Objective: The game is based on the famous puzzle “Rush Hour”. A player wins if they can slide their colored tokens out of the board before the other player does.

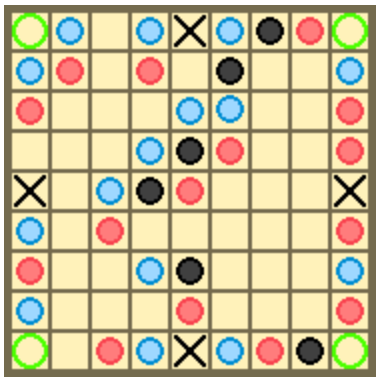

Fig 1. Game Board after Phase 1

Materials: 15 tokens in one color, 15 tokens in a second color, 6 tokens of a third color, and a grid of size 9 by 9

How-to-play:

- The game is played on a 9x9 grid, with 4 exits in the corner, and 4 blocker tokens in the middle of every edge.

- When the tokens reach an exit square, they are removed from the board.

- Each player is handed 15 regular tokens of the same color, and 3 blocker tokens.

Phase 1

- Each player takes turns placing their tokens on the board. They may place a blocker instead of one of their colored tokens.

- No token may be placed on an exit square.

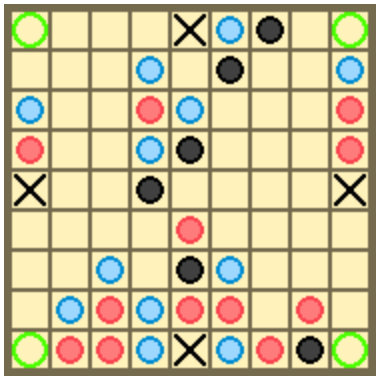

Fig. 2: Turn 1, Direction Down
Note how the tokens in the lower left and right exit play

Phase 2

- The player who placed a token first decides a direction; up, down, left, or right. All the non-blocker tokens slide in that direction until they can slide no more.

- If a token is stopped on an exit square, it instead ‘slides out’ and is removed from the game. Other tokens continue to slide as if it wasn’t there.

- The next player then chooses a direction that is not opposite to the one their opponent just chose (i.e. up cannot be chosen immediately after down). They can, however, choose the *same* direction, effectively losing their turn.

- The same move may not be made 3 times in a row.

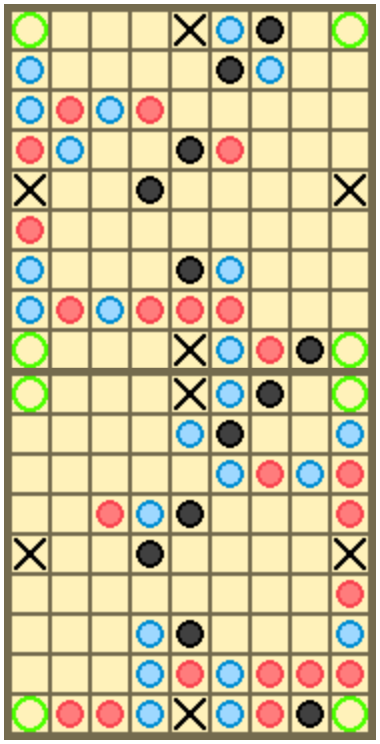

Fig. 3a & 3b: Turn 2 Options
Top image is left, bottom is right

Winning condition:

- The first person who slides all of their tokens out of the board first wins the game.

- If all their tokens would slide out of the board on the same turn, the winner is decided by which tokens would slide out first. For the example on the left, Blue would win because their last token would leave play before Red’s last token would. If both slide out at the same time, the match is a draw.

- If no tile leaves play in 4 turns, the game ends. Whoever has the least tokens on the board wins. If both players have the same amount of tokens, it is a tie.

GRAVITY - THE SLIDING PUZZLE GAME

Gravity - 2 players - A competitive game where you HARNESS THE RAW THEORETICAL POWER OF GRAVITY to slide tokens around the board and eventually have them exit from the corners before your opponent is able to remove theirs. First to do so (or have the least tokens on the board) wins.

BUT WHAT DOES THAT MEEEAAAN?

Gravity was designed as part of a 4-week class on board game design, and focuses around making a competitive version of various sliding puzzles. It almost resembles a prospector panning for gold, shifting the balance of the pan while gold flecks and other bits of dirt move around. The idea was to have players move or 'slide' pieces across the board depending on the direction a player would choose.

INSPIRATIONS

When we were brainstorming ideas, one of the things we both had some experience with the game 'Rush Hour,[1]' a puzzle game where the goal is to slide pieces back and forth in order to clear a path for your car to exit the board. Klotski[2] (or, that ancient Chinese game because I'm too hipster for these normal games but not hipster enough to know it's name or that it's actually Polish) and the sliding puzzle[3] also came up due to similar mechanics and mathematical analysis. We thought that a competitive, multiplayer version of this would be simple enough to learn, have good depth, and be fun to play.

While we liked the idea, we initially tossed it in the scrap bin, only to bring it back out when some of the other ideas proved too complicated.

Starting with the base game Rush Hour, we had decided quickly to trim all the vehicles into 1x1 tokens, as that made things easier to visualize (and was what we had available, but don't tell no one). Exits were quickly added, then moved to the corners due to the incredible difficulty getting more than a few tokens out ever. While having tons of leftovers would have kept with the initial Rush Hour theme better, it didn't really seem fun in a competitive setting to have endings with only one or two tokens removed and some fifteen tokens left over. Instead, we added the blocker tokens. While these still represent a departure from Rush Hour, as they do not move; this became

necessary to prevent things filtering out in 3 or 4 turns, as well as adding some additional strategy to the game.

Some thought was put into making a Connect-4 style apparatus to replace the board that would actually use gravity to move pieces about, though our ability to actually design and create such a thing meant this idea lasted the better part of thirty seconds.

And with that, Gravity version 1 came to be, though it was still imaginatively named ‘Rush Hour’ at this point. We knew the game was still in a rough state at this point, but we had most of the concepts down, or so we thought, and it went into playtesting.

It did not go well.

Once the rules were clarified and the testers allowed some time to get used to play, the game ended in stalemate after stalemate after stalemate, and many of the tokens would leave play too soon for the amount of pieces to feel impactful. While our own playtests had similar issues, we didn’t want to change things until more people had experience with the game to see if this was just an us problem. We were able to address the second problem easily enough, we just increased the amount of pieces from ten regular tokens and two blockers to fifteen and three, respectively, and while the testers had more fun with the more blockers and pieces moving about, it quickly resulted in stalemates again. On occasion, someone’s piece got wedged somewhere, resulting in a victory by timeout. Better, yes, but still not ideal.

In these ties (and timeouts), they were invariably caused by one player moving one way and the other player moving in the opposite direction. So, we just banned doing that. An incredibly heavy-handed maneuver to be sure, and we felt it pretty quickly. One player could only move up and down, and the other could only move left and right, something that became incredibly restrictive and lead to terrible moves being made by both players. Often, player one would be forced to score their player two’s tokens, and then the player two would score player one’s tokens. That didn’t look right, and it certainly didn’t *feel* good. Looking at the way the rule had been written, it had said you couldn’t move in the *opposite* direction, making no note of what would happen if you chose the *same* direction as the opponent.

When we tested this rule in particular with it’s loophole known to both players, it was almost always done when moving in an ‘assigned’ direction would result in a player sliding more of their opponent’s tokens out than theirs, if they even could slide any of theirs out. While on the surface, it didn’t appear to do much, the opponent always made the move that the other refused to make, it flipped the ‘assigned’ directions, changing the strategies and plans of both players. And the ties stopped coming, at least most of the time, something we both declared ‘good enough.’ So, we went to playtesting again, much more confident in our game’s ability to be a game worth playing.

It, too, went poorly.

A few groups tested the game, and neither group seemed to pick up on this rule, instead assuming they really were locked to the ‘assigned’ directions. Due to the ‘loophole’ nature of this rule, it shouldn’t have been too surprising. In addition, these groups found the moving and placing of more tokens tedious, something wholly unexpected based on previous feedback. So, we were unable to take much out of this. The idea of placing an exit in the middle came up, but was dismissed as ineffectual. It would clear out the middle of the board, but would become mostly useless after a few turns.

In the end, the lack of complexity was alleviated by the addition of more tokens, the inevitable tie issue was somewhat resolved by more-or-less banning the moves that led to ties, and the rule sheet was run through multiple times to ensure that it reads correctly.

STRATEGIES AND ANALYSIS

1. The opening

A common opening that we and our play testers used in the game is placing a token next to one of the exits, so that they can prevent the other player from blocking that exit, and secure at least one point in the first slide. The second player may follow to make sure that he/she earns the same amount of points as the first player in the first slide, which will lead to a situation in figure 1 below.

We believe that a bad move to make in the first turn is placing a token on one of the edges anywhere but next to the exit. By doing this, the first player has allowed their opponent the chance to isolate that token easily by placing a blocked token next to it, like in figure 2.

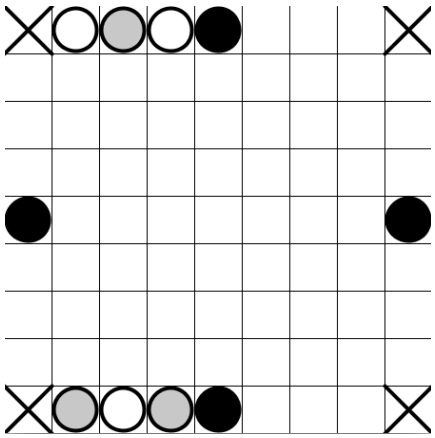

Figure 1

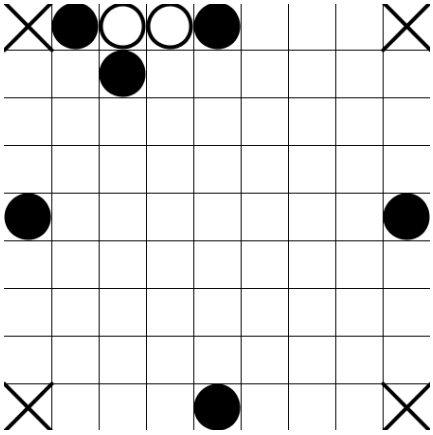

Figure 2

The first player can start their game in the middle of the board, but it might take the players a few first slides to get the first token fallen off the board.

Suppose the two players start off the game with a situation described in figure 1. After the second player places down his/her third regular token, the first player now can start thinking about the second slide. After the first slide, all the pieces on the board will be moved to the left

side. Now if the first player places his token on the left edge of the board or any positions one spot to the right of a block token, that token will not change its spot after the first slide. However, placing any token next to a block token might provide the second player a chance to isolate it,

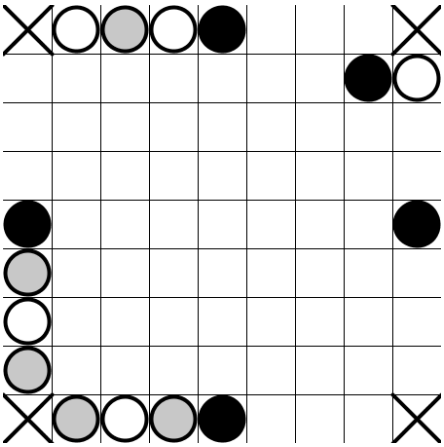

Figure 3

the first player might be better placing token next to an exit, then placing a block token to the left side to make sure that the token still stay in its spot after the first slide. The second player in his slide cannot slide in the opposite direction, so he is better choosing a perpendicular direction to slide the token. That might lead to a board similar to figure 3.

This is one of the many strategies that we thought that is optimal to both players. However, our play testers have tried various opening strategies that prove to be equally fun and efficient, so we encourage our players to be as creative as they can.

2. Isolated tokens

In this section, we will demonstrate some configurations that we thought to be very undesirable during a game, which could cause a token to be stuck and no matter what both players do, they cannot get those tokens to the exits. We will also provide some strategies to avoid these situations.

The first scenario that is very unlikely but has happened during the playtesting is completely isolated tokens (figure 4). This could happen if a player places a regular token on an edge. This can be easily be prevented by placing more regular tokens next to the edge token, making it harder for the opponent to completely block them (figure 5).

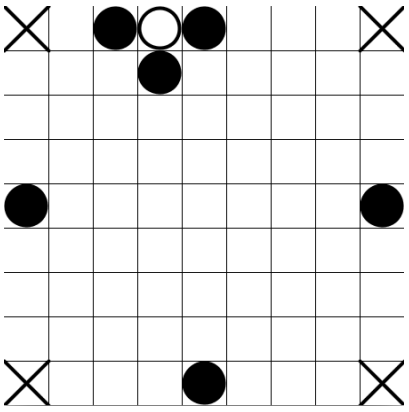

Figure 4

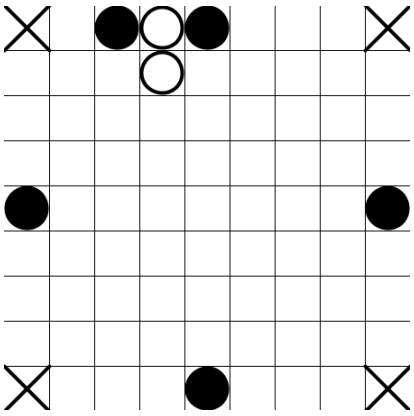

Figure 5

Another situation that was discovered during playtesting is described in figure 6. We can clearly see that matter what move is made, the white token can not make it to the exit. A good solution for this problem is placing a block token in the same column with the white token (figure 7).

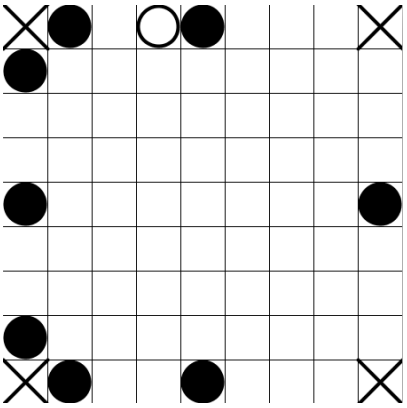

Figure 6

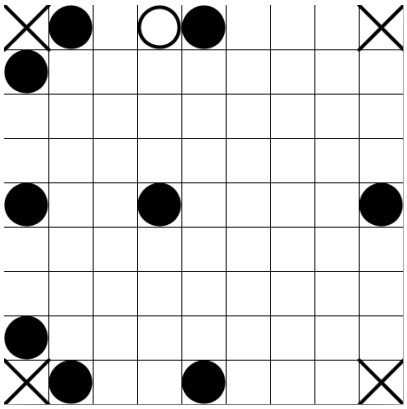

Figure 7

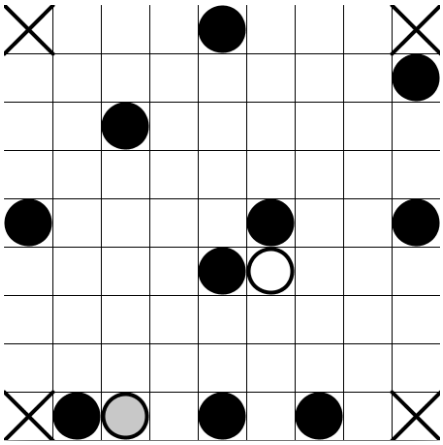

Figure 8

3. The indefinite stalemate

An indefinite situation is frequently encountered during the game, either because there are isolated tokens remained or both players trying to prevent the other player from making any progress. To prevent a tie, we added rules stated that player cannot undo their opponent move, and if there happens to be an indefinite situation, the player with less regular tokens remain wins. However, a tie could still occur during the game, and often we can see it ahead. We are going to display an example of the indefinite stalemate in figure 8.

In the board in figure 8, grey goes first and cannot slide left or right. If grey slide up, the best move white could make is to slide right and wins the game in 1-2 slides. So grey decide to slide down. If white slide right, grey will have a huge advantage by sliding up, so white will choose to remain to board in the same position by sliding left. If grey slide up, white can slide right to the position in figure 9. Grey prevent white from winning by sliding up again. If white choose to remain the same board situation by sliding right, this leads to an indefinite stalemate. If white slides left, grey could slide up and wins the game in 2 moves (figure 10), so white is better with an indefinite stalemate.

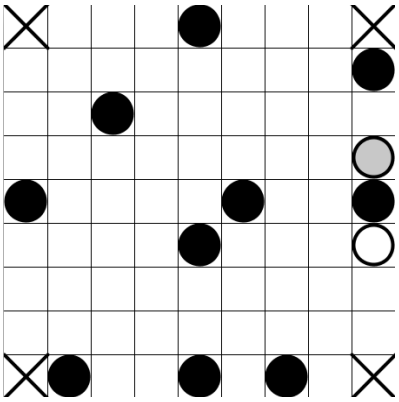

Figure 9

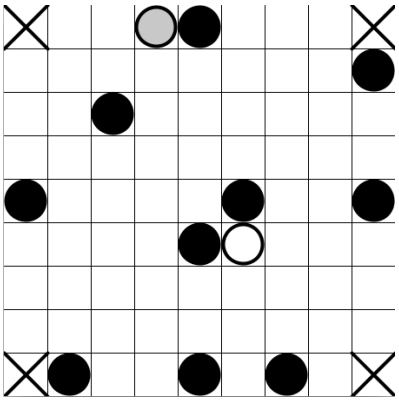

Figure 10

OPEN QUESTIONS

After multiple playtesting, we were reported that Gravity was not as interesting as we thought it would be, but we still think that the game still has opportunities to become a great strategic game. That's why we hope that you, our reader can contribute your ideas to make the game better and more appealing. Below are some of the problems we get back from our play testers:

- Tie still happens frequently during game play.
- People dislike having to move the pieces around every turn. (We thought this problem can be fixed by making a computer version of the game. With the paper version, there is not much we can do but to shrink the size of the board, or decrease the number of tokens played, which will decrease the amount of fun. However, some of our play testers love getting to move the tokens around.)
- The board shape and the position of the exits are not creative. We have received suggestions to move the exit to the center of the board, but we thought that might create the problem of some tokens get isolated frequently during game play.
- The play time is too short: Some people claim that the game usually ends in some first few slides. We intended the game to be a quick, less than 5 minutes game so we did not add any random elements to the game, but we encourage our readers to try them out.

PUZZLES

One reason why we stick to this game is the strategic nature of it. Even though the playing can be short, and tie can happen a lot, we believe that the second phase of this game could be used as puzzles, but more complicated than the traditional "Rush Hour" puzzle because of the two players factor. In this section, we will present a quick example of a puzzle derived from the game (Figure 11).

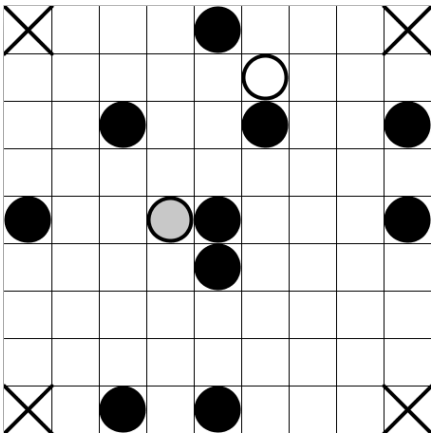

Figure 11

We believe that if grey goes first, whatever move grey makes white can win the game in 2-3 slides. Can you prove/ disprove our belief? What if white goes first?

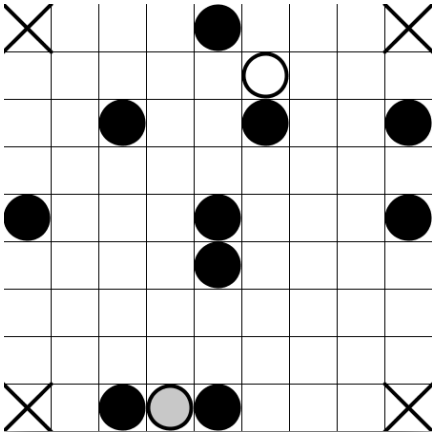

Figure 12

Answer:

If grey slides left or right, white can immediately win by sliding up. If grey slides up, white can win by sliding to the right. So grey will choose to slide down (this will never happen in a real game play, since grey will be unable to move in at least one direction). Now, if white choose to slide right, the game will hit an infinite stalemate immediately, since grey will have to prevent white from winning by sliding down, and white can choose to keep the board in the same position or slide left. If white slides left, grey will prevent white from winning by sliding down, forcing another infinite stalemate. The best move that white should do is to keep the board in the same position by sliding down, forcing grey to either slide left or right (since 3 consecutive down is illegal), and white can win easily by sliding up, making an exit in the upper left or upper right corner. If white moves first, white also could also force a win by sliding right, forcing grey to slide down. Now white slide down again, forcing grey to either slide left or right, and white can claim his/her victory by sliding up.

We believe that this puzzle is an excellent demonstration of how repeating the move of your opponent can result in a win, even if it seems like we are not making any progress on the board.

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