

HANDLING THE PAST: METHODOLOGICAL REFLECTIONS ON OBJECT INTERACTION IN PHYSICAL AND XR ARCHAEOLOGICAL CONTEXTS



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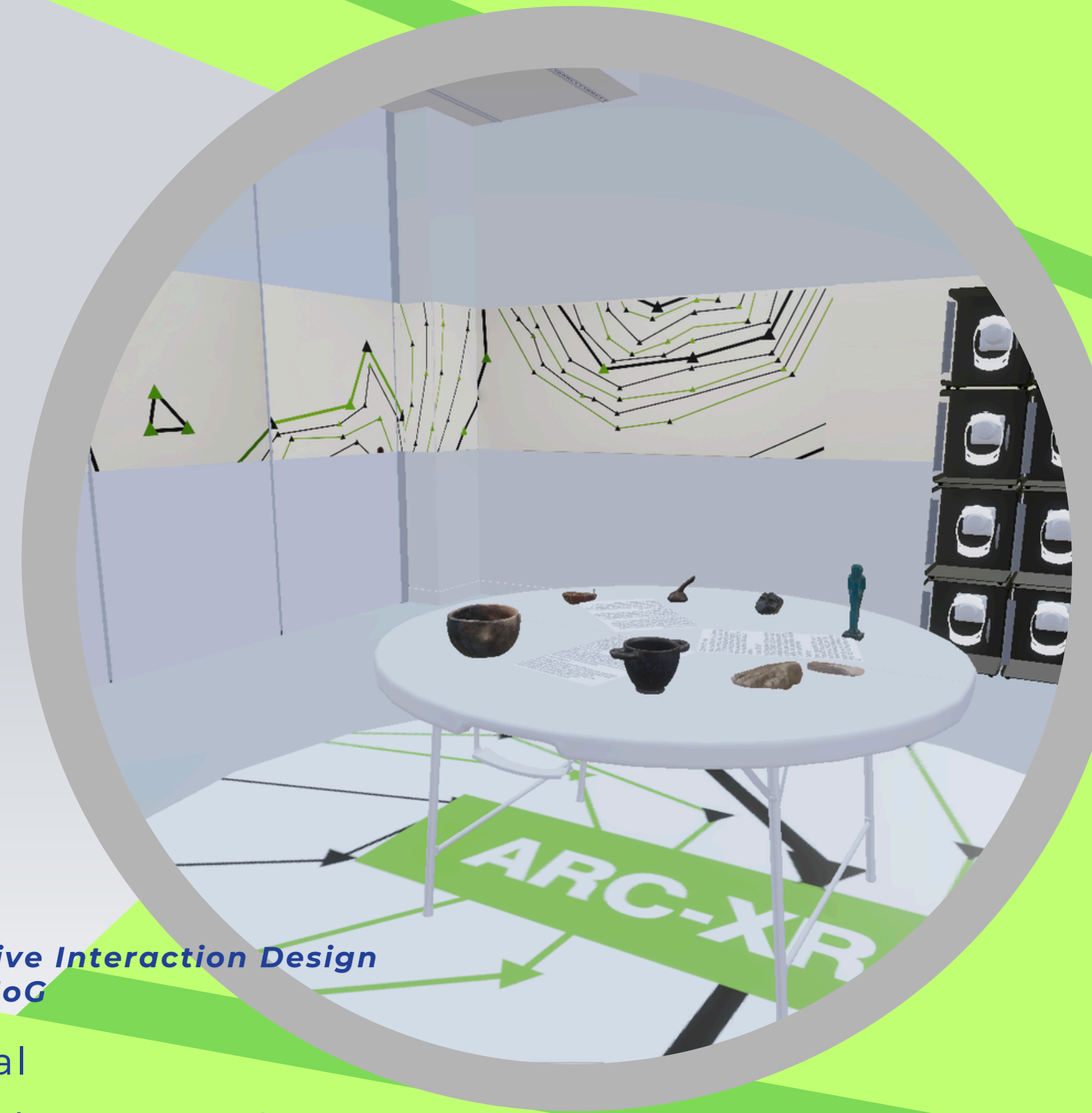
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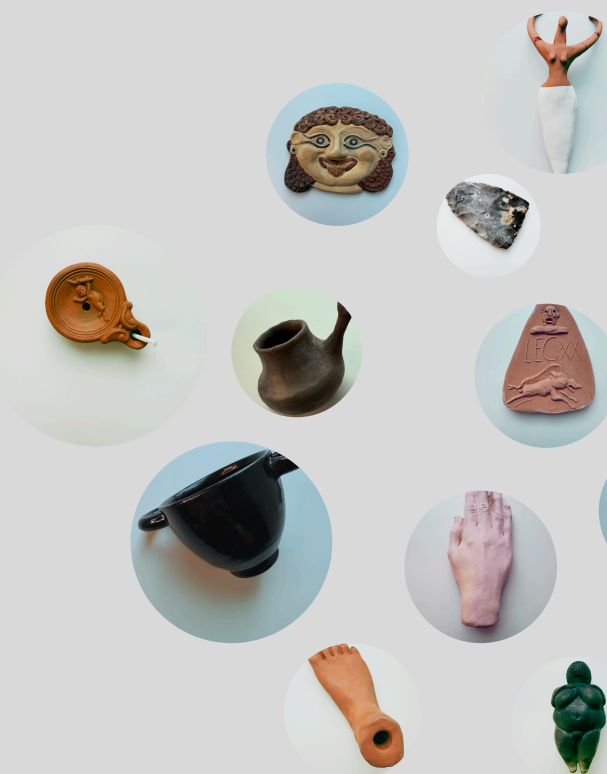
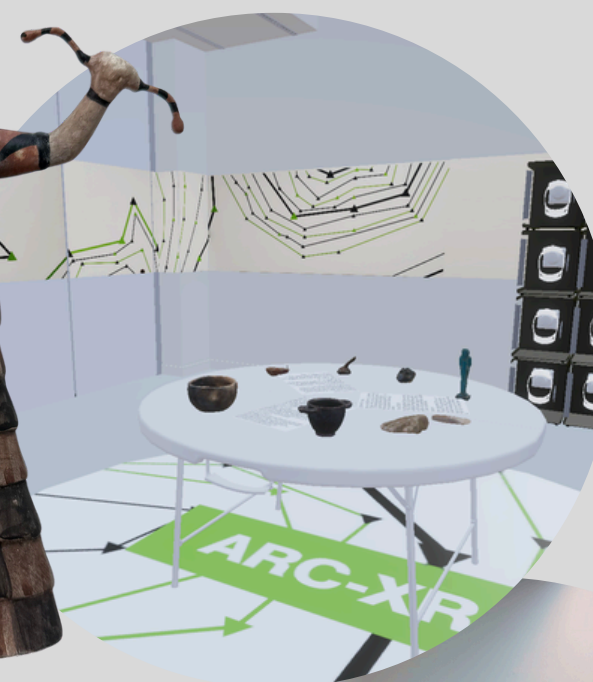
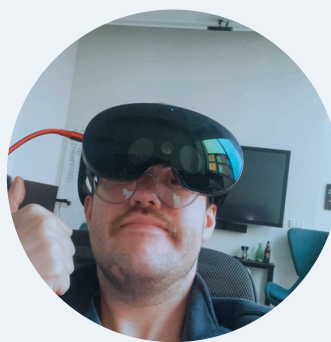
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FUTURE SOCIAL INTERACTIONS IN XR (FUSION)

- ERC-funded through UKRI guarantee project running until 2028
- Led by Dr Julie Williamson, Professor of Immersive Interaction, in the ARC-XR lab, School of Computing Science
- The aim is to merge physical and virtual social spaces through XR/VR tech to create rich human-to-human interactions
- Use of sensors and cameras to analyse gestures, voice, positioning, and other social signals in hybrid settings
- Try to build a cross-reality behavioural database to model social signals that persist across virtual and physical spaces

Meet the team



Research Questions

(RQ1) *Object turn taking*

How do participants interact with cultural objects in immersive virtual vs. physical environments?

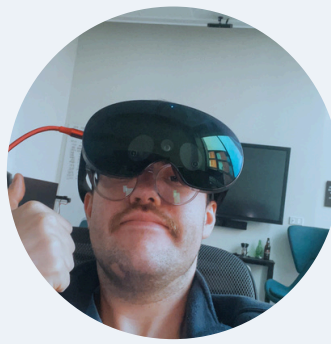
(RQ2) *Perceptions of authenticity*

Do participants perceive and reflect on the authenticity, function, and significance of cultural objects differently depending on virtuality and reality?

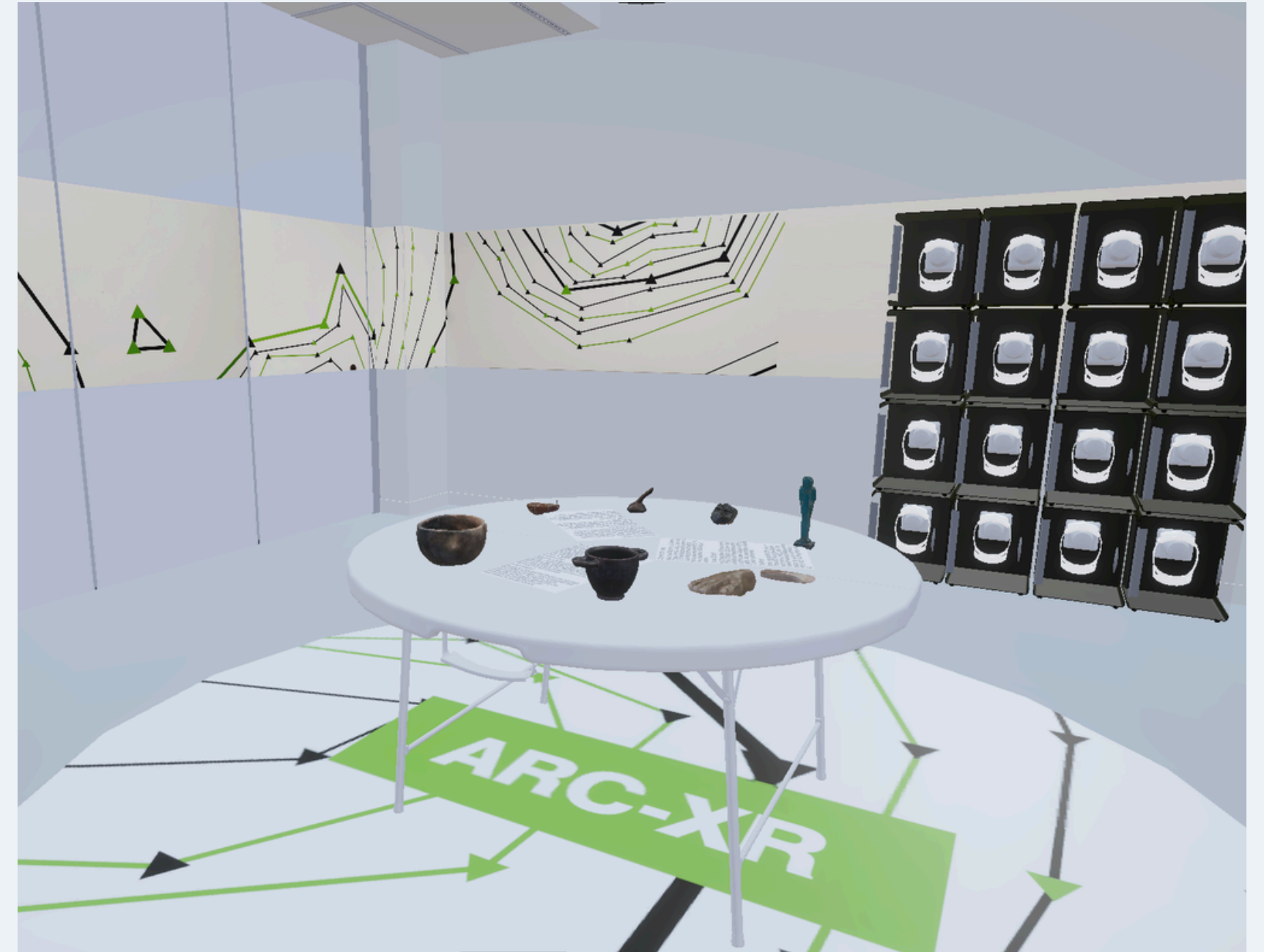
(RQ3) *Anchor bias*

Was anchor bias present between physical and virtual experiences?

Culture Heritage in social XR

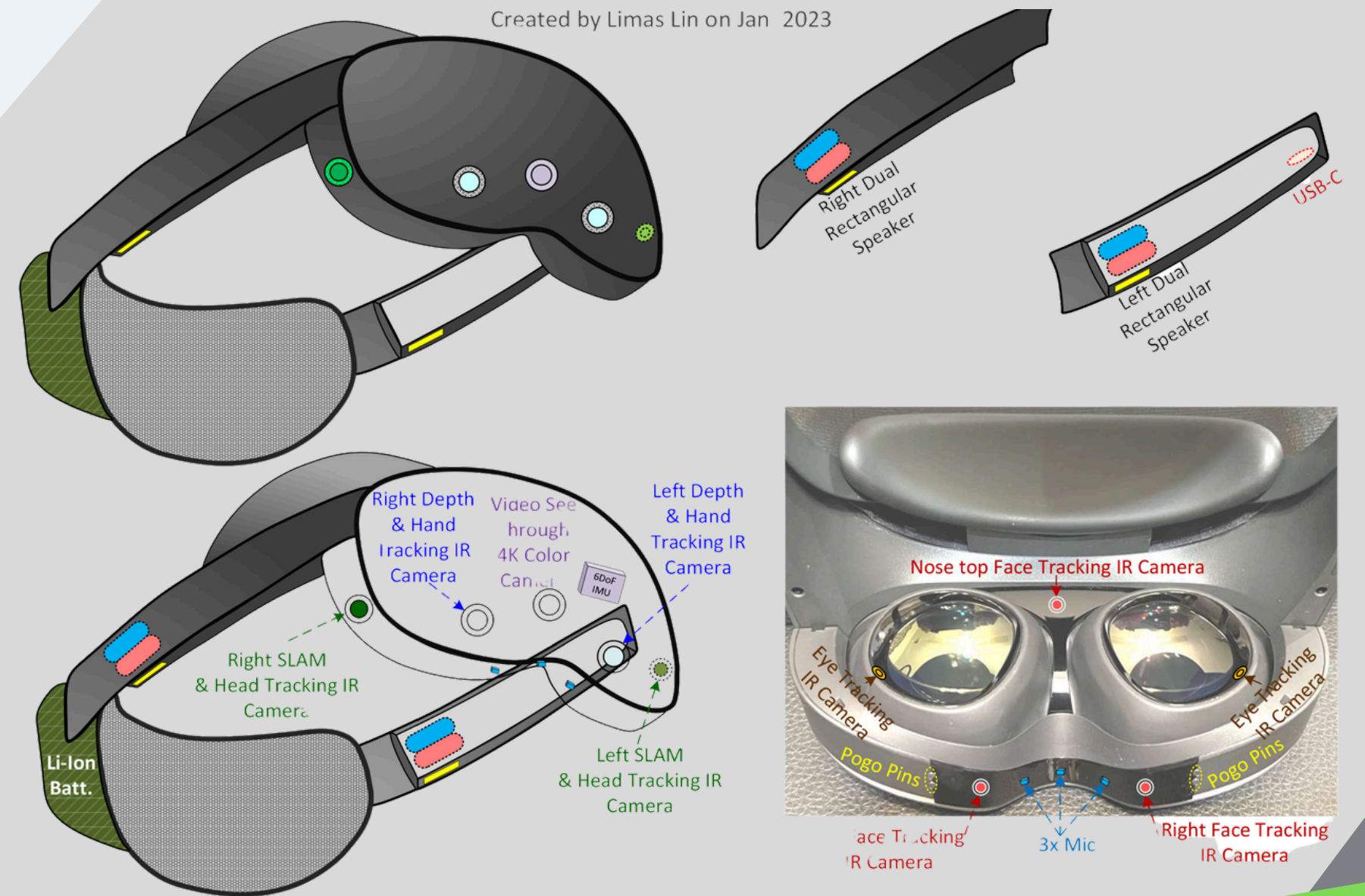
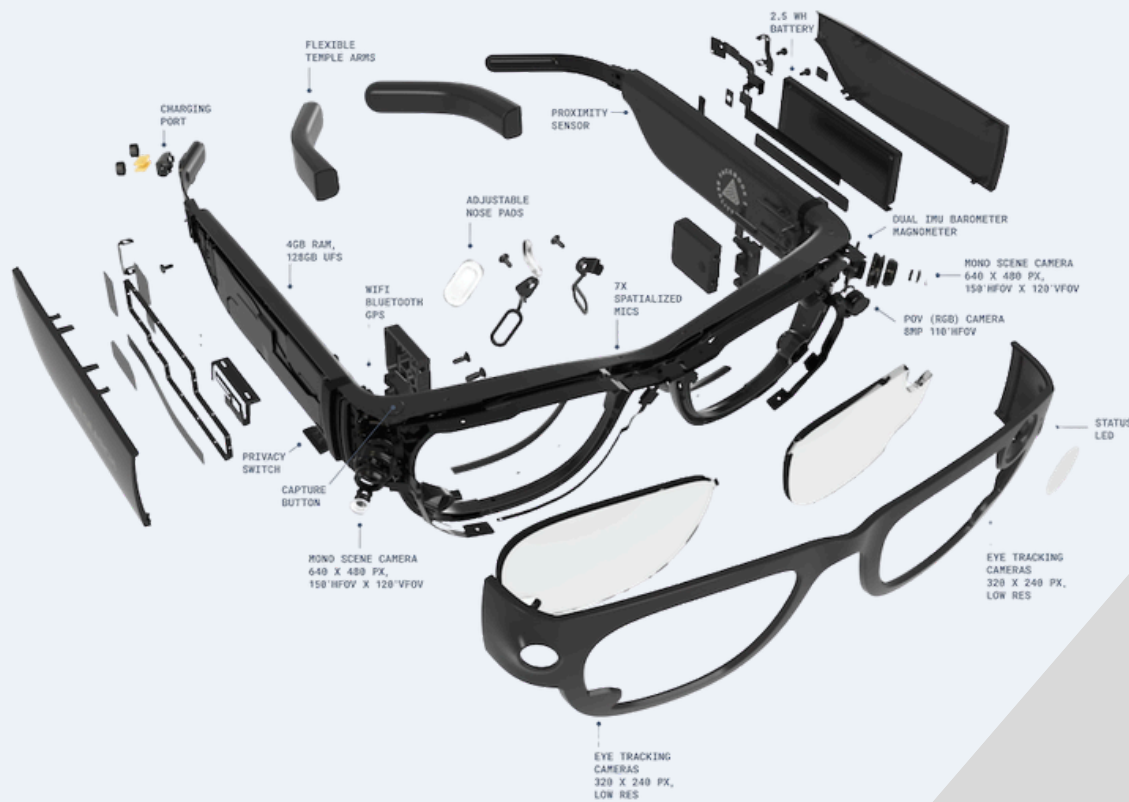
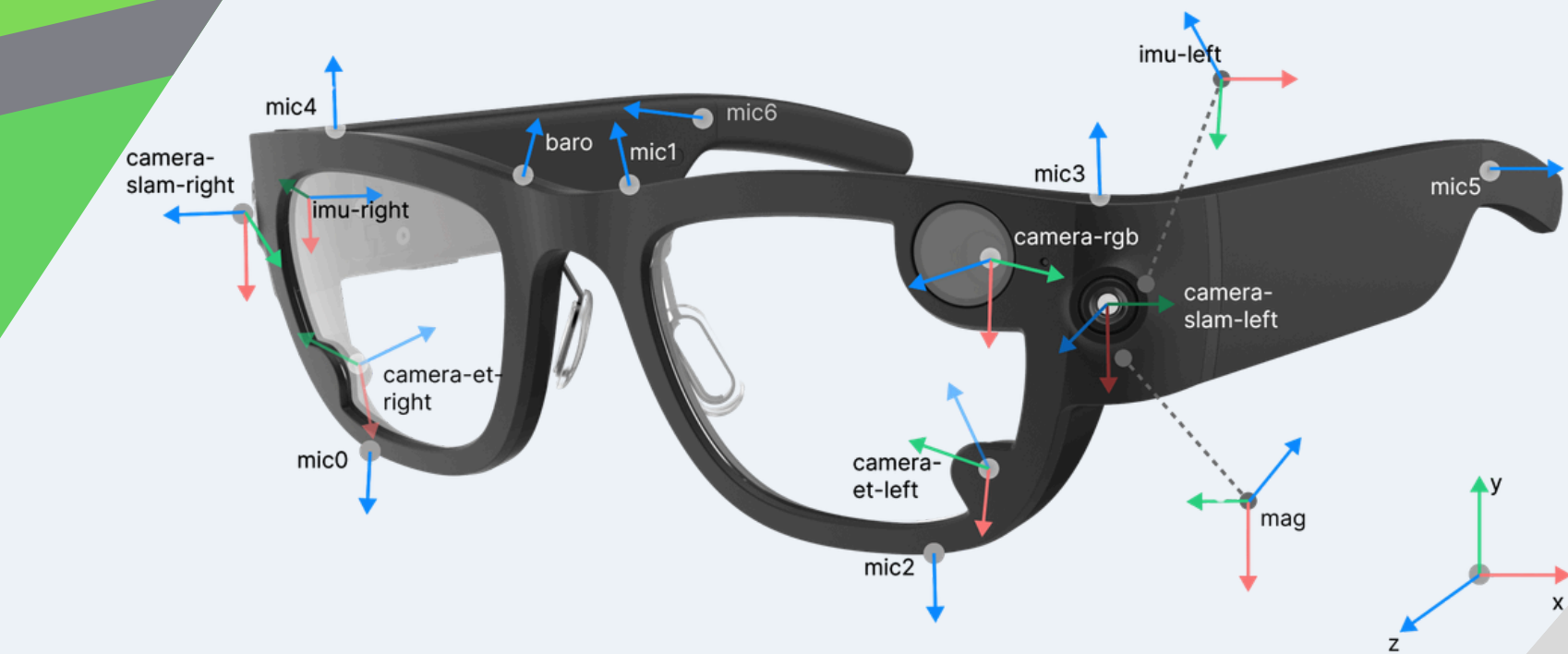


EXPERIMENTAL DESIGN ARC XR-LAB + DIGITAL TWIN



EXPERIMENTAL DESIGN

ARIA GEN 1 & META QUEST PRO VR



EXPERIMENTAL DESIGN

COUNTERBALANCED CONDITIONS

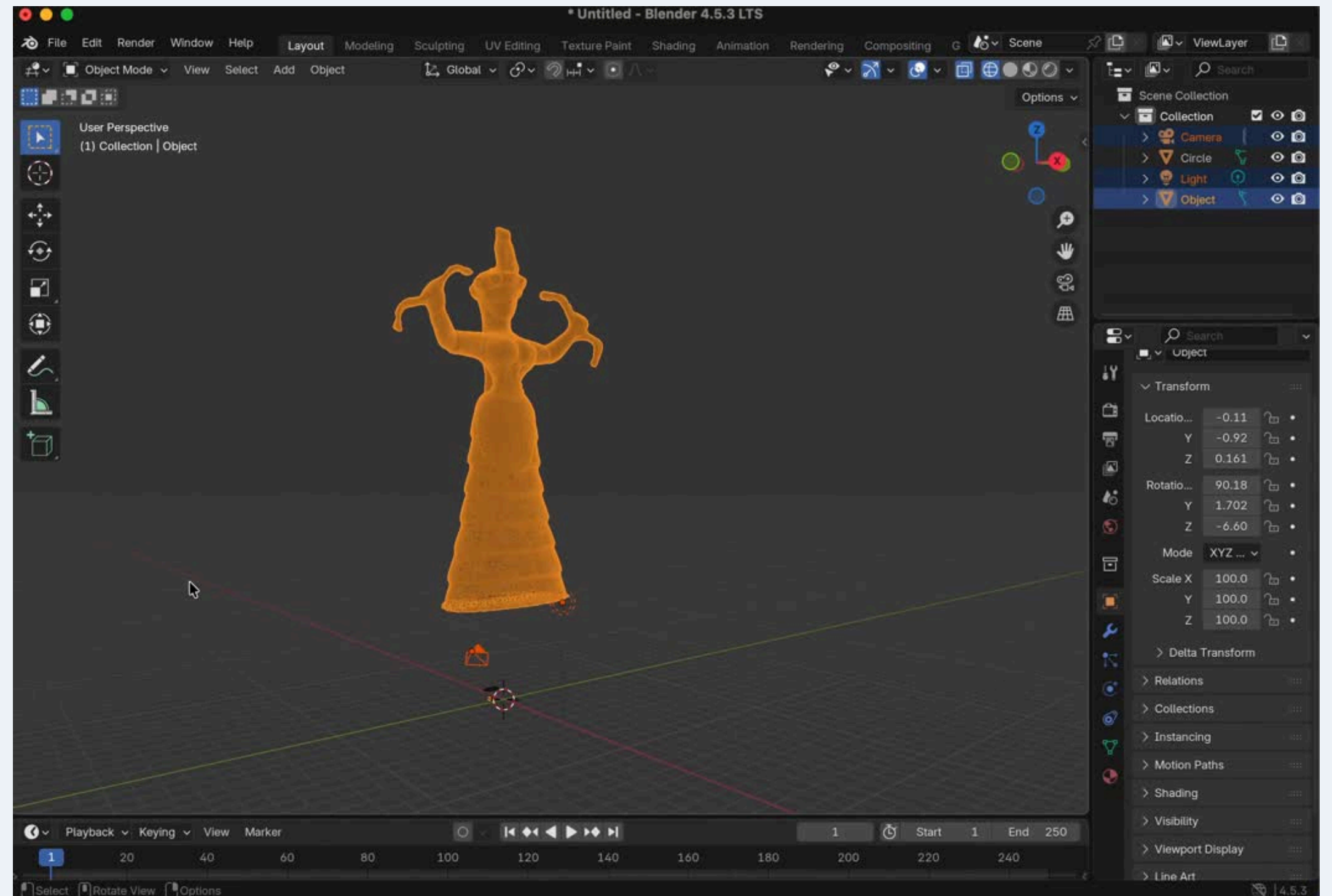
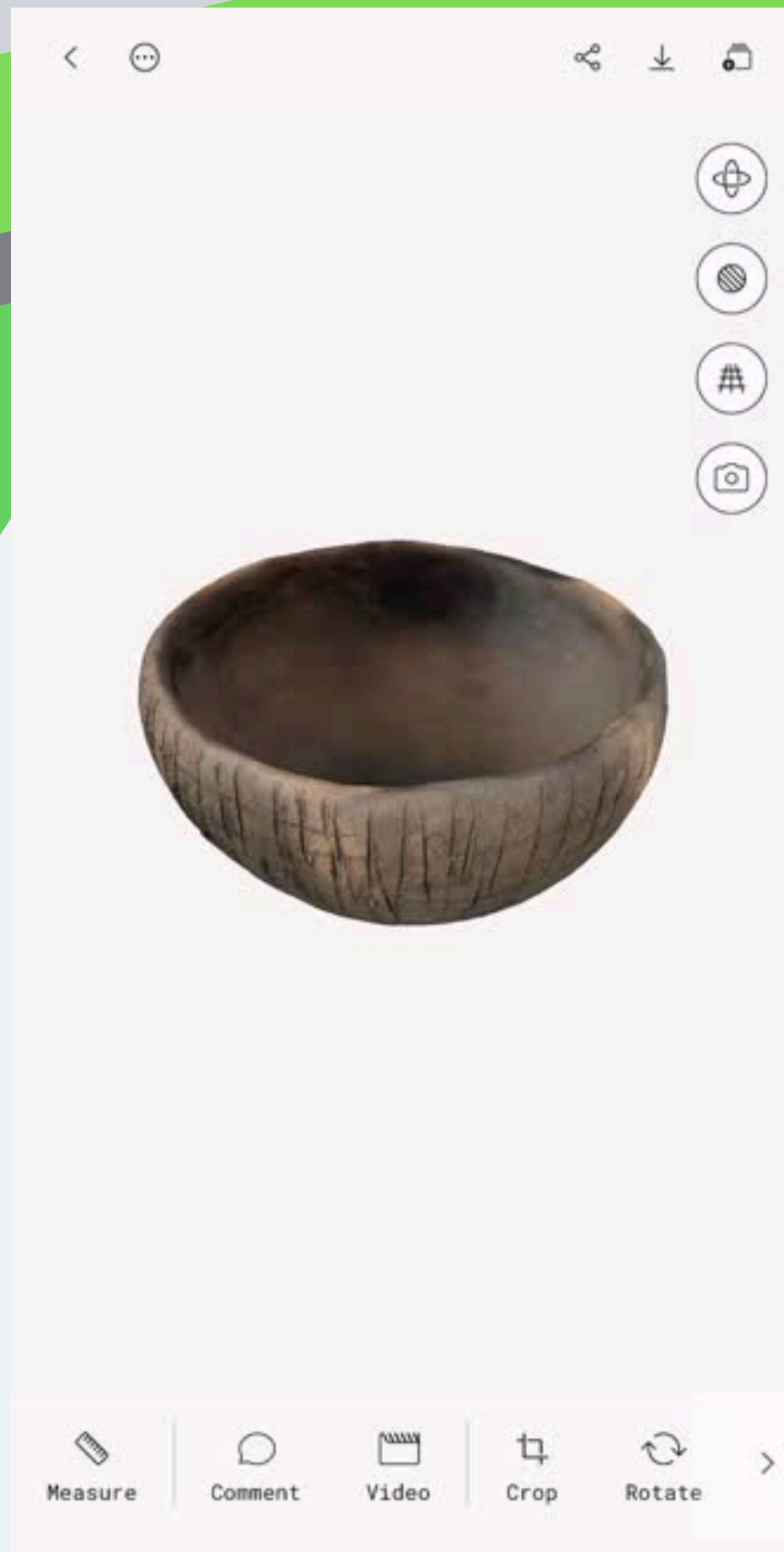
Group	Participants	First World	Second World	Set of Objects (first round)	Set of Objects (second round)
A	6	Virtual	Physical	1 - 9	10 - 18
B	6	Physical	Virtual	1 - 9	10 - 18
C	6	Physical	Virtual	10 - 18	1 - 9
D	6	Virtual	Physical	10 - 18	1 - 9

x2

CULTURAL OBJECTS



3D SCANNED AND RECONSTRUCTED OBJECTS



EXPERIMENTAL DESIGN TASKS



GROUPING OF OBJECTS

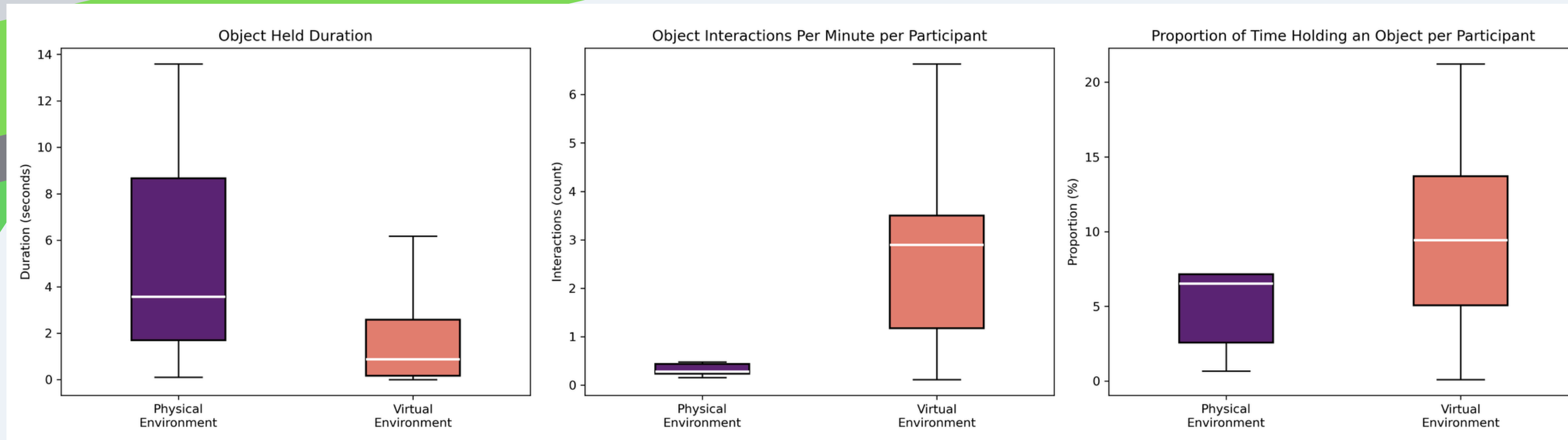


STORYTELLING

REALITY VS VIRTUALITY



RESULTS



RQ1 — Interaction with objects in virtual vs physical

Quantitative

Average individual object hold was longer in the physical environment (Wilcoxon Signed-Rank Test, $W=55$, $N=24$, $p<0.001$) - **people were holding objects for longer in Physical**

But, significantly fewer holds per minute (Wilcoxon Signed-Rank Test, $N=24$, $W=0$, $p<0.0000001$) - **people were not touching objects frequently in Physical**

Proportion of total time holding objects was lower in the physical setting (Wilcoxon, $N=24$, $W=42$, $p<0.001$) compared to the digital one - **people were reluctant to touch the replicas, but when they did, they held them for longer**

RESULTS

RQ2 — Authenticity, function, and significance across settings

- Authenticity and Accuracy emerged as a central theme
- Physical replicas were often treated as authentic, driven by perceived meaning rather than originality status
- Virtual replicas were engaged with more but perceived as less authentic, reflecting debates on aura and credibility in digital heritage
- Immersive experiences are more effective when they are perceived as credible and faithful to archaeological evidence
- Our findings echo and extend prior work showing a persistent preference for originals, crucially, a preference driven by perceived authenticity

RESULTS

RQ3 — Anchor bias across condition order

- Counterbalanced design tested order effects
- Clear anchor bias when the physical condition was experienced first (Groups B and C preferred physical afterwards)
- Mixed or weak anchor bias when VR was first (Group A showed signs of VR preference; Group D showed no consensus, inherent technical limitations, or motion sickness likely diluting anchoring)

TASK RELATED REMARKS

Grouping of Objects:

- funcional vs art/ritual/symbolic
- household/domestic vs decorative/ornamental
- tools/utility vs spiritual/healing vs military
- practical vs ornamental vs esoteric
- chronologically/geographically (Roman, Greek, British Bronze/Iron Age) vs powerful female characters
- practical vs supernatural/ritualistic
- drinking vessels vs utility vs ritual
- practical tools vs lucky objects
- female vs male objects
- followed the descriptions in the instructions

TASK RELATED REMARKS

- The avatars and the virtual environment helped people with the storytelling.
- Various degrees of following the archaeological information, from the actual use of the object all the way to aliens.
- People had a lot of fun while creating the stories in both environments.



TASK RELATED REMARKS

Storytelling Themes:

- death offerings and gravestones
- use of drinking vessels for various purposes
- social gatherings
- warfare and death
- female figurines being given as a gift for fertility to women
- death and superstition leading to the use of apotropaic symbols
- infidelity and revenge
- cooking and food processing
- family gatherings under oil lamp light
- accidents and healing offerings
- use of objects as representation of people (i.e. babyfeeder as a baby, handaxe as a father or a man)

TASK RELATED REMARKS

Storytelling Themes:

- fighting over the same lover
- mixing of herbal and medicinal substances in pots to heal painful body parts
- mermaids giving potions to their desired ones and praying to Cupid to help them
- Medusa and the Snake Goddess battling each other or being twin sisters and representing the good and the evil
- alien sisters falling from the sky and then trick people
- female battle between a goddess of fertility and a goddess of childless and carefree women
- drunk people making bad decisions

TASK RELATED REMARKS

Storytelling Themes:

- brother jealousy and violence
- non glorious deaths of soldiers, curses and misfortune
- breastfeeding mothers and mothers feeding babies their first solid food
- naming places and individuals in the stories (i.e. Domenico in Italy when talking about Roman objects)
- fires burning down houses
- a Neanderthal lighting the first spark of fire not knowing that hundreds of years later someone else is using the same fire
- people getting bitten by snakes and then ask for help and been given Snake goddess statues as a protection

TASK RELATED REMARKS

Storytelling Themes:

- people being wronged and then doing rituals to protect themselves
- Medusa working a 9-5 job and needing her special coffee cup
- people combining their stories and adding more details and (only) two stories about archaeologists discovering artefacts
- one of them about two archaeologists in love carrying artefacts in their pockets as their emotional support items!

GR_A2_SPEAKER 3:

‘I THOUGHT THE VIRTUAL WAS A BIT SAFER, I ASSUME, BECAUSE IN THE TASKS OF MAKING UP THE STORIES, HAVING THAT HEADSET ON, IT WAS WAY LESS EXPOSING. YEAH, BECAUSE AS SOON AS YOU WERE SEEING EVERYTHING, IT WAS LIKE, OH, I'VE GOT TO BUILD SOME BULLSHIT OUT OF MY BUM.’

GR_A2_SPEAKER 6:

‘JOYFUL, YOU KNOW, AS CARTOON CHARACTERS AND STUFF. IT WAS KIND OF PUT YOU IN A... NOT A SAFE MINDSET, BUT SORT OF A WHIMSICAL MINDSET, I WOULD SAY. SORT OF THAT, LIKE, WE'RE ALL JUST KIND OF MESSING AROUND. THERE'S ALL THESE CHARACTERS, AND THEN--OH, I WAS THROWING OBJECTS AROUND.

YEAH, SO IT WAS QUITE SILLY. SO THEN YOU COULD JUST SORT OF DO ANY STORY, YOU KNOW?’

GR_C2_SPEAKER 7:

‘I THINK I FELT THAT IN THE VR, MAYBE BECAUSE IT WASN'T REAL LIFE, IT MADE ME FEEL A BIT MORE CREATIVE IN COMING UP WITH THE STORY. I THINK WHEN WE WERE JUST DOING IT IN PERSON, I FELT A BIT RIDICULOUS TO SUGGEST THINGS. I CAN HAVE A BIT MORE FUN OR CREATIVITY WITH IT.’

INTERESTING POINTS FROM THE RTA

The avatars felt like personas and characters rather than people (embodiment?)

GR_B2_Speaker 4:

‘Oh your your character has like this colour of leotard, your character has a moustache and then obviously we're like stealing people's objects and stuff.’

GR_B2_Speaker 2:

‘Yeah. So you're in a room with people like fake characters you don't know so you can just talk but then I would talk to everyone anyway. [...] but I think when you've got the headset on and everyone's a different character there's none of that pressure or like unconscious bias or anything like that [...]’

GR_B2_Speaker 5:

‘[...] because there's a mask as well obviously not a real mask but no one can sort of see each other essentially what the actual actors are than obviously anyone I'm not particularly shy myself but It takes away that element, so you almost feel like you're in a different world, and therefore people tend to get a little bit more confident in those scenarios, comparatively. So relax. It was really fun.’

INTERESTING POINTS FROM THE RTA

People were impressed by how quickly they got immersed and adjusted to the VR environment.

GR_B2_Speaker 2: 'I lost my free will in there because I was like there's a you know what I mean we did all stand around the table.'

People mentioned touch quite a lot.

GR_C2_Speaker 7: 'Because it was quite nice to feel like the weight of it, I think, in your hand.'

Fun and playfulness are very much related with VR - maybe something to think about?

GR_B2_Speaker 2: 'Your inner child was definitely in that room.'

People didn't want to move much in the VR environment. GR_D2_Speaker 4: 'Didn't do a lot of actual moving around the room, so...'

LIMITATIONS AND NEXT STEPS



Use of controllers - hand tracking



Inherent technical limitations of current headsets, which might have hindered the anchor bias



Further analysis on turn-taking is possible with current and future data



PRACTICAL TAKEAWAYS



Expect higher interaction rates with virtual objects and design for safe, comfortable handling.



Support authenticity through credible detail and transparent context in both physical and virtual experiences.



Measure and report anchor bias systematically as part of XR evaluation.



Think or plan for social etiquette design choices in multiperson XR.



Consider playfulness and the role of avatars in the experience.



Consider including storytelling, as it's a great tool for engagement in XR.

THANK YOU!

