TERM
PROJECT

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PUZZLING PLACES

IMMERSIVE 3D JIGSAW PUZZLE

Domain:
- 3D jigsaw puzzle game

- Available on Apple Vision Pro Version 1.0 and above

Functionalities:
- Assemble highly detailed, photorealistic 3D models.
- Engage with puzzles in a spatial and lifelike VR environment.
- Use natural hand movements to pick up, turn, and place puzzle pieces.
- Use eye-tracking and easy-to-use controls for smooth interaction.
- Enjoy relaxing sounds that change as the user solves the puzzle, creating a calming experience.
- Work on puzzles while multitasking with other apps in Apple Vision Pro's Shared Space.

Company/Price:
- Developer: Realities.io Inc.

- Price: Free to download with in-app purchases for additional puzzle packs.
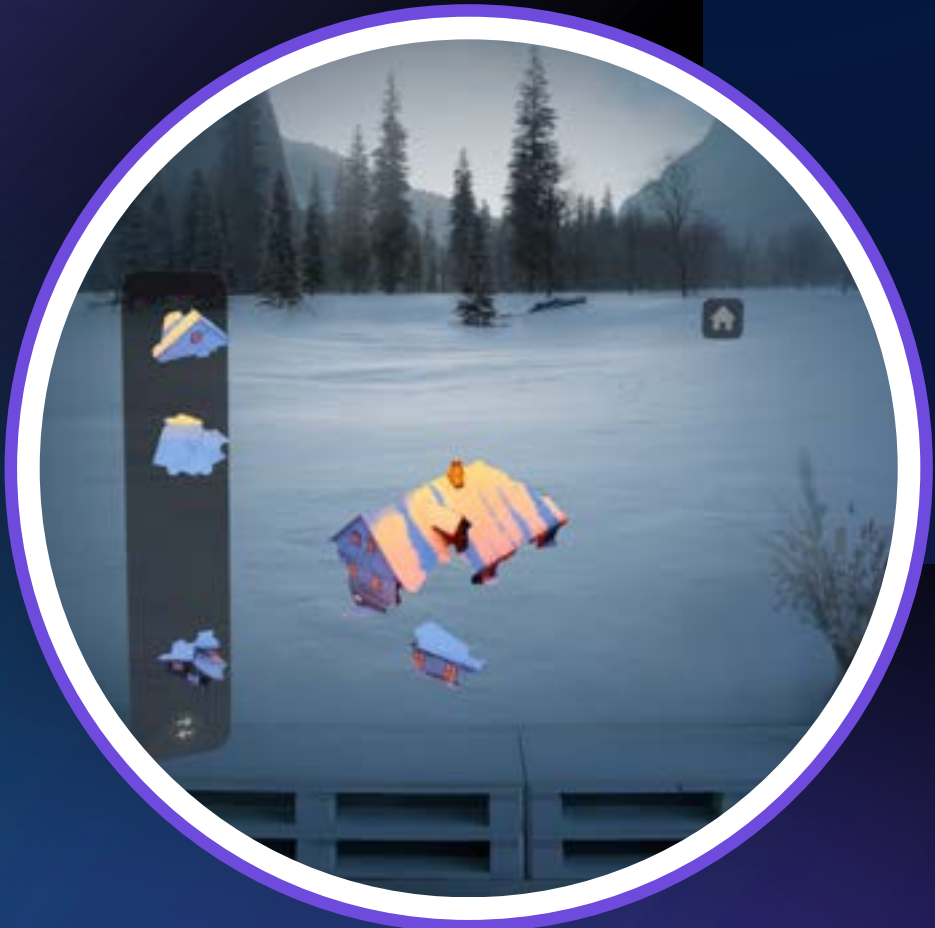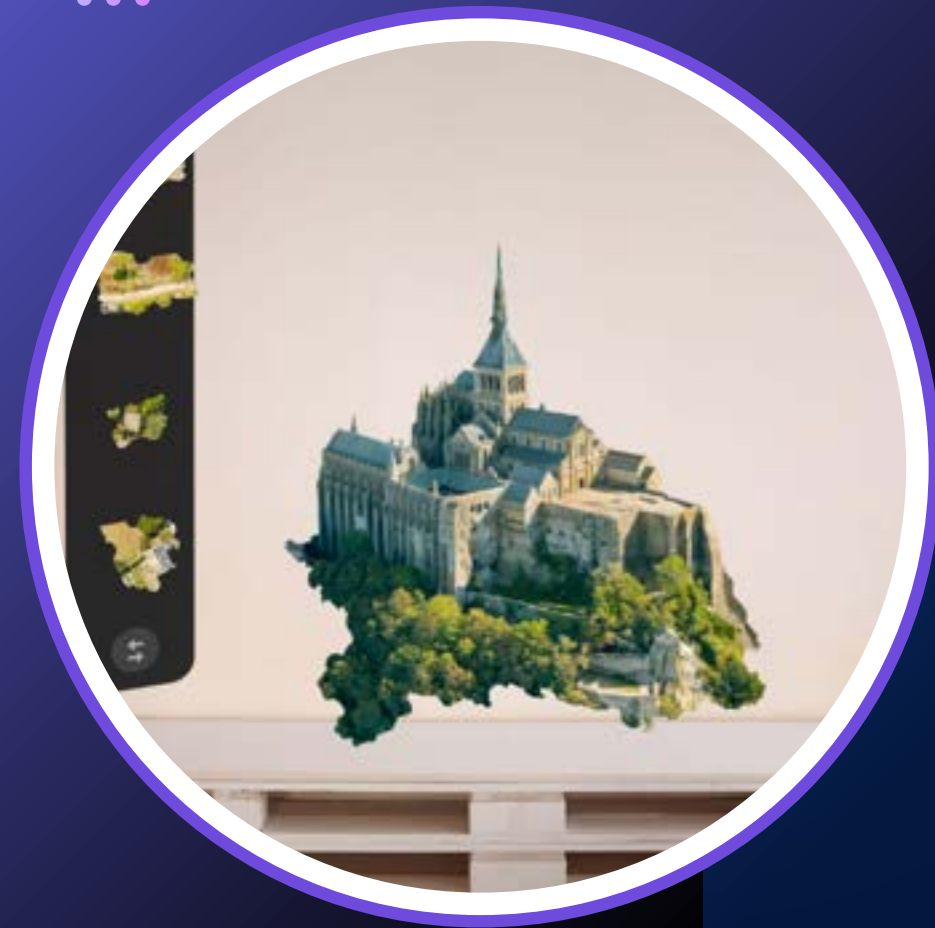
LITERATURE REVIEW FINDINGS

- **Usability and Comfort**

In VR games, users appreciate intuitive and immersive experiences but also face challenges with comfort, control, and usability. We need smooth interactions, especially with VR features like eye tracking and hand gestures.

- **Immersion is Key**

VR and AR games are most engaging when they make players feel fully "inside" the experience. Adding realistic visuals, spatial audio, and the ability to explore puzzles from different angles, as suggested in one study, can improve the immersive experience.

- **Spatial Awareness and Physical Adaptation**

Games should adapt to the user's physical environment to create a stronger emotional connection and enhance immersion. The gaming applications can integrate spatial awareness, allowing users to view puzzles from different angles in their physical space.

USER STUDY PROTOCOL & METHODS

Introduction and Consent

- Participants were greeted and introduced to the study's objectives, emphasizing that the focus was on the app's usability, not their problem-solving skills.
- Consent was obtained through a written form and oral confirmation, ensuring participants were aware of potential risks (e.g., motion sickness) and their right to withdraw at any time.

Pre-Experience Questionnaire

- Participants completed a Google Form with demographic questions and prior VR experience to understand their background and potential influences on gameplay.

Tutorial Session

- Participants watched a short tutorial video (*A Guided Tour of Apple Vision Pro*) to familiarize themselves with the device and interaction techniques.
- After the tutorial, participants practiced basic device operations (e.g., navigating menus) to ensure confidence before the task.

USER STUDY PROTOCOL & METHODS

Gameplay Task

- Participants launched the *Puzzling Places* app on the Apple Vision Pro and attempted to place three puzzle pieces into the correct positions within five minutes.
- We monitored gameplay to observe interaction patterns, comfort, and task success.

Post-Experience Questionnaire

- After gameplay, participants completed a Game Experience Questionnaire (GEQ) to rate their experience across seven dimensions: Sensory and Imaginative Immersion, Flow, Competence, Positive Affect, Negative Affect, Tension, and Challenge.

Post-Task Interview

- Participants participated in a semi-structured interview to share qualitative feedback on their experience, focusing on usability, immersion, and areas for improvement.

PARTICIPANT DEMOGRAPHIC

Gender: 1 Male
VR Experience: None (0)

Gender: 1 Female
VR Experience: Moderate (1–10)

ENVIRONMENT SETUP

Location: User Studies Lab

Recording: Mirroring&Video

Tracking: Timer

TASK SETUP

1

Demo Video
Vision Pro
Navigation

2

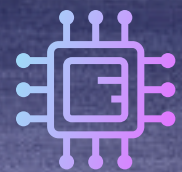**Open the App**
Find Puzzling Place
app and open it

3

Puzzle Task
5 minutes to fit the
first 3 puzzle pieces

4

Time Tracking
Time tracked for
first 3 pieces

PARTICIPANT 1

PARTICIPANT 2

GROUP 5

WHAT WORKED WELL

Ease of Learning

Video clarified device basics. Participants adapted to VR quickly due to the interactions suited their mental model

Task Setup

The task setup hepled the users to navigate better and us to monitor

Engagement

Puzzle was fun and immersive boosting engagement.

GROUP 5

WHAT DIDN'T WORK WELL

Technical Glitches in Screen Mirroring

Glasses Compatibility

Overwhelmed Novices

Small Sample Size and Minimal Diversity

WOULD CHANGES BE INCORPORATED

- Enhancing Onboarding Experience
- Enhance Accessibility for Users who wear Glasses
- Customized Tutorials
- Inclusion of Broader Demographics

USER PERFORMANCE DATA

Task completion times: Both the participants aced the tasks with definitive time taken for each step ranging from getting used to headset physically and optically, navigation, features, app functions, misclicking, etc. The average times for a new user (P1) and the mediocre user (P2) were the similar. The new user (P1) was taking a little more time to get started but they caught up to the mediocre user (P2) after getting the hang of it.

Success rates: Both the participants successfully completed the tasks without needing any type of technical assistance or otherwise. The success rate for P1 and P2 combined were 100%. The demo was helpful for both the users cause they had never experienced the Apple vision pro.

USABILITY QUESTIONNAIRE RESULTS

The post-experience usability questionnaire revealed insights into user satisfaction and interaction quality across multiple dimensions, summarized as follows:

Sensory & Imaginative Immersion

Both participants appreciated the detailed 3D visuals and spatial audio, rating this aspect highly.

Flow & Competence

The intuitive gesture-based controls allowed users to feel progressively competent, though initial navigation posed minor challenges.

Positive Affect

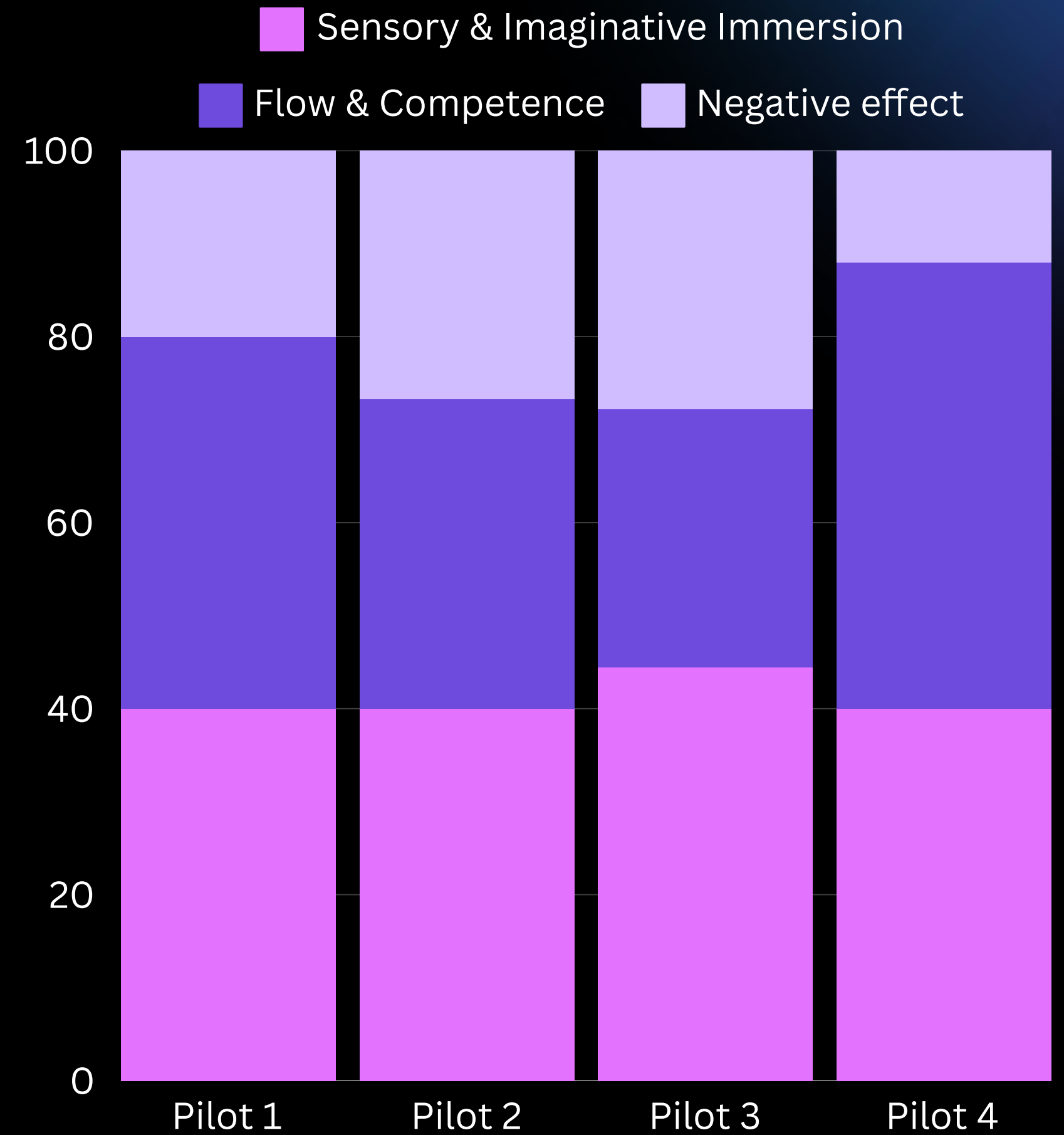Both participants enjoyed the experience, citing engagement and a sense of accomplishment upon completing tasks.

Negative Affect

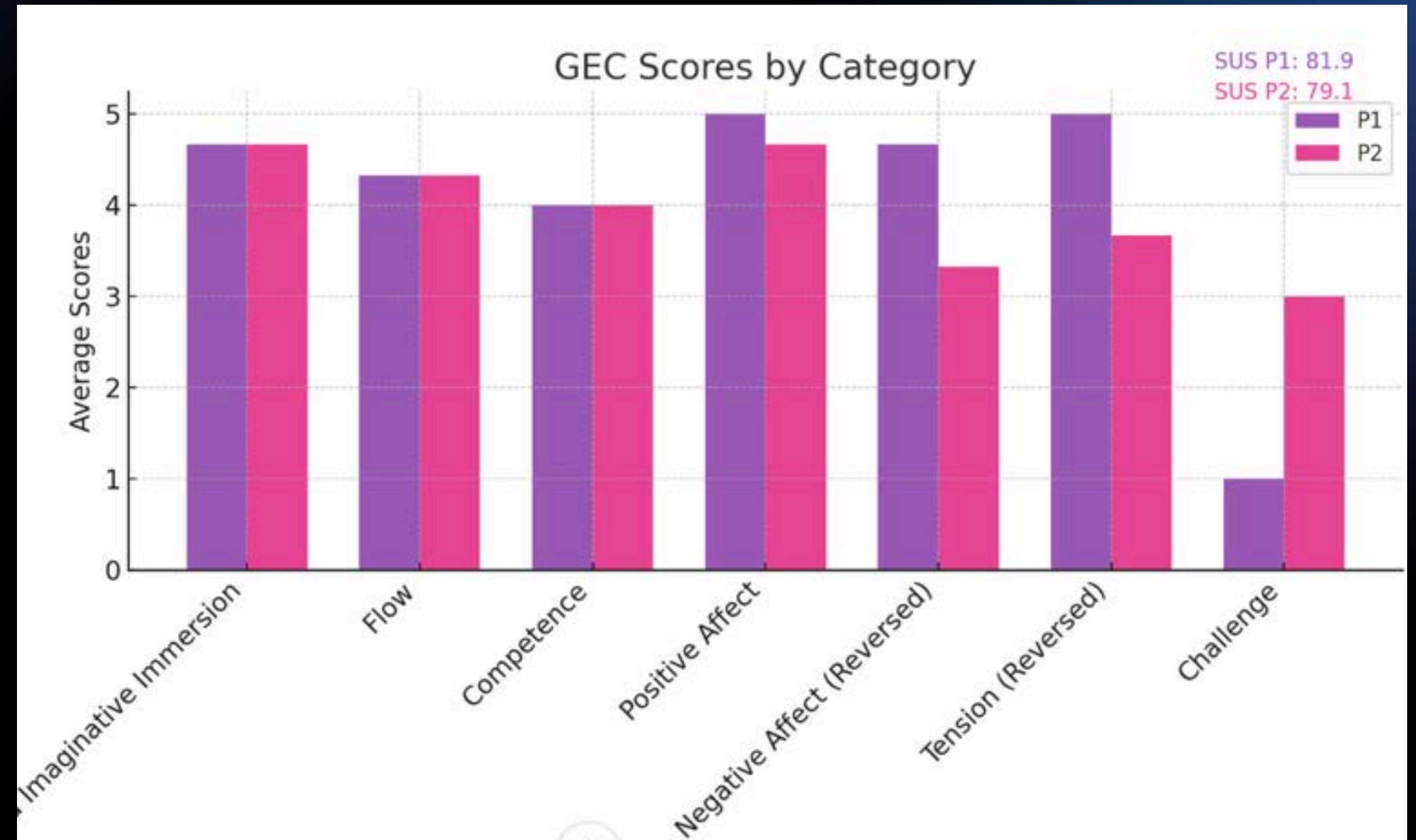Minimal frustration was reported, primarily during initial interactions with object rotation and navigation.

USABILITY GRAPH

The categories represent key components of the game experience, with reversed scores for Negative Affect and Tension to align them positively for comparison.

GEC Scores by Category

SUS P1: 81.9
SUS P2: 79.1

Average Scores — categories: Imaginative Immersion, Flow, Competence, Positive Affect, Negative Affect (Reversed), Tension (Reversed), Challenge

Legend: P1, P2

Here is the graph comparing the **GEC (Game Experience Components)** scores for P1 and P2 across the categories. The SUS **(System Usability Scale)** scores for each session are as follows:

SUS P1: 93.3
SUS P2: 86.7
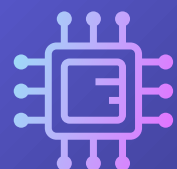
CHALLENGES / USABILITY PROBLEMS 1

Fear of Puzzles

Both users were apprehensive about doing a puzzle solving task **where their strategies would be monitored live by our group.**

P1: "I've been bad at puzzles since I was born."

P2: "You guys didn't tell me it was a puzzle."
"Is this the same one he did? Or is this one harder?"

CHALLENGES / USABILITY PROBLEMS 2

Piece/House Rotation

Both users mentioned problems with rotating puzzle pieces and the house.

P1: "I had trouble rotating the pieces, so I had to rotate the house instead. I was thinking I could rotate the piece but I couldn't."

P2: "Were you guys turning the house? It was turning on its own?"

"It took a while for me to actually get used to it. The rotation part of it was a little bit hard, but most of it was fun."

"Turning around the house - that part was a little bit tough. Grabbing the pieces and finding it [the spot where it fit] was okay, but turning the house - I wasn't able to figure it out.

CHALLENGES / USABILITY PROBLEMS 3

Unaware of More Puzzle Pieces in Side Menu

Both users were surprised when they were informed there were more puzzle pieces to choose from on the side menu that had to be access by scrolling down.

P1: "3 more pages?"

P2: "More pieces?!"

SUGGESTIONS FOR IMPROVEMENTS

Object Rotation Guide

Incorporate object rotation guide in Apple Vision Pro tutorial or at the beginning of the app itself.

Better Feedback

P2: "Probably better feedback. Things highlight when we see them, but audio and some other indications would have been better."

Side Menu Expansion

Because both users had trouble seeing all the puzzle pieces available, a larger side menu or a menu that is constantly scrolling might help users finish puzzles faster because they are aware of more pieces.

Easy Tutorial Puzzle

It might benefit the app to add smaller, simpler tutorial puzzles to enhance user confidence and inspire them to attempt the more complicated puzzles in the real game.

REFLECTION ON THE STUDY

More Data

Make sure questionnaire questions are structured to provide long answers (more data).

Mirroring Issues

Mirroring with VR headsets can be difficult and can change the experience of the participants in the study.

Written Responses

Having participants type responses within a text-box of a certain size might encourage longer and/or more thoughtful responses.

Observation Room

Group members could have moved to observation room in order to make participants feel more comfortable solving puzzles during the task.

REFLECTION ON THE STUDY

Evaluation Method

Video recordings enabled detailed analysis of user interactions, capturing insights missed during live observation.

Background Effect

The dark background helped users stay focused and made the VR experience more real by reducing distractions and break in presence.

Visibility Feature

Indicating more pieces at the bottom with visual cues encourages scrolling and increases user awareness.

Tutorial Impact

Both participants performed better and faster in completing puzzles, demonstrating the effectiveness of the tutorial on the device. The same can be followed with tutorial of the app.

CONCLUSION

- The app creates a highly immersive experience with realistic 3D visuals, spatial audio, and tactile feedback.

- Both participants completed tasks, demonstrating the app's accessibility and functionality.

- Identified issues include difficulties with object rotation, navigating the side menu, and compatibility for users wearing glasses.

- Participants highlighted the need for improved feedback mechanisms and simpler tutorial puzzles to ease the learning process.

- The study emphasized the app's ability to engage users effectively while identifying areas for further enhancement in usability and onboarding.