Anne Xie, Elizabeth Onstwedder, Julia Ridley
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Final Report

Pathfinders: Navigation Board Game

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The Game / Integration

Pathfinders is a 2-player cooperative navigation game where players use controlled communication to practice communicating about shared landmarks, perspective taking, and direction giving. The game fades scaffolding by having players progress through modular boards of 3 difficulty levels (easy -> medium -> hard). The rules for our game (printed and included with the game) begin on the next page.

Pathfinders Rules

Goal

It is the year 2500, and by this time humans have mastered intergalactic space travel. Suddenly, your spaceship breaks down and hurls you onto an alien planet, separating you from your travel partner. You know that there is an abandoned spaceship somewhere on the planet that you can use, but you need a way to get to it. Luckily, you find your short-distance teleporter in the wreckage, but it can only go short distances before refueling. If you can find your way to a fuel reserve, you can teleport to a new location that gets you closer to the abandoned spaceship. Your partner will also need to reach a series of fuel reserves to get closer to the spaceship. At the end of the game, you and your partner should reach your abandoned spaceship and can use it to head back to Earth. Your partner knows where the fuel reserves are, and you must work together to guide you to their locations... *But be careful, your partner can't see barriers that might be in your way!*

Game Pieces

Board Pieces

There are two types of board pieces:

Map boards   **and World boards**
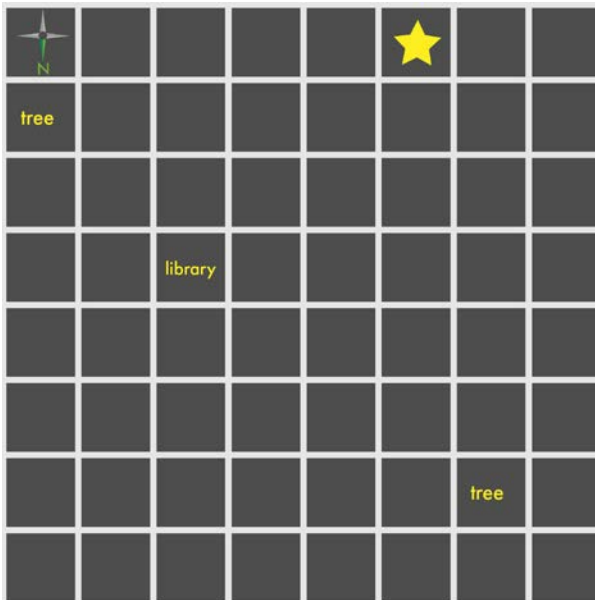
The map boards show where your partner's closest fuel reserve is and the names of some shared landmarks.
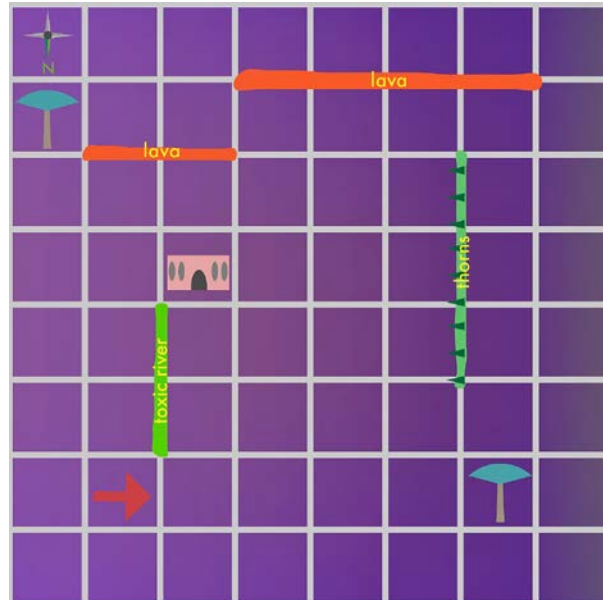
The world boards show what you can see around you, where you start, images of some shared landmarks, and barriers.

As you move through the game, the boards you uncover will become more difficult, ending in the most challenging level. You will move through 3 boards in the game.

Information Tokens

You can place each of the three types of information tokens on their respective boards.

Cardinal Direction	Relative Position	Route Distance
Information using North, South, East, and West, as defined by the compass on the maps	Information using left, right, in front of, and behind, relative to your current position and the direction that you are facing	Information using the number of non-diagonal squares or relative distance between locations

Player Pawns

You get 2 types of pawns:
- The yellow pawn represents you as you move through the world board.
- The white pawn represents your partner and the location that you guess they are at.

The face on each pawn indicates the direction that you are facing when giving relative position information or when updating your partner about your position while moving.

Timer

The sand timer lasts for one minute and determines the length of the lightning round.

Game Setup

Start by flipping over all of the map and world board pieces so that the grid side is facedown and the color side is visible.

Take a green world board and give your partner the corresponding map piece, and vice versa. (You should now have one world board piece and one map piece in front of you, and there should be two sets of orange, yellow, and red board pieces.)

Take your pawn (the yellow one) and place it on the starting square (the one with the red arrow) in your world board facing in the direction indicated by the arrow.
For information tokens, each player should start with:
- **3** route distance tokens
- **4** cardinal direction tokens

- **8** route distance tokens

Which you should place on or next to the corresponding token boards.

Gameplay

Information Sharing

Each turn, you can only ask for or give information about *your* world board or *your* position. You and your partner may collectively use up to **3** tokens per turn, and you can decide who should spend them (i.e. who should ask or answer questions).

When you spend one information token, you can say that type of information about *one* landmark or about your position.

> For example: "I am 5 route distance from the tree" is acceptable, but both "I am 5 route distance from the tree and 9 from the library" and "I am 5 route distance east of the library" would require 2 tokens.

When you give information, the information tokens are spent and added to a pile along with your partner's spent tokens. These tokens will stay spent until one player correctly guesses the location of a fuel reserve.

Note: If both you and your partner spend all of your information tokens, you lose.

Moving

After sharing information with your partner, you can move up to **5** squares on your world board. You cannot move diagonally. You may move through any **landmarks** on the board. **Tell your partner how you are moving and if you make any turns.** You **cannot** tell your partner about the number of squares you moved or the cardinal direction that you moved.

> Valid example: "I moved forward, then I turned right, then I moved forward."

Barriers on the board (lava, toxic rivers, thorns, chasm, etc.) prevent you from moving through them. You may move through the squares that are adjacent to the barriers, but you may not pass through the gridlines that have barriers on them. You may tell your partner that there is a barrier on your board, but you may not convey any information about the location of the barrier.

Location Guessing

During your turn, when you think you know where the fuel reserve is, you may spend **2 of each information token**, which triggers a **lightning round**. During this lightning round, you will have **1 minute** (as marked by the sand timer) to ask and answer as many questions as you want using all three types of information. At the end of the

round, you make your final guess about the location of the fuel reserve. You can make your guess using a combination of cardinal direction and route distance.

For example: "I think the fuel reserve is 3 north and 5 east of the library."
If you are correct, the information tokens that have been spent are recovered and are split evenly between you and your partner by type (you may decide who gets the extra token if there is an odd number of that type of token). If you are wrong, those tokens stay spent until one of you correctly guesses the location. Your partner can only tell you that your guess was wrong, and cannot tell you the correct location.
Note: If both you and your partner spend all of your information tokens, you lose

In addition to the lightning round, you may spend **1 of each information token** to make a guess without starting a lightning round. Your partner confirms or denies the location like in the lightning round.

Board Expansion
After you have confirmed the location of the checkpoint and reached it, you have received a fuel boost and can teleport to a new area of the planet - a new piece of the board is unlocked. In this piece, like the original piece, there is a starting location and a starting direction for you to face. Gameplay proceeds as in the first round.

Once you confirm the location of your first checkpoint, take a world board piece that is *yellow* on the back (e.g. world A), and give your partner the corresponding map board piece that is *yellow* on the back (e.g. map A). Once a checkpoint is confirmed on a yellow board, do the same with one pair of world and map board pieces that are *red* on the back.

Order to select board expansions:
1. **Green (easy)**
2. **Yellow (medium)**
3. **Red (hard)**

How to Win: You and your partner win the game when you both successfully reach your abandoned spaceship at the end of the red level.
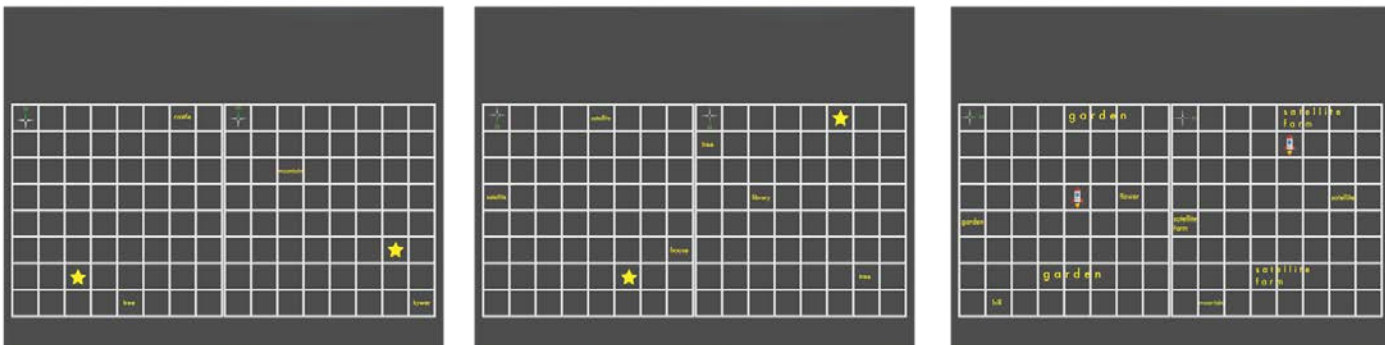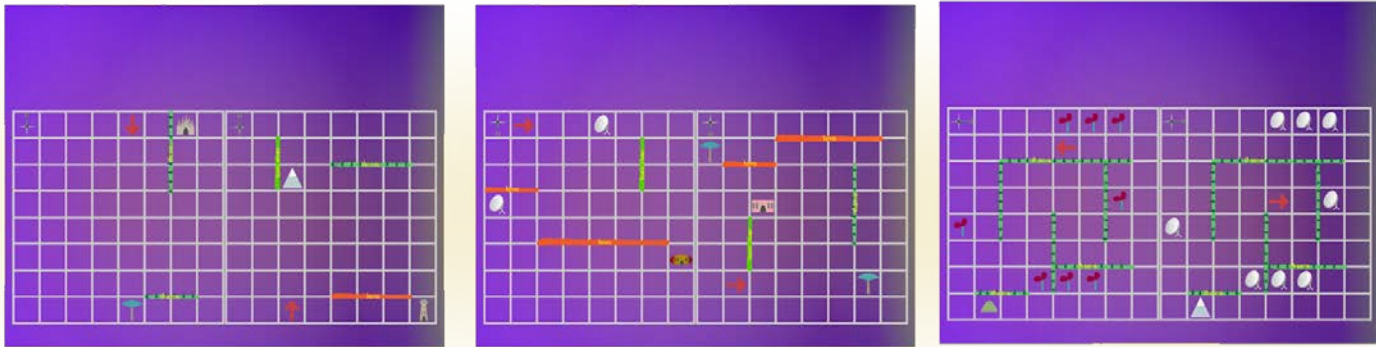
From left to right: green, yellow, and red example boards. World boards on top (purple), map boards on bottom (gray)

Evaluation of Learning

We observed some evidence of learning within our game:

1. Players became more specific with requesting and receiving information. For example, players started from not knowing what information would be useful to share (e.g. "What do you want me to tell you?") to then giving their partner detailed information: "I'm relatively far away from the tower, but I'm looking towards it."
2. Players got faster as they progressed through the levels, which indicated that at least within the game they were learning.
3. Finally,we noticed that as they played, players were more likely to use the relative position information tokens, which are underpowered in the game. Since the relative position is most like real-world navigation where you are "seeing" the world around you, we hope that this would transfer to better navigation skills.

Unfortunately we did not have the opportunity to evaluate transfer of knowledge outside of our game. As a future direction, it would be nice to do a pretest -posttest evaluation of our game

using a real navigation task, not one that is situated on a comput er, to better determine whether the navigation skills in our game can translate to real life navigation and communication.

EDGE Framework

We drew on several learning science principles to incorporate into our game.

Learning Science Principle	Mechanic
Scaffolding	In the easier boards, there are fewer confusing landmarks, which makes communicating their location easier
Fading	For the harder boards, the scaffolds from the easier boards are removed
Interleaving	Practice using cardinal direction, route distance, and relative position are all being used together, and are interdependent
Feedback	You receive feedback from your partner about your moves and guesses about checkpoint locations
Multiple Routes Principle	Players have to decide on their own which route to take, all of which are valid but some of which are more efficient
Self-Explanation	For the sake of confirming shared information and using this information to give accurate directions and act upon directions appropriately, the game drives players to give

	clear self-explanations for how they are interpreting information and acting upon it

Since we are assuming that the players already know what each type of navigation information is (cardinal direction, relative position, and route distance), we are instead aiming to have this game teach and practice strategies for conveying that inform ation and using it to build a more complete map of the world around them. We want to incorporate **scaffolding** so that at the start of the game the checkpoints are fairly easy to achieve and don't require a lot of mental transformation, but then remove those scaffolds as the game progresses and they wander further out towards the endpoints. As the scaffolds are removed, the information becomes more ambiguous and more effort is taken on behalf of the player to incorporate all of the information into a coherent picture of the area. While this might sacrifice replayability, we believe this will improve the educational outcome of our game.

We also struggled with how to incorporate **feedback** in a non-digital game that can't accurately track state. However, by makin g the game collaborative, players are motivated to not only give the clearest information possible but to attempt to clear up misconceptions when they think they happen. The drawback is that the only time players get truly corrective feedback is at the end of a "lightning round" when one player makes a guess about where a checkpoint or endpoint is, and the other player confirms or denies that position.

Another learning science principle that is included in our game is **self-explanation**. Depending on how much we decide the communication should be controlled, players are constantly giving their justifications for their reasoning when they are talking to their partner. Then, the partner can either agree or disagree with that reasoning and provide their own self-explanations for why they think that is the case. Encouraging self-explanation is important for sense-making and understanding, which are the necessary learning processes for the learning goals we are trying to teach in this game.

MDA Framework

We have also tried to align our learning objectives (listed below) with the MDA framework.
1. Describe where a location is relative to a landmark in terms of cardinal direction, relative position, and route distance
2. Determine what combination of information is necessary and sufficient to explain to someone where a location is relative to a landmark(s)

3. Given a description of where a location is relative to a landmark in terms of some combination of cardinal direction, relative position, and route distance, plan a route to that location

For **mechanics** , they are mostly focused around the idea of restricting information and regulating what can be done each turn. This enforces the controlled communication mechanic between players and requires them to meet the learning objective of giving clear directions and utilizing multiple sources of navigation information. While we were unable to simulate a 3D presence in the environment due to the restrictions of a physical game, we w ere able to force players to mentally take a 3D perspective by forcing them to use relative position and pretend that they were in the position of their token. Additionally, the controlled communication of only being allowed to use certain types of informa tion at certain times acts as targeted practice for those skills which might not get a lot of use otherwise, such as cardinal direction. Through rounds of playtesting we decided on the appropriate amount of each information token (3 route distance, 4 cardi nal direction, and 8 relative position) to incentivize the players to use relative position, which directly addresses one of our learning goals of orienting to landmarks.

The mechanics of controlled communication leads to a cooperation **dynamic** where both players are incentivised to give as much and as clear information as possible within the restrictions that are set. Since the game is collaborative, if both players don't have the exact same set of information it helps make them interdependent in order to win, and therefore one player is less likely to dominate the gameplay as can happen with collaborative games. We noticed in the 2nd and 3rd playtesting sessions that when given more time for their turns, players would try to collect as much information as possible, even if it didn't seem directly relevant to them reaching their checkpoints or endpoints. Because of this we shortened the turn length to 1 minute to encourage more succinct language and less information -gathering for its own sake. However, we also discovered that the controlled communication mechanic sometimes felt too restrictive, which made communication frustrating instead of stimulating. We also found the dynamic of giving/receiving all of the information related to one player's board, then flipping to the other player's board, such as "let me get you here, then I can get to mine", which showed a collaborative and focused gameplay tactic.

The relevant **aesthetics** for this game are challenge, fellowship, narrative, and discovery.

The challenge aesthetic comes from the difficulty in beating the game. Players have to communicate with each other given limited information, which is challenging compared to regular navigation. All of our players indicated pride and pleasure when they were able to reach a checkpoint or endpoint, which shows that they were satisfied when they could overcome the challenge.

The fact that the two players have to work together to achieve a common goal creates fellowship and a shared bond that can be carried outside of the gameplay. The collaboration makes the game fun and playful, while also creating an environment to encourage learning together. It is also relevant to the learning science principles because it incentivizes the players to perform their best when navigat ing and communicating, rather than to give bad information to try to deceive other players.

The narrative aesthetic is implemented in the story inherent to the game. The starting story sets the stage for an intergalactic alien travel story and provides r elevant background that frames the gameplay. The fact that players have to collect pieces of a teleporter in order to reach a spaceship and go home adds value and logic to the getting to each checkpoint, and makes the players more invested in the outcome o f the game. Our visual design for the alien planet also touches on a sensory aesthetic, because we were striving for a beautiful alien landscape with vibrant colors. While our visual design could have been more polished, the color scheme both ensured that the boards read as an alien planet and were pleasing to look at.

Finally, as the story is built out and the players get more pieces of the board, the discovery aesthetic is invoked. As they get closer to the endpoint the landmarks get more confusing, which could end up reading as them moving into "uncharted territory" rather than a more defined or colonized area of the planet.

Learning Objectives / Background

Literature review and theoretical CTA: [Link](#)
Cognitive task analysis brainstorming: [Link](#)
Cognitive task analysis synthesis and findings: [Link](#)

Learning to navigate is not a formal subject. You don't really learn in school about how to find your way around in the world. What schools do teach is what cardinal directions are, and how to use a compass in real life or a compass rose on a map. But what are some strategies to help people get from point A to point B when they have never gone that way before? There are many components to successful navigation, so we wanted to start our project by narrow ing down the scope of the learning objectives to what is particularly hard about navigating. Is it that maps are difficult to read? Is it orientating to cardinal directions? Translating 2D maps to the 3D world?

In order to address this, we did some **liter ature review** about the skills necessary for navigation. One paper categorized spatial navigation skills into survey knowledge, which is acquired from reading maps and gives a broad overview of the topography of the area, and procedural descriptions, which is acquired through turn-by-turn directions and gives the user a first-person model of traveling through an area (Thorndyke & Hayes-Roth, 1982). Survey knowledge requires more cognitive processing than procedural knowledge, since procedural knowledge is the more automatic memory based on repeated traveling through a route. Because of this, we ruled out targeting procedural knowledge, since we want to see how our learners can navigate in a novel environment. Within survey knowledge, there are two main types of navigation cognition: egocentric reasoning and allocentric reasoning (Klatzky, 1998). Egocentric reasoning is orienting with respect to your own body (e.g. "I walked away from the library, so it is now behind me"), while allocentric reasoning is orienti ng to something outside of the body (e.g. "The library is east of me, which means that the restaurant is north of me").

These different types of navigation cognition present different difficulties in navigating. Having to calculate the orientation betwee n two landmarks is different from having to orient yourself towards the direction that you came. In order to figure out which parts were most difficult, we performed three types of cognitive task analysis.

For our **CTAs** we recruited three high school seni ors. We chose this demographic because we suspected that because they grew up using GPSs, they might be less capable of navigating on their own.

The first task was an orienting task where the participants were dropped in a location using Google Street View as if they had just come out of a subway station, with the use of a map with

landmarks, but not cardinal direction. The task was to go 2 blocks South down a specific street. We determined the amount of difficulty they had in the task through how much ti me they took to complete it. This task proved to be very easy, and all of them completed it within 3 minutes. All of them exhibited a similar strategy of picking a landmark from the map (a restaurant on the corner) and then aligned the landmark with their own perspective (i.e. "I oriented towards Popeyes and went there"). Since the task was easily completed by all 3 participants, we assumed that they already had the prior knowledge and skills for this type of navigation and we did not need to devote our gam e solely to teaching this.

For the second cognitive task analysis, we wanted to investigate the ability to maintain orientation when following directions. The participants were told to start at a particular location, then follow a set of directions (e.g. "turn right, go 2 blocks, then go left") to get to a destination. At the destination, they were asked which direction they started at, and which direction was North. This CTA took longer to perform because of the directions, but also seemed to require more brain power than the previous CTA. One main finding was that they did not seem to maintain a cardinal orientation while they are moving, but rather back-calculated the orientation at the end by mentally retracing their steps.

Our third task for CTA (giving and receiving directions) investigated how people communicate One participant (Player A) was given a map of a location with a start point and an ending point while the second participant (Player B) would be placed at a point in Google Street View. Player A would have to plan a route between the two points and give verbal directions to Player B, who would have to navigate in Street View to the ending location. We created two routes, one we hypothesized to be easier (in Chicago, which is on a grid system), and one we hypothesized to be harder (in London, which does not have a grid and is just generally a somewhat confusing place to navigate) to try to determine which factors made navigating more difficult. Our participants actually wanted to try a third r oute, so during playtesting we quickly created a third route in Venice. Direction-givers were provided with a printed Google map with the start and end points marked in pen (except for the impromptu Venice task, where they were shown the map in Google Maps with start and end points and were able to zoom in and out and move the map around).
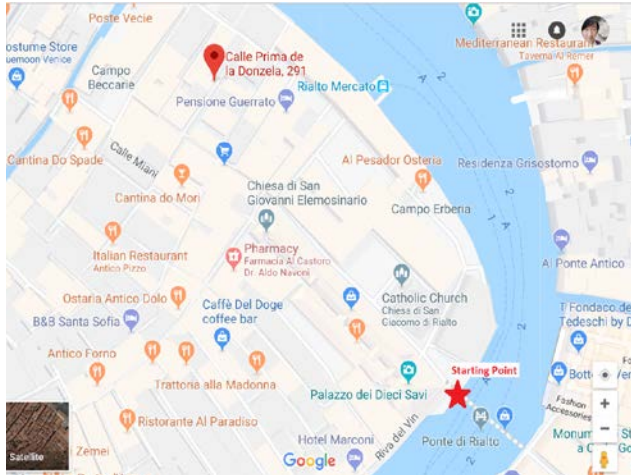
 Map that direction -givers saw for final task in Venice
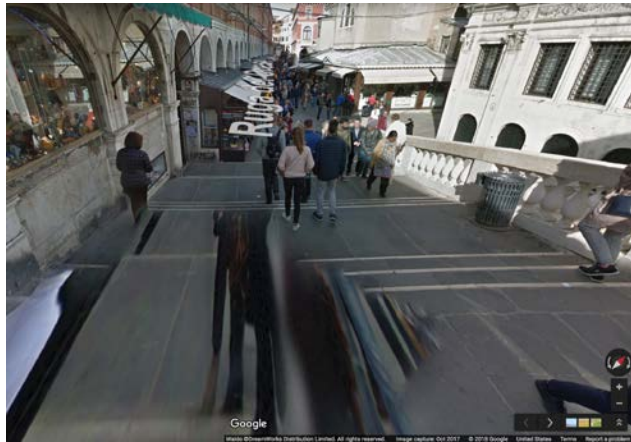
 Start point in Venice that 'walker' saw

 End point in Venice that 'walker' saw after reaching the location based on teammates' directions.

The results of our CTA helped us to narrow down our possible learning objectives:

- Navigate from one location to another from a first-person point of view
  - Using landmarks / map / step-by-step directions but no GPS
- Plan a route go to from one location to another
- Give clear directions to help someone else get from one location to another

- ○ Empathy/perspective taking
- ○ Using landmarks
- ○ Communicating clearly
- ● Improving "sense of direction"
  - ○ Orienting

Our original idea for a game was a digital/physical hybrid where one player would have a Google Streetview-type view and the other player would have a map-type view. However, due to the limitations of implementation, we decided to make a physical -only game. Because of this, we determined that improving a sense of direction within a 3D world would not be a feasible learning goal. Instead, we focused on the goal of giving clear directions to help someone else get from one location to another. This learning goal is reflected in our third CTA and in the strategies for communicating navigation information. In particular, we noticed that landmarks on maps might look different than landmarks in real life, and so navigating via landmarks requires making sure that you and the navigator know which landmark s match.

The following graphic represents the strategies that our players used to communicate:
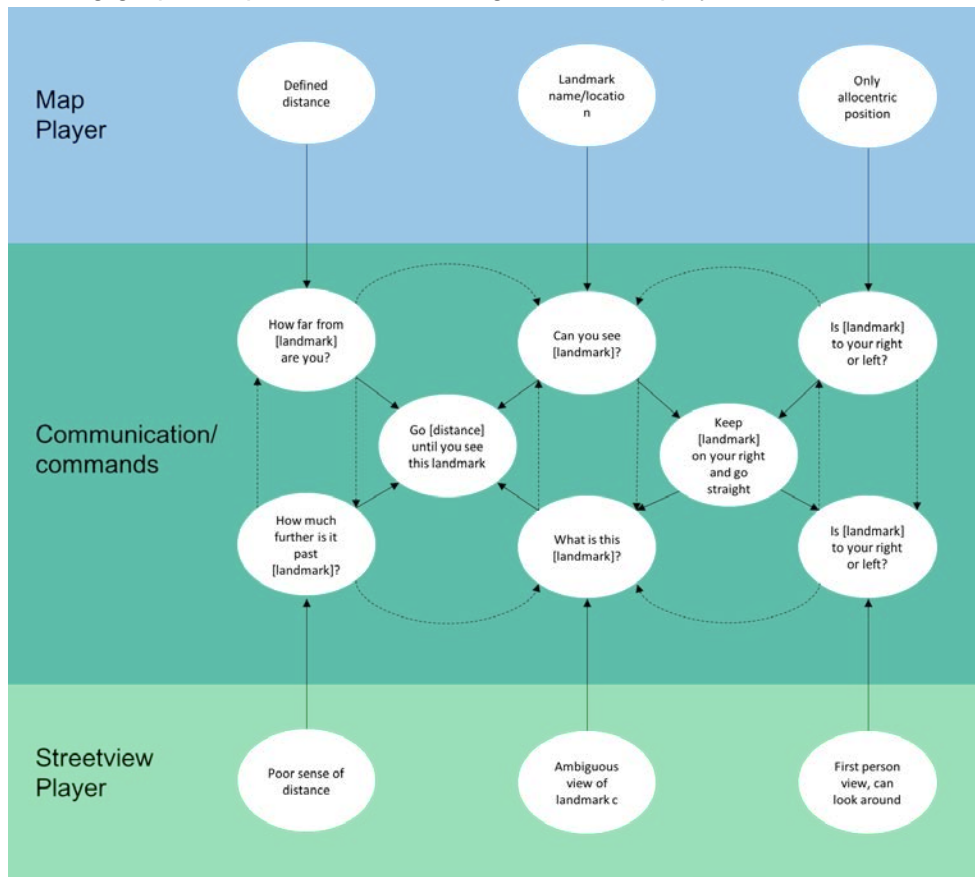
There were certain types of communication that we saw more frequently, especially those that involved clarifying ambiguous information and directions. This cyc le of direction giving became the basis for our game rules.

Once we started to prototype and solidified our direction in creating a physical game, we determined that the objective of "improving the sense of direction" would not be addressed well in our game. We reformatted the possible learning objectives to focus on 3 navigation and communication skills:

1. Describe where a location is relative to a landmark in terms of cardinal direction, relative position, and route distance
2. Determine what combination of information is necessary and sufficient to explain to someone where a location is relative to a landmark(s)
3. Given a description of where a location is relative to a landmark in terms of some combination of cardinal direction, relative position, and route distance, plan a route to that location

Ideation / Prototyping

General Approach

We began ideation in earnest after completing our cognitive task analysis. Through CTA, we noted some of the difficulties people have when navigating, which helped guide our ideation. For example, we saw that maintaining a sense of direction was challenging, therefore in our ideation we considered ways to try to address a learning objective of helping players develop a stronger sense of direction. We had also noticed that com municating about landmarks was difficult, which led us to consider cooperative games.

A challenge for us throughout the ideation and game design process was that a key difficulty people had when navigating was translating the world around you (3D view) into a map (2D view), but it is difficult to create a 3D view with a 2D board. We considered the idea of having a hybrid digital physical game, but could not find a suitable API for Unity to do this within the timeframe, and therefore ultimately ended up cho osing different learning goals to focus on and a physical board format.

We knew that we wanted to incorporate scaffolding since we wanted to try to teach players. We also felt that this would fit nicely in a game, because increasing levels of difficulty in games can be challenging in a fun way. We knew that our game would almost certainly include a challenge aesthetic since games are a good way to introduce desirable difficulties and help learning. Other than this, we tried to be open -minded about the aesthetics of the game. We did like the idea of including a fellowship aesthetic in our game because we noted that our CTA participants had fun doing the collaborative direction giving/receiving task. A challenge throughout the design process was balancing aes thetics with learning goals. In particular, it was difficult to predict whether a game would be fun for players   - we had to test it to find out.

List of ideas

1. Navigating a map
   a. Using a compass and/or static map (without map that adjusts to your current GPS location)
      i. Since most kids don't grow up using a non-interactive map anymore
      ii. Using landmarks
      iii. Better suited to electronic medium (to show first-person point of view)
   b. Board itself is the physical representation of the environment (3D)
      i. Rather than just a map
      ii. movable/adjustable physical features (mountains, rivers, etc)
      iii. Contour lines?
   c. Roll dice or shake the map to change the map

            i.   Constraints: rivers must be continuous
- d. Players have different snapshots/pieces of information?
- e. Orienteering-style (synthesizing different types of information to create a full picture of where you are)
    - i. Compass
    - ii. Landmarks
    - iii. Map
        1. Latitude, longitude
    - iv. Sun/star positions
        1. Perception of how far you've traveled
        2. Distance
        3. Time
- f. Overview of map navigation/orienteering: https://www.summitpost.org/compass-basics-an-introduction-to-orientation-and-navigation/358187
- g. Trails that have different branching
    - i. Put your person piece on the map
    - ii. Card shows you what you see (e.g. "the way you're facing, the sun is to your left, the slope is grading down, and your compass looks like this")
    - iii. Could make more difficult by not providing every piece of information (like previous but you can't see the sun), so you have to keep track of where you were in the last turn
    - iv. Could need GM to keep track of where everyone is (battleship style, with one person who knows everyone's true location), or maybe the person on your right could keep track of your position
    - v. Cards could give you a hint about where you are (e.g. you can use your phone as a lifeline, but only 2 times)
    - vi. Multiple routes, some end in dead ends, some routes are more efficient than others, first person to get from point A to point B wins
2. Two person board game just focusing on map, orientation, sense of direction skills (no translation from 2D to 3D) - giving and receiving directions can still be a challenge with only 2D representation (map would probably be board)
3. [see picture below]
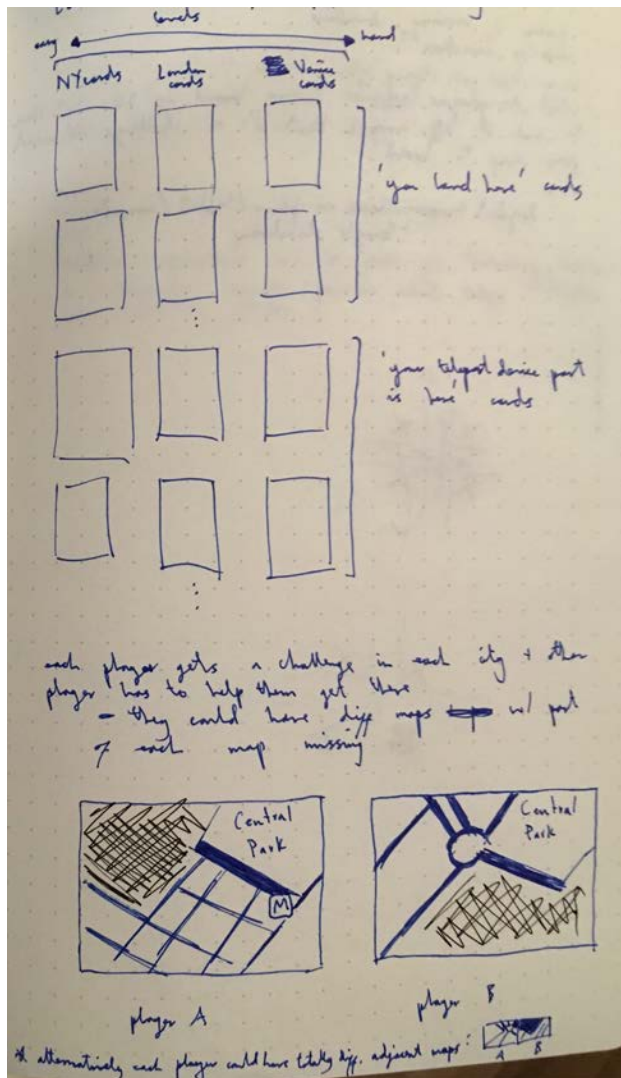
4. For just cardinal sense of direction: have a beacon that tells you when you are getting close to your desired location (e.g. you need to go northwest, and the game will tell you when you are getting hotter or colder by making the beacon brighter), even if there are other objects in the way or the street does not exactly follow that direction. But once you reach the destination, you have to turn around and find your way back to the start or another location without any beacon

5. Have them look at a map and plan a route to a destination, then plop them in the 3D view and have them walk it themselves. But then there are things that get in the way and make them deviate from their route (e.g. a monster is blocking the entrance to the road) and you have to re-route.

6. For translating 2D to 3D: They can see a map and a 3D view side by side, and they play an "I-Spy" to find different things that are hidden in the environment (but some can only be seen from the map, some can only be seen from the 3D perspective). Then they have to navigate towards one of the map locations.

7. More controlled communication: 2 players see 3D views of the world, but one sees only the location of landmarks and the other sees the streets necessary to get to the

landmarks. Player 1 has to get player 2 to the location by estimating distance to the landmark and using cardinal directions, while player 2 has to deal with the obstacles in getting there (e.g. the streets/buildings in the way). This would also work with just 2D maps I guess

8. Battleship-style: 2 players move towards a goal. They have a map of the world and have to figure out where the other person is on the map to attack them while they simultaneously attack you. Each round you ask a question of another person about what they can see, and then you can either try to attack them or move yourself
    a. Need to make sure players use navigation skills and not just logical reasoning to put together where everyone is - maybe controlled communication mechanics?
9. Similar to battleship game but collaborative instead of competitive- you are trying to find your missing hiking buddy and you have a map of their world and vise versa, trying to find how your maps connect and navigate there
10. Matching game: Identify landmarks both on a map and in-person
11. Give directions to an AI who will move based on the direction and distance you tell it to move to ultimately get to the destination
12. 3D MMORPG landscape where you are given a 2D map that is largely filled out but requires solving a puzzle to unlock/reveal an important missing piece of the map
13. Draw a map for someone else to follow to get to where they need to go
14. Navigate a 3D world and draw in landmarks on a map to help you easily find the same path for the return trip
15. Roleplay as a bird who can have both aerial and from-the-ground perspectives to find your missing friend
    a. Limitation on aerial view due to tiredness/lack of food
16. Parkour your way to where you're expected to go
17. Given a board that is not a map but a 2D (or attempted 3D?) representation of the world, you're placed somewhere on the board and given a card with directions using landmarks to get you to an end point.
18. Given board like the game above, you're given a card with an end point to get to. Each turn you roll a dice and can only move that many spaces. At some points on the board, you can ask people (shopkeepers, passersby) for help. Goal is to get to your endpoint before others get to theirs?
19. Given an actual map board and pictures of landmarks, you have to navigate to each of the landmarks by figuring out what represents them on the map (eg for a hill you'd need to understand contour lines, for a church or post office you'd need to know the symbol or look it up on the key)
20. Single player digital game with 1st person view, given an end point and no map but a set of directions, get to the end point. At certain points you can stop and ask people for help.
21. Board is representation of world, you have part of map but not all of it and have to get to a certain end point. First part of your journey you can use map for, but then you have to rely on other things (list of landmarks you should pass, directions about turning). At certain points in board you flip a card and have something revealed to you? Eg what a building is, what you would see at a given point.

      a.   Reasoning about features of the environment to help you with navigation (e.g. avenues vs. streets in NYC)
22. Given a bunch of tiles representing a world and a stack of cards with information about the world, assemble the world by following the clues in the cards (eg "the big church is north of the river and east of the school" "the school is at coordinate A5")
23. Praying towards Mecca as a Muslim
24. Something to do with the sun moving throughout the game (creates time pressure aesthetic, you can navigate from the sun/shadows)

Prototype Iterations

Iteration 1

Each player has one board where they move and one map where their partner moves. The goal is for both players to reach 2 checkpoints and an endpoint. You can see on the map where your partner's checkpoints are, but you cannot see where your checkpoi nts are, therefore you must communicate using cardinal direction, route distance, and relative position. On each turn you roll a die to determine which type of information you can use. On each turn you share one piece of information of the type determined by the die (by either giving an update about your own position or requesting information about the other person's position), complete up to 5 movements (turning counts as moving), and update your partner about how you have moved using the same type of info rmation. We used grids printed on paper as the boards and small pieces of papers as player and checkpoint markers:
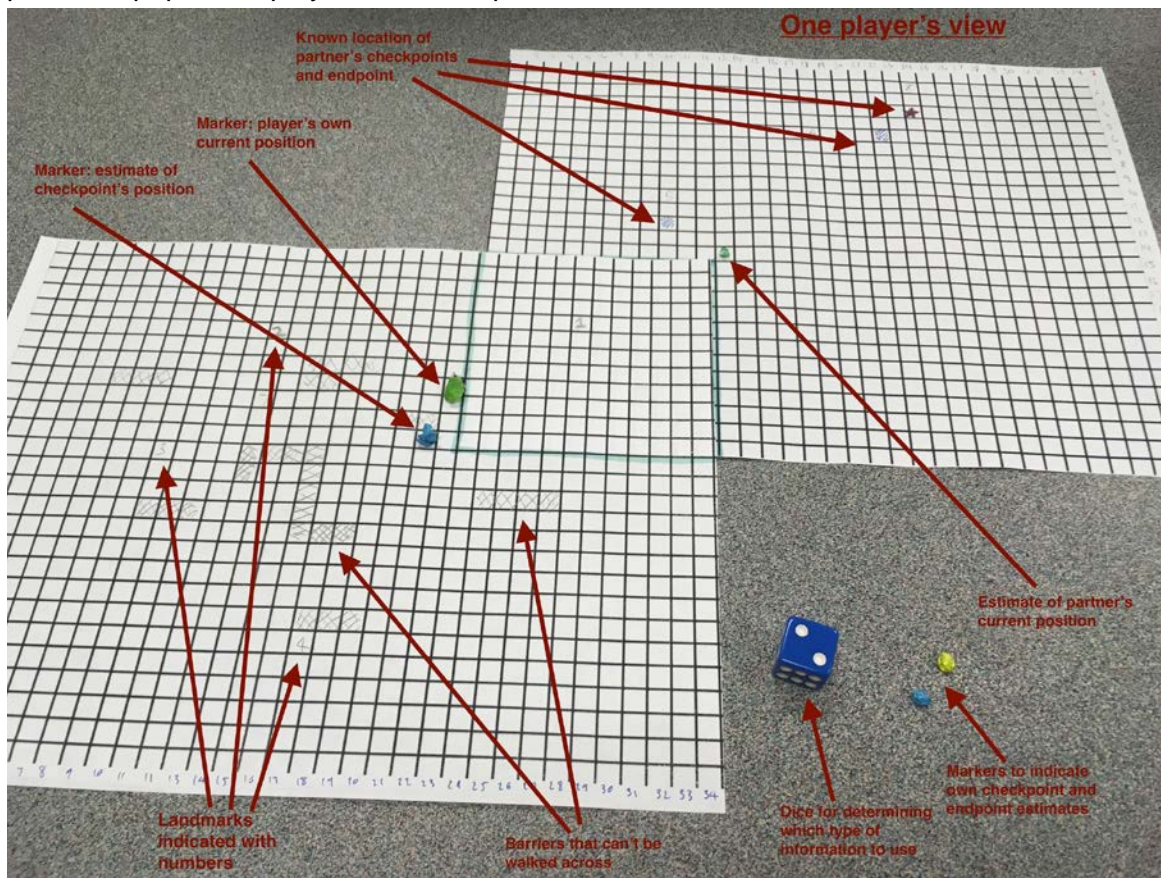
What we wanted to find out with this very rough first prototype:
- Do the basic mechanics (exchanging information then moving) feel like a game?
- Is there potential for this type of game (one based around helping each other navigate) to be fun?
- Does this type of game get at any educational objectives around navigation?

Iteration 2
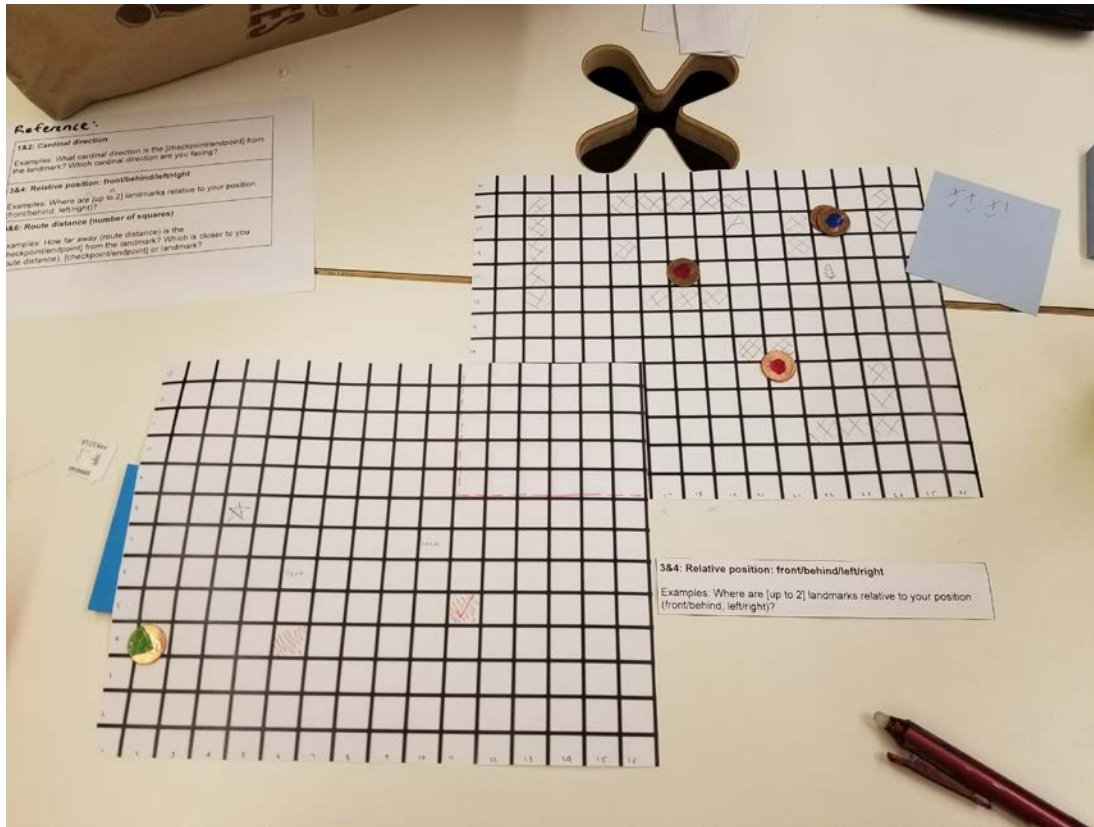
Changes from last iteration (see playtesting section for more details):
- 2 minutes to share as much information of the type as you want in each turn, rather than only sharing 1 piece of information per turn
- Select type of information for turn by drawing a card instead of rolling dice
- Larger grid squares (it was hard to move the pieces and count)
- Coins as markers (direction markings on player markers, red dots for checkpoint markers and blue dot for endpoint)
- Added cards for the different types of information
- Addition of a 'lightning round' where when you thin k you're close to the checkpoint you have 1 minute to share information of any/all types and at the end check the location of the checkpoint
- Instead of numbers, landmarks are drawn on the board where you move and written on the board where your partner moves

What we wanted to find out:
- Does the lightning round help the game move more quickly?
- Does having drawn landmarks on one board and written landmarks on the other help simulate our CTA task?

Iteration 3
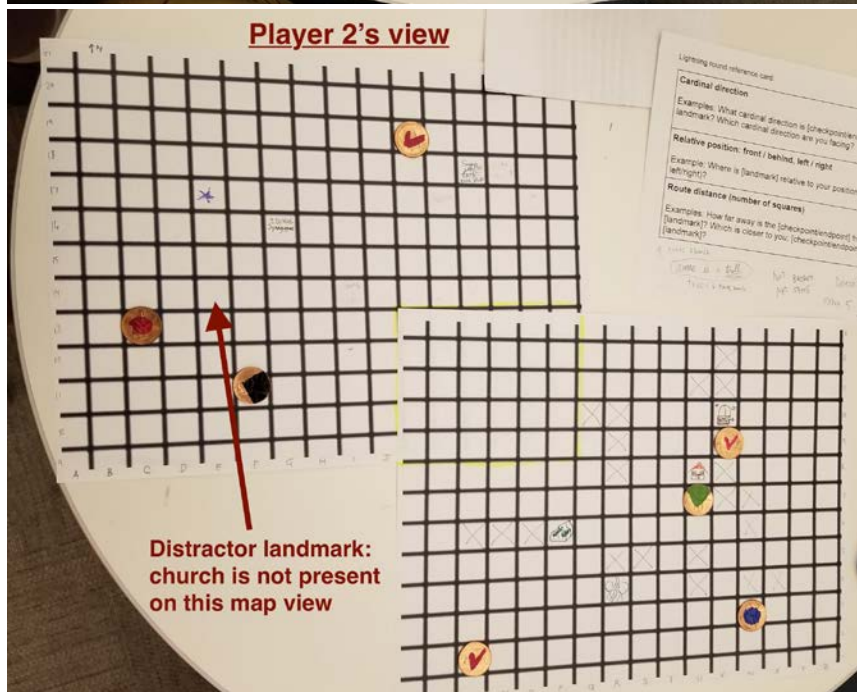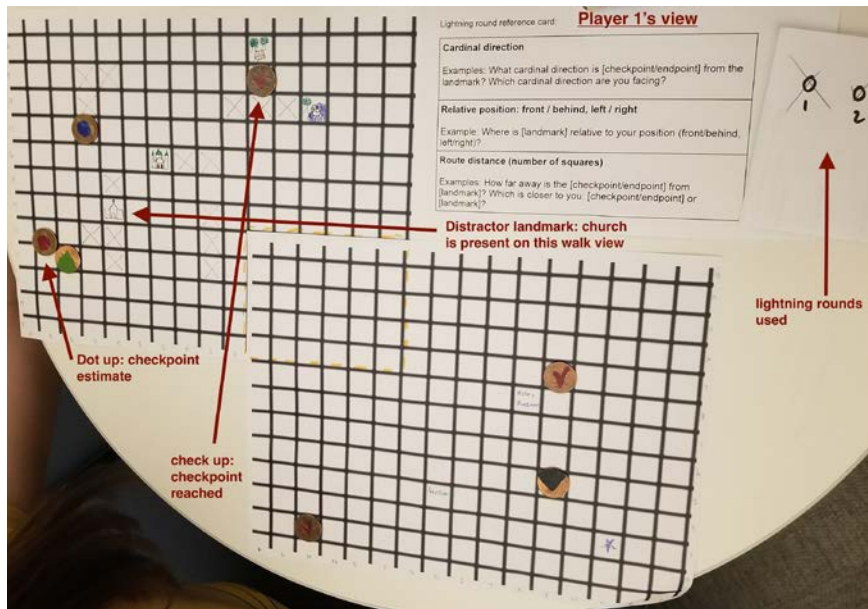
Changes from last iteration:
- Added distractor landmarks (some landmarks that appear on your board/map aren't on your partner's board/map, in addition some of these are very similar e.g. greenhouse and arboretum)
- Back of checkpoint marker coins have a check on, so that for each checkpoint you ca n note whether it has been reached or not)

- Sheet with number of lightning rounds on (players cross off the rounds as they use them)
- More barriers
- 3 minutes for each turn

What we wanted to find out:
- Do distractor landmarks make it harder, and do they force players to communicate more clearly about landmarks?
- Does having more barriers force players to communicate more? (because there are more differences between their boards that affect how they move)

Iteration 4
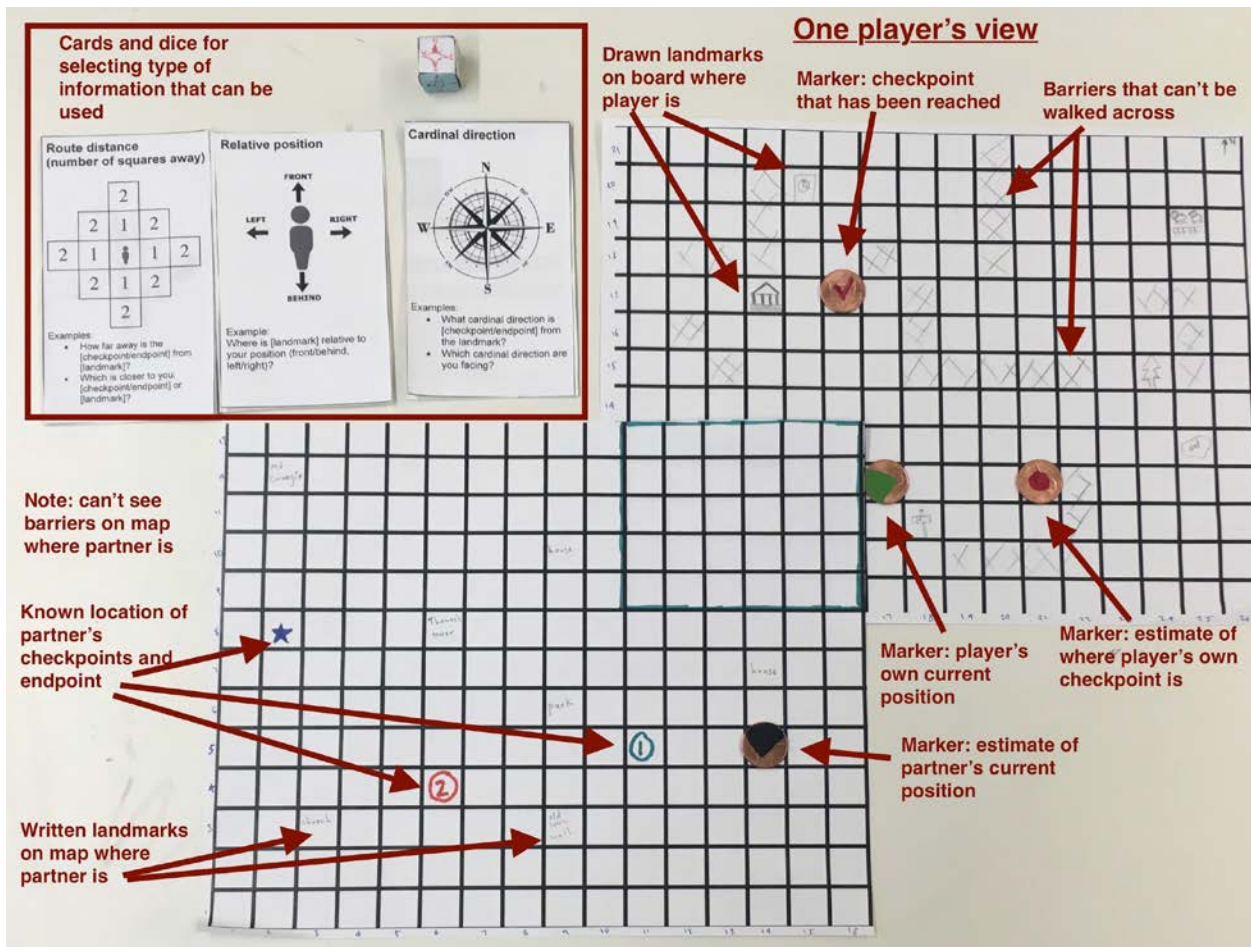
Changes from last iteration:
- Roll a customized dice instead of selecting a card to determine

- Shorten turns to 1 minute and allow rolling the dice multiple times during the turn so that players can use multiple types of information (we actually ended up changing this during the playtest - see playtest notes)
- Can choose to use a lightning round each turn, if at end of lightning round you guess checkpoint location incorrectly you can't move for that turn

What we wanted to find out:
- Do the shorter turns and allowing lightning rounds on e ach turn make the gameplay less slow and frustrating?

Iteration 5
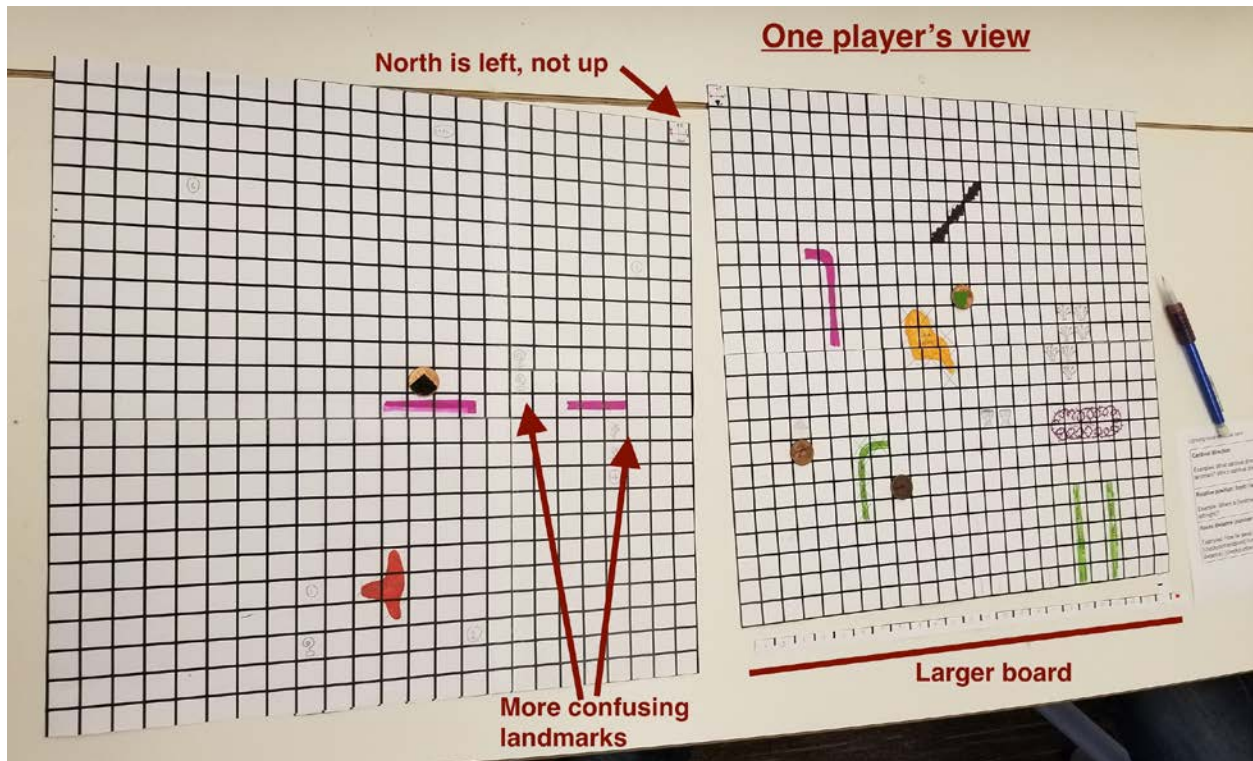
Changes from last iteration:
- Add some storyline to theme landmarks around
- Allow use of all information at all times, but shorten turns
- Make board more complex (larger board, more landmarks, more confusing landmarks, more barriers) so that using all types of information at all times isn't too easy
- Make barriers look more menacing to make it clearer that players can't cross them
- North not at the top of the board
- Landmarks drawn on both maps, not written

What we wanted to find out:
- Does allowing use of all information at all times reduce players feeling as if they are censoring themselves and therefore make the game more fun?
- Is a larger board with more landmarks and barriers difficult enough when players can use all types of information at all times?
- Does the game pace work? Too fast or too slow?
- Does counting from the edge of the board work as a way to confirm checkpoint locations without having coordinates on the board?
- Is having the top of the board not be north more challenging? Does it improve people's sense of direction? (We realized that we were unlikely to discover the answer to the last question through playtesting)
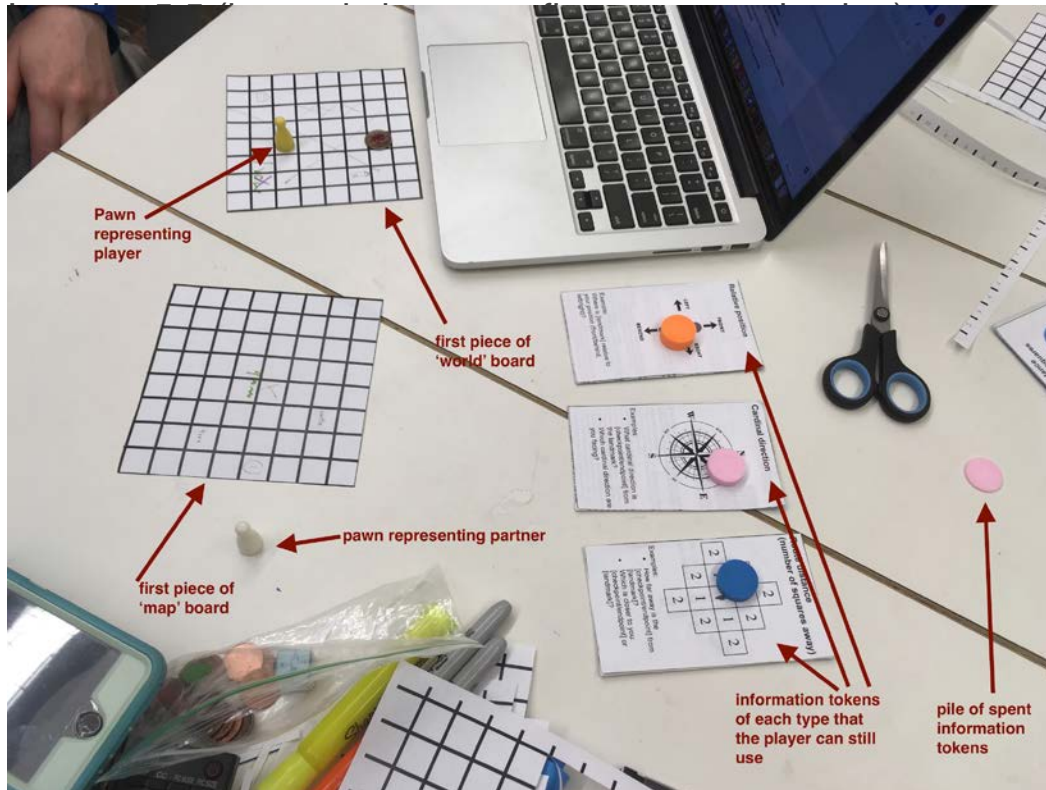
Changes from last iteration:
- Board split into pieces, after you reach a checkpoint you earn a new piece of board and your partner earns the corresponding piece of map, and you have to communicate to figure out how it connects to your existing board
- Information tokens - one for each type of information (cardinal direction, relative position, route distance), spend them when you give information (inspired by Hanabi's time tokens)
- On each turn, can spend as many information tokens as you want and then move 5
- To start a lightning round (1 minute where you can use any type of information) you must spend 2 of each type of token. If at the end of the round you guess correctly, all the spent tokens are recovered and split between both players. If you guess incorrectly, the 6 tokens remain in the spent pile until someone guesses a checkpoint correctly

What we wanted to find out:
- Do the information tokens provide a good level of control in the communication? (Good level = controlled enough that gameplay isn't confusing, but not so much that the game is boring)
- How many of each type of information token should there be?

Iteration 6
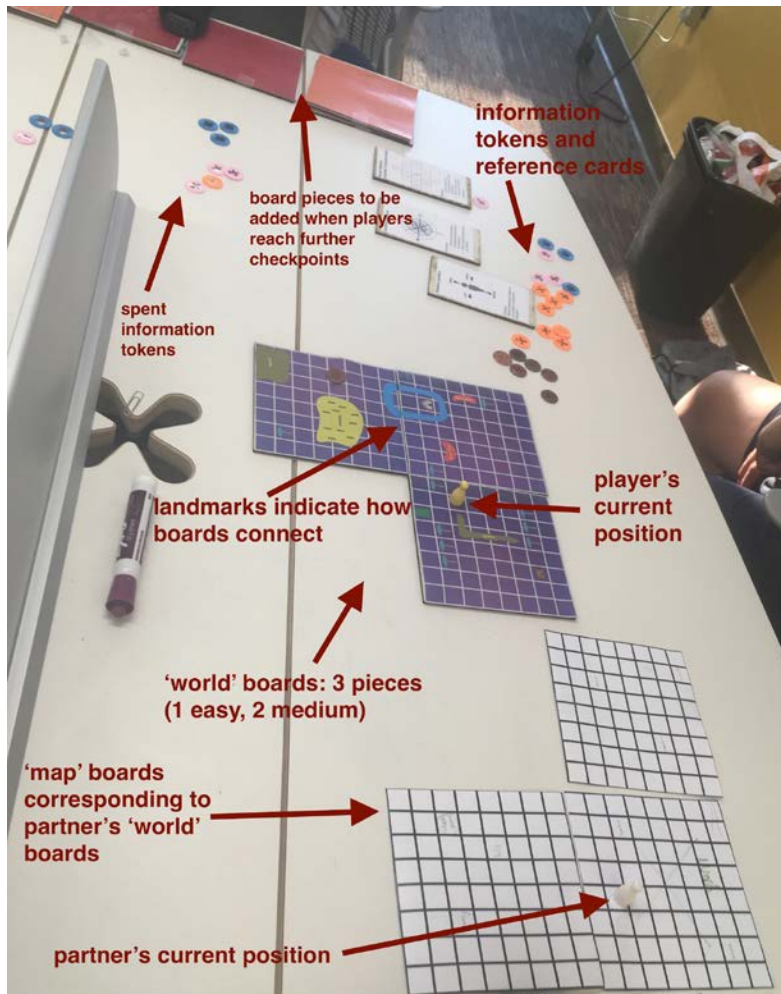
Changes from last iteration:
- 4 route distance tokens, 6 cardinal direction, 8 relative position
- Digitally made colorful boards for world mounted on lasercut wood
- 6 board pieces, each with 1 checkpoint, with four levels of difficulty: one easy (identified by green back of board piece), two medium (yellow back), two hard (orange back), one very hard (red back)
- Narrative added

What we wanted to find out:
- Are the landmark icons the right level of difficulty? (not too easy to identify and gives the feeling of 'alien planet', but not too unbelievable)
- Does spending 6 tokens for a lightning round incentivize not doing a lightning round until you have enough information?
- Are the number of each kind of information tokens good?

Iteration 7

We used the same board pieces as in Iteration 6 to test the mechanics of turn taking and restricting communication, but modified the boards slightly by adding a direction to face at the start, indicated by an arrow on the start square.

Changes from last iteration:
- Only spend 3 tokens total per turn (but can decide how to divide those among the two players)
- 3 route distance tokens, 4 cardinal direction, 8 relative position
- Can update on your movement using only relative position e.g. "I'm moving forward, turning right, and moving forward again" to incentivize using relative position and perspective taking

What we wanted to find out:
- Does restricting the number of tokens you can use per turn help the turns feel clearer?
- Does adding a starting direction and having fewer route distance and cardinal direction tokens nudge players to use relative position more?

Final version

Changes from last iteration:
- Solidified narrative
- Changed number of boards: the final game has 3 levels (easy, medium, and hard, indicated by green, yellow, and red backed boards respectively). There are 4 boards of each level (12 boards total), but in one play of the game each player will use 1 board of each level (3 total). This provides some replayability since on the next game a player could use only boards that they have never seen before. It also helps keep the game to a more reasonable length than 6 boards did.
- Boards no longer connect, because it was too easy (players could just keep using landmarks from previous boards) - instead each board is distinct
- Brought back North not facing the top of the board for harder levels
- Changed board design: easy boards have two distinct landmarks, medium boards have two of the same landmark and one different landmark, hard boards have multiple clusters of the same landmark
- Higher fidelity digitally made map boards

Playtesting / Evaluation

In our second navigation CTA task, we noted that participants did not keep a sense of cardinal direction as they moved around and turned in Google Street View. Rather, they used backwards reasoning to calculate which cardinal direction they were facing based on prior knowledge of where they were facing at a certain point and which way they turned later.

Our third CTA task with giving and receiving directions, as described in the earlier Ideation / Prototyping section, revealed a few insights.

1. Originally, we thought the direction-giver would see the Street View screen but the walker wouldn't see the map, but our playtesters wanted to try it without direction-givers seeing Street View which seemed more fun (and better mimics no GPS). This also makes every player indispensable to gameplay, since no one player is able to see all sets of information and micromanage the team.
2. Additionally, our playtesters particularly enjoyed having two people giving directions to the walker. The two direction-givers enjoyed strategizing together to send the walker down a certain route and giving these directions together. One playtester, focusing on the walker's perspective, mentioned that he enjoyed having two direction-givers because the direction-givers were able to correct each other if one person started giving incorrect directions, and since this balanced out each direction-giver's (communication-related) strengths and weaknesses.
3. It was generally helpful for direction-givers to follow the walker's lead, as landmarks the direction-givers would see on their map were difficult to communicate to the walker's first-person perspective if these landmarks did not have explicit visual signs. It was much easier for the walker to point out landmarks for the map-readers to find - rather than the other way around.

Playtest #1: Fri, 4/13 7pm at Newell-Simon Hall

Players: Julia (game designer), Anne (game designer)
Recruitment: N/A
Playtest notes:
Audio recording: [Link]

Rules:
- 5 movements per turn
  - Turning counts as 1 movement
- Checkpoints: Other person has information about checkpoints you need to go to (collect items/energy)
- Barriers: Dangerous places where monsters hide
  - Barriers do not obstruct players' vision past the barrier
- Communication:
  - Choose between whether you're giving an update about your own position or requesting information about the other person's position
  - Roll dice that tells you what kind info you can give (roll again if roll a 5 or 6)
    1: Which cardinal direction are you facing right now? (NSEW)
    2: Where is <up to 2 landmarks> relative to your position" (left/right, front/behind)?
    3: How far away are you from this landmark? (route distance - not Euclidean)
    4: Describe what you see from your perspective (up to 2 landmarks)
  - Roll dice first, then move
  - Moving
    - I'm moving X spaces forward
  - Give information about goal (checkpoint/endpoint)

Playtest setup: We crumpled up pieces of paper as markers for the players. Blue is Julia, black is Anne, and green is the other player (since each player has their own board). Landmarks are specified by numbers marked on the map, barriers are specified by x's marked on the map, checkpoints are marked on the map as colored blue squares, and endpoints are marked on the map as stars. For reference, a picture of Anne's board setup is included below:
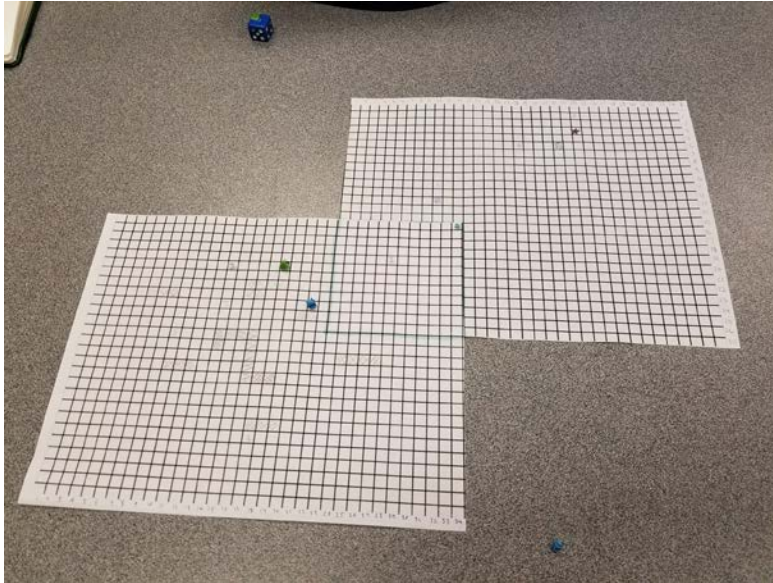
- "Describe what you see from your perspective (up to 2 landmarks)" & "Where is <up to 2 landmarks> relative to your position" (left/right, front/behind)?" are pretty much the same question, given how Julia decided to interpret "Describe what you see from your perspective (up to 2 landmarks)."
  - **Change for next time:** Remove "Describe what you see from your perspective" from the set of turn instructions
- **Issue that arose: Need to be able to g   ive information about the checkpoints**
  - **Change to rules during gameplay:** After a player gives information about where they are and where they're moving, they should give information to their partner about their checkpoint.
    - Turn structure:
      1. Where I am
      2. Where I'm moving
      3. Where your checkpoint is
- **Insight:** Being accurate at counting spaces is a prerequisite
- **Issue that arose:** Should players be able to write down/track what was said? Or be able to do it from memory?
  - Tedious to write - not similar to real situation
  - But also in real life, have multiple points of reference (e.g. visuals of surroundings)
  - **Decision:** Players should not need to rely on writing down information
- **Issue that arose:** Adult fingers are too fat to count grid spaces
- **Issue that arose:** Should players specify specific checkpoints?
  - For now (but still very much testing), only say 'a checkpoint' and not which checkpoint it is

- **Insight:** Need a new set of prompts with respect to checkpoints because they don't translate super well from the landmarks
    - For now, #2 is checkpoint relative to you
    - But maybe we should do something with checkpoint relative to landmark? Because gets to allocentric spatial reasoning
- **Issue that arose:** Controlled communication
    - Can't the tell other person where you think they are? - but if communication is too controlled may not be fun, fellowship aesthetic comes from discussion
    - When I think I'm at a checkpoint, do we confirm? And how do we do that? Give definitive position of checkpoint or of yourself?
        - Think checkpoint, because it's fixed, otherwise you're still moving towards an unknown
    - I wonder if you should know your endpoint but not the checkpoints - have satisfaction when you reach the end, and have vague idea of overall direction?
    - Maybe when you think you're close to a checkpoint you could have a timed 'free' (ish, only about that checkpoint) discussion to try to get the person there
        - How many landmarks can you talk about
        - What can you talk about relative to what
        - How much time do you have (is 1 min too short, too long, just right?)
        - Use same types of info as cards/dice roll but can't combine? Can't say 'checkpoint is 2 south of landmark 5' but can say 'checkpoint is south of landmark 5' and later 'checkpoint is 2 away from L5'
        - Maybe you have to exchange pieces of info, one person can't say many things
        - **Change:** Lightning round that showed up in later iterations

Playtest #2: Saturday, 4/14 7pm at METALS annex

Players: Julia (game designer), Anne (game designer)
Recruitment: N/A
Playtest notes:
Audio recording: Link
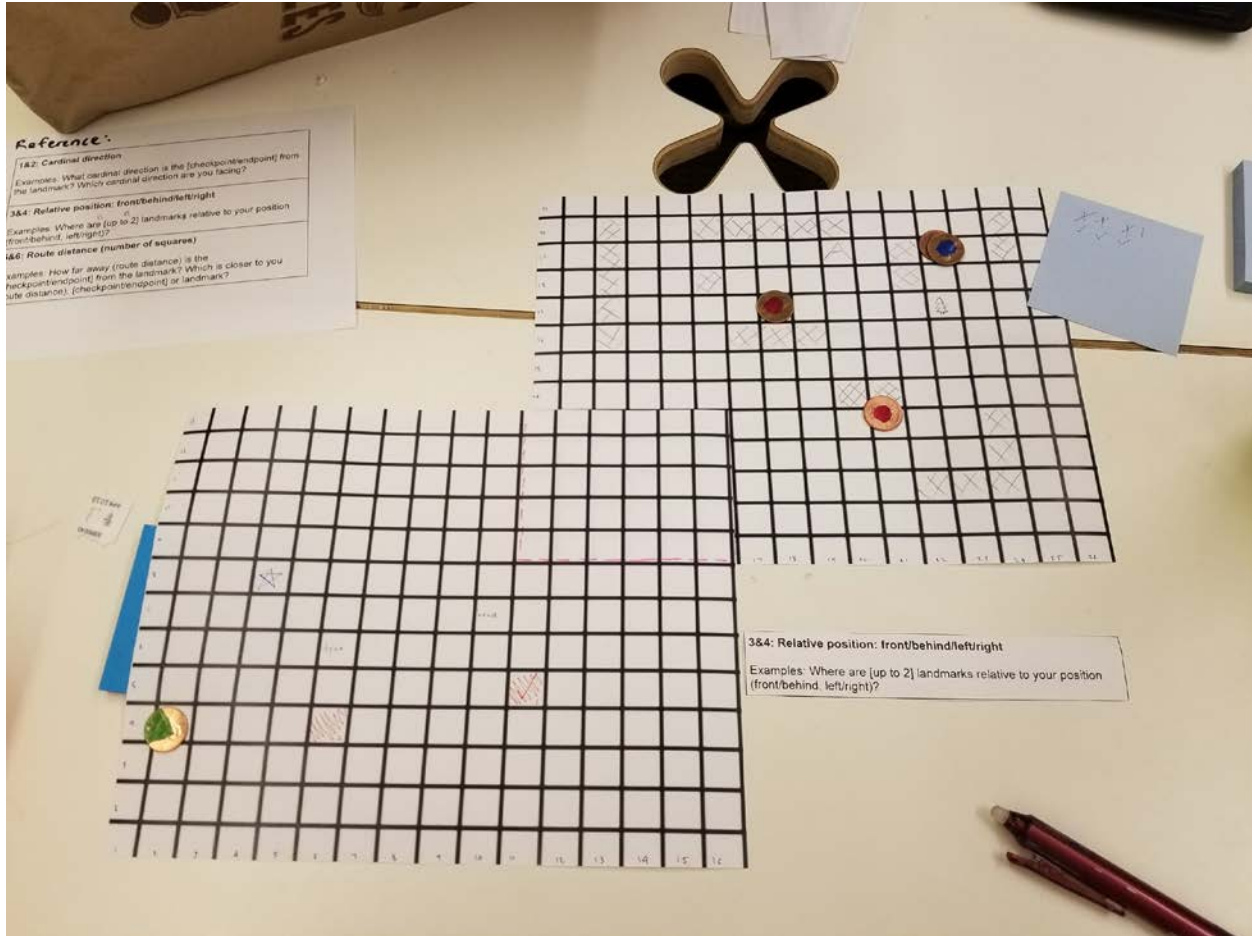
Materials:
- Painted pennies to mark players (with direction), 2 checkpoints, and endpoint for each player
- 2 map grid boards (1 per player)
- Cards (see below)

Cards:

1&2: Cardinal direction Examples: What cardinal direction is the [checkpoint/endpoint] from the landmark? Which cardinal direction are you facing?
3&4: Relative position: front/behind/left/right Examples: Where are [up to 2] landmarks relative to your position (front/behind, left/right)?
5&6: Route distance (number of squares) Examples: How far away (route distance) is the [checkpoint/endpoint] from the landmark? Which is closer to you (route distance), [checkpoint/endpoint] or landmark?

Rules:
- **Flow of each turn:**
  - Card to determine type of information you can share/get
  - 2 minutes for each turn
- **Controlled communication:**
  - Focus only on one player per turn
- **Checkpoint lightning round**
  - 1 minute lightning round
  - ~~Each person gives one piece of info at a time~~
    - Each player given a reference card at start of game with all 3 pieces of info players can use
    - Can combine info into information
  - 4 opportunities to initiate this lightning round per person per game
    - 2 checkpoints, 1 endpoint, and 1 "extra life"

Notes (**Detailed notes table** [here](#)):
- Player markers: Anne (A) is black; Julia (J) is green
- Who starts?

- ○ Youngest player goes first (A)
- A: "Wait, we need a timer. You should time me, and I should time you."
  - ○ **Issue that arose:** Timing is an important logistic that needs to be managed during the game
    - ■ Might be annoying to remember someone needs to time - maybe we can get an hourglass to flip?
- A: "I'm facing east and going 5 spots to the east and now I'm east of the mountain landmark and west of tree but south of both"
  - ○ **Insight:** Shouldn't have landmarks only a few squares apart E-W or S-N
  - ○ **Insight:** 2 mins feels too long
- J draws route distance card
  - ○ Julia is counting multiple route distance options from landmark
  - ○ Anne is updating her estimate of where Julia is
    - ■ **Insight:** "There is perspective-taking where I have to remember she has no-go zones, and route distance doesn't take these into account"
- **Issue that arose:** Is 2 mins just for talking, or is that your whole turn including moving?
  - ○ **Change for rest of gameplay:** After 2 mins can move but can't talk anymore --> incentivised to be quick
- **Issue that arose:** Determining mechanic to confirm when person is at a checkpoint
  - ○ Julia: ""I think you might be at a checkpoint actually" Anne: "oh okay"
  - ○ **Change for rest of gameplay:** Player initiates lightning round and at the end of the minute, guesses what their checkpoint is using grid coordinates. Other player who knows exact location of checkpoint confirms
- Julia: "Cardinal direction. I think I'm north of the checkpoint, [Anne confirms] I'm fairly sure I'm north of both the tree and the house [Anne: oops] I'm also currently facing south"
  - ○ **Issue that arose:** A: "I'm confused about whether I can ask her questions or whether I'm just waiting for her to ask questions"
    - ■ **Change for rest of gameplay:** Either player can share or ask information about the player who currently has their turn, according to their drawn card
- **Issue that arose:** Julia guesses checkpoint incorrectly at the end of a lightning round
  - ○ **Change for rest of gameplay:** Other player can say whether it's correct or incorrect but not share the position of the correct location
- **Issue that arose:** Do you confirm where the checkpoint is and then move, or do you move to where you think the checkpoint is?
- A: "Hah dude I told you it was SE of the house"
  - ○ **Insight:** Memory may be a confounding factor
    - ■ A: "I was tempted to have a notepad for remembering things"

- **Issue that arose:** What happens if you guess the checkpoint correctly but you're not within 5 spaces of checkpoint because you update your guess of where the checkpoint is, and you're correct but it's more than 5 away? Can you move there or not?
    - **Change for rest of gameplay:** No you can't move there, but now you know exactly where the checkpoint is and you can move there on your next turn, tell the other person you're there, and then move 5 more
- **Issue that arose:** A: "Did she get the checkpoint? I need to mark that somehow"
    - **Change for next iteration:** checkpoint penny markers with checkmarks on the other side of the coin
- **Issue that arose:** Controlled communication - sharing route distance and direction gives precise location
    - J: "I'm moving 5 west"
    - **Change for rest of gameplay:** A: "You can't say 5, but you can say you're moving west and I'll know"
- A: Which way is my goal?
    - J: I think it's to your front and right
    - A: From the tree, where is the goal?
    - J: Weird because tree doesn't have a direction
        - **Insight:** Relative direction only works with players who have a direction
- **Issue that arose:** Players know exactly where the other player is once they reach a checkpoint
    - **Potential change for future iteration:** Random chance spots that teleport you to different spots

Design decisions based on results from Apr 14 playtest:
- If they're playing game for first time 3 minutes per turn, otherwise 2 minutes
- For replayability, could have levels and different boards
    - More checkpoints, more similar landmarks, more blocked off paths
- Hourglass or something that beeps instead of phone timer ideally
- Is this meeting our educational goals?
    - J: I think so
    - Landmarks goal
        - A: we might add distracting landmarks eg on board I'm moving on, I have the landmarks that Julia has but maybe I also have some she doesn't have so we have to communicate more clearly about landmarks
- Maybe for first level, smaller board and 1 checkpoint 1 endpoint
- Okay to give advice following the card
- In lightning round, fine to say "I'm 2 south of the checkpoint" (combine different types of info)
- Easy: 8x6 for each sheet of paper

- Medium: 16x13
- For tomorrow (Sun 15): 16x13 but more confusing landmark icons. Can we each make a medium level board?

Playtest #3: Sunday, 4/15 7pm at CMU University Center

Players:
- Billy
  - 30 years old
  - Prior experience with subject area:
    - Difficulty with navigation whil e driving
    - Directionally challenged while driving & hiking ("I get lost in parks")
    - "This is why I have GPS"
- Elizabeth (game designer)

Recruitment: Billy is Anne's (game designer) friend who reached out wanting to playtest our game!

Playtest notes (full not es here):

Audio recording: Link

Videos of gameplay: Video 1, Video 2, Video 3

Explanation of rules:
- 3 minutes per turn
- Markers
- Map layout
- Confusion about numbers being on both axes
  - Changed the long axis to A-Z
- Who goes first?
  - Flip a coin: checkmark or dot?

Playtest:
- Billy: Confused about "Phipps" / " arboretum" / "Monopoly house" landmarks
    - **Insight:** Players should not have seen the map board beforehand. This playtest is somewhat rigged because Elizabeth knows what's going on with some of the more confusing landmarks due to prior discussion amongst game designers
- Billy: cardinal direction
  - Elizabeth: I'm facing east, because I think I have to go around the swan lake? (E is seeing a picture of a lake with a swan in it on her map)
  - B: "I think you guys are trolling me"
    - Crossed out "park" of "Swan Park" and wr ote "lake" on his map
    - **Insight:** Some players are very particular about landmark names
  - Elizabeth: "west of the arboretum & the monopoly house"
    - **Insight:** Elizabeth is displaying empathy by referring to the shared landmark by what Billy refers to it as: the "monopoly house"
  - B: "Greenhouse/arboretum is north of me"
    - "Indoor thing with trees. … marijuana?"

- - - E: "I'm pretty sure we're not talking about the same landmark"
      - **Insight:** Elizabeth's prior knowledge of the board is too OP
- **Issue that arose:** Confusion about lightning round (Billy)
  - **Change made for the rest of gameplay:** Only use a lightning round when you can reach checkpoint/endpoint within the movement portion of your turn
- Billy: cardinal direction
  - Which direction do you think I'm facing?
  - "Based on where I'm facing….?"
    - Elizabeth: "But cardinal direction is a fixed thing"
    - **Insight:** Cardinal direction and relative direction may seem interchangeable to players.
- Elizabeth: route distance (35 min 30s into audio recording)
  - 2 from checkpoint
  - 2 from swan lake
  - 4 from trees & bench
    - **Issue that arose:** Billy is writing this information as notes on his reference card
      - Chose to allow this happen for now and see how this notetaking goes
  - **Issue that arose:** Confusion about if we can get information about both players during one person's turn
    - **Change made for the rest of gameplay:** Decided to only do directions/questions related to the person whose turn it is
- Elizabeth: lightning round #1 (39m 40s)
  - **Issue that arose:** Billy's confusion about route distance (counting the squares between rather than adding one)
    - **Insight:** Movement vs. route distance is a distinction we need to make/address
      - Billy counted a turn as a potential route distance
  - Billy still writing notes
  - Guess: L19
    - Billy: "Incorrect" (It's actually at J19)
  - **Insight:** Potentially rethink the idea of how to get to checkpoint
    - "Accidentally getting to checkpoint"
- Billy: cardinal direction
  - **Insight:** Maybe players shouldn't have pencils - Billy's taking a lot of notes
  - Billy: East of me is the 2 trees and stupid river that's not on your map
    - **Insight:** Players will still refer to landmarks even if they know they don't exist on the other player's map
  - Elizabeth: Are you precisely southwest of the monopoly house?

- - - B: I'm more west than southwest
    - B: I'm directly southwest of the baby carriage with the 3 s tars
    - **Insight:** "More west than southwest" and "directly southwest" are clever ways to communicate more precise location using cardinal direction
  - ○ Elizabeth: I think the checkpoint is southwest of you, but not directly?
    - I don't think you're directly southwest... but it's pretty much southwest of you
    - Billy: Is it more south or more west?
      - ● E: More west
- ● Billy: lightning round
  - ○ E: I think you're 5 route distance away from checkpoint
  - ○ E: I think you're 9 route distance from the monopoly house, but I may be wrong
  - ○ E: Monopoly house is pretty far away from your nearest checkpoint
    - 14 squares without barriers, but you probably have some barriers
    - **Insight:** Player takes perspective of their partner by assuming the route distance is incorrect due to potential barriers that the direction-giver cannot see
  - ○ M2 checkpoint guess
    - E: Yes!
    - "I used math. And she said no barriers, so I just counted!" (51m 30s)
    - **Insight:** Billy is using a pen as a marker on his reference card to point out which information he can use during each turn (related to "material knowledge" learning principle)
- ● Elizabeth: relative position
  - ○ The synagogue is to the front and to my right
  - ○ Checkpoint is in front of me and to my left
  - ○ The 3 domes is the synagogue
    - Billy: "I'll just call it 3 domes too"
    - **Insight:** Players communicate to agree upon shared landmarks and how to refer to them
  - ○ Everything is to my left, besides park benches which is to my right
  - ○ B: Checkpoint is more to the front of you than to the left of you
    - **Insight:** Players are using similar strategy with "more east than north" with relative position as well
- ● Billy: relative position
  - ○ B: Where is the 2nd checkpoint relative to the monopoly house?
    - E: The monopoly house doesn't have a in front or behind....
    - B: Is it more right or more behind?
      - ● E: Kind of the same...? ...Amount right or behind?

- - - ■ B: Can you give me more relative position details related to the end position?
    - ■ B: Is the endpoint directly behind me? E: No
    - ■ B: Is the endpoint more behind me than the 2nd checkpoint?
      - ● E: Yes
      - ● **Insight:** B is using pencil to mark/note all this information
      - ● **Change made for rest of gameplay:** Billy's pencil was taken away
        - ○ **Change for future iterations:** No writing utensils
- ● Billy moving: hit checkpoint at M2
  - ○ Now have 5 movements
  - ○ **Issue that arose:** Clarify that a 180 degree turn is 1 movement
    - ■ **Insight:** Consider placement of barriers around checkpoints
- ● Elizabeth: cardinal direction (67 min)
  - ○ B: The 3 dome synagogue is more south of the endpoint
  - ○ B: The endpoint is more south of the swan lake
  - ○ B: In order of southness: landmark, landmark, checkpoint
  - ○ B: In order of westness: endpoint, checkpoint, ….
  - ○ **Insight:** Listing landmarks in order of southness/westness is an interesting player strategy.
  - ○ E: I don't think you have a church, do you?
    - ■ E: Hmm, okay, you don't know anything about the church
- ● Billy: route distance (70m)
  - ○ I'm 5 route distance away from the greenhouse arboretum thing
    - ■ **Insight:** Player is heavily relying on prior knowledge of Pittsburgh Phipps Conservatory & Arboretum as a cue for the map's visual reference
- ● Elizabeth: cardinal direction (76m)
  - ○ **Issue that arose:** Confused about if her marker moved on the table between turns
    - ■ Trying to check playtest pictures to confirm
    - ■ **Potential change for next iteration:** Make markers harder to move?
- ● Elizabeth: relative position
  - ○ **Insight:** Billy thinks "directly in front" means it's 1 square directly in front, whereas Elizabeth thinks it refers to all squares in front of the player
- ● **Insight:** Can't recover from poorly used lightning rounds (re: Elizabeth's scorecard)
  - ○ **Changes for future iterations:** May want to punish incorrect checkpoint guesses some other way that's less permanent
    - ■ **Changes for the rest of gameplay:** can share lightning rounds among both players, as it's a collaborative game (1h 38m)
- ● Elizabeth: cardinal direction

- - - B: There's nothing directly north of you
      - E: Yeah, that's correct
    - B: But you might think that even if…
      - B: Do you have a church on your map?
      - E: The church is to the NW of me
        - E: But it doesn't really matter...if you don't really know where it is, you shouldn't navigate by it
        - **Insight:** Billy tried to navigate by a landmark he didn't have on his map since he heard Elizabeth talk about it
    - B: I think we need a number of squares card to help
      - **Insight:** Billy is starting to realize that direction and distance together reveal precise location
- Billy: cardinal direction
  - The house is directly north of where my marker is
    - E: the monopoly house?
      - Yes
    - Oh, that's interesting.
  - And directly east of me are barriers
  - South of me are barriers
  - SE are barriers
  - SW there's barriers
  - NW there's a few barriers too
  - **Insight:** The turn length is too long if a player can ramble on about where all their barriers are
- Elizabeth: get info first before lightning round - relative position (1h 38m)
  - The synagogue is equal parts ahead & to my right
    - **Insight:** Relative position feels like a proxy for cardinal direction

Debrief:
- B: I learned I'm bad at giving directions.
  - Because I reached the endpoint faster than she did
- B: My memory is not so great, which is why I wrote down so many notes
  - "You write down notes on map if no GPS"
    - E.g. "Make a right at the Exxon"
- B: Synagogues usually have 1 dome
  - Not 3 domes
  - "I still don't think that's a synagogue"
  - **Insight:** Prior knowledge and conceptions affect players' use of landmarks
- **Insight: It's a long game**
  - Pace feels slow
  - Long time in between turns

- ○ B felt 3 minutes felt long
- B liked the "trolling" with the confusing landmarks
  - ○ That's not a museum (pointing out the history museum)
- E is not a fan of the distractor landmarks
  - ○ Trying to negotiate where it is
  - ○ Maybe just focus on the actual landmarks
- B liked the barriers
  - ○ Zigzagging through them
    - ■ Super difficult for the endpoint
- **E: frustrating to not talk about reactions**
  - ○ Different mechanism to exchange information, but not give any information about moving
  - ○ **Losing an opportunity for learning for not being able to test strategy when learning**
- B: liked how the strategy where landmarks were not directly on the same x -axis or y-axis
- **E: feels unsatisfying to not use all strategies you can think of where you can think of to figure out where someone is**
  - ○ **Change for future iteration:** Allow players to use all pieces of information

Changes to next iteration:
- **3 minutes is too long for a turn - change to 1 minute**
  - ○ Give less information & be forced to prioritize most important information
  - ○ Faster pace
- **Use all types of information to orient yourself** - learning
  - ○ Related to one checkpoint
  - ○ **Perhaps you can't say how you're moving**
  - ○ **Part of navigating is putting together different types of information**
  - ○ **Not enough immediate feedback about relevant info**
    - ■ Don't get opportunity to ask about it
  - ○ **Probably limit to 1 minute like lig htning round**
    - ■ Faster pace
  - ○ **More landmarks around the 1st checkpoint**
  - ○ **Nudged into following a route related to landmarks**
    - ■ **For later checkpoints, landmarks that make it harder to determine location**

New Rules:
- 90 seconds: roll dice
- Before moving, can choose to use 1-minute lightning round during each turn
  - ○ At end of lightning round, determine checkpoint/endpoint guesses

- If incorrect, can't move this turn

Playtest #4: Monday, 4/16 7pm in Newell-Simon Hall

Players:
- Natalia: Design of Educational Games classmate, self-described bad navigator
- Pankaj: Design of Educational Games classmate, self-described bad navigator

Recruitment: OH! Lab Playtesting Night. Players are also playtesting their own games for this course.

Playtest notes (full notes here**):**

Audio recording: Link

Rules:
- 60 seconds per turn: can roll dice multiple times within turn
  - Changed this midway through playtest because gameplay was too easy (players pinpointing each others' exact positions within 20 seconds)
    - Changed back to only rolling dice once & communicating that information
- Before moving, can choose to use 1-minute lightning round during each turn
  - At end of lightning round, determine checkpoint/endpoint guesses
  - If incorrect, can't move this turn

Playtest:
- N informed P about overlap of information
  - Decide to list all landmarks
  - Decided that Pankaj should stay put
  - **Insight:** Players choose not to move as a strategy to keep track of each other
- P: lightning round
  - Pankaj used his coordinates to communicate where he was
  - **Insight:** Having the coordinates on the map may not be a good idea
    - **Change for future iteration:** Consider alternatives to confirming checkpoint/endpoint locations without coordinates

Debrief (20m in audio recording):
- P: I don't know directions any better
- N: I got a better handle on cardinal directions
  - Very easy with north being the top of the map
  - **Cardinal direction didn't have much difference between North & front**
- Annoying that we didn't have the same landmarks
- Unclear that we couldn't step on the x's
  - **Barriers didn't look scary enough**
- Don't understand when you wouldn't know the same landmarks if you both had a map
- Frustrating:
  - Didn't know rules for lightning rounds
  - Didn't realize it'd be useful to guess
- **What was fun?**
  - **Lightning round**
    - But confusing initially
- Didn't notice landmarks less near the 2nd checkpoint
- Strategy: Pankaj wanted to always align both players north
- **Insight on player strategy:** Pankaj didn't move much, so Natalia would know about where he was
  - **Using landmarks & staying put until another die roll**

- - - To communicate exactly what you wanted to communicate
  - Natalia: Mistakenly putting where Pankaj was
  - **Turning should/shouldn't count as a step (mixed opinions)**
  - **P: would prefer to talk about using all information at the same time**
  - **N: biggest challenge was to censor myself with all the types of information**
  - **N: Should be penalty for messing up & saying things you couldn't say**
  - **Were the communication constraints fun at all or purely frustrating?**
    - **Had to consciously censor yourself**
    - **I mostly failed at that most of the time**

Challenges:
- How much should communication be controlled?
  - Too much → Game isn't fun because it's too scripted
  - Too little → Game is too easy
- What is the appropriate turn length?
  - Too short → Players become frustrated that they can't communicate effectively
  - Too long → The game drags
- Confirming locations of checkpoints without giving it away on the map and without using a coordinate system

Changes for next time:
- **Story**
  - **Theme landmarks around story**
  - **Make barriers look more menacing**
- **Print an actual set of rules!**
  - **Comprehensive, ensures that we explain all relevant rules**
- **Allow use of all information   at all times**
  - **If still doing timing: 30 secs at most**
- **Add complexity via board**
  - **Way more squares (double size of board)**
  - **Confusing, similar landmarks**
  - **More barriers - and make them look menacing**
    - Lava?
    - Thorns?
    - Radioactive waste?
- **After checkpoint, must move but n   ot communicate about it**
  - Tie this into story
- Remove timing & turn taking?
  - Perhaps each board has a time limit
    - Bronze medal time (e.g. 20:00)
    - Silver medal time (e.g. 15:00)
    - Gold medal time (e.g. 10:00)

- **North not be top of map**
  - **Make one map with South at the t   op**
  - **Make one map with either West or East at the top**
  - **Make players' maps of same area with different directions at the top of map**
  - Make top of map facing a diagonal? (e.g. NW)
- Time tokens?
  - Spend time tokens every time they move
  - Watch videos of Hanabi for reference
  - Tie this into story

Playtest #5: Sunday, 4/29 7pm at METALS Annex

Players:
- Julian
  - 24 years old
  - Prior experience with subject area:
    - Generally has good sense of direction
    - Uses cardinal direction a lot when giving directions/navigating
- Samantha
  - 31 years old
  - Prior experience with subject area:
    - "I have a terrible sense of direction"
    - "I'm okay at giving directions"

Recruitment: Julian is Elizabeth's significant other, and Samantha is a METALS student in Anne's METALS capstone project group.

Playtest notes   (full notes here):
Audio recording: Playtest, Debrief
Video of gameplay: Video

Rules:
- Verbal explanation of rules
- Introduction of sci -fi narrative: traveling using broken teleporter on alien planet
- Allow use of all types of information at all times (i.e. not just during lightning rounds)
  - 30 second turns, with each turn focusing on that particular player's location and movement
Setup:
- Board size made larger: 24 x 24
- More landmarks (although more shared and less distractor landmarks)

○ Some landmarks appear differently for different players (see below)
- Julian has East at the top of both of his boards
- Samantha has South at the top of both of her boards

Julian's view:
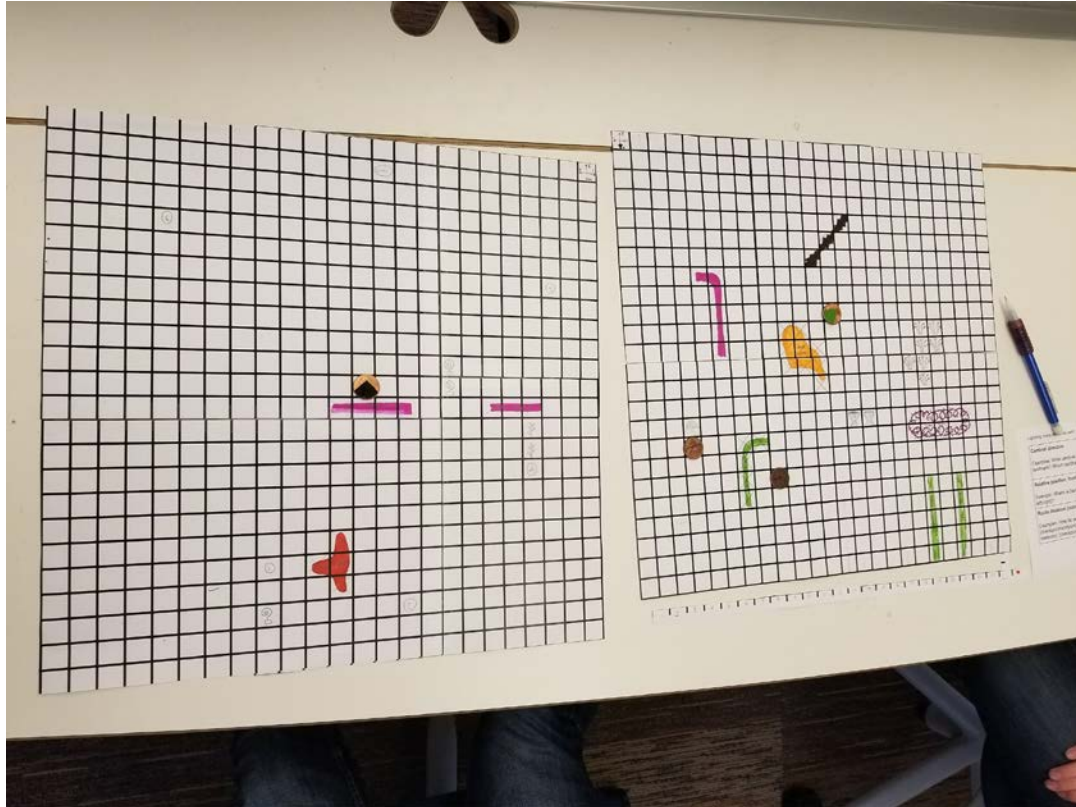
Samantha's view:

Playtest:
- Took about 13 minutes of gameplay for both players to each reach 3 checkpoints (6 checkpoints in total)
  - **Insight:** Game is too easy and short
- J started asking S about where she was during his turn
  - **Insight:** Extended to 1 minute for first turn because of initial confusion / learning curve
- S: "You are how many west...? I see a house and a toxic river next to each other…" [end of time for J's turn]
  - **Insight:** Timed turns are confusing and potentially distracting when it cuts off players' train of thought, so **we decided to get rid of turns after the 1st turn** .
    - **Insight:** Players naturally took "turns" by focusing on getting one player to their checkpoint and then focusing on getting the other player to their checkpoint, one at a time.
- S: "I'm just west of the lava flow that looks like a T."
  - **Insight:** Players use the shape of landmarks to distinguish between similar landmarks (e.g. different lava flows on the board).
- **Insight:** When communication is not restricted, players default to using a com bination of cardinal direction and number of squares in that direction with our grid board layout.

This way, players can communicate *exactly* where they are and *exactly* where their partner should go.
- ○ J: "I think you should move 2 squares to the east."
- ○ S: "If you just go down one space south, you got to your checkpoint."
- ○ **Change for next time:** Incentivize using relative position instead of cardinal direction, and make the exactness of this direction (e.g. exact number of squares) less accessible for greater challenge.
- ● S doesn't see the light orange lava flow barrier in the middle of J's map, but J was able to easily bypass this barrier with little problem.
  - ○ **Insight:** S: "It would have been interesting if we'd come across the moment where he couldn't walk where I was telling him to go."
  - ○ **Change for next time:** For increased challenge, make barriers that only the explorer can see more of a hassle to get around.
- ● Players counted out squares from the same Southwest corner of the board to confirm checkpoint locations with each other.

Debrief:
- ● S: It was annoying counting out squares from the same corner of the board, although we collectively decided on and self-imposed this confirmation method.
- ● S: It was annoying that the map had South at the top, since we're taught in architecture school to draw all maps with North at the top.
- ● S: Nice/reassuring to hear things like "now you're directly south of the question mark"
- ● J: Should map not be fully revealed at beginning? Maybe sheets of paper to cover. Can also play into event cards
  - ○ **Change for next time:** Modular board that slowly reveals more of the map

Changes for next time:
- ● Create **information tokens** to facilitate controlled communication with practice using particular types of information
  - ○ Must use to *give* information to partner
  - ○ Eliminates need for timed turns
- ● **Modular boards** : 6 pieces of map board for each player (12 pieces in total x 2 different views per piece = 24 board pieces)
  - ○ 1 very easy board
  - ○ 2 easy boards
  - ○ 2 medium boards
  - ○ 1 hard board
- ● Increase the **satisfaction of reaching a checkpoint**
  - ○ Board reveals itself
  - ○ Information tokens are replenished

- Change how **landmarks** are represented
  - Change board layouts for What explorer sees vs. what direction-giver sees
    - Explorer: Drawn icons for landmarks
    - Direction-giver: Written names for landmarks
  - Make landmarks more ambiguous for more difficult levels
- Consider using event cards
  - Temporarily cannot use cardinal direction
  - New obstacle appears
    - E.g. Lava erupts
  - Event moves you around to a different location (e.g. faulty teleporter)
  - **Decision:** Difficult to trigger event cards based on movement on the board (without alerting players beforehand that there's a card on a specific square), so scrapping this idea for now

Playtest #6: Tuesday, 5/8 6pm at METALS Annex

Players:
- Napol
  - 29 years old
  - Prior experience with subject area:
    - "I use Google Maps all the time", I barely use a real map
    - Self-described bad navigator
- Roger
  - 29 years old

Recruitment: Roger is a classmate, and Napol is a METALS student.

Playtest notes (full notes here**):**
Videos of gameplay: Video 1, Video 2, Video 3

Rules/setup:
- Introduced information tokens and high -fidelity boards with colorful digitally produced game assets on wood backing
- Each player's board is composed of six 8x8 pieces that connect in a particular order that only the explorer can see

Playtest:
After some clarifying questions about the rules, the playtest ran fairly smoothly.
- Roger is using the checkpoint tokens to mark out multiple options of the checkpoint
  - **Insight:** players want to triangulate mathematically using route distance where the checkpoints could be instead of using cardinal direction and relative position
  - **Change for next time:** only give 1 marker for the current checkpoint instead of 6 for all the checkpoints
- R: The distance ones are good, but I don't know what the point of the relative position ones is
  - **Insight:** Even with the token ratio, people don't want to use relative position
  - **Change for next time** : add starting direction as well as starting location
- N: We should use as many tokens as possible before the lightning round, because then we get them back
  - **Insight:** people don't feel like they have to choose carefully which information to use
  - **Change for n ext time:** fewer tokens of every type to make players think more carefully about what information is most useful at this point in the game

Debrief:

- R: was confusing to know when I could move and how much I could move
  - **Change for next time:** make turns clearer, maybe instead of talking about whatever they want they can only talk about the location of the player who's about to move and the checkpoint they're trying to reach
- N: it gets easier as they go on, because there are more landmarks to compare to
  - **Change for next time:** we did <u>not</u> want the game to get easier with each successive board, we wanted it to get harder to incorporate the scaffolding and fading learning principles.
- N: also you don't need to know the direction anymore, because you know where they are coming from with the old board
- R: the obstacles function as ways to eliminate certain squares, (obstacle actually helps, rather than prevents them)
  - **Change for next time:** Fewer obstacles around the checkpoint to make it harder to rule out possible check point locations? Or could have barriers on gridlines rather than in the squares
- R: confusing how many squares I could go and what I had to do in one turn
- R: Love the boards. I liked having to say "library" and "tower." It was fun to imagine that this was a library. I knew what Napol was talking about, it was a funny interpretation
  - **Insight:** the narrative aesthetic seems to be working as we hoped. Our game may also have some sensation aesthetic.

Changes for next time:
- Clarify what a **turn** is by placing more restrictions on information: When it's someone's turn players can only talk about that person's location and checkpoint, not those of the other player. Maybe also restrict number of tokens you can use each turn.
- Make it **harder** overall - more confusing landmarks, maybe fewer tokens
- **Fewer route distance tokens to disincentivize mathematically triangulating** instead of using navigation skills
- **Incentivize relative position** more - add starting direction as well as starting location
- Add a way you can confirm location of checkpoint without doing lightning round
- Find a way to **make later boards harder rather than easier (incorporate scaffolding+fading)**. Perhaps the boards don't connect and are just separate levels. In the narrative, this would be you teleporting to a different part of the planet rather than walking into the adjacent part.

Playtest #7: Wednesday, 5/9 10:45am at METALS Annex

Players:
- Yulin
  - 24 years old
  - Prior experience with subject area:
    - "I am the worst person in directions
    - "But that could mean that I am empathetic enough to give valid directions"
- Elizabeth (game designer)

Recruitment: Yulin is a METALS student who all 3 game designers take classes with.

With this short playtest, we wanted to clarify **what a player's turn looked like** and **if this t urn structure made sense to players** . We also wanted to test how gameplay would look **if players could not tell their partner directly about where their checkpoint was** (e.g. "Your checkpoint is northeast of the mountain") but instead had to give directions t o their partner (e.g. "You should move forward and turn right").

Playtest notes:

Rules:
- Can move up to 5 squares per turn
- Can use up to 3 information tokens per turn
- Players could not tell their partner directly about where their checkpoint was (e.g. "Yo ur checkpoint is northeast of the mountain") but instead had to give relative position - focused directions to their partner (e.g. "You should move forward and turn right").

Playtest:
- About 10 minutes in total, including time taken to describe rules
- E: "The castle is in front of me and to my right."
  - Y: "Does that make sense?"
  - Y started writing things down on a post -it note pad with a pen
    - **Insight:** Players want to track the previous information they have received.
- Y: "Move one step to your left" <spent relati ve distance token>
  - **Insight:** Rules about information tokens (particularly, how specifying the number of steps/squares requires using a route distance token) were unclear in our quick explanation.

- **Insight:** Despite the rules, Y still naturally gave information about where E's checkpoint was, so we should allow for this.

Debrief:
- Yulin did not know when to ask for information and when to tell/give Elizabeth information.
  - **Change for next time:** Turn structure with explicit focus on one particular player's location/movement/goal will help players know what to do and how to play.

Changes for next time:
- Allow players to talk about where their checkpoint is in relation to landmarks, but players should use relative position to update their partner about how they are m oving.

Playtest #8: Wednesday, 5/9 11:15am at METALS Annex

Players:
- Julia (game designer)
- Elizabeth (game designer)

Recruitment: N/A

During this shorter internal playtest, we tested **how many of each information token** we should give each player and if the **mechanic with only using relative position to talk about how you are moving** would work to give players enough information to infer where their partner is.

Playtest notes (full notes [here](#)**):**

Rules:
Same as last time with one addition: When moving, use relative position to talk about how you are moving.

Playtest:
- J: "The house is to my right, and the top forest is in front of me and to my ri ght"
  - **Insight:** " Top" is a sneaky way to say northernmost when both players' boards have North at the top.
  - **Change for final version:** Make the top of the map a different cardinal direction for different board pieces.
- E: "I went forward, turned left, went forw ard, turned right, and went forward."

- - **Insight:** Relative position in conjunction with knowing the rule of moving up to 5 spaces works decently well to allow players to infer where their partner is generally.
    - **"Change" for final version:** Keep this movement-related relative position communication mechanic.
  - E: "How many forests do you see?"
    - J: "I guess 3 patches of forests"
    - J: "Not the little forest"
    - E: "The forest to your left, the checkpoint is route distance 3 from the edge of the forest that is most in front of you"
    - **Insight & change for next time:** Grouped landmarks are confusing - save for the harder boards
    - **Insight & change for next time:** Duplicate landmarks are hard - save for harder boards
  - E knows where her checkpoint is before even doing a lightning round
    - **Insight:** People are cautious about using the lightning round, as we've seen in previous playtests. Players often know the location of the checkpoint before even using the 1-minute of free information sharing during the lightning round.
    - **Change for next time :** Players can "spend" 1 of each information token to guess the checkpoint location without the 1-minute lightning round to share information (which you would need to spend 2 of each information token for)

Other changes for final version:
- Have each player start with 4 cardinal direction tokens, 3 route distance tokens, and 8 relative position tokens
- Put barriers on the lines of the grid rather than in the spaces, since barriers in spaces automatically rules out potential locations where a checkpoint could be

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