Exploring players' adaptation to non-Euclidean video game environments

Video Games for Research

Group 4

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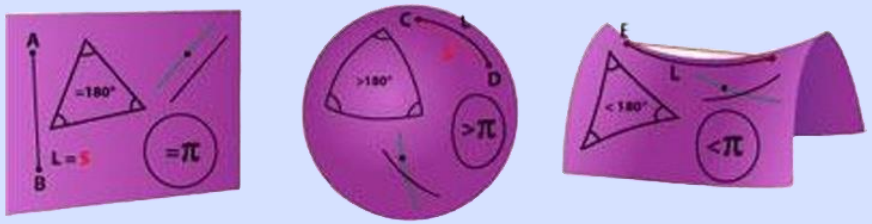
Introduction

- **Euclidean Geometry** is the geometry of the plane (zero curvature) and consists of specific axioms (Postulates of Euclid)
- **Non-Euclidean Geometries** are all geometries where some of these axioms do not apply
- **Motivation:** Non-Euclidean game mechanics are currently trending (infinite loops, forced perspective, gravity manipulation, shifting between 2D and 3D)



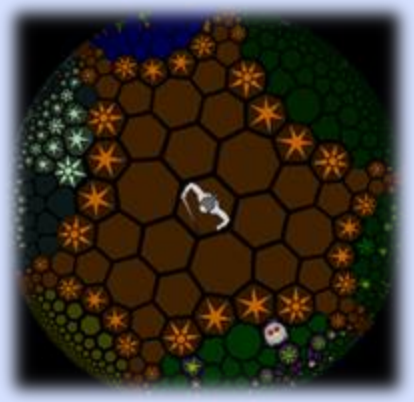
Euclidean **Elliptic** **Hyperbolic**

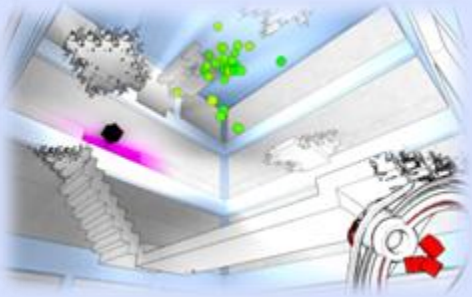
Non-Euclidean

Image from https://elikakurniadi.wordpress.com

Research Question

- *"How do players adapt to non-Euclidean video game environments?"*
- **Hypotheses:**
  1. *Non-experienced players struggle to navigate*
  2. *Players who play action video games have greater visual attention in the game area and therefore perform better* - Pöhlmann et al. (2022)
- Non-Euclidean games VS games with Non-Euclidean mechanics

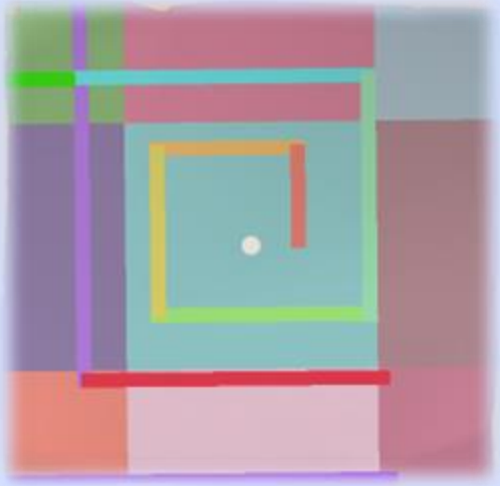




Images: Hyperbolica, Portal, HyperRogue, Non-Euclidean Chess, Antichamber

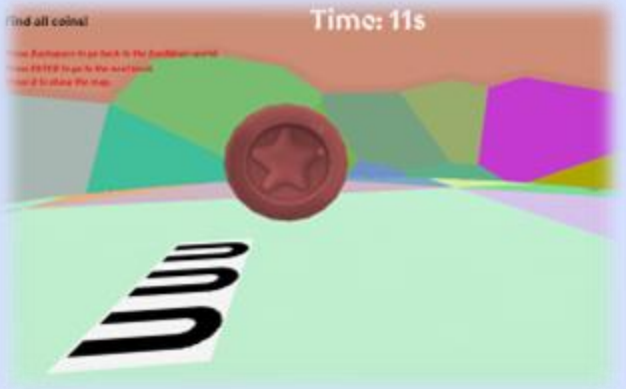
Research Method

- **Survey**
  - 22 participants (mostly 22-26 y/o)
  - Pre-survey
    - *Gaming background (e.g. playtime, genres)*
    - *Familiarity with non-Euclidean games*
  - Euclidean VS Non-Euclidean game
  - Post-survey
    - *Experience while playing the game*
    - *Opinions on aspects of the levels*
- **Demo!**



Euclidean

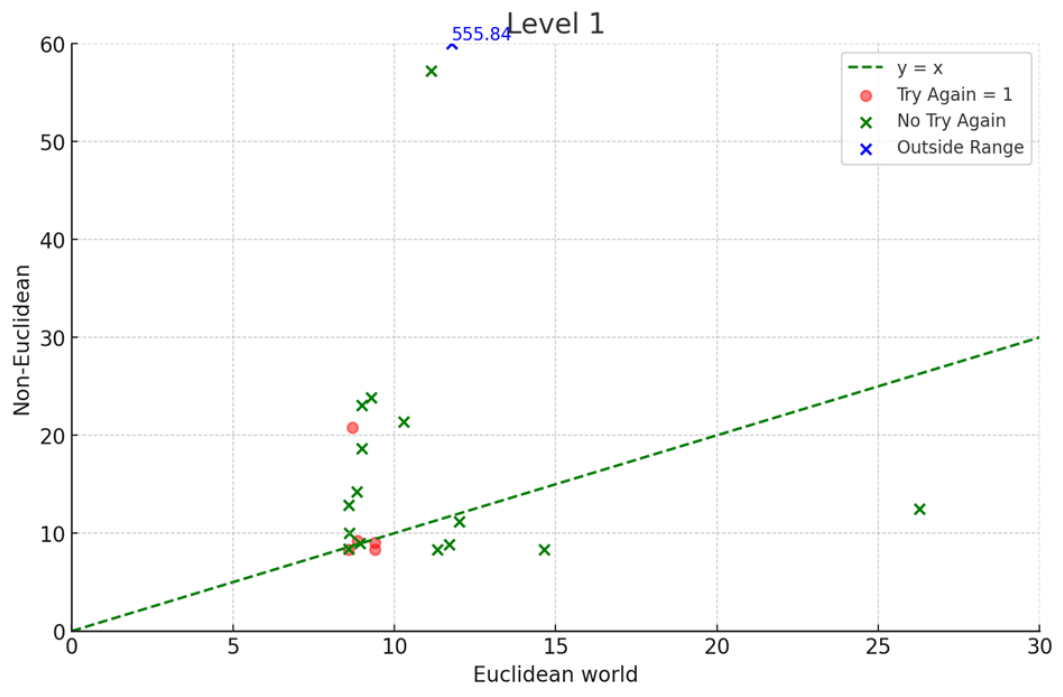
Non-Euclidean

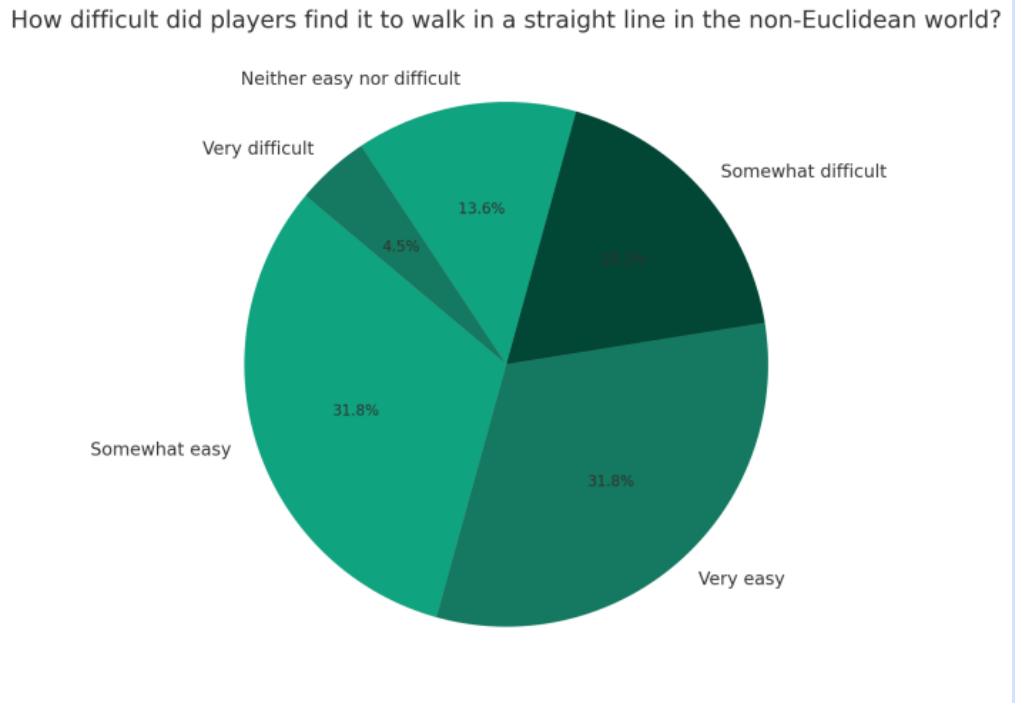


Try the game! https://play.unity.com/mg/other/vg4r_web

Results

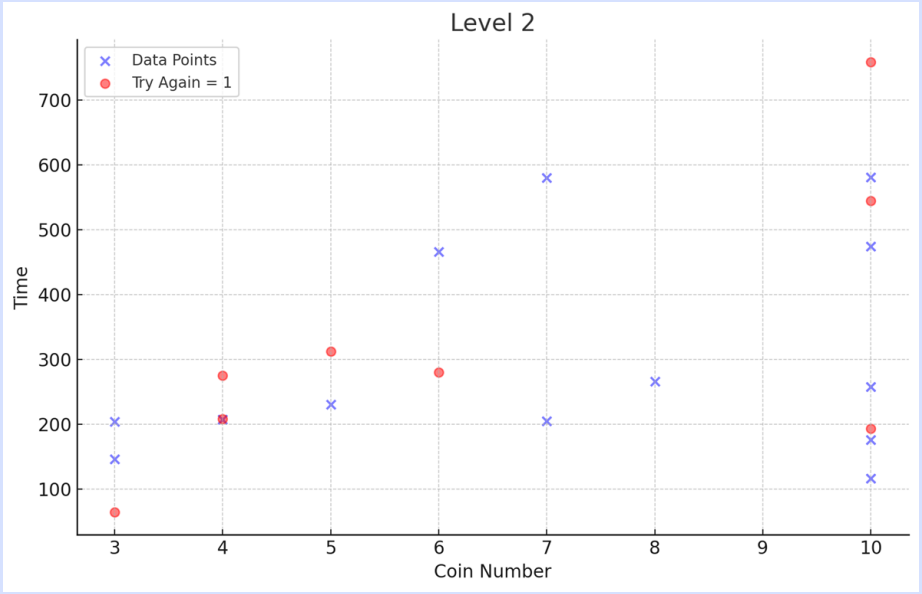
- Level 1
  - Can players **go straight** in the non-Euclidean environment?
  - How well do they adapt?

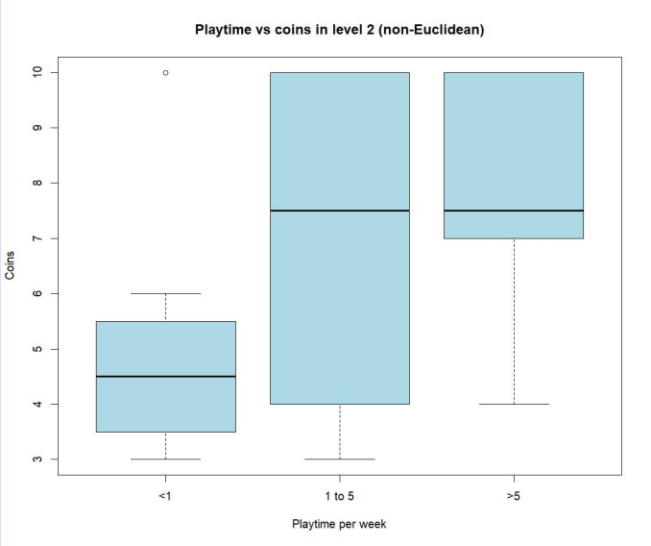




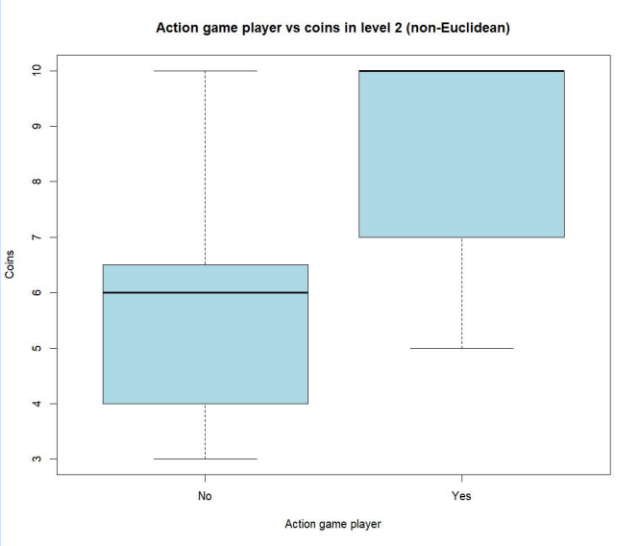
Results

- Level 2
  - Can players find all the coins?
  - How well do players adapt to the non-Euclidean environment **with only map markers (letters) and a few reference objects?**
  - Which factors are relevant?





Hypothesis 1

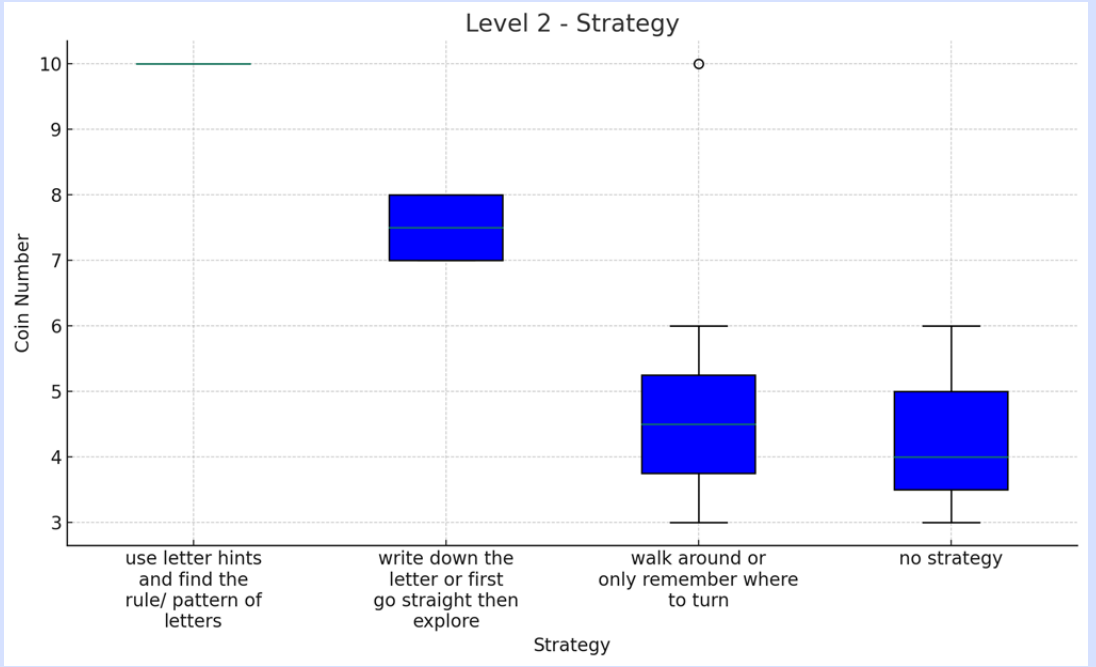


Hypothesis 2

Results

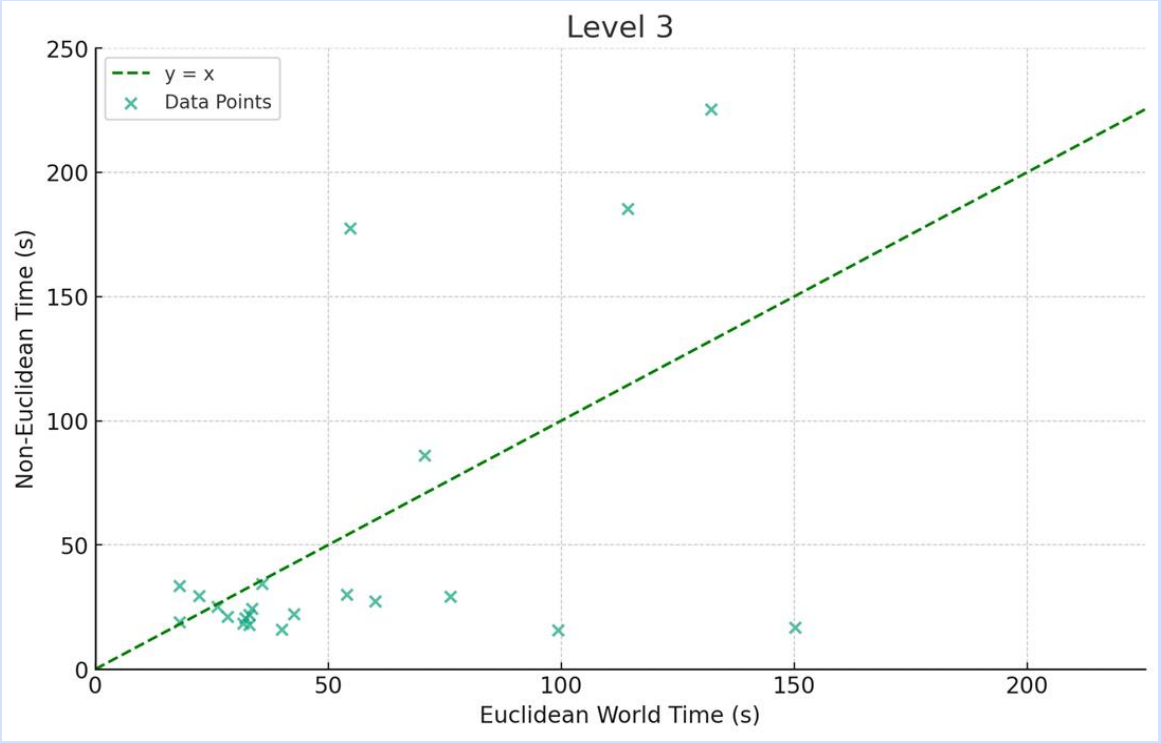
- Level 2
  - What is the player's navigation **strategy** in the non-Euclidean environment?

Both Euclidean and non-Euclidean worlds in level 2 included some mathematical symbols. Did you use them while playing the game? If yes, how?	Do you think the mathematical symbols made the directions clearer or more confusing for you?	Describe the strategy you used to find coins in the non-Euclidean world.	coin number
I used them as checkpoints to see if I crossed the same point twice	Clearer	I didn't manage to find 2 counts in the non Euclidean world.I don't know their location	8
No	Yes but didn't pay attention	Non Euclidean level 2 couldn't find 4	6
yes, i used the arrows	yes	i gave up	3
No	Didn't change much	Remember the combinations of directions (like RRRDDD) and walk to them from the origin point	7
No	No	No	4
I saw a pic and didn't use it	No	Followed the colors	5
No (but i used the letters)	Letters helped. Others i did not notice	I notes the positions on the euclidean world (letters) and used them to navigate (L-left. Etc.)	10
They were my only points of comfort, the only friendly spaces in the world. I still got lost anyway.	It was confusing anyway	First go in straight lines from the center, then suffer and wander aimlessly	7
Yes! They describe the steps you need to take to get to the coins	Clearer	Follow the instructions on the ground	10
Didn't use	I didn't think about it	I first looked around but it didn't work, so i started using the map to look for squares with repeating letters in groups of 3.	10
No	N/A	Just explore	3
I didn't use them to navigate but I used them to confirm that I'm not taking the same path twice	Neither	At first I went straight and then I explored the furthest corners of every direction (U,D,R,L) which helped for the first coins. Then I got lost	8
Yes	A bit clearer but still needs a lot of thinking	Record the route and the symbols	5
No	More confusing	Count the squares and directions in reference to the beginning square	10
No	I didn' t notice that is a mathematical symbol	Trying to remember where should I turn the direction	4
I use it to relocate my position	Clearer	I supposed to use drawing to map the coins, but I didn' t	6
No	-	Memorizing	4
Of course. There was a clear pattern in the coins position. It took me a while to understand how the map "worked" in the non Euclidean world	Clearer definetly	3U, 5U then 3L, 5L, then 3D,5D, then 3R,5R then 3U. And the two remaining letters where always filled with the previous one. So from U you merge it with L and then you merge it with D ecc ecc	10
no	Useless	Walking around	10
No	More confusing	I followed patterns since I found most at places with 3 or 6 consecutive characters at first try. At the second one, I noticed the exact patterns.	10
never even noticed them	never even noticed them	brute force and coordinates	10
No	No	Walking around	3



Results

- Level 3
  - Can players find the coin in the non-Euclidean world **faster** when they know where the coin is **in the maze** in the Euclidean world?
  - Always visible reference objects and mini-map



Results

- Beyond data

Conclusion & Future Work

- Hypotheses:
  - *Non-experienced players struggle to navigate*
    Yes!
  - *Players who play action video games have greater visual attention in the game area and therefore perform better*
    Yes!
  - In this game, how people adapt to non-Euclidean environments is also largely dependent on the **strategies they use for navigation**

- **Future work**: *How can non-Euclidean games improve players' spatial reasoning?*

Thank you for listening!

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