Steruyo – Research Project Report

Table of Contents

1 Project Deliverables

Deliverable 1: Steruyo (The Project Itself)
Download link: SteruyoPlaytestPublish.zip

Steruyo is an exploratory research project that focuses on the application of dichoptic (different image per eye) imagery to games user experience. The game is a simple spin on the classic arcade game PuyoPuyo, played instead in stereoscopic view. The game features two screens that can be adjusted to the comfort of the player that are intended to be viewed using a manual stereoscopic technique such as crossing one's eyes. The effect of this is that both screens "overlap" perceptually, opening the door for the game to take advantage of dichoptic imagery, in particular, dichoptic colour. In Steruyo, the certain blobs that the player will encounter are literally two colours at the same time (a different colour to each eye). This induces the effect of binocular rivalry which the player must take advantage of in order to exploit the unique rules of Steruyo vs regular PuyoPuyo. This adds a new layer of depth to gameplay and serves as a proof of concept for dichoptic colour as a mechanic in games—one that has seldom been seen in games to date.

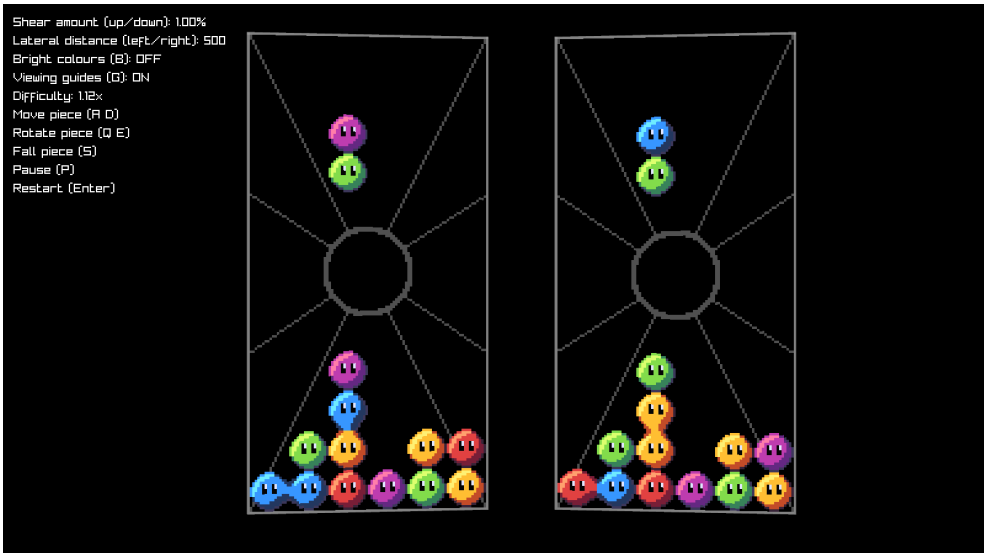

Fig 1.A: The final game running with all accessibility and control settings listed and view guides enabled

Deliverable 2: Demo Video
YouTube link: https://youtu.be/3fhk5wz3FZg

This is a recording showcasing all of the features of Steruyo. Accessibility / comfort features are all shown off including lateral distance, shear, viewing guides, and a bright colours setting.

Deliverable 3: User Experience Research Study
Instructions and Questions: Steruyo Instructions and Qs

As an exploratory research project, the primary motivation for conducting user research with Steruyo was to be open to whatever results came from it. This project serves as a sanity test for dichoptic colour as a mechanic in games.

2 Evaluation

2.1 Target Audience

The target audience for this was young adults 18-26 that are completely comfortable with regular day-to-day stereo vision (using both eyes). There were some willing participants that had to be discounted due to having visual impairment such as one eye being much weaker. This target audience was important to isolate as members outside this group would not be able to achieve the dichoptic imaging effects and would unfortunately only obfuscate the data.

2.2 Method

Participants were given the build accompanied by a set of instructions on how to play the game. The instructions participants were given can be found in the appendices along with the questions that they were asked after playing the game. This user research study was conducted to obtain detailed, qualitative data from a small sample size. The questions focus on three main pillars: comfort, gameplay experience, and binocular rivalry / fusion. Playtesters would start by reading the instructions to prepare them for what to expect and look out for, and then would play the game for between 1 and 15 minutes depending on their level of comfort and interest.

After they finished playing, they filled out a series of questions designed to identify some basic correlations such as comfort level to viewing settings, but more importantly leave the floor open for any findings that they may have. After all, as an exploratory project it was important to be open when it comes to results, as there is no hypothesis trying to be proved here; only information to be gathered steered by the focuses of the research question.

2.3 Results and Discussion

Results consisted of qualitative feedback from 7 participants. Each participant played the game, having read the rules, for 1-5 minutes, and then answered a series of questions targeted at the pillars outlined in 2.2.

One pitfall of the core deliverable which was addressed in the format of the research component is the onboarding; the game itself does not stand on its own to a new player. Especially with the nonconventional viewing method of manual stereopsis, it's important that users have been informed on how to use the project to achieve the desired effects. Originally, the user experience research side of things was just going to involve playtesting and questions, but in the interest of developing the core deliverable on a restricted timeframe, I offloaded the onboarding to a set of written instructions included within the research study template itself. This worked well. Outside of some people skipping right to the game having not read the rules and having to backtrack, as soon as people had read the rules they were able to grasp the core of the game.

I was surprised by how well people picked up the cross-eye stereopsis technique with no experience; the adjustable knobs for comfort within the project and view guides definitely played a big role in this. One participant stated, in regards to the viewing guides (lines in the background of the play space), “the view guides option made it easier to tell when I had the lateral distance configured most comfortably for playing the game”. Another had a different

perspective saying that “I didn’t use the view guides so much to keep my eyes centered on the screen but to align the pieces as they fell.” In fact, every player who was able to engage with the game without discomfort had edited the lateral distance between the game boards uniquely. This adjustment was, however, dependent on both the screen resolution of the player, and the player's preferences, and as such can’t be quantitatively analysed for specifics numbers.

There was some insight shown into the nuances of dichoptic colour perception in the feedback given. One particular playtester noted that “some colours may be harder to have visibly conflict than others. I found it harder to shift the static representation I see between blue and green, than red and green for example. Although I’d always be able to identify both of the colours, even if I couldn’t consciously switch between both.”

Another correlation I observed was that while the "bright colours" function did improve players' reported distinction between dichoptic colours, testers who did not engage this option reported less discomfort than those who did. As such the colours used in both modes may need to be tweaked so that players are both as comfortable and discerning as possible when engaging with the "steruyos". This is a point where my research into Xiong et. al. (2021) would come into play significantly. A possible extension of this project would be to allow players configuration options that alter the specific colour variations that they play the game with. Doing so under a controlled environment would allow for quantitative analysis that follows on the work of Xiong et. al. in drawing the line between binocular colour rivalry and fusion.

It was clear from the responses to the study that building these systems for an XR environment would greatly help accessibility and comfort. When asked about how long it took to stop playing from discomfort, one playtester noted “I didn’t stop playing due to discomfort, more that my eyes eventually got tired of being crossed, and slipped into unfocus for just a moment, which was enough to cause me to lose focus of the board, which had stacked up by the time I had regained control.” Another described how they worked around this issue stating that “cross eye was too difficult on my eyes, so I would look in the dead centre of both boxes and each eye would focus on one box and then mentally make a switch for what side I am focusing on”, evidently opting for the eye divergence method over crossing of the eyes. It is reassuring to see in the results that people were able to achieve the same dichoptic results using both methods of manual stereopsis, with 3 people diverging, 1 crossing, and 1 a mix of both (the remaining two playtesters played the game without stereopsis).

This game serves as a proof of concept that you can indeed exploit the phenomena of dichoptic vision to provide novel, unique mechanisms for video game applications. This area has promise for the world of XR, where manual stereopsis is substituted for one screen each eye, making the effects much more accessible.

3 Learning Reflection

My primary learning goal for this project was to dive into the world of user experience research studies. I feel I was able to better my understanding of how these kinds of studies are run, albeit having worked on a much tighter deadline than most. Due to time constraints following the events of SXSW Sydney, I was not able to dedicate as much time into building this project as a launchpad into the world of research quite as much as I wanted to. However,

the time I have spent on this project has already inspired me to reach out to visual sciences friends at Macquarie to see where this can be properly taken. I have been able to create some hands-on experience for myself in exploring the realms of dichoptic colour perception through an interactive medium, and this may one day inspire a masters or PhD thesis if the time were to come.

A secondary learning goal I had with this project was to apply my skills in solo software development to produce a finished, polished final product that I can add to my portfolio. Unfortunately, this outcome could not be met to my desired standard as the project itself had to be rather barebones. However, as I will talk about more in section 5, the work and study that I have conducted using this project already shows potential as an opportunity to polish up the user experience research angle of things. The research results section of this report is something I can tidy and polish up into a nice portfolio showcase for the world of research, shifting focus from strictly software development into the less obvious applications of that skillset.

My tertiary learning goal for Steruyo was to bring the fields of cognitive and visual sciences into the interactive medium by uniting them with the field of games studies. I feel I have satisfactorily achieved this personal learning outcome and have set a solid foundation for continuing on this avenue into more science focused future prospects. This direction really excites me, and while it wasn't what I expected the focus of this project to become, I am thrilled to see where it may take me in the future.

Finally, I feel I have succeeded in conducting exploratory research for the first time as a student. While the scope of this project was certainly small, the communication and presentation skills that I have developed along the way will go a long way in my ability to craft and communicate experiences and ideas through my expertise in the interactive medium. I am particularly excited about furthering research into dichoptic perceptual phenomena as the results of this study have highlighted some great leads in continuing the work of visual scientists like Xiong et. al. Considering the circumstances, I would consider this project a success in the field of exploring advanced game development from the angle of exploratory research and qualitative user experience study.

4 Industry Relevance and Future Work

Dipping my toes into the world of user experience research has been an enjoyable outcome of this project for me, and one that I imagine will be useful when it comes to industry positions that I aim to go for. In my current role of game and level design, playtesting plays a monumental role in ensuring a solid player experience. The experience, albeit limited in scope, of reaching out to people and running formal playtests online that I have gained from this project will show application in all forms of playtesting and communication with players in future projects that I am a part of.

Given the time to revisit this project, I would seek to more presentably collate the results gathered into a solid portfolio piece for specifically qualitative data collection and analysis. Producing fact sheets and findings in a digestible manner that can be easily put on a single page would be a great way to show my ability to distill the most valuable facets of data gathered and present it concisely.

As for the game itself, while not specifically related to the topics discussed here, I am currently interested in taking Steruyo and using it as a base for a study into UX design and game "juice". Turning it from the barebones prototype it is now into something with a lot more feedback and feel, most obviously a score system, would be a great opportunity to explore how systems can be polished—something that will be particularly relevant to my capstone project Aberrate Inc as we near content completion.

5 Appendices

Participants were given the build accompanied by a set of instructions on how to play the game. The instructions were as follows:

Instructions:
This game is intended to be played stereoscopically.
This means crossing your eyes to merge both images into one. There are settings including viewing guides and lateral distance / shear to make this effect easier to achieve comfortably.

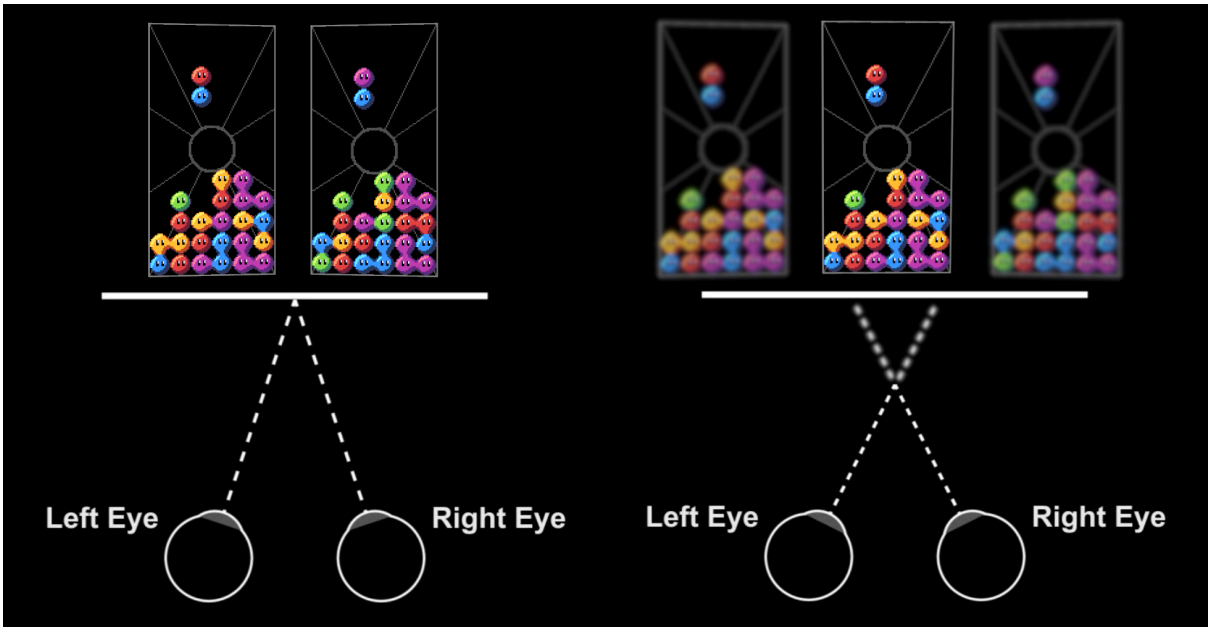

Fig 3.2.A: Instructions on how to achieve the cross-eye stereo vision effect.

The rules of the game are based on PuyoPuyo; stick 4 or more blobs ("steruyos") together to make them disappear. The game gets faster over time.
Steruyos can stick to other steruyos that are the same color.
Some steruyos can be two colors simultaneously (one color to each eye). These 2-coloured steruyos can stick to other steruyos that are *either* of these colors. e.g. A red/blue steruyo can stick to a red, or a green/red steruyo.

While playing, pay particular attention to the 2-coloured steruyos and how they affect your gameplay experience.

If at any point you experience dizziness, disorientation, or headache, stop playing immediately.

Research Questions:

1. Are you comfortable with using both eyes simultaneously? (yes/no)

2. Did you know how to cross / diverge your eyes going into this game? (yes/no)

3. When playing, were you able to focus your eyes properly (achieve a clear stereo image / not blurry)? (yes/no)

4. If you answered NO to Q3, were you still able to play the game with it blurry? (yes/no)

5. Did you play this game by crossing (see above) your eyes, or diverging (looking "through" the screen / unfocusing your eyes)?

6. Please briefly describe your experience with using this stereoscopic technique to play the game. (Was it easy / hard? Did you experience any strain / headache?)

7. Please briefly describe your experience with blobs ("steruyos") that were a different color in each eye (2-coloured). Could you tell which two colours they were? Did it look like one color half way between, or two distinct colors at the same time? Did the colors keep changing or stay the same?

8. If you tried out *Bright Colors* mode, did this change how you perceived the effects from Q7? If so, how?

9. Did the rules of the game make sense to you? When you understood the rules, were you able to play comfortably even with the 2-coloured steruyos?

10. Did you feel like the 2-coloured steruyos made the game easier or harder? Why?

11. Do you think you ever play a larger game with stereo colour effects as a mechanic (for example, a VR detective game with clues highlighted in stereo colour)? Please briefly justify your decision.

12. If you had to stop playing due to discomfort, how long did it take for this discomfort to become a problem?

1. Please list the game viewing settings that were most comfortable for you.

Distance from screen (cm):
Lateral distance (units):
Shear amount (%):
Bright colors (on/off):
Viewing guides (on/off):

2. Do you have any final notes / thoughts about this game, stereo technique, 2-colour effects, that you'd like to share?

3. Do you consent to your answers being used anonymously to conduct research / analysis? (yes/no)

Link to data: Steruyo - Data Gleaned from Qualitative Responses

6 Statement on Generative AI use

Generative AI was not used in any capacity for this project.

7 References

Compile. (1991). Puyo Puyo [Video game]. Compile.

Gundlach, B.S., Alireza Shahsafi, Vershbow, G., Wan, C. and Kats, M.A. (2018). Enhancement of human color vision by breaking the binocular redundancy. Scientific Reports, [online] 8(1). doi:https://doi.org/10.1038/s41598-018-30403-y.

Qi Xiong, Hui Liu, Zaiqing Chen, Yonghang Tai, Junsheng Shi, and Wuming Liu, (2021). Detection of binocular chromatic fusion limit for opposite colors, [online] Available at: https://opg.optica.org/oe/fulltext.cfm?uri=oe-29-22-35022&id=460492.