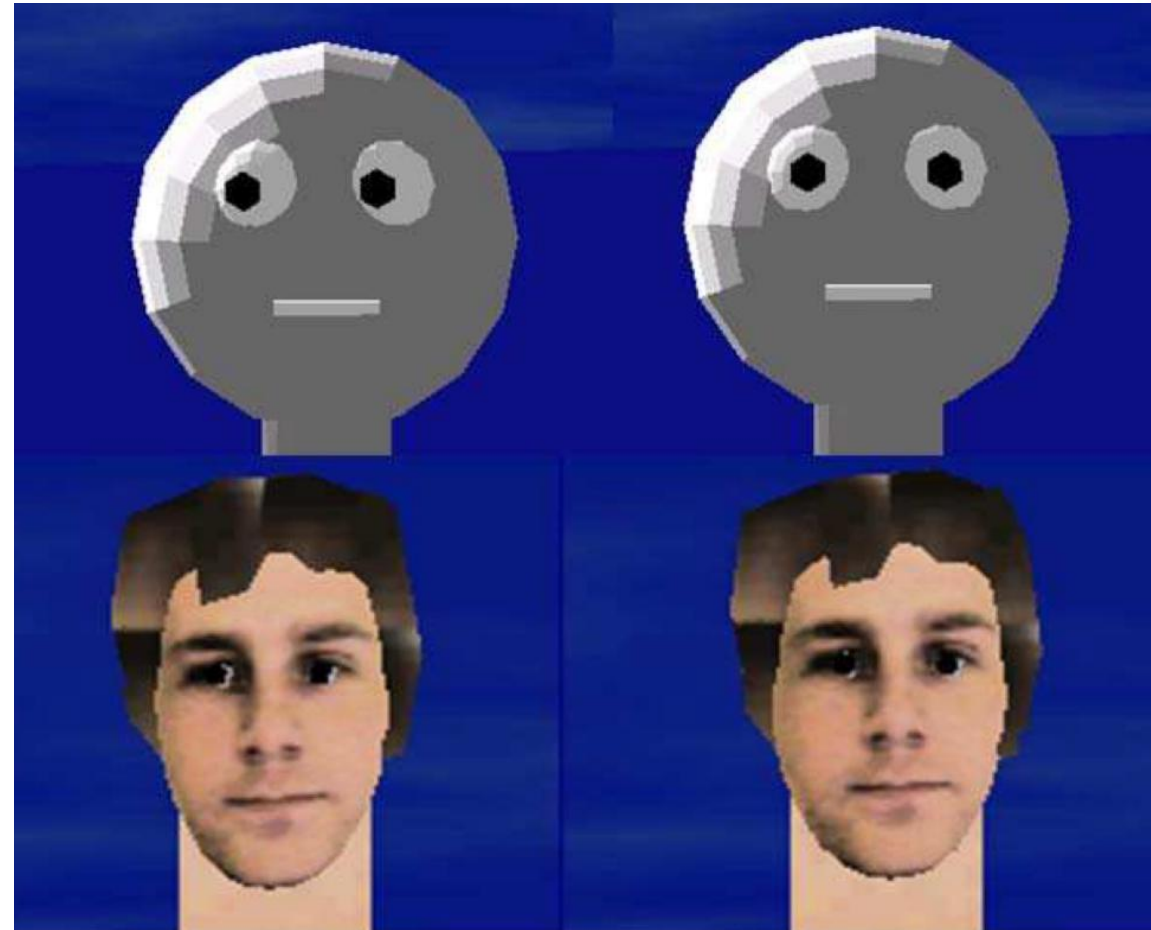
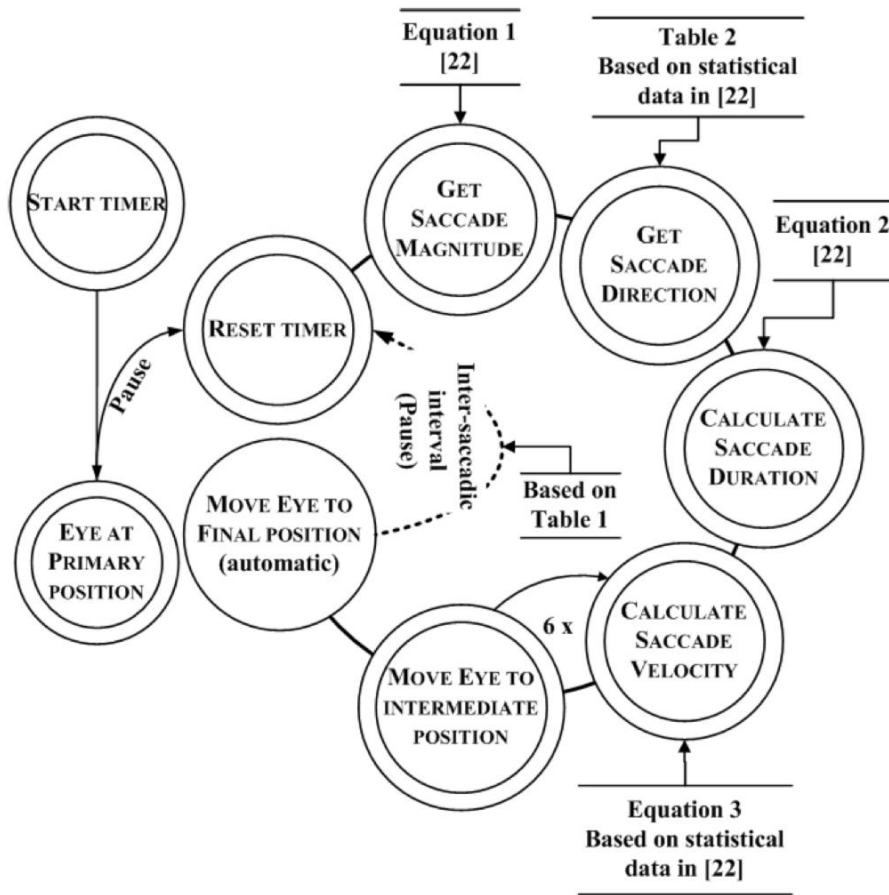


Microphone
(voice)



Hand Tracking

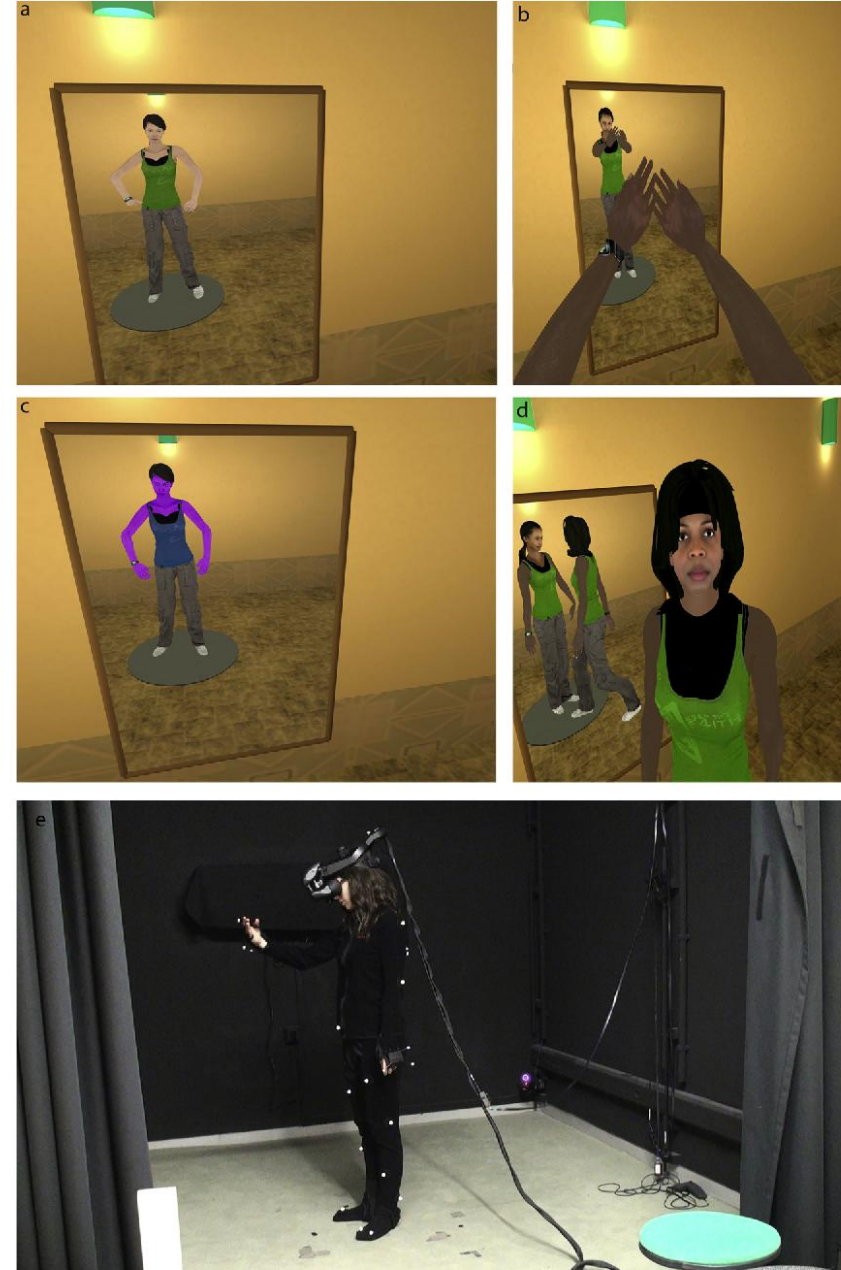
Eye Gaze Model



Vinoba Vinayagamoorthy, Maia Garau, Anthony Steed, Mel Slater 2004. [An eye gaze model for dyadic interaction in an immersive virtual environment: Practice and experience](#). In: Computer Graphics Forum

Embodiment

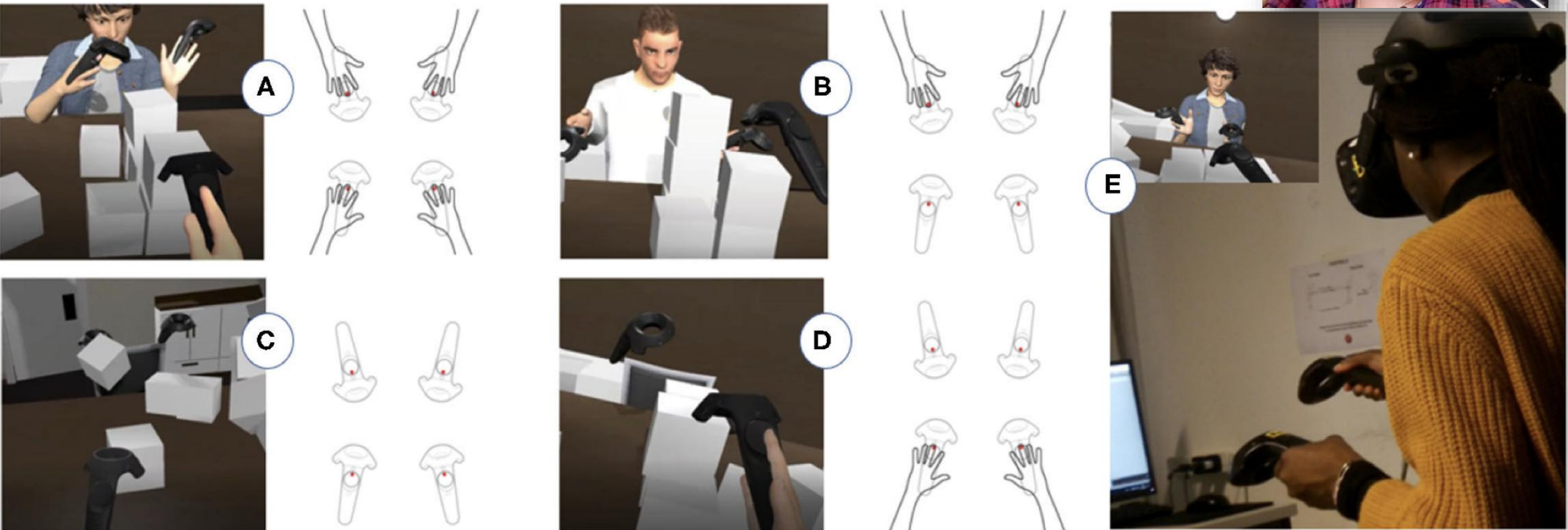
- How we own our virtual bodies
- They can impact us, not just other people



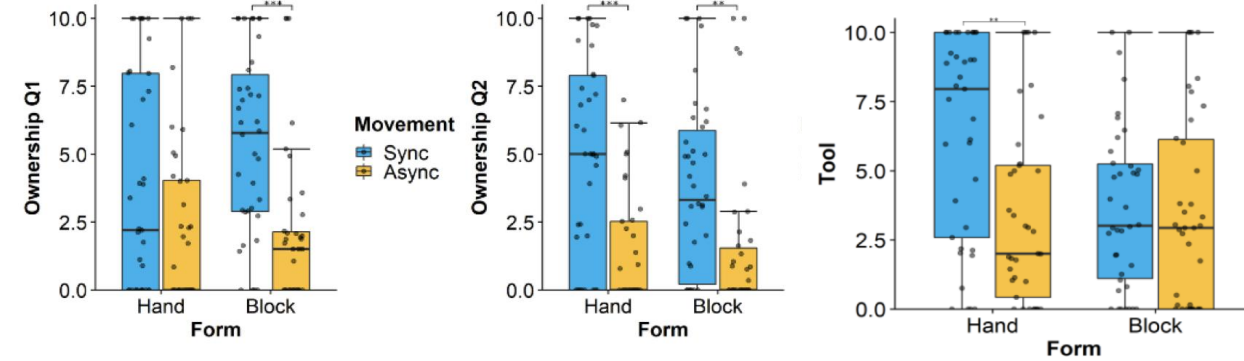
Body Ownership



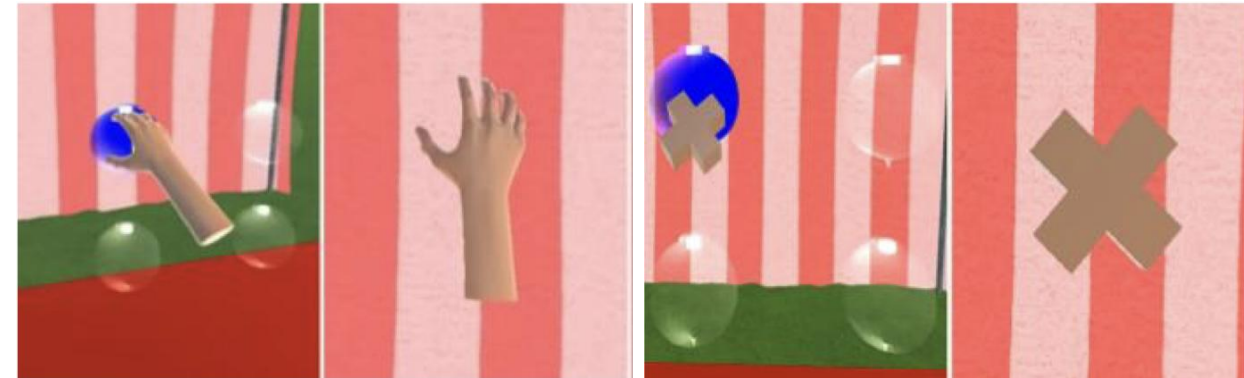
Collingwoode-Williams, Tara; O'Shea, Zoe; Gillies, Marco and Pan, Xueni. 2021. **The Impact of Self-Representation and Consistency in Collaborative Virtual Environments.** Frontiers in Virtual Reality



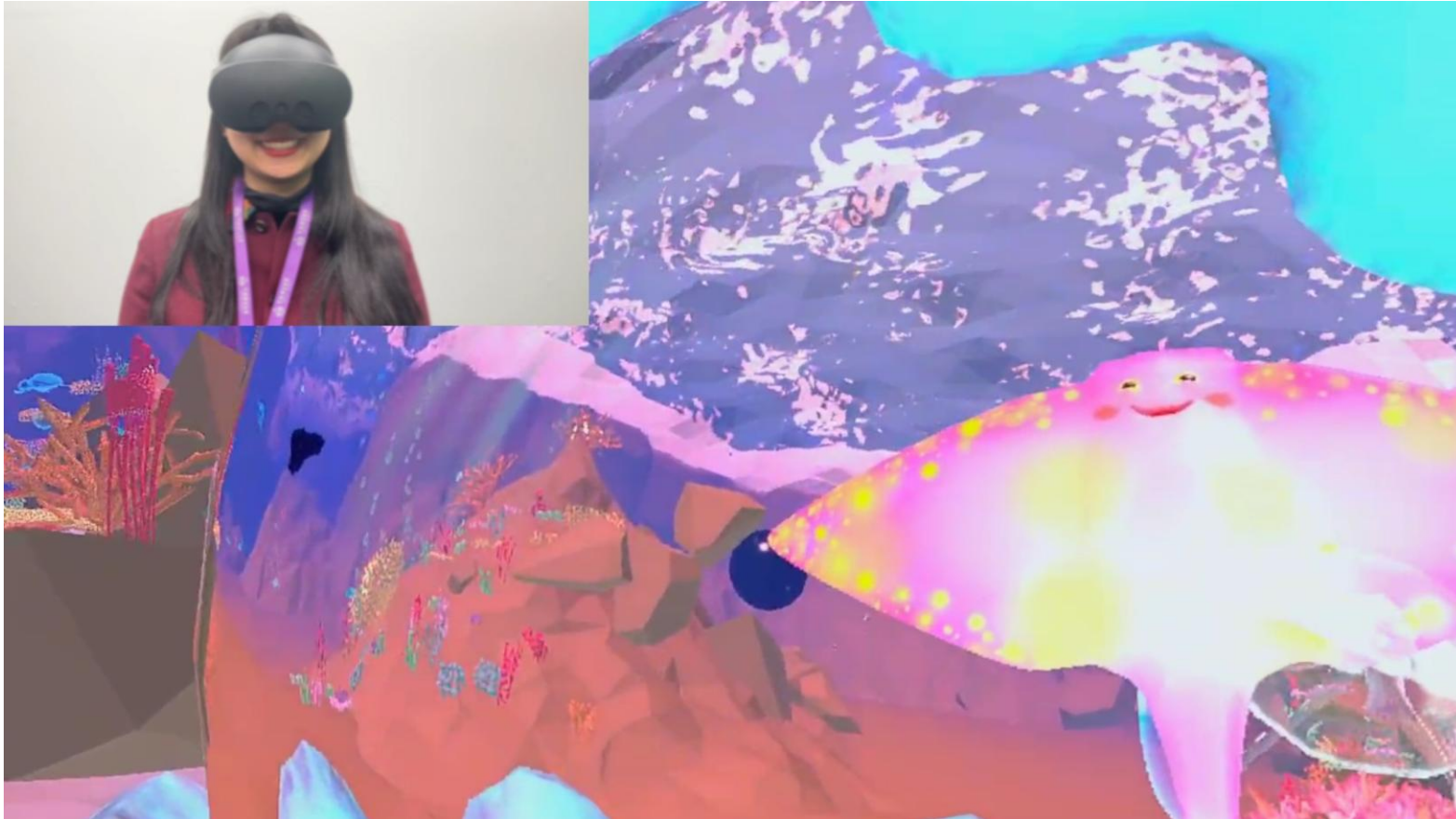
Body Ownership



Dewe, Hayley; Gottwald, Janna; Bird, Laura-Ashleigh; [Brenton, Harry](#); [Gillies, Marco](#) and [Cowie, Dorothy](#). 2022. **My virtual self: the role of movement in children's sense of embodiment**. IEEE Transactions on Visualization & Computer Graphics, 28(12), pp. 4061-4072



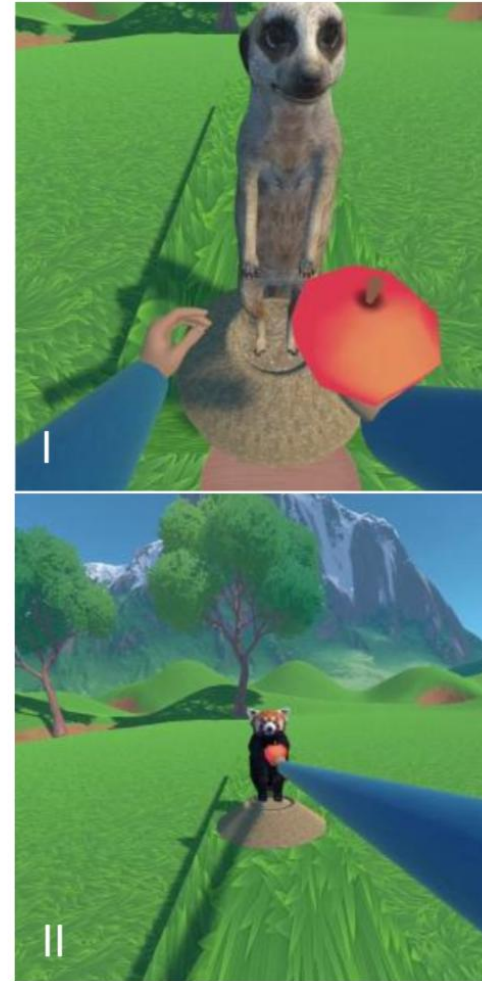
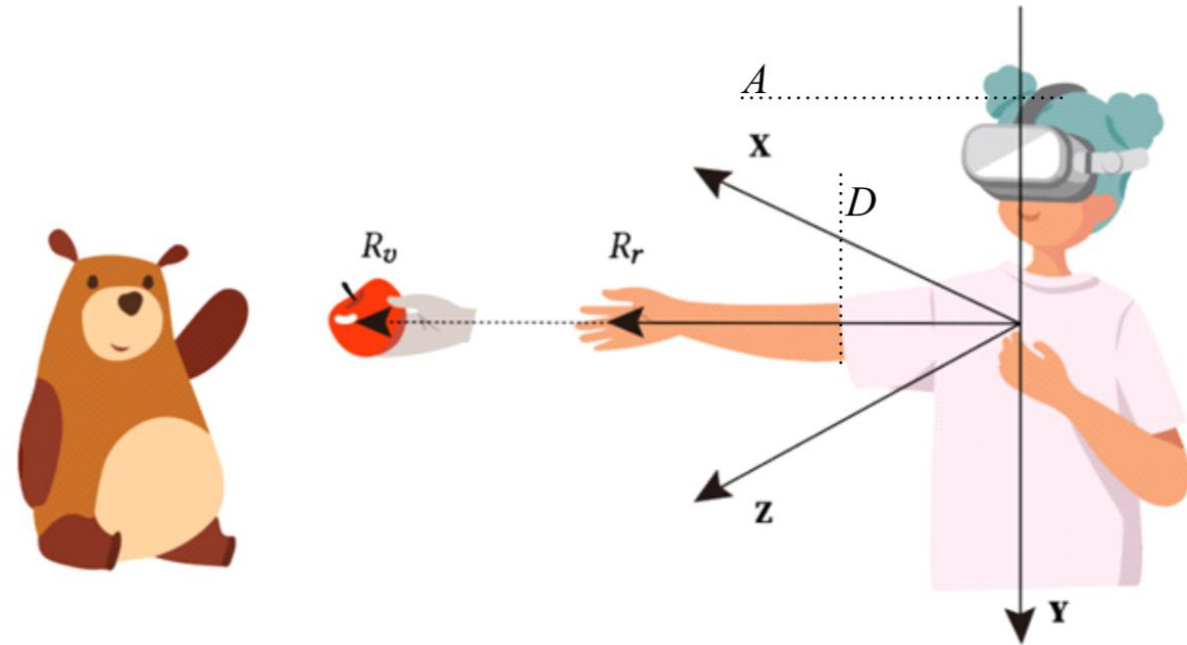
Our Actions Impact our Emotional State



Chaojing Li, Zillah Watson, Sylvia Pan, Marco Gillies. (2025). Forced Smile Creates Positive Mood: A Qualitative Analysis With a VR Experience *CHI Late Breaking Work*

A

B



$$R_v = F(R_r) == \begin{cases} R_r, & \text{if } R_r \leq D \\ D \left(1 - \frac{R_r - D}{A - D}\right) + M \cdot A \left(\frac{R_r - D}{A - D}\right), & \text{if } R_r > D \end{cases}$$



Leif Johannsen; Claire Yuke Pi; Simon Thurlbeck; Marco Gilles; Sylvia Xueni Pan; Dorothy Cowie (2025). Embodiment of a functionally altered virtual arm in children and adults. *Bioarxiv*. <https://doi.org/10.1101/2025.01.03.631079>