Intent Statement

"By combining grid-based navigation mechanics with two abilities – one that allows the player to turn the level upside-down, and another one that allows them to change holes into walkable tiles and walkable tiles into holes –, I intend to create a maze game that rewards players for utilizing visual-spatial reasoning and for planning their movements out carefully."

Research and Thesis

My goal is to develop a system in which the player must use visual-spatial reasoning to make their way through a grid-based maze. The player should think their actions through carefully and pay close attention to their surroundings so they can reach the end of each level in an optimal number of movements. Traditional maze games do not require a high level of visual-spatial reasoning to solve, since even though they might take some effort to navigate, the player only has to keep track of walls – and, in some cases, enemies or other obstacles – to make their way through. Because of this, I plan to take this simple concept and give the player two unique abilities. The first ability allows them to turn the maze upside-down at will, while second lets them reverse the spaces upon which they can and cannot walk. These will force the player to examine not only the area immediately around their avatar, but the rest of the maze, as well.

My first bit of research into creating this system came from a deconstruction of Big Duck Games' puzzle game *Flow Free*, which was released for iOS and Android devices in 2012. *Flow Free* is a grid-based Numberlink puzzle game where the player must use their finger to connect a variety of colored nodes without allowing the lines to intersect. At the end of each level, they are rewarded depending on the number of movements it took them to complete the stage, ranging from a simple "Level Complete" to a more exciting "Perfect!" if they complete it in as few moves as possible. Levels do not feature time limits (outside of an optional "Time Trial" mode) or even a fail state, so the player can take all the time they need to link nodes together. I found this system incredibly interesting because it forces the player to pay close attention to the level's layout if they wish to succeed. Even so, it manages to retain a stress-free, even cozy environment where the player is never uncomfortable stopping and taking some time to plan out their next move. This inspired me to try to emulate a similar atmosphere in my system. However, I was still unsure about whether or not I wanted to include a timer (or at least a simple time-tracker) or a more complex scoring system. After

all, I wanted to create a more difficult game than *Flow Free,* and I believed that adding heaping on tension might help get players invested in clearing each level.

With that basic design idea figured out, I began researching other aspects regarding visual-spatial puzzle games. I mostly wanted to examine visual-spatial reasoning and learning more deeply, as I believed that doing so would help me to understand the player's limitations (such as the number of objects they could keep track of at once) and develop more interesting, complex puzzles. This led me to a pair of sources discussing the educational properties of visual-spatial reasoning. The first such source is a short booklet distributed by Ontario's Ministry of Education as teaching material. It mostly describes ways in which spatial reasoning relates to geometry and mathematics as an educational tool ("Spatial Reasoning"). People can improve their spatial reasoning skills "through an assortment of activities… across all age groups" ("Spatial Reasoning"), such as solving puzzles, playing video games, or building objects out of blocks ("Spatial Reasoning"). Furthermore, visual-spatial puzzles can require a variety of skills, such as mentally rotating an object and comparing two or more items to determine their congruency ("Spatial Reasoning"). These aspects of the booklet, combined with words from my peers and personal testing, encouraged me to change my game's design rather substantially. Originally, *Reversal* only gave the player a single on-demand ability, which both rotated the level upside-down and swapped the spaces upon which they could and could not walk. In order ensure that the player could learn and improve from the game's systems without growing disoriented, I split this ability in two and made the space-swapping aspect only available on certain tiles. This, in turn, helped me to divide the required visual-spatial skills – mental rotation and object manipulation – in a way that made level design more interesting and diverse.

The second source I looked into for my project is an excerpt from *Upside-Down Brilliance: The Visual-Spatial Learner* (2005), a book written by licensed psychology Dr. Linda Silverman. Whereas the Ministry of Education's piece defines visual-spatial learning and explains its value in terms of mathematics, Silverman discusses the specific learning styles of both visual-spatial and auditory-sequential learners, with an emphasis on the former. She describes visual-spatial learners as "whole-part learners who need to see the big picture first before they learn the details" (Silverman 6), and states that when they master a topic, they

retain it extremely well (Silverman 6). She also notes that spatial and sequential learners approach learning from near-opposite angles, particularly in regards to time. Because auditory-sequential learning requires careful analysis and step-by-step progression, "[a]uditory-sequential learners are extremely aware of time but may be less aware of space" (Silverman 6), whereas visual-spatial learners "are often preoccupied with space at the expense of time" (Silverman 6). This served as the final push to make me remove any sort of timer from my game's base design, as it would likely not appeal to either type of player. It also encouraged me to approach the game's tutorial levels with both player types' styles of learning in mind. While *Reversal* will likely most appeal to visual-spatial learners, I want to at least set up the first few levels so that auditory-sequential learners can quickly understand the gameplay, even if they might struggle to solve the game's later puzzles. This will involve an option to view the game's controls at any given moment, as well as slowly introducing the rotation and space-swapping mechanics over time.

After looking over these two educational sources in depth, I decided that my next course of action would be to research ways that I could improve my game's feel and player feedback. Puzzle games need especially strong feedback to make sure that players are aware of their every move and that success feels good, so this was a natural choice. It also stemmed from my desire to improve on *Flow Free*'s simple reward system. To best incorporate this idea, I looked into a research journal that covers the topic in depth. This journal, written by Hao Wang and Dr. Chuen-Tsai Sun of the National Chiao Tung University, places a great deal of emphasis on various types of in-game rewards, as well as their potential real-world applications. One particularly important concept they discuss relates to immediate in-game rewards, which allow players to easily understand certain outcomes (Wang & Sun). They also claim that there are eight main kinds of reward forms, including scores, experience points, virtual items, achievements, and feedback messages (Wang & Sun). For my system, I plan to use two of these types: scores (which I will implement as end-of-level rewards to display the player's rank) and feedback messages (including animations for player movement, falling off the level, and using the two main abilities). The score system will be especially important, since I plan to implement a "three star" system that rates the player

based on their in-game movements. In doing so, I will create a fairly complex ranking system without going too far overboard, and I can still utilize *Flow Free*'s comfortable atmosphere all the while. That said, I also understand that I must avoid utilizing too much feedback, lest I risk overwhelming the player, especially given that they must focus on the environment at all times.

System and Mechanics

As *Reversal* features systems and mechanics relating to both navigating each level and rewarding the player for reaching each level's exit, I will be splitting them accordingly.

Maze Navigation System:

The Grid: *Reversal*'s puzzles take place upon a large grid of different spaces. Levels feature various sizes of grids, with their shapes ranging from rectangles to squares with cut-out pieces. The player must navigate this grid to reach the level's exit.

Movement: The player can move the player character one grid space in any of the four cardinal directions using the W, A, S, or D keys.

Falling: If the player character walks over an open grate or moves off the grid, they will fall down and teleport back to the starting space. Falling does not reset the player's "Spaces Moved" counter (see: **Ranking**).

Spaces: There are a variety of space types that can appear on the grid. Each type has a different effect:

- **Closed Grates:** If the player moves the player character on top of a space depicting a closed grate, the player character will remain in place without falling.
- **Open Grates:** If the player moves the player character on top of a space depicting an open grate, the player character will fall into it.
- **Switches:** If the player moves the player character on top of a space depicting a yellow or orange switch, the player will gain the ability to transform the open and closed grates into one another (see: **Space-Swapping**). After leaving the space, they immediately lose this ability.
- **Start and End Spaces:** If the player moves the player character on top of either the start or end spaces of a level, the player character will remain in place without falling. Touching the end space also ends the level instantly.

Rotation: The player can press the spacebar while not moving or falling to turn the level upside-down. While the level rotates, the player character's on-screen position does not change. This means that if the space they are standing on swaps with an open grate, they will fall into it. Similarly, if the space swaps with either a closed grate or an inversion button, they will land safely and can continue acting from thereon. The start and end spaces cannot rotate under any circumstances.

Space-Swapping: While the player is standing on a switch, they can press the "F" key to transform all closed grates into open grates and all open grates into closed grates.

End State: There is one end state:

- If the player character reaches the end space, the player wins the level and receives a rank based on the moves it took them to complete it (see: **Ranking**).

Reward System:

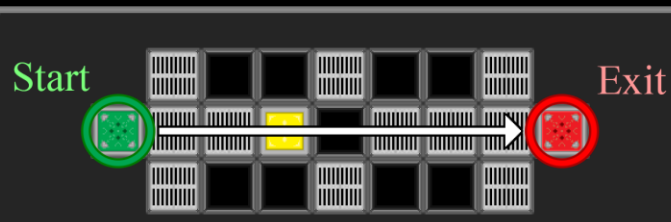
Ranking: Every time the player moves a space on the grid, their "Spaces Moved" counter increases by (1). This number is always visible on the screen, and it is always compared to an "Optimal Moves" number. At the end of the level, the player receives a rank based on their total score.

- **One Star:** The player completes the level with a "Spaces Moved" counter that is at least double the "Optimal Moves" number (i.e., "20 / 10").
- **Two Stars:** The player completes the level with a "Spaces Moved" counter that is less than double the "Optimal Moves" number, but the "Spaces Moved" counter is still higher than it (i.e., "15 / 10").
- **Three Stars:** The player completes the level with a "Spaces Moved" counter that is less than or equal to the "Optimal Moves" number (i.e., "10 / 10").

Reversal

Visual Design Document

Reach the exit in as few moves as possible!



Controls

Move

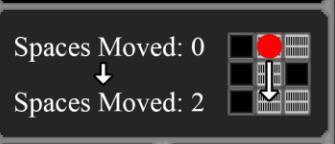
Space

Rotate Level

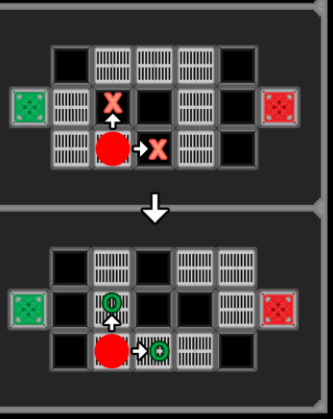
F

Hit Switches

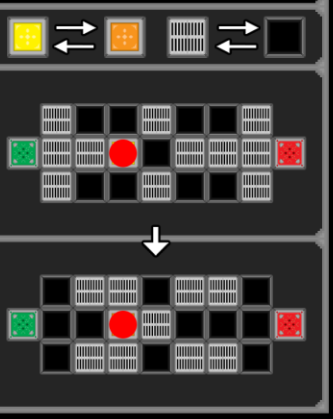
Earn stars for efficiency!



Use rotation to open new paths!

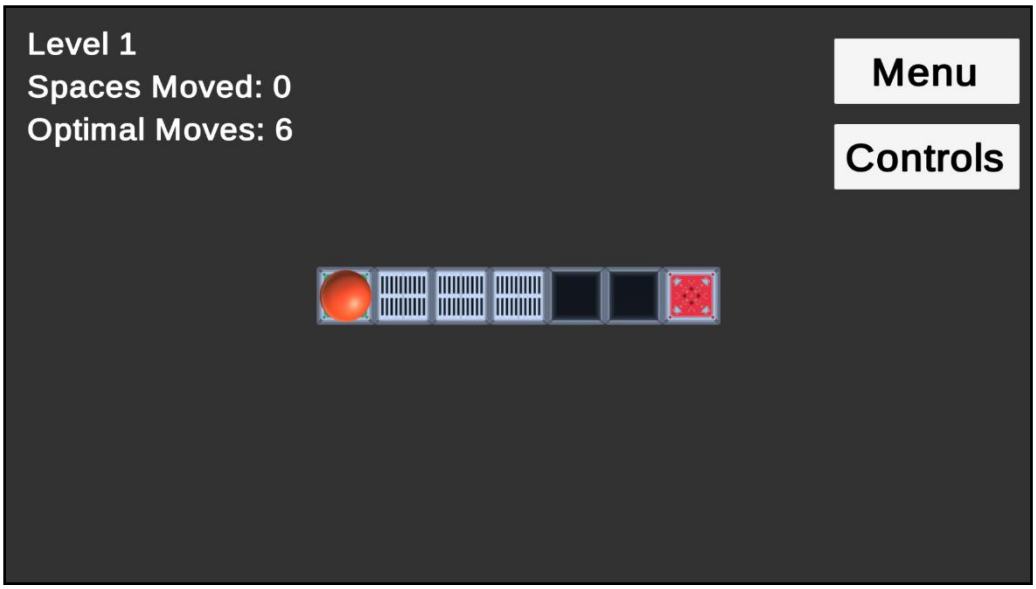


Hit switches to swap tiles!

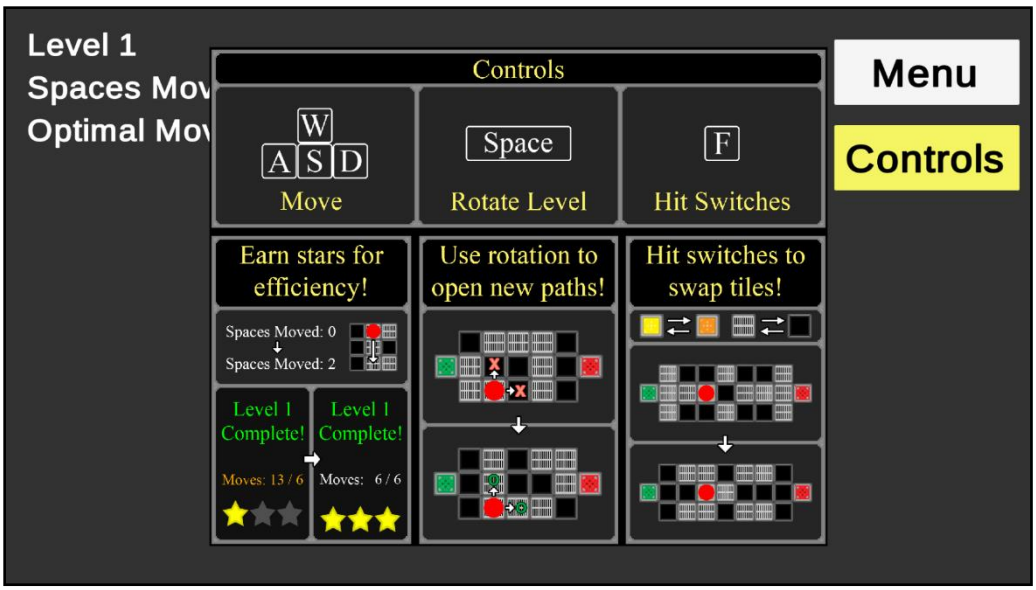


System Storyboard

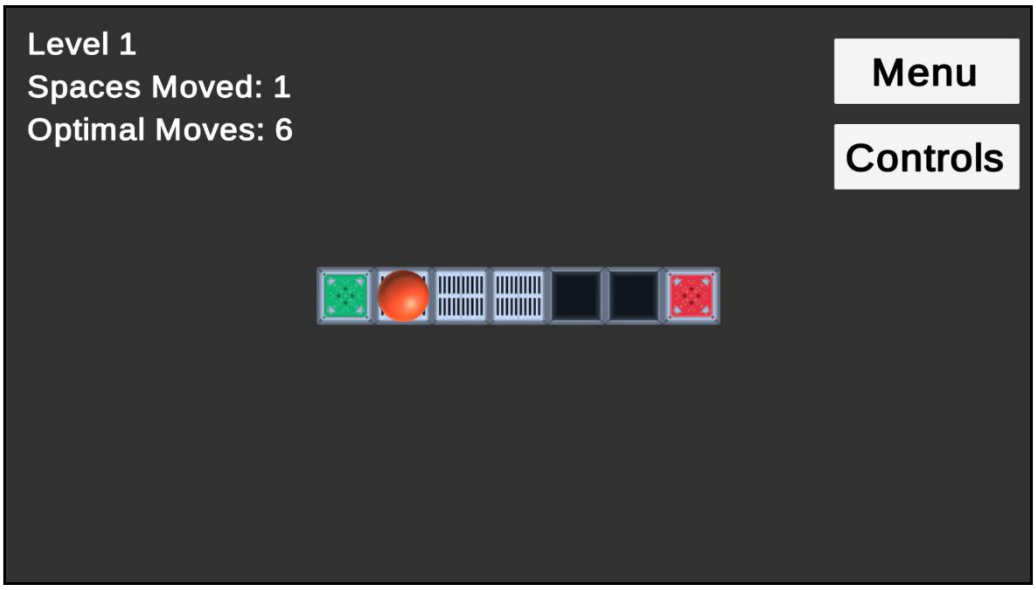
This section contains a basic storyboard of *Reversal*'s gameplay. The storyboard includes a depiction of the main movement system, level rotation, activating switches, the win condition for each level, and the ranking system.



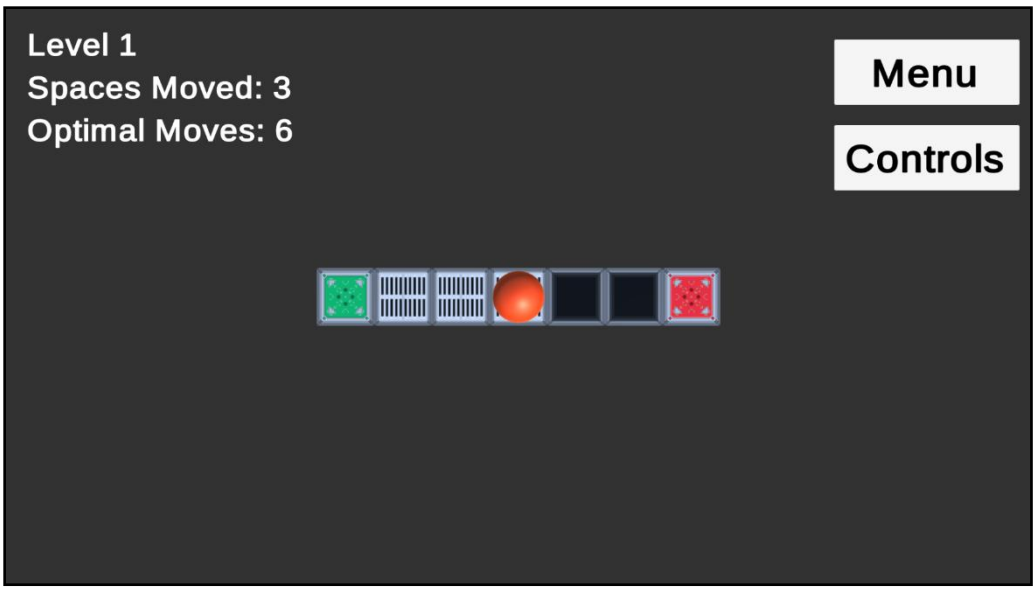
After starting up the game, the player finds themselves at the beginning of the first level. They can immediately see UI elements displaying the current level, the number of spaces they have currently moved, and the optimal number of moves it should take to complete the level (top-left). They also see two buttons: one leads them back to the main menu and one that shows them the game's controls (top-right).



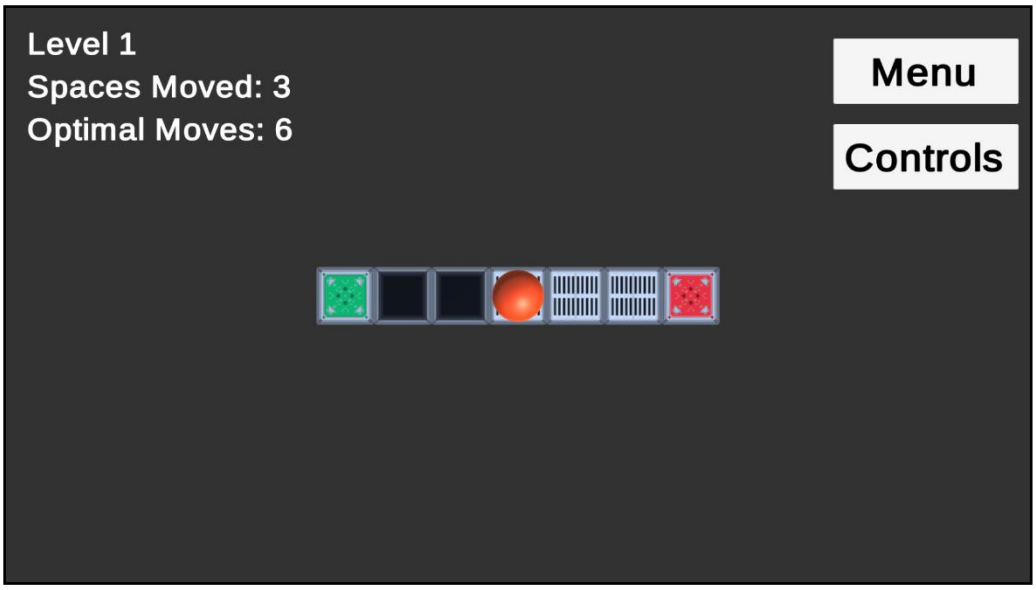
In order to ensure they understand the gameplay, the player clicks the "Controls" button. This brings up a screen that either teaches them or refreshes them on the basic mechanics and controls. During this time, the player character is immobile, and none of the player's inputs have any effect. They can click the "Controls" button a second time to close the menu.



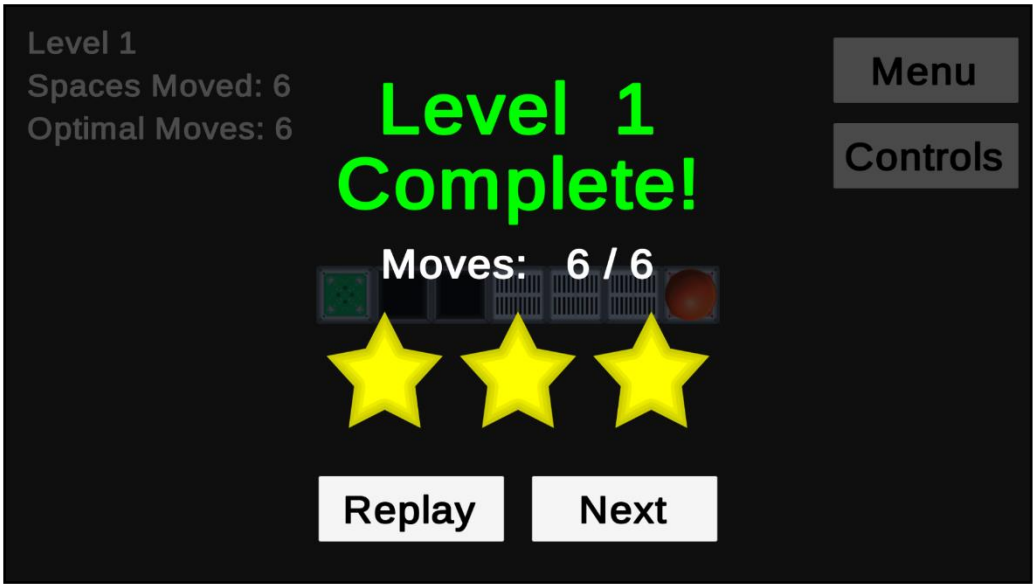
After closing the menu, the player clicks the "D" key. This causes the player character to move one space to the right and increases the player's "Spaces Moved" count by one. Additionally, because the player character is standing on top of a closed grid space, they do not fall down.



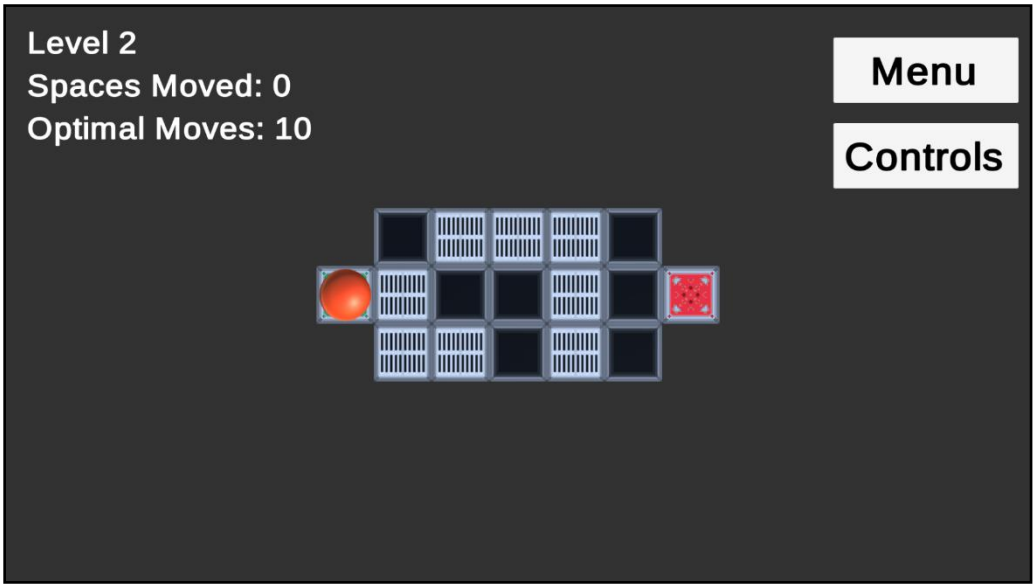
The player moves two more spaces to the right over the closed grates, only stopping when they come face-to-face with a space depicting an open grate. Because of the “Controls” menu, they know that these spaces serve as obstacles that they cannot normally pass.



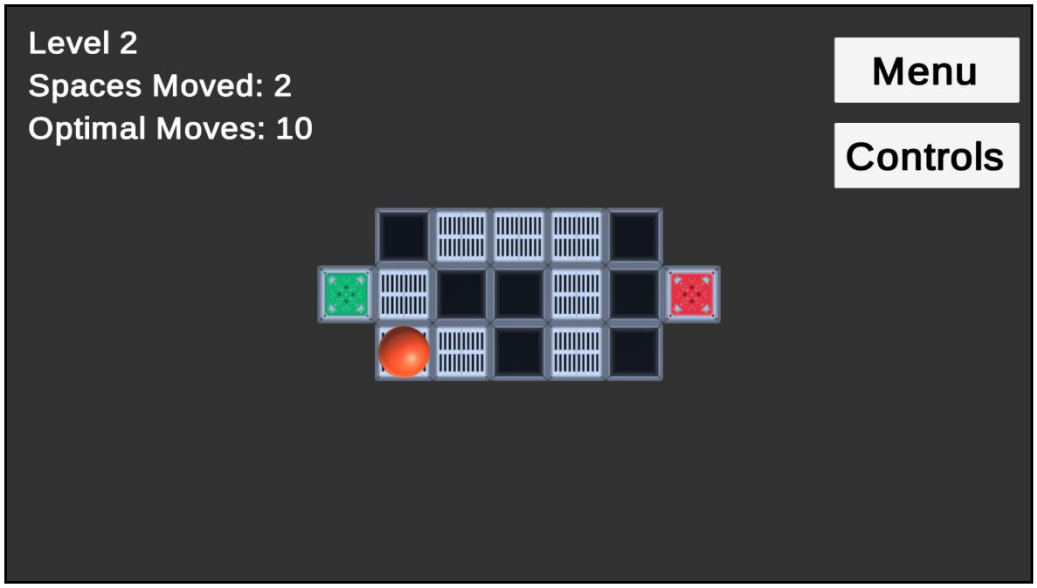
The player, remembering the controls, presses the spacebar. This plays a short animation where the player character rises up, the level turns upside-down, and the player character descends on the space they are now above. As a result, the player can now move the character over the spaces that were once open grids, securing a way to the exit.



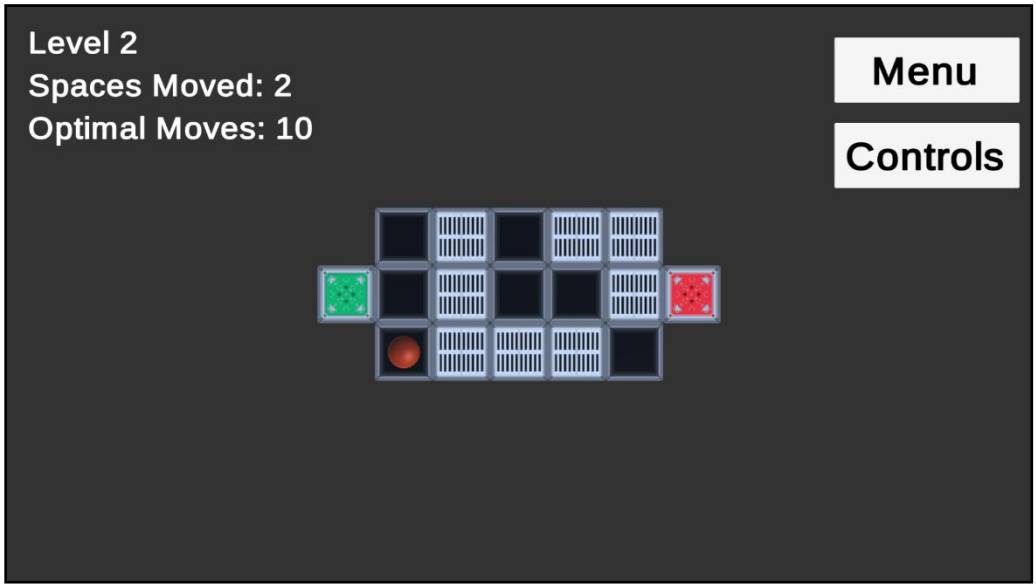
The player walks to the end of the level, which triggers the end-of-level animation. During this scene, the player receives a rank based on the number of moves it took them to finish the level. Because they completed it in six moves – the optimal number –, they receive all three stars. The player can then either replay the level or move on to the next one.



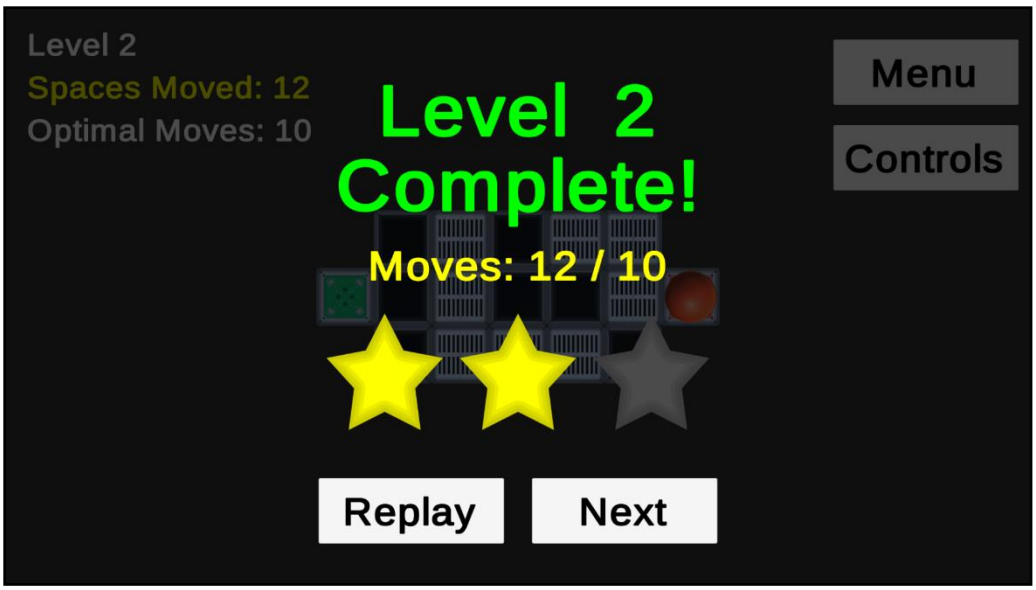
They select the "Next" button, transferring them to the second level. The UI elements displaying the level and optimal moves also change to indicate this, and the "Spaces Moved" count resets.



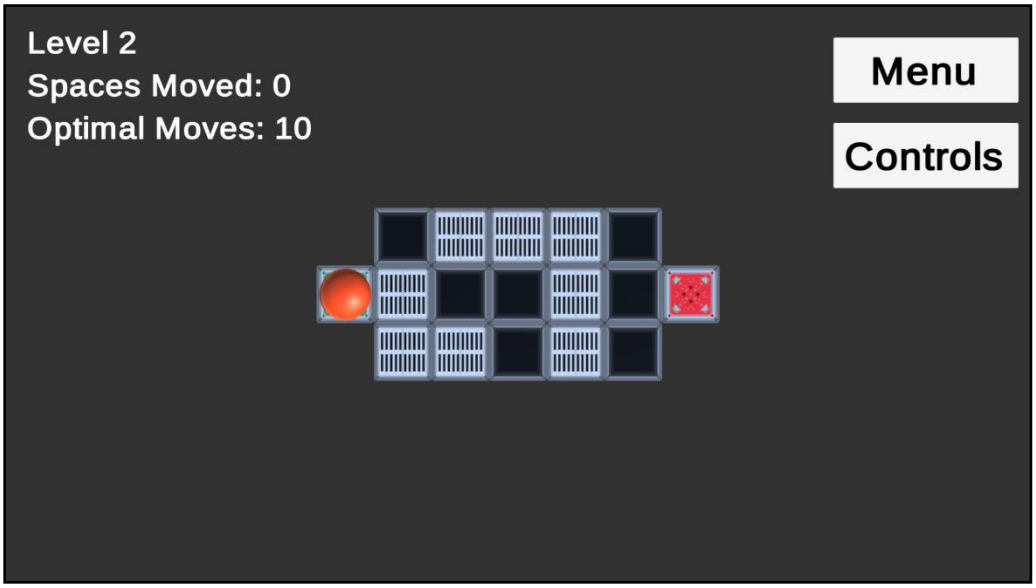
The player takes a couple steps into the level, and, wanting to view its workings more closely, presses the spacebar to rotate it.



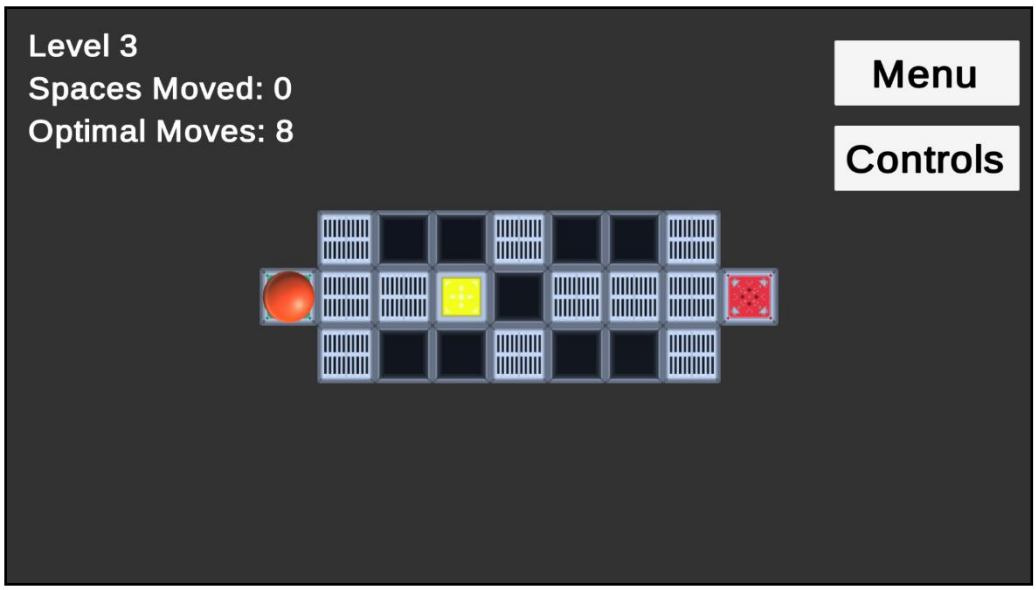
Unfortunately, the player misjudged the level layout, and as a result, the player character comes down on top of an open grid space after the rotation ends. This causes them to fall into the pit as if they walked over it, warping them back to the level's entrance.



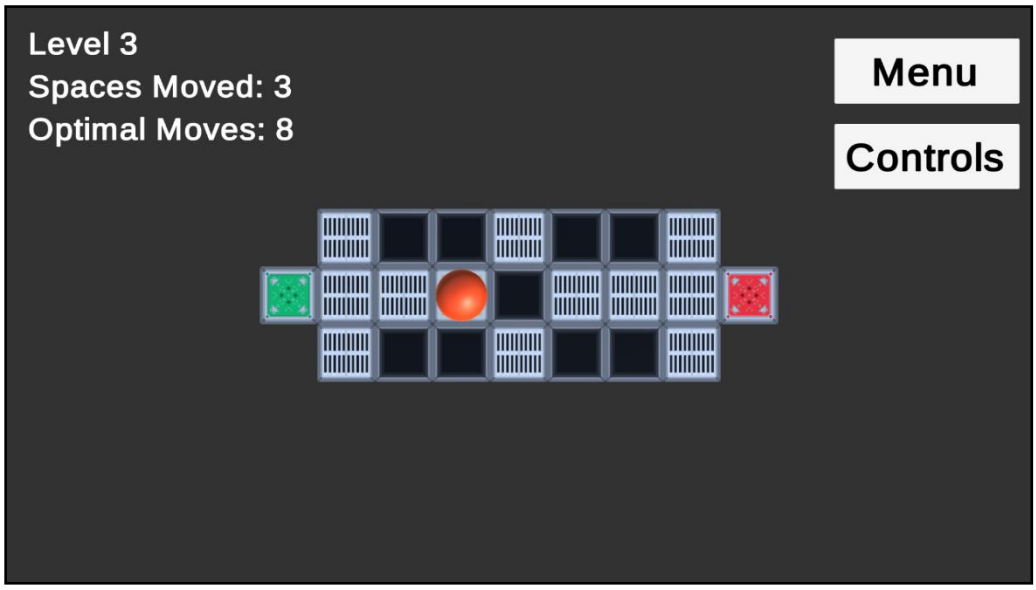
Though the player still manages to complete the level, falling has made it impossible for them to clear it in the optimal number of moves. This is shown via the "Spaces Moved" text's color changing from white to yellow, which shows that the player will no longer receive a three-star rating. At the end of the level, they receive a two-star rating.



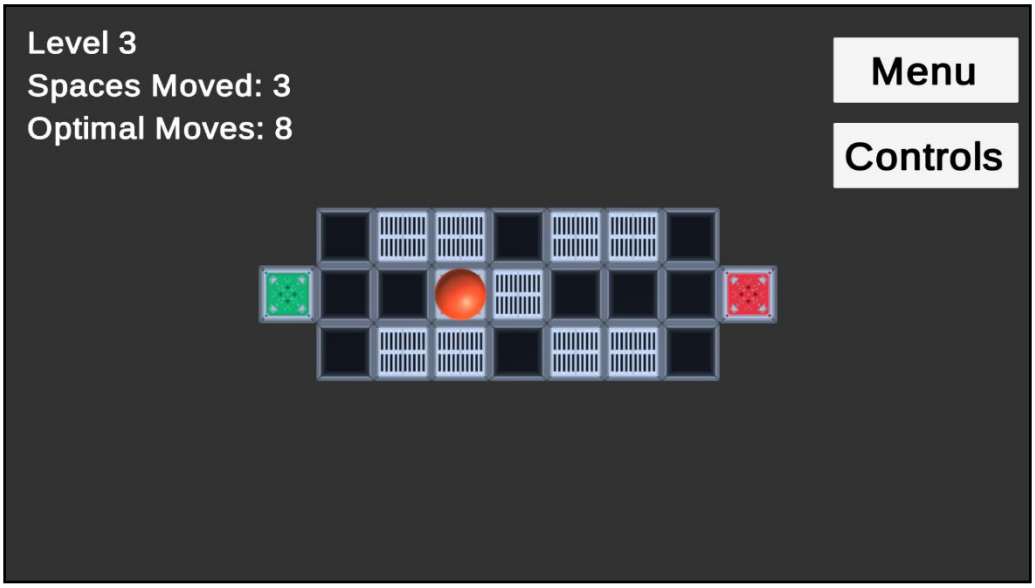
Desiring a better rank, the player selects "Replay" instead of "Next," which completely restarts the current level. This includes resetting the player's "Spaces Moved" counter to zero.



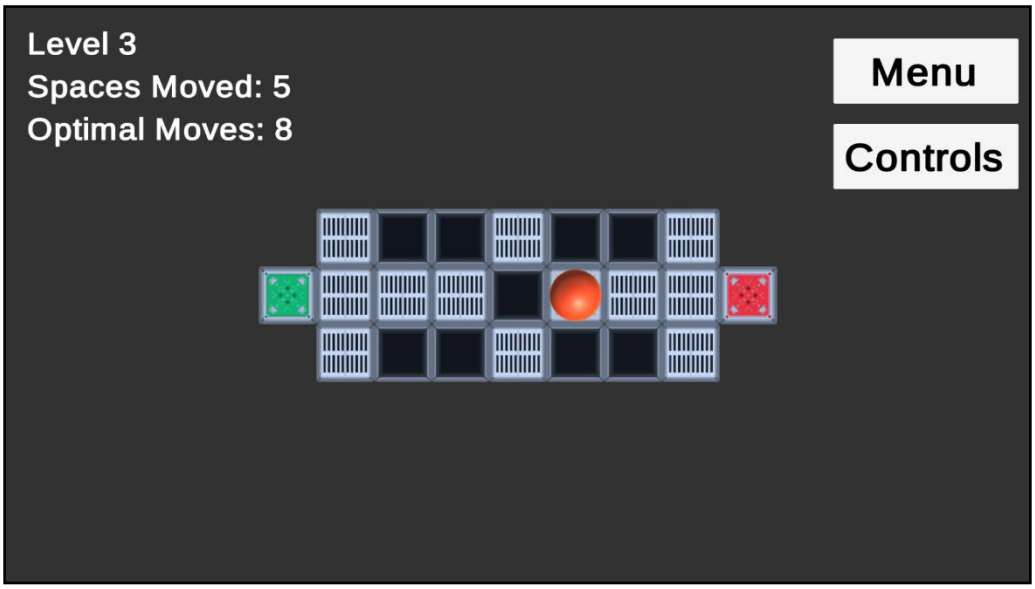
Upon clearing Level 2 with a higher rank, the player decides to move on to the third level. There, they immediately notice the yellow switch sitting nearby, as well as the fact that the level's layout makes it impossible for them to reach the level's exit using movement and rotation alone.



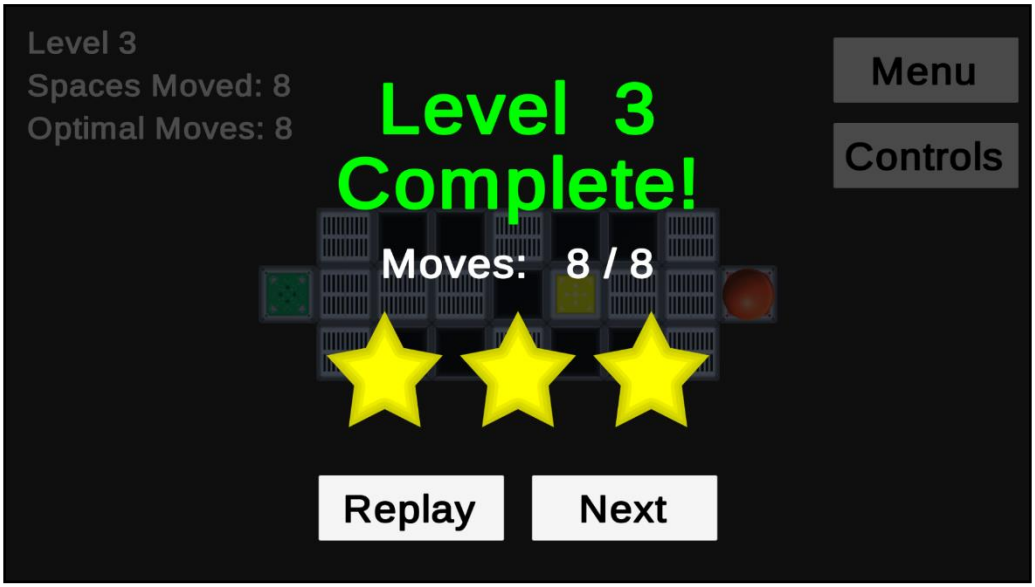
The player moves overtop the yellow switch and briefly re-examines the "Controls" menu to check how to use it.



They then press the “F” key, which makes the player character jump into the air and land on the switch, triggering it. This turns every open grate into a closed grate, and vice versa. It also turns all switches in a given level orange until the player triggers them again. If the player falls off the level while it is swapped, its layout automatically returns to normal to prevent softlocks.



With the level swapped, the player carefully navigates the central area and combines both rotating and swapping to reach the other side of the first pit. This puts them on a direct path to the exit.



The player reaches the end of the third level, earns the highest rank as a marker for learning the initial gameplay systems, and chooses to continue onward to see what lies in store.

QA Testing

Test Plan:

Goal: The goal of this test is to gain feedback and to establish whether or not *Reversal*'s system is successful in achieving my original intent. My questions and analysis will focus on the player's progress throughout the game, the process they took to solve each level, and their understanding of the systems and mechanics. I will consider this a successful prototype if testers react favorably to the rotation and switch-activation mechanics; show that they understand them, the controls, and the ranking system after only a short time spent playing the game; visibly improve at the game over time; and complete most of the levels. This test will take place informally with at least five testers.

Procedure:

1. Introduce testers to the game's basic concept
2. Show testers the "Controls" menu or the " to familiarize them with the controls and mechanics
3. Have testers play through all five levels currently in the game
    a. Give them the option to give up if they become frustrated or stuck
    b. While they play, observe their thought processes, emotional responses to the system, and the amount of time they take to perform each action
4. Once testers have finished playing the prototype, ask them to fill out the accompanying survey

Questions:

1. How many total levels did you complete?
2. What kind of reasoning did you use more often when approaching each puzzle?
3. Do you feel the rotation mechanic added to or detracted from the maze navigation system?
4. Do you feel the switch-activation mechanic added to or detracted from the maze navigation system?

5. When you first started playing, did you find it easy or difficult to visualize how each level would rotate?
6. If you found it difficult, did you find it easier to visualize as you continued playing?
7. Was it clear how the "Spaces Moved" and "Optimal Moves" UI elements correlated to your ranking?
8. What impact, if any, did the ranking system have on your playstyle?
9. What impact, if any, did the lack of a fail state have on your playstyle?

Survey Link: https://goo.gl/forms/xTIPDZWzb8NAwBJH2

Test Process:

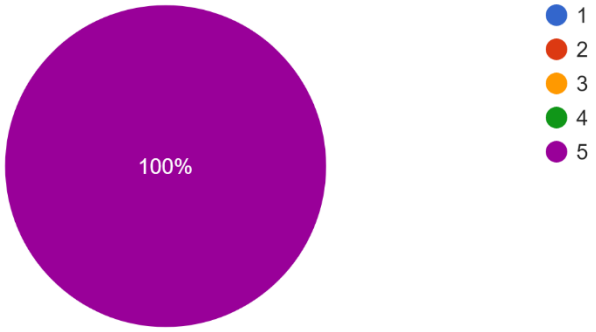
Summary: On March 7, 2019, I sat down in Champlain College's CCM 224 and tested the mostly complete version of *Reversal* with five game design students. Each tester approached the game from a slightly different angle, allowing for a more interesting and less biased set of tests. As a result, each of the results, along with my in-test observations, provide clear feedback for the system and the accompanying mechanics.

Test Results:

Question 1:

How many total levels did you complete?

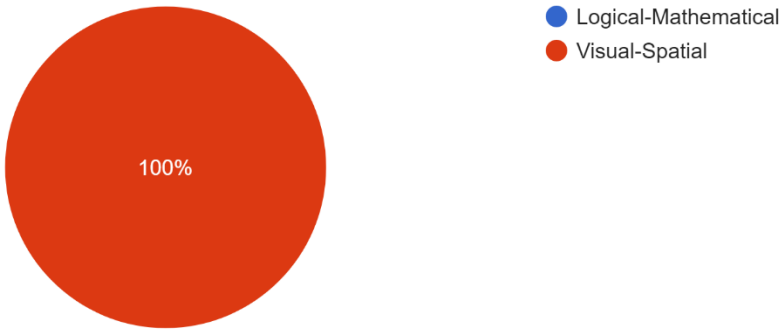
5 responses



Question 2:

What kind of reasoning did you use more often when approaching each level?

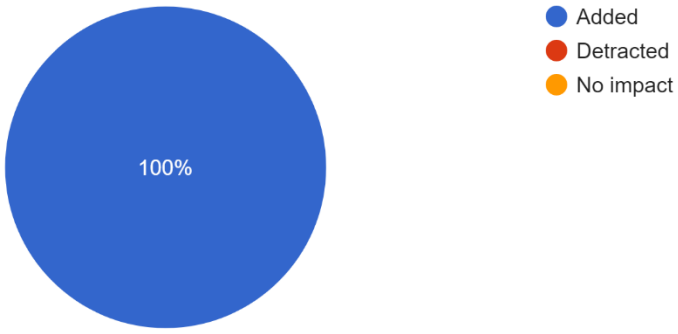
5 responses



Question 3:

Do you feel the rotation mechanic added to or detracted from the maze navigation system?

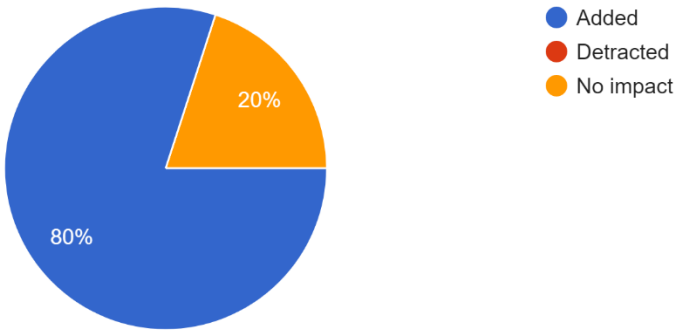
5 responses



Question 4:

Do you feel the switch-activation mechanic added to or detracted from the maze navigation system?

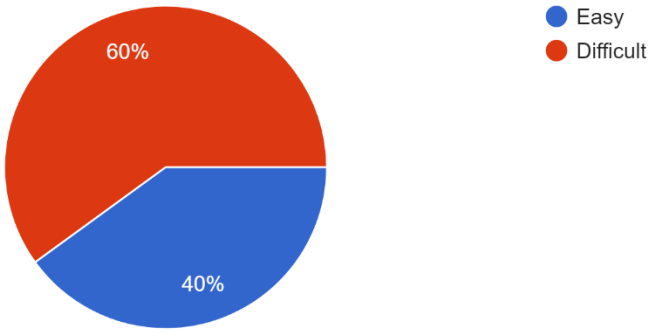
5 responses



Question 5:

When you first started playing, did you find it easy or difficult to visualize how each level would rotate?

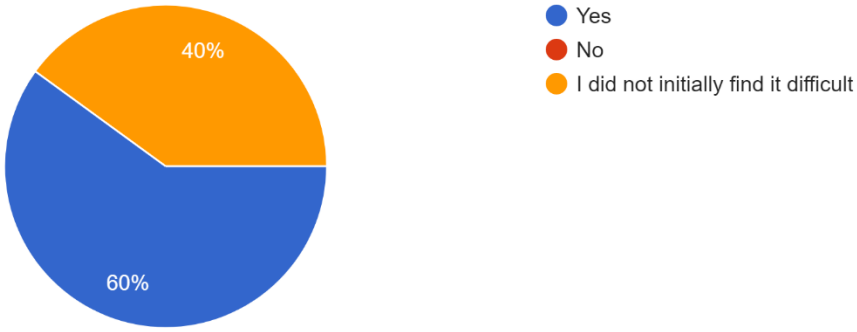
5 responses



Question 6:

If you found it difficult, did you find it easier to visualize as you continued playing?

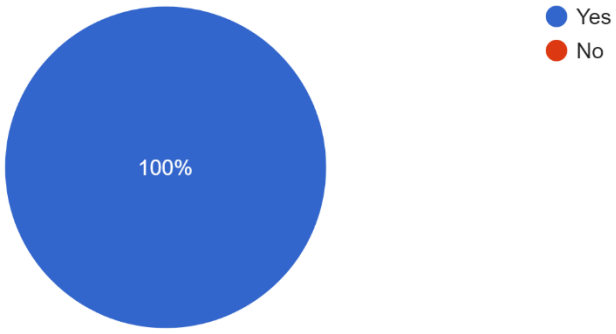
5 responses



Question 7:

Was it clear how the "Spaces Moved" and "Optimal Moves" UI elements correlated to your ranking?

5 responses



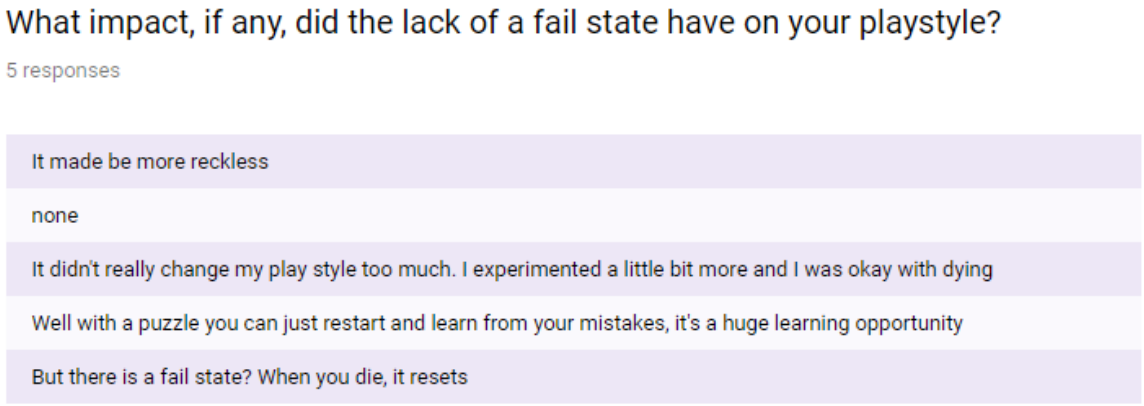
Question 8:

What impact, if any, did the ranking system have on your playstyle?

5 responses

It had no impact for me personally
it made me try to think through the puzzle before just randomly experimenting
It made me try and think about how I can complete each level faster
It gave me an incentive to go back and improve my ranking on the levels.
None

Question 9:



Test Observations:

- All testers completed the five levels present in the prototype. However, most of them received one- or two-star rankings for several levels, including the final ones.
- Testers often misclicked and walked off the edge of the level or into an open grate, forcing them back to the starting space.
    - Falling seemed incredibly punishing, and few testers who fell completed a puzzle with higher than a one- or two-star rating
- Testers tried to understand how rotating each level would affect the player character's position, sometimes physically pointing or gesturing at the screen to determine how it lined up.
    - Some of them had difficulty discerning the level's rotation, and they would occasionally wander around a level's exit for a dozen or more moves before finally reaching it. This was especially notable in Level 4 and Level 5.
- Testers appreciated the "Controls" button, though roughly half of them did not notice it at first.
- Testers all showed interest in the game's concept and gameplay.

QA Analysis:

The prototype managed to appeal to testers and shows a great deal of promise. However, there are a few minor issues that dampened the experience. One such issue relates to the testers often misclicking on the keyboard, which resulted in the player character moving into an open grate or off the grid's edge and being sent back to the starting space. This happened several times to each of my five testers, and all of them expressed frustration each time it did. The most egregious case occurred at the end of Level 5, where one player accidentally fell off the grid one space away from the exit. While I could easily attribute this issue to the testers rather than the game, it happened so frequently that it is clearly something that I should look into. Testing different control schemes – such as having the player click a space with the mouse and then having the player character move there automatically – might be a good way to mitigate it. A different solution may involve redesigning the game so the player character cannot walk into an open grate or off the grid in future iterations, ensuring that a misclick cannot kill them unless the player accidentally rotates them over an open grate. This is something of a last resort, since while it would solve what is currently the game's highest source of frustration, it would also make the game far easier, which some players may dislike.

Another problem I noticed during testing is that falling is far too punishing. While it is not technically a "fail state", falling still forces the player to restart the level from the beginning, with the only change being that their "Spaces Moved" counter does not reset in between. One tester argued that this made falling more punishing than a standard death, since the player cannot restart a level without first reaching the exit. This ensures that they will not receive any more than two stars if they fall even a single time, and if they fall near the level's exit, they are likely to have an incredibly high number of moves on their "Spaces Moved" counter in comparison to the "Optimal Moves" number. Fixing this issue should allow for more experimentation, as a different tester acknowledges, and it should make it easier for players to become engaged with the game. Currently, I believe the best solution is to turn falling into a full reset. This means that it will reset both the player character's position and the player's "Spaces Moved" counter. This is the simplest solution, and it does not contradict with any other in-game systems (or proposed systems, at that). It would also provide the player with a quick way to reset in case they go over the "Optimal Moves" counter, and though it is still

technically a “fail state”, it is not terribly punishing compared to the original event. As such, I believe that this is the best way to go about fixing the issue.

In spite of these problems surrounding inputs and falling, testers still reacted quite positively to this game’s theme and gameplay system. They all seemed to enjoy it to at least some degree, with one claiming that it was “[v]ery nice and polished” and another describing the puzzles as “interesting and well thought out”. Players also consistently finished every level, displayed improvement regarding the game’s systems over time, expressed that the UI was easy to read, and – perhaps most importantly – primarily utilized visual-spatial reasoning to solve each puzzle. All testers also seemed to enjoy puzzling out how to reach each level’s end to varying degrees. These reactions all fall in line with my intended player experience.

Survey Link:

https://docs.google.com/spreadsheets/d/1-W3MtRW9OAVEahf_o_y-rO2NcJVfyZWsL4fJ1c3XqO0/edit?usp=sharing

Postmortem

Given the feedback I received from QA testing, I can conclude that my system proved successful, with only a few minor problems causing it to suffer. My testing went well overall, with the "Controls" menu in particular making it easy for testers to learn and become accustomed to *Reversal*'s control scheme. I was also careful to make my systems clear and easy to follow so that testers would not become lost. Most testers stated that the rotation and switch-activation mechanics added a lot to the maze navigation system, and that as a result, they had to better utilize visual-spatial reasoning to make their way through. Furthermore, given that testers would pause mid-game to plan out their actions and to determine where their next rotation would leave them, I clearly fulfilled my intent statement. The ranking system also shows promise as a tool for making players more invested in the game and for encouraging them to more carefully solve the puzzle.

As a whole, I found my time working on *Reversal* to be an excellent, enjoyable, and valuable experience. Through it, I learned quite a bit about how to better design my game, and that changing mechanics partway through a game or project's life-cycle is sometimes not just beneficial, but also necessary. Originally, both rotation and switch-activation were attached to the same mechanic, but thanks to performing research, speaking with my peers, and testing the game, I realized that they worked far better separately than together. This made the game far easier for players to understand without removing much of its initial complexity. It also made level design more fun and interesting, and it let me implement fairly strong visual feedback for both rotation and when activating the switches. Lastly, the game's overall simplicity allowed me to focus on developing the player experience. This, along with more research, led to the creation of the in-game animations and the ranking system, both of which make the game far more enjoyable to play.

Annotated Bibliography

Flow Free. iOS, Big Duck Games, 2012.

Flow Free is a Numberlink puzzle game released for iOS and Android devices. This game saw its release in 2012, with three sequel games – *Flow Free: Bridges*, *Flow Free: Hexes*, and *Flow Free: Warps* – being released over the next five years. This, along with each game's generally high reviews, informs me that its gameplay is popular.

- Gameplay relies on visual-spatial reasoning, as the player must use their fingers to link color nodes together without crossing any pre-formed lines (or "pipes").
- After completing a puzzle, the player receives a rank based on the number of moves it took to complete it.
    - If they completed it in as few moves as possible, they receive a "Perfect" rating.
    - Otherwise, the game simply displays "Level Complete".
- Some puzzles contain a wide variety of mechanics, such as the ability to warp from one side of the map to the other, or blockades that prevent the player from accessing a grid space from a specific direction.

The emphasis on visual-spatial reasoning and the scoring system are the aspects of *Flow Free* that I find most interesting. Forcing the player to closely watch each aspect of the level and rewarding them for careful, planned out movements matches my intent exactly, though I would like to make the puzzles in my system more difficult to make the reward feel sweeter.

"Paying Attention to Spatial Reasoning." *Government of Ontario,* Queen's Printer for Ontario.

This booklet, which was distributed by Ontario's Ministry of Education, focuses on spatial reasoning as it pertains to geometry and mathematics. It is clearly meant as a teaching aid so that teachers can help their students improve these concepts more clearly.

- The booklet defines spatial reasoning as a variety of concepts, tools, and processes relating to the movement of objects in space.
- Spatial thinking involves three key components – concepts of space, tools of representation, and processes of reasoning –, which help to investigate and solve problems in geometry and mathematics.
- Studies have shown that it is possible to improve spatial thinking through various activities, such as playing video games and completing puzzles.
- One type of visual-spatial thinking involves creating a mental image, retaining it, and mentally altering it. This might include taking an imaginary cube and viewing it from a different angle.
    - Some spatial skills, especially mental rotation, have garnered attention from researchers as being highly related to mathematics learning and achievement.

Though this booklet primarily focuses on the educational applications of visual-spatial thinking, it is nonetheless invaluable to developing my system. Attaining a better understanding of visual-spatial reasoning will make it easier for me to create levels that cater to this line of thought. Additionally, the focus on mental rotation, which is a major component of my system, will help me to develop a two-dimensional field that is easier for players to visualize and learn to manipulate.

Silverman, Linda Kreger. "Upside-Down Brilliance: The Visual-Spatial Learner." *PEGY*, PEGY, 24 Nov. 2005.

This excerpt of a book from Dr. Linda Kreger Silverman discusses visual-spatial learning styles, as well as information regarding this type of reasoning

in general. Silverman is a licensed psychologist with several published papers, many of which pertain to visual-spatial reasoning and learning.

- Silverman describes visual-spatial reasoning as coming from the brain's right hemisphere, which allows people to understand movement in space and perceive whole objects, rather than individual details.
    - This means that visual-spatial learners learn information all at once, rather than from repetition or practice over time.
    - They must understand the larger picture before they can understand the individual details, and in some cases, they might miss the details entirely.
- Silverman also notes that "auditory-sequential learners" – people who learn through words or lectures, rather than images – are generally the opposite of visual-spatial learners.
- Visual-spatial learners focus mainly on space at the expense of time, while auditory-sequential learners focus mainly on time at the expense of space.

These points are important for creating my system in a way that can teach both types of learners how to play it, such as through incorporating an in-level "Controls" menu. It also makes it clear that I should not implement any sort of timer in the game, seeing as the auditory-sequential learners will possibly panic from such a thing, while the visual-spatial players might not notice it at all.

Wang, Hao, and Chuen-Tsai Sun. "Game Reward Systems: Gaming Experiences and Social Meanings." *ResearchGate*, ResearchGate, May 2012.

In this research paper from the National Chiao Tung University, Taiwan, co-authors Hao Wang and Dr. Chuen-Tsai Sun how video game rewards systems provide players with positive feedback and encourage constant progression. Sun is a professor at the university's computer science department with dozens of published papers.

- There are a massive variety of in-game rewards, such as virtual items, points, visual effects, secret areas, hidden levels, and social interaction between players.
- Providing players with immediate feedback makes the outcomes of their actions easier to discern.
- Wang and Sun propose eight types of in-game rewards:
    - **Scoring**, which marks player performance using progressively higher (or lower) numbers.
    - **Experience points**, which show player progression by developing the avatars they control.
    - **Virtual items**, which players (or their avatars) can use to show off their progress to other players.
    - **Resources**, which are similar to items but more often correlate with practical game use.
    - **Achievements**, which reward players for completing certain conditions.
    - **Feedback messages**, which provide players with immediate positive or negative feedback. They are commonly used as sound effects or video clips.
    - **Plot animations and pictures**, which involve narrative feedback and advance in-game stories.
    - **Unlocking mechanisms**, which give players the ability to explore new levels or other in-game areas.
- Reward mechanisms can use anticipation to provide fun long before rewards are provided, especially if players know what they must do to earn them.

Each of these aspects is important if I wish to make a strong puzzle game that makes players think their actions through carefully. It will help me to implement a strong player feedback system, which will allow players to know that their actions have value. Additionally (and perhaps more importantly), it will allow me to implement a reward system for players after they complete each level, further improving the play experience and incentivizing them to play to the best of their ability.