

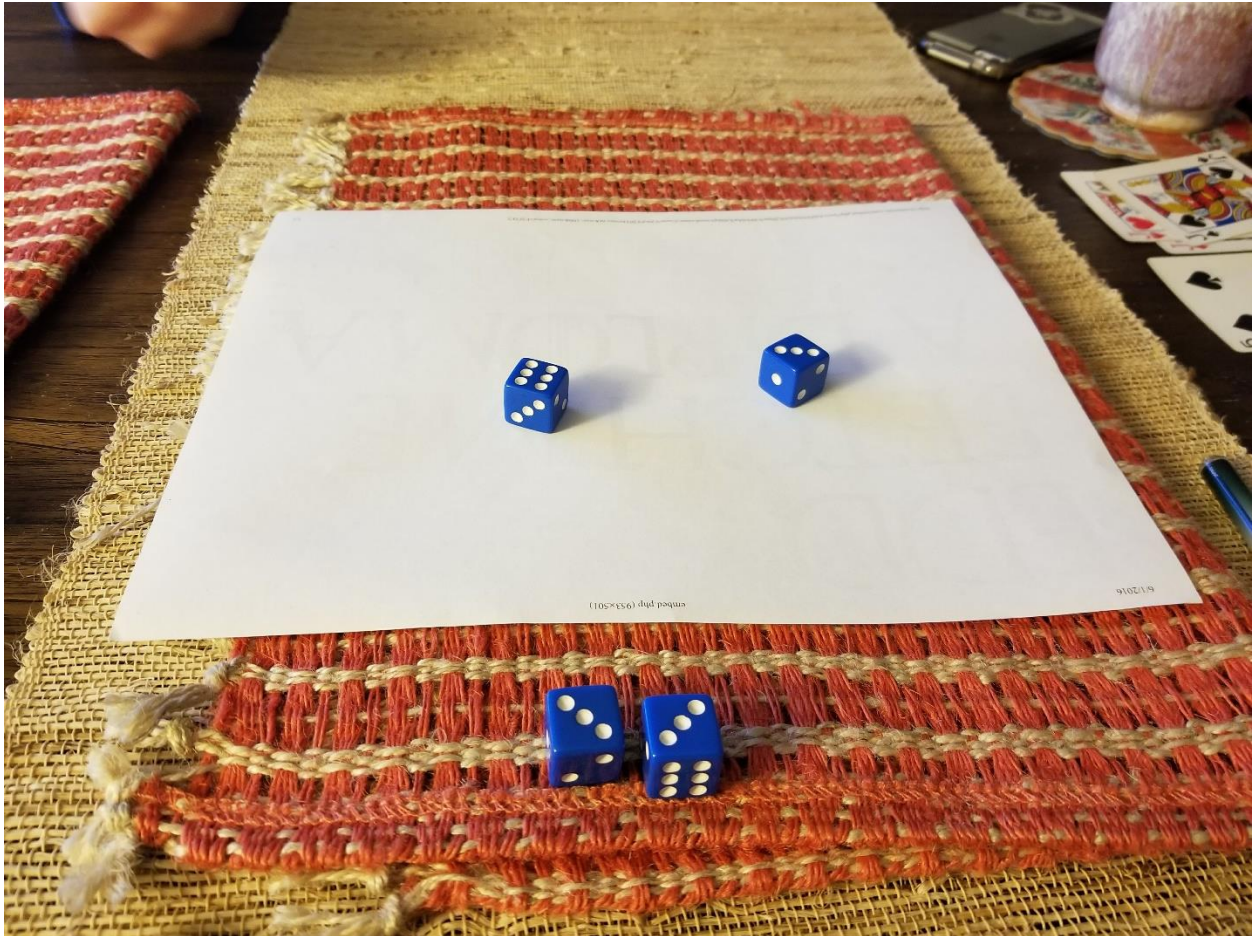
Notes from your brainstorming, or whatever process you used to get to your initial idea.

- Dice in box: Box is the playing board and also keeps dice from going everywhere
- Dice jenga: Remove the dice from a vertical tower Bejeweled-style to clear groups of matching numbers and eventually clear all dice
- Cornhole dice: Throwing dice into a box from a distance
- 3D domino dice: Joining dice by numbers on sides (rather than by top or bottom faces) of dice
- Egyptian Rat Screw with dice (initial set of rules below)

The initial set of rules.

Dice game inspired by Egyptian Rat Screw:

- Materials: 10 dice, facedown deck of cards (used as a tangible way to represent points), clear area in the middle of the table (i.e. the board), space on the table outside of the board for each player to roll their dice and to keep any dice not in play
- Players: Up to 6 players can play at a time. In the beginning of the game, each player must select a unique lucky number out of the set: {1, 2, 3, 4, 5, 6}.
 - Whenever another player rolls a double of the player's lucky number, the player earns 1 point.
 - Whenever a player rolls a double of their own lucky number, they earn 3 points.
- Starting with two randomly rolled dice on the board, players must take turns to roll another pair of dice to match the numbers of or create n-in-a-row consecutive straights with the dice on the board.
- **The goal of the game is to have the most total points when *all* dice are cleared from the board.**
- Points can be earned with the dice a player is able to clear each round:
 - 2 of a kind: 1 point
 - Consecutive 3 straight (e.g. 4, 5, 6): 2 points
 - 3 of a kind: 3 points
 - Consecutive 4 straight (e.g. 2, 3, 4, 5): 3 points
 - Clearing board: 15 points
 - **If a player clears some dice from the board but there are still dice remaining on the board, they must keep rolling 2 dice until nothing can be cleared from the board with their last roll (which adds these dice to the board in play).**
- Before the next player's turn, only the most recently rolled 2 dice should be kept on the board in play if there are more than 2 dice on the board.
- Face-down cards were used as point markers, as these are physical, tangible, and make it easy to see how many points players have with a quick glance. Any other identical, easy-to-count items can be substituted as point markers.
- Probability note: To get the consecutive-3-straight with 1 die on the board, the probability is 2/36 for a 1 on the board, 4/36 for a 2 on the board, 6/36 for a 3 on the board, 6/36 for a 4 on the board, 4/36 for a 5 on the board, and 2/36 for a 6 on the board.



Play-test notes:

- 1) Saturday, 2/3 12pm: I first play-tested this myself while pretending to be 2 different players. The first player to roll was able to clear dice from the board six times in a row (i.e. rolling 6 times) in the same turn, which was a little concerning.
- 2) Saturday, 2/3 2pm: I then play-tested this initial idea with 2 friends (J and H) who were part of the same underclassman friend group that played many board games together (both a year younger than I am – but from the same undergraduate institution). They both graduated from college the summer of 2017. J is working as a full-time analyst and watches gaming playthrough streams in her free time, and H is a first-year male computer science PhD student at CMU. Both are self-proclaimed nerds.
 - a. H started off the round and accumulated 12 points from clearing dice consecutively during his first turn. This supported my initial hunch that long streaks are not difficult to achieve.
 - b. After I won the game during the first round (after both H and J had finished their turns) by clearing the board, I mentioned out loud that the game didn't feel very satisfying and asked my playtesters to tell me what they thought about the gameplay. Both H and J felt there was not enough strategy in the game, since everything was left to luck.
 - c. H mentioned this game reminded him of Yahtzee, so we decided to play a game of Yahtzee instead. J and I had never played Yahtzee before this.
 - d. **After playing Yahtzee, we talked about what we liked (+) and disliked (-) about Yahtzee:**
 - i. + Each round has an effect on the next round

- ii. + There is a healthy dose of strategy involved:
 1. Players must keep track of the “long game” and factor their short-term roll and round decisions based on this.
 2. Others’ scores likely affect how much risk you are likely to take.
 3. The 2 re-rolls per turn allow for strategy within the turn and give players hope and add an element of surprise, even if their initial rolls are not that good. For example, J got a Yahtzee after a first roll that she completely redid and her first re-roll that resulted in three 3’s.
 - iii. + The rules are simple to understand (even though the strategy is not)
 - iv. + The game only requires 5 dice and a scoring sheet (which H drew from memory, as his family plays Yahtzee a lot – even over Skype with a webcam).
 - v. – Your actions cannot directly impact the other players’ scores
 - vi. – Mental math with adding 5 dice for scoring is a little troublesome
 - vii. – I had a lot of bad luck with my rolls, so I felt like surmounting this was impossible even with strategic re-rolls.
- 3) Saturday, 2/3 3pm: H picked up 3 dice and threw them, and J followed suit by picking up another 3 dice and throwing these. On a whim, I decided that **this could be a competitive battling game, where dice with higher numbers defeat other players’ dice with smaller numbers.**
- a. Rules:
 - i. Materials
 1. Number of dice = 2 times the number of players
 2. Subset of regular playing card deck with all aces, 2’s, 3’s, 4’s, and 5’s (i.e. 4 A’s, 4 2’s, 4 3’s, 4 4’s, and 4 5’s)
 - ii. Objective: First to collect a straight (A, 1, 2, 3, 4, 5) or 4 of a kind (e.g. 4 aces) wins. This way, collecting 4 of a kind is theoretically quicker, but collecting a straight is much easier.
 - iii. All players must roll 2 dice at the same time, taking care to note who threw which dice.
 - iv. The player with the single highest number in their roll goes first. If multiple players each have the same highest number, then the second highest number of these player’s rolls must be compared (and the third if necessary). However, if a player rolls a double, these would be counted together to be a higher number than a 6. To go first, the player would have to use both of these dice at the same time as a double.
 - v. This player selects another player’s die that is of a smaller value than their highest number die and selects the corresponding number card to add to their scoring hand.
 - vi. The next player with the next highest single number rolled now goes and tries to “defeat” a so-far-undefeated die that is of a lower value than the players’ highest number die. If there are no dice that this player can defeat, then the subsequent players get their turns to try to defeat so-far-undefeated dice. This continues by player order until no one is able to defeat any undefeated dice.
 - vii. All players collect their dice and each re-roll their 2 dice.
 - viii. The gameplay repeats until a player collects a straight or 4 cards of a kind.
 - b. Gameplay debrief:

- i. Not satisfying to play. Gameplay was too easy, and getting a straight was not a challenge at all – which meant there was little conflict.

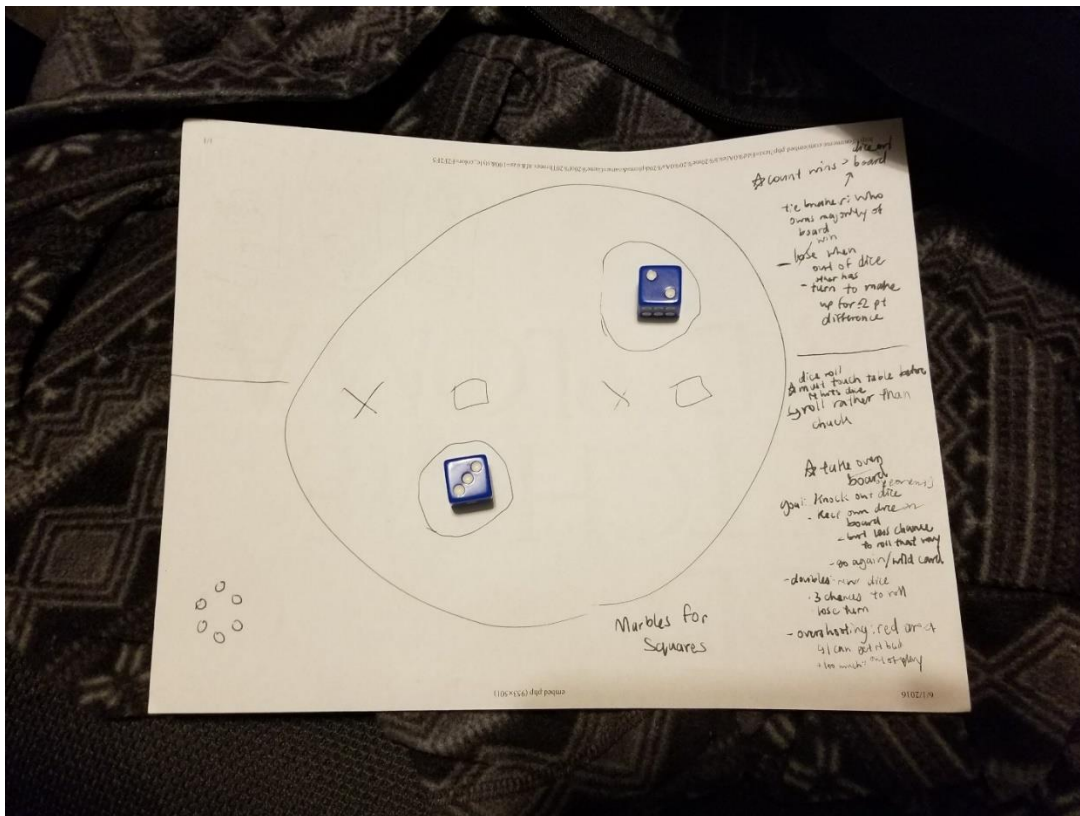
Saturday, 2/3 3:30pm: H had to leave, but J remained to help playtest and brainstorm some games that would hopefully be more fun. **Some ideas that we tested but didn't make the cut:** 1) Simultaneous Yahtzee turns where each players' dice thrown out for reroll are up for grabs in a common area, 2) Texas Hold'Em with dice instead of cards (but no betting, since we kept all rolls unhidden).

- **We talked about what dice are often used for:**
 1. **Movement**
 2. **Conflict**
 3. **Triggers for events**
 4. **The main set/hand used in Yahtzee**
 5. **Reducing choice (i.e. helping indecisive people choose from a constrained set of choices)**

Saturday, 2/3 4pm: J and I each started throwing a die in the air while trying to pick up another die (similar to the gameplay of jacks) before catching the thrown die. The difficulty curve to throw two dice, pick up another die, and catch these two dice seemed too high to me. J suggested the idea: "marbles with dice." We started throwing dice at other dice to see how this worked out. **This was fun but challenging, so my initial prototype (that I am satisfied with) is based off this concept: "Marbles for Squares."**

Initial rules of "Marbles for Squares":

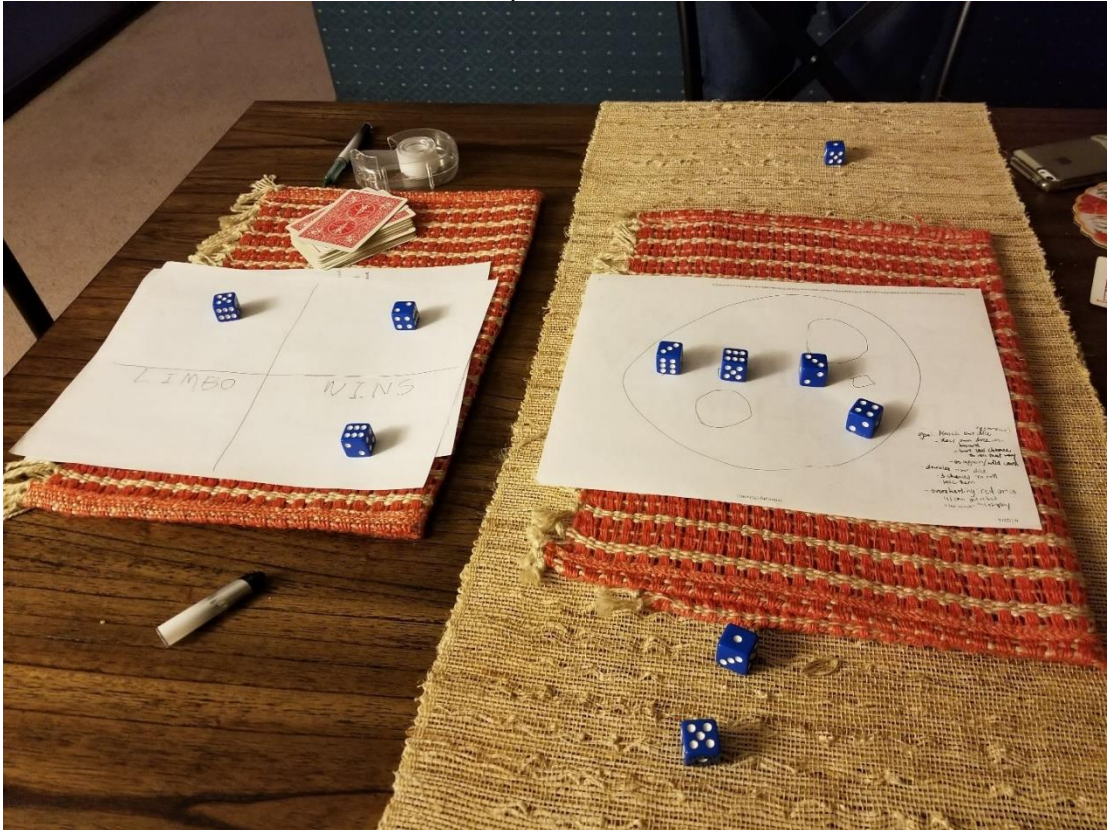
- 1v1 turn-based game design. Each player has 5 dice of the same color, but players' dice colors are different. (I only had 10 dice of the same color, so we put tape on 5 dice to indicate they belonged to one player, while the untaped dice belonged to the other.)
- Setup: Each player rolls two dice and places these dice on a diagonal in a 2x2 square layout on the board. (The picture below shows one player's dice placed on the board.)



- Goal: The player who has collected the most of their opponent's dice (i.e. "wins") when both players have run out of dice (i.e. all dice are either on the board or in the other player's "wins" stash) wins the game. In the case of a tie, whoever has a majority of dice on the board (i.e. in the ring) at that point wins the tie.
- **A player starts the game by rolling their dice that are not in the board or in limbo.**
- **If any of these rolled dice match any of the opponent's dice on the board, you can use each of those matching dice to try to knock out the opponent's corresponding matching dice from the ring.**
 - Players must stay on their side of the board (marked by the line through the center of the board) when throwing dice, and players must throw dice in from outside of the confines of the circular board (i.e. your hand cannot pass into the circle region).
 - **Matching dice must be thrown one-at-a-time.** Rolling doubles that match with at least one of an opponent's dice gives the player more opportunities to hit these matching dice.
 - **If any of your dice land in the ring during your attempt to knock out the opponent's dice, your dice must stay in the ring as is.**
 - **If your thrown die lands outside of the ring, and you do not knock out any other dice from the ring, you get your die back - which can be rolled starting from your next turn.**
 - **Any of your opponent's dice you accurately (i.e. correctly matching, for example: you used your 6 to knock out your opponent's 6) and successfully knock out of the ring get added to your "wins" count (see left side of picture below).**
 - **Any of your dice that you use to knock out dice you are not allowed to knock out (examples of dice you are not allowed to knock out: opponent's**

dice that do not match with the number of the die you threw, any of your own dice) go into “limbo” (see left side of picture below). The dice that were incorrectly knocked out are placed face-up back into the ring, so the side that is facing up is the side that was facing up after they were knocked out. **Your turn ends immediately after placing any of your dice in limbo, even if you had more matching dice from your roll (i.e. additional opportunities to knock out the opponent’s dice).**

- **To get your dice back from limbo, you must give up your normal roll on a later turn and use the 2 designated “limbo” dice to roll doubles within 3 rolls. Up to one die can be retrieved from limbo per turn.**



- In this 1v1 version, the 2x2 grid for limbos and wins provides a physical representation to track each player’s “wins” and dice in limbo spatially (which helps to offset the fact that all dice are of the same color in this initial playtest).

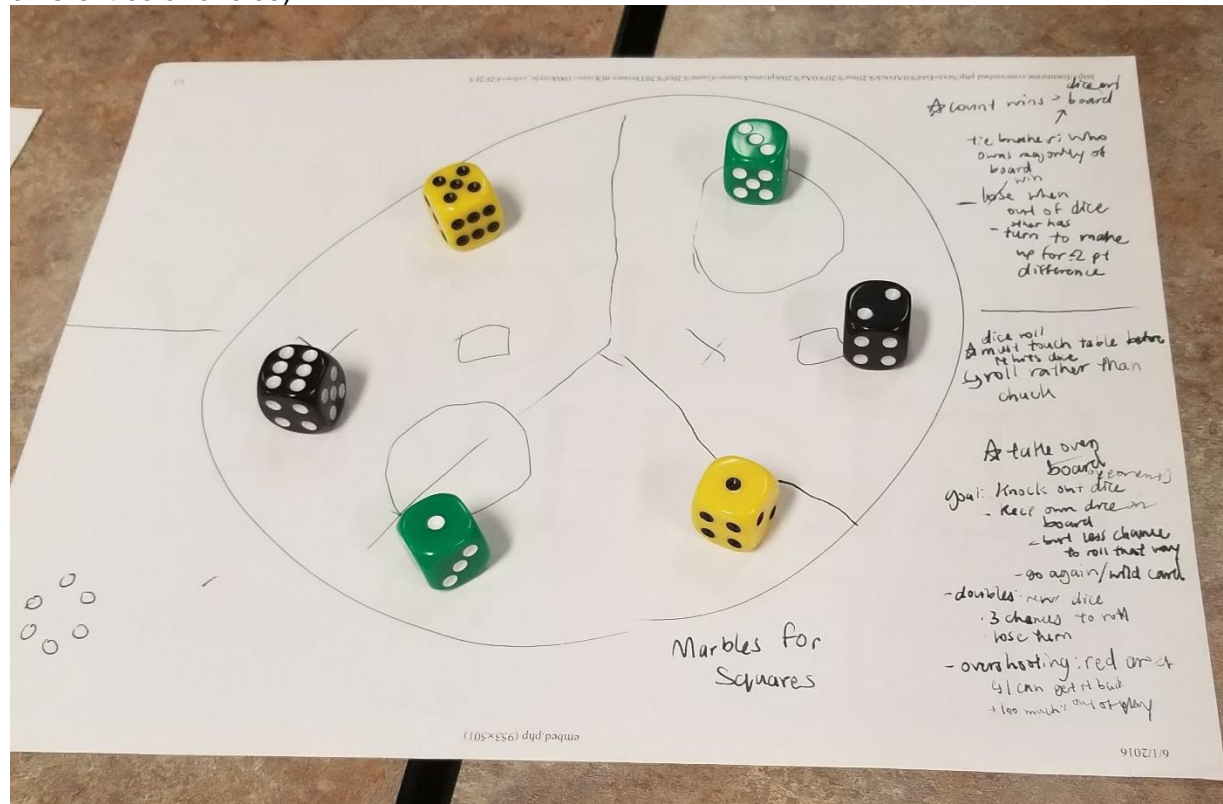
Written analysis of each of the playtests you conducted (note dates and times, and who played – even if it is just you), and the revisions you made.

Since “Marbles for Squares” is designed to be a short game (<15 minutes per game), I decided to do more playtests.

- 4) Saturday, 2/3 4:30pm: J and I played the game with the rules above.
 - a. Since this game requires fine motor control, it’s useful to point out that I had more accurate aim hitting dice with other dice than J did.
 - b. We tested this initial version, and I won when I ran out of dice. It was odd how I won the game with only one of J’s dice in my “win” collection, since most of my dice were on the board. However, we decided this should be a natural ending

point, since a player can't get any dice back to roll once their dice were on the board or in the opponent's "win" collection.

- 5) Saturday, 2/3 5:00pm: J and I played again with some revised rules:
 - a. You stop playing when you run out of dice, but if there is less than 2 point difference in "wins," the other player gets another turn. This prevents players from scoring a "win" to take the lead and then dumping all of their matching dice onto the board to quickly run out of dice to end the game.
 - b. The dice roll must touch the table before it hits the target dice. This forces players to roll the dice rather than chuck them.
 - i. Chucking dice was making them fly all over the place off the table.
 - c. Functionally, this did not change our gameplay because we were not trying to exploit the rules, and the results were similar to the first play-test. I won after getting one "win" and occupying the majority of the board. J got her extra turn after I ran out of dice to roll/throw, but she missed and did not change the state of the game.
- 6) Sunday, 2/4 8:00pm: Playtest group session with 3 classmates
 - a. Players: 2 ETC production students, 1 Tepper student
 - b. The following picture shows the starting set up with 3 players (each with a different color of dice).

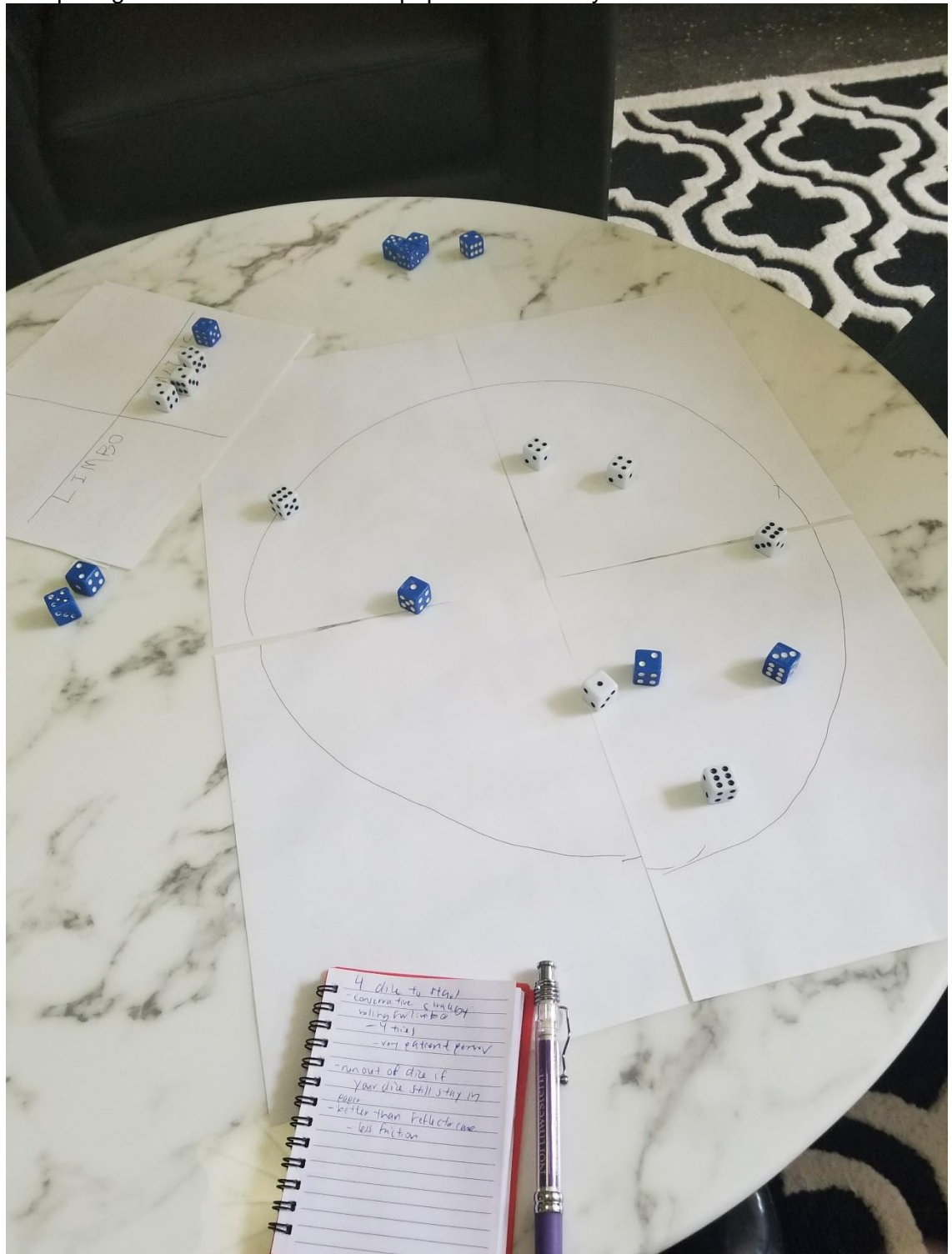


- c. Players generally thought the game was fun and thought the game design suited a large range of ages, since it is relatively simple and doesn't require much strategy.
- d. However, dice kept flying everywhere and needed to be retrieved under tables in Hunt Library, which my classmates mentioned was the least enjoyable part of the game.

- e. I did not mention the “roll rather than chuck” rule and noticed that most players either threw overhand to hit other dice (as one person noted, similar to a beer pong throw) or flicked the die like a marble.
 - f. The dice were generally hard to hit, since the shape of dice allows for less control and accuracy than the round shape of marbles.
 - g. Some suggestions I received:
 - i. Add a barrier around the board to stop dice from flying everywhere and possibly prevent players from flicking the dice.
 - ii. Randomize the setup at the beginning like in billiards rather than doing a meticulously symmetrical setup.
 - iii. Allow players to go around the table and allow for greater mobility and control for their dice throws, like in billiards.
 - iv. Make the board bigger to encompass the size of 4 sheets of paper.
- 7) Sunday, 2/11 1:40pm: Z and me with reflector case
- a. Player information: Z is 30 years old and spends most of his time playing chess competitively for fun.
 - b. I now had 10 white dice in addition to my original 10 blue dice, so I played as white, and Z played as blue.
 - c. We each started the game by rolling 4 of our dice into the ring. Each player had 3 dice to start rolling with, and the remaining 3 dice were set to the side to be earned when rolling a triple or quadruple.
 - d. Since I didn't have a barrier built yet, I improvised with my photography reflector case to try to prevent dice from flying everywhere. This added some friction to the board and also made the dice significantly more difficult to knock out of the ring due to the inverted dome shape that is lowest in the center of the ring and highest at the outer edges. After ten minutes of trying in vain to knock out dice, I decided to switch back to a flat paper board. The larger size of this board seemed good though.



- 8) Sunday, 2/11 2:00pm: Z and me with 4 sheets of paper
a. Setup: larger board with 4 sheets of paper. No barrier yet.



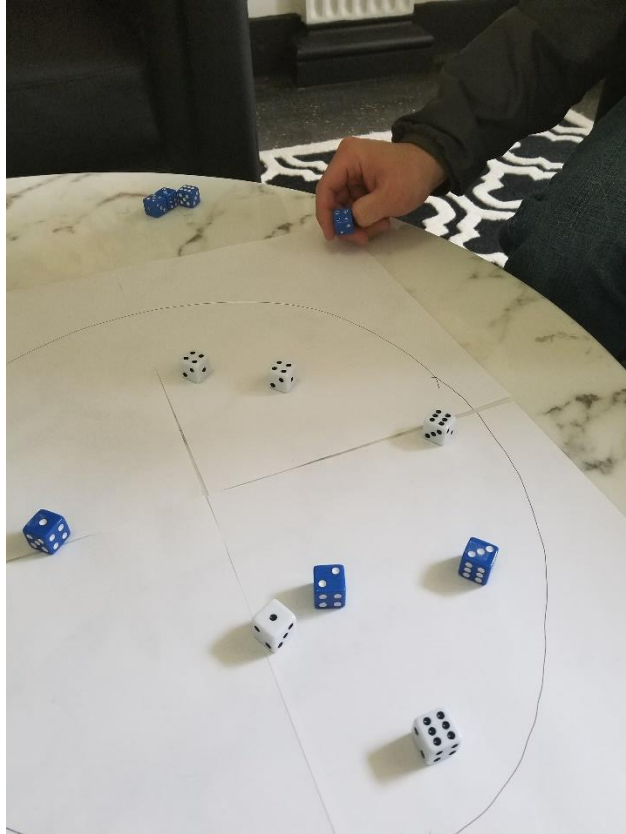
- b. Z still played as blue, and I still played as blue.
c. Z pointed out that the current rules allowed conservative players to exploit the "limbo" mechanic in a 1v1 situation. Since the opponent cannot knock out the player's dice from limbo to remove them from play, and players can continuously

use their turns to retrieve dice from limbo, a winning strategy could be to knock incorrect dice out on purpose to stall in limbo and attack the opponent's dice when the opponent starts to run out of their own dice (i.e. ammo) because these dice fall into the board.

- i. Z used 4 of his turns just to retrieve his dice from limbo (to end up with a final hand of 4 dice), as I only had 2 dice at my disposal – later to become 1 (since I threw the die, and it landed in the board) just before his 4th turn spent rolling to retrieve his last dice from limbo. Since I could not do much with only 2 dice, Z did not have much to lose by sacrificing his turns to accumulate his dice from limbo for subsequent turns.
- d. Z mentioned the paper was better than the reflector case for game play. Now dice were actually getting knocked out of the ring without too much difficulty.
- e. Z and I started talking about different methods to throw individual dice.
 - i. Players could throw overhand.



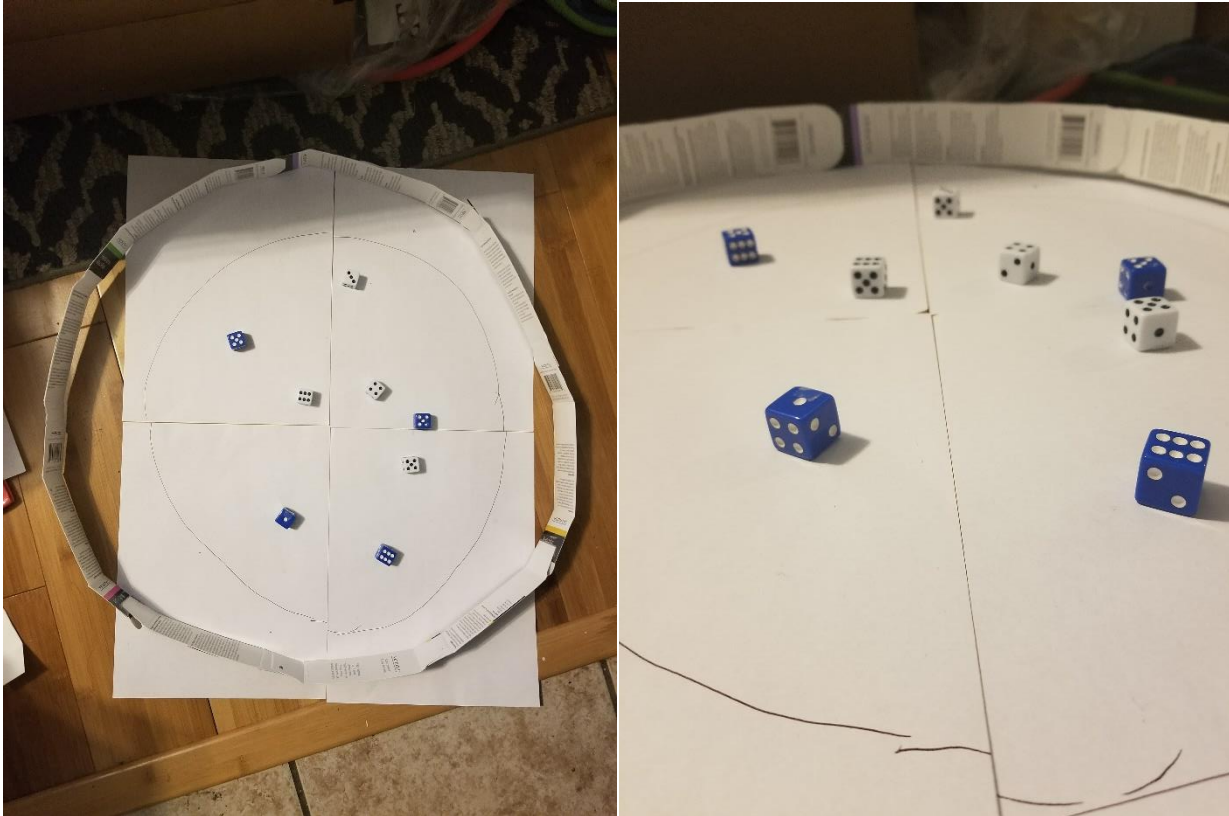
- ii. Players could do a combined flick-throw, which Z found similar to the flicking action in marbles.



- iii. Players could flick from the table, which Z did not find as satisfying and accurate as the hybrid flick-throw, although my playtest group members opted for this method.



- 9) Sunday, 2/11 3:00pm: Just me. Created border & overhauled rules
 a. 1v1 setup pictures with cardboard barrier border (to keep dice from flying everywhere):



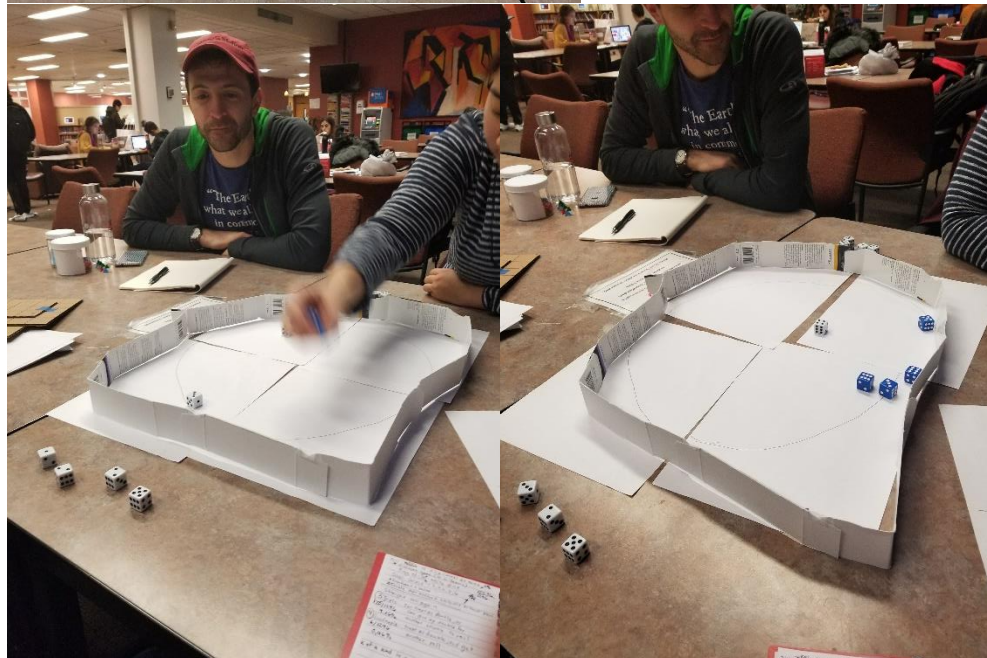
- b. I thought it was a little confusing how players could hit the “correct” matching dice, but it could flip over as it was being hit, which would require the player to put their dice in limbo, so I decided to make aiming for an explicit dice less explicit by changing the rules to the initial version of the final ruleset (see detailed final rules below this entire playtesting portion).
- i. 2 player game (or 2 teams)
 - ii. 10 white dice on the board
 - iii. Roll 4 blue dice at once every turn.
 - iv. Goal: Collect one dice each with values 1, 2, 3, 4, 5, 6.
 1. Any white dice that are knocked out of the ring with your blue dice are yours.
 2. Doubles (that you roll with your blue dice) that match with the number of a white dice on the board allow you to collect this matching white die.
 - v. Special rolls:
 1. Straight (e.g. 2, 3, 4, 5): Player gets to roll again
 2. Triple: can either treat as a double to collect a matching white die, or can give up this double power for another roll
 3. Quadruple: Can collect a matching white die and also get another roll

- vi. Beginning of your turn: Can roll in any of your white dice into the ring before rolling the 4 blue dice
 - 1. Gives player giving up their white die a chance to get a desired number and first dibs to claim it

10) Sunday, 2/11 7:20pm: Playtest group session with same 3 classmates, playing on 2 teams (2v2)

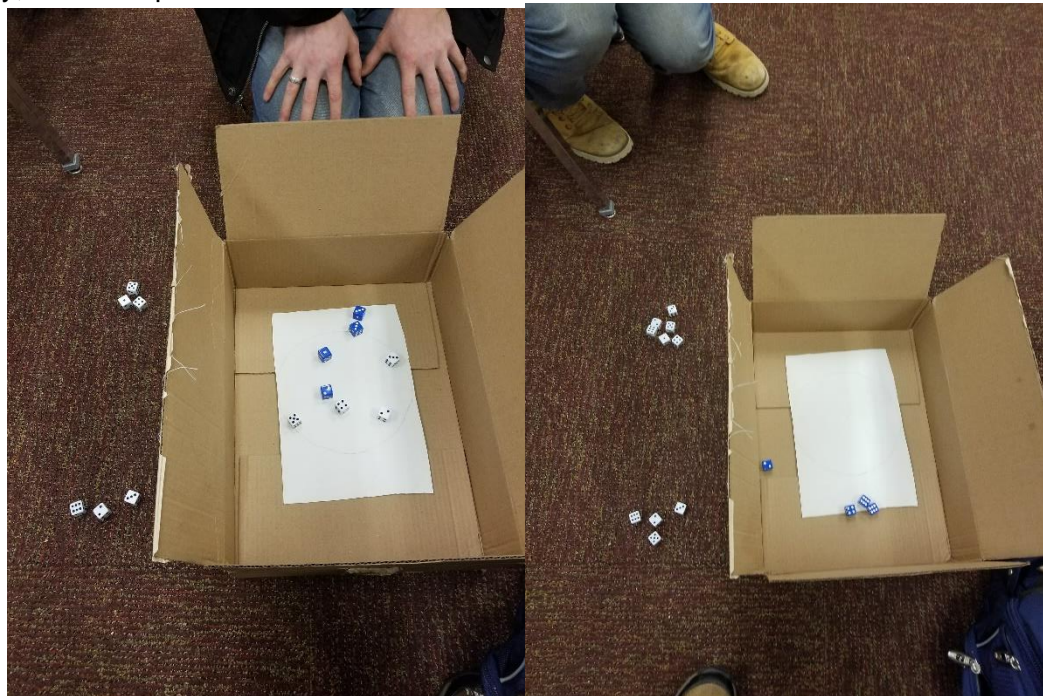


a.



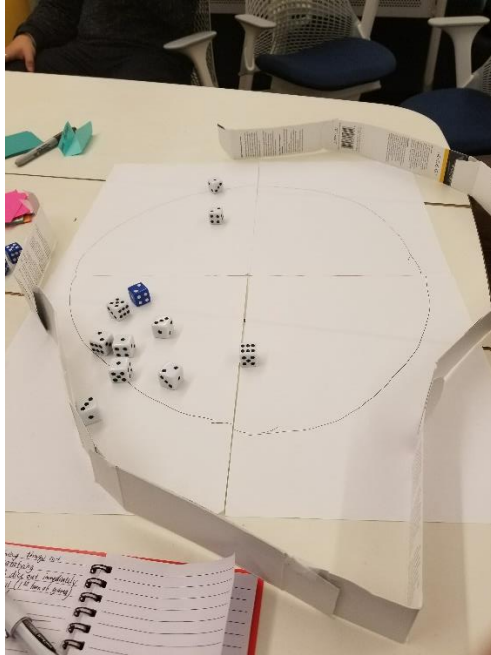
- b. Duplicate white dice need to be put in immediately after they are “won.” Otherwise, one player can hoard the dice, which leaves nothing for the other player to do.
- c. We ended up several times where both players had 5 dice, but no one won, since there were only 10 white dice. I borrowed 2 of my classmate’s dice to add to the set of white dice to allow gameplay to continue.
- d. Suggestions:
 - i. Try a smaller arena so the end game isn’t as dragged out.
 - ii. Make the barrier taller, since some dice still bounce over and out of the barrier.
 - iii. Maybe use the inside of a cardboard box and make this a squatting game.

11) Monday, 2/12 1:20pm: METALS classmate R at the end of class in the classroom

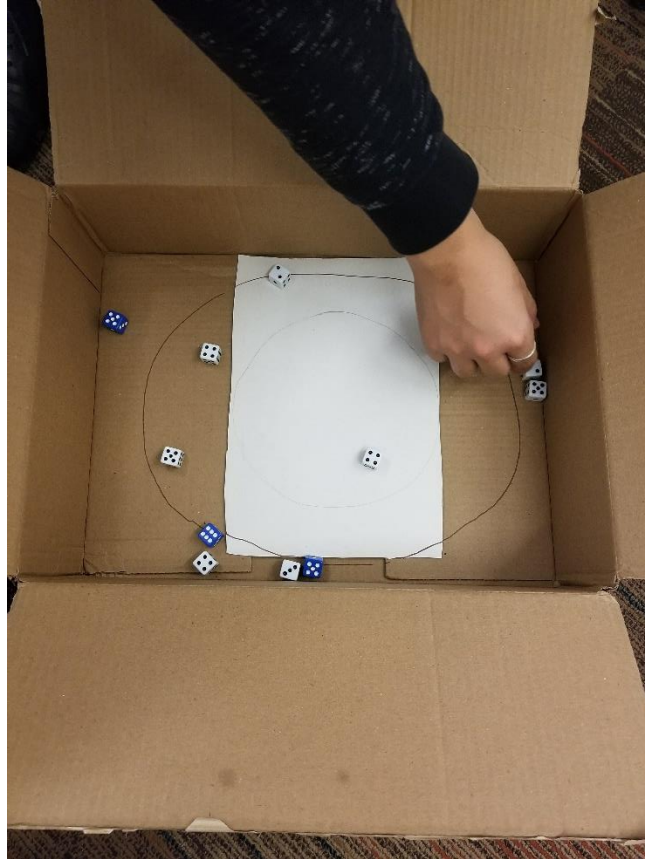


- a.
- b. R really liked the action of knocking dice out.
- c. R won but found the win not very satisfying. I suspect this was due to the lack of control related to the mechanic of throwing all 4 dice at once.
- d. R hit 3 white dice out immediately on his first roll (the first turn of the game), which was likely a result of the smaller ring I created.

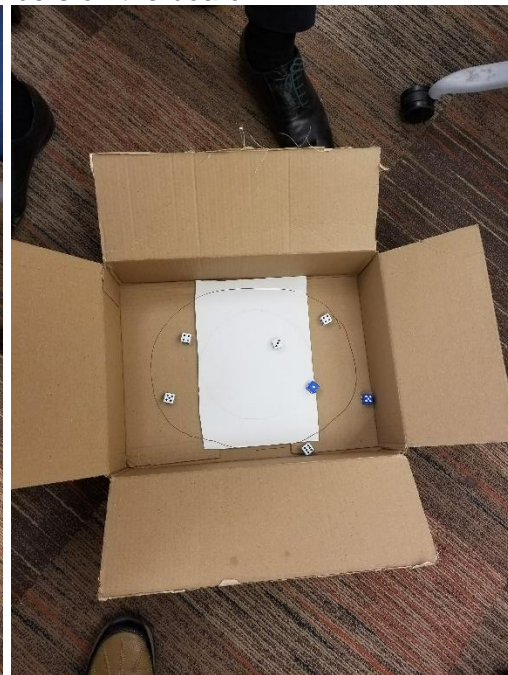
12) Monday, 2/12 3:10pm: METALS classmates Ju and L with broken border



- a.
 - b. My METALS classmates Ju and L were rushed for time, so we dealt with this partial cardboard barrier setup because I wanted to return to a larger board. Subsequently, dice were falling everywhere, especially since L did really well knocking white dice out by chucking all 4 blue dice.
 - c. 10 white dice is probably not enough, since both Ju and L reached 5 dice, and I had to add in two surrogate blue dice that were pretending to be extra white dice.
 - d. Most importantly, near the end of the game, it was harder and harder to get white dice (since the opponent also had 5 of them), so gameplay stagnated as both players tried to flip over the final white dice to get the number they needed.
- 13) Monday, 2/12 3:25pm: METALS classmate N
- a. This time, I started the game with 12 “white” dice (still using the 2 blue surrogate dice with green tape marks as additional white dice).
 - i. Perhaps players could take alternate approaches to winning, such as getting 5 of a kind. Would need to work around the duplicates rule to do this.
 - b. The cardboard box as a medium is compelling and adds a sense of randomness and noise – within the context of some additional control. N found it weird that he was able to hit the box and hit the dice outside of the ring without hitting the dice directly.
 - c. The first roll always knocks out a lot of dice, so players should alternate who goes first in each game.

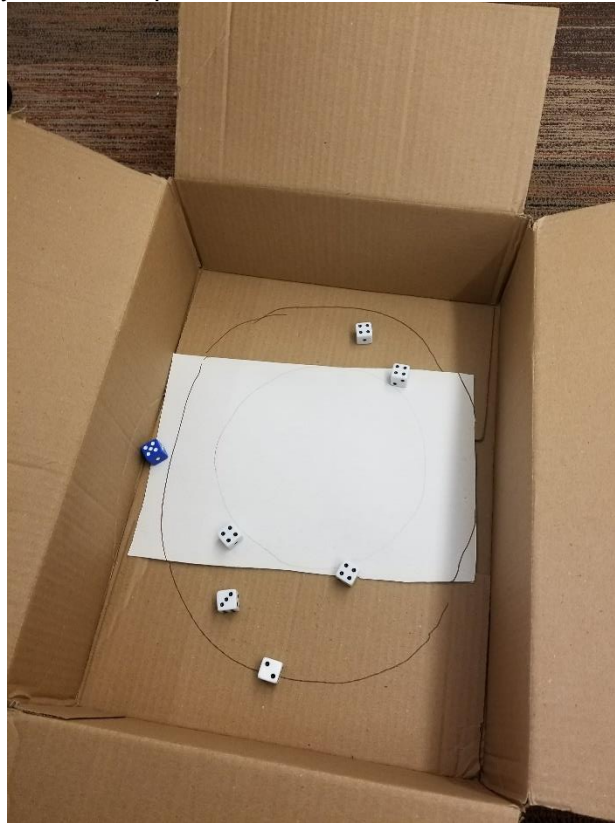


- d. Throwing the dice one by one was N's personal preference, and this was the most fun part of the game for him.
 - i. I decided to incorporate this option into the rules, so players would not be forced to roll all the blue dice at once. This way, there are more opportunities to change the numbers on the board.

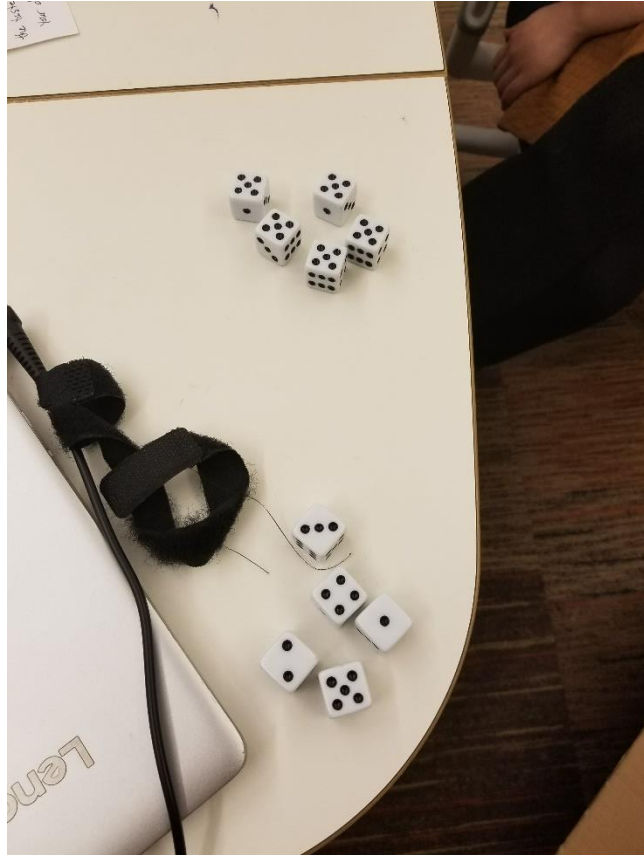


- e. N said he had a lot of fun playing thihs game.

14) Monday, 2/12 4:40pm: METALS classmate M who is also taking this class



- a.
 - b. M said this game was not much fun to him, since he doesn't feel that he can build any skill or progress by throwing dice.
- 15) Monday, 2/12 6:20pm: METALS classmate T & me
- a. I changed the rules to 1) allow for both players to be able to win despite my constraint of only having 10 white dice and also 2) solve the stagnating problem where the game drags out at the end:
 - i. Once one player accumulates 5 dice of different values (and is 1 die away from winning), the other player picks a number to change all of their dice to, and now this second player's objective to win the game is to get 5 of a kind.
 - ii. This allows for some sense of control, despite the randomness of the dice flipping over and rolling onto different sides on the board.
 - b. T ended up winning the game by getting five 5s (after seeing that the final white die left on the board was a 5), although it turned into a 1 as she was throwing dice one-by-one at this one scoring die. With her last blue die, she hit the white die out, and it flipped back to a 5.



- c. T thought the most enjoyable part of the game was the suspense/curiosity she felt between the time the blue dice left her hands and when she saw the final result of her throw.
- 16) Tuesday, 2/13 7:30am: Just me
- a. Changed rules to only use 3 blue dice instead of 4 blue dice
 - i. Reduces probability of doubles from $13/18$ (~72%) to $4/9$ (~44%), since people were more often than not getting doubles on their turns in my playtests with 4 blue dice
 - ii. Also since people took too long throwing 4 dice one at a time into the box
 - b. Added the challenge rule option where the player with 5 dice can roll a double to change the number (for 5 of a kind) that the other player will be trying to get
 - i. This way, a player could think they are choosing a number that will make it harder for the other player to win, but they can also play a hand in their own demise if luck plays out against them.
 - c. Created bigger space between box walls and ring of play
 - i. Allows more room for white dice to be knocked out
 - d. Decided to allow for freedom over how many blue dice are thrown at a time
 - i. Since my playtesters seemed to have fun with the accurate control afforded by throwing 1 die
 - ii. And since other playtesters also enjoyed throwing multiple dice at once and causing a big shift of events on the board

Final set of rules for “Marbles for Squares” (AKA “65”):

- Players: 2 players (or alternatively, 2 teams of any number of players)
- Suggested age of players: 4 years old and up
 - o Anyone with fine motor skills to be able to throw/drop a die with relative accuracy at another die and able to identify doubles when rolled
- Materials:
 - o 13 standard six-sided dice of the same size, shape, and weight
 - 10 white dice
 - 3 blue dice (or any color besides white)
 - o Box that is 11”-15” wide x 14”-18” long x 7”-12” tall
 - o Sturdier piece of cardboard/paper to cover the floor of the box and make the floor level (i.e. not uneven)
- Setup: Draw an oval ring by first drawing 4 points and then connecting them:
 - o 2 points that are located roughly 2 dice lengths away from the midpoint of the longer box walls
 - o 2 points located roughly 3 dice lengths away from the midpoint of the shorter box walls
 - o (Thus, all other distances from the ring to the box wall should be greater than these dice lengths, after these 4 points are connected by drawing an oval.)



- Setup: Roll all 10 white dice into the box.
 - o Dice that fall outside of the oval ring during this roll must be placed back inside of the ring with the same side up (i.e. without being rotated).

- Objective: Collect 6 white dice - one each of a 1, 2, 3, 4, 5, and 6.
 - o **White dice can be collected face-up (i.e. not rotated) if they fall outside of the oval ring as a result of the 3 blue dice being thrown into the box.**
 - o **If a double or triple is rolled with the 3 blue dice,** the player who rolled the double/triple can also collect any white die on the board with the same number as the double/triple they rolled.
 - o **Any duplicate-number white dice that a player collects must be rolled back into the ring at the end of their turn.** For example, if a player already has a 1 and knocked a white 1 out of the ring, they must roll this die back into the ring. Dice that fall outside of the ring during this roll must be placed back inside of the ring with the same side facing up as it had at the end of this roll.
 - o ***Once one player accumulates 5 dice of different values (and is 1 die away from winning), the other player must pick a number to change all of their dice to, and now this second player's objective to win the game becomes getting 5 of a kind (i.e. 5 dice with identical numbers).**
 - **For this player trying to get 5 of a kind, any dice that is not of the number they are trying to get 5 of a kind for must be rolled back into the ring at the end of their turn. The duplicate-number white dice rule no longer applies to this player.**
 - **The player with 5 dice can challenge this number choice by rolling the 3 blue dice and getting a double or triple. If this player with 5 dice rolls a double/triple, they can now choose the number that all of the other player's dice will get changed to.**
 - *For example:* After Player A has collected 5 dice (a 1, 3, 4, 5, and 6), Player B decides to change the 4 dice he has to become four 2s. Player A chooses to challenge this and switch the number Player B will need to get 5 of a kind for by rolling a double with the 3 blue dice. Player A gets a double by rolling a 4, 3, and 4. Player A decides the new number that Player B will collect (which can be the same number as the original number Player B selected) will be 6, so Player B turns his 4 dice to become four 6s. Player B now needs to collect five 6s to win the game.
- This is a turn-based game where only one player is taking actions at a time.
- **At the start of a player's turn,** they take the 3 blue dice and must roll them into the box. Any sort of roll/throw is allowed, and the player can move around the box to throw from a different angle, **so long as the player's hand does not enter the box** during this process. The 3 dice can be rolled or thrown one-by-one, in a group of 2, or all at the same time. **No dice can be collected by the player until all 3 blue dice have been rolled into the box.**
 - o **White dice can be collected face-up (i.e. not rotated) if they fall completely outside of the oval ring as a result of the 3 blue dice being physically thrown into the box.**
 - o **If a double or triple is rolled with the 3 blue dice,** the player who rolled the double/triple can also collect any white die on the board with the same number as the double/triple they rolled.
 - o **Any duplicate-number white dice that a player collects must be rolled back into the ring at the end of their turn.** For example, if a player already has a 1 and knocked a white 1 out of the ring, they must roll this die back into the ring. Dice that fall outside of the ring during this roll must be placed back inside of the ring with the same side facing up as it had at the end of this roll. (See the exception to this rule under the condition when the other player has collected 5 dice.)

- Touching or manipulating the box/box floor itself is not allowed (except the minimal contact that occurs when retrieving dice).
- Any white dice that have already been collected by a player cannot be rotated or flipped (except in the case when the other player has just collected 5 dice of different values – see * above).

An estimate of what this game would sell for in retail, if it were mass produced. Explain what you base this on.

I would not mass-produce this game to be sold in retail, since the design was focused to be accessible without requiring any special materials – besides the dice involved.

To give an estimate though, this price would be about the cost of two differently colored 10-packs of six-sided dice of the same size/shape/weight: about \$5-10, according to Amazon prices for multi packs of dice from the same manufacturer.

In this age of online shipping and Amazon, I expect players to find a small-medium cardboard box on their own to draw a circle/oval in and play with as their board.

Anything else you feel is relevant (for example, a probability analysis)

Probability of rolling (at least) doubles with 3 dice: $4/9$ (~44.4%)

It's a $1/6$ chance that the first two dice will match. If they don't, then it's a $2/6$ chance that the third will match one of those two numbers, so that's $1/6$ (for a match on the first two) plus $5/6$ (the chance of that not happening) times $2/6$ (the chance that even if the first two dice don't match, you get doubles), or $6/36 + 10/36 = 16/36 = 4/9$

Probability of rolling a triple (3 of a kind) with 3 dice: $1/36$ (~2.8%)

Note: Rolling a triple is included in the subset in the calculation above for the probability of rolling (at least) doubles.