Symmetry in Board and Video Games

When developing a game, one of the most common, natural thoughts a creator can have is making the game as symmetric as possible. As mathematicians, we define symmetry as being able to perform a rigid body operation on an n-dimensional object and still obtain the original object pre-operation. However, in game design, developers have slightly tweaked the definition to their own liking, allowing them to apply the meaning to non-visual characteristics of their game. For instance, a gamer designer would consider a game where both players have the same rules and resources as a highly symmetric game. The amount of symmetrical aspects your game holds has a significant effect on the overall gameplay of the game, and whether developers consciously think about the symmetry involved in their games, the majority of a game’s rules will correspond to the symmetrical nature - in this case, how similar “opposing sides” are - of the game.

To start off, let’s cover the instances of highly symmetric games. For simplicity, we will analyze the most recognizable board game on the planet: Chess. Visually, we can see the $D_2$ symmetry about the diagonal axes of the board; this defined symmetry is a solid foundation to create a fair game: One player does not have a significant locational advantage over the other, making it a truly even game. However, to get the game started, one player must break the symmetry, both visually and invisibly. Although both competitors have the same pieces and each of those pieces has the same abilities as the opponent’s pieces, the first move completely changes the game. The player who has the right to make advancements on the opponent for the first time in the match not only breaks the symmetry of the game, but – in many cases – gives them a significant advantage of victory for the rest of the game. Chess’ “first mover advantage” is so momentous that the competitor with the white pieces (the player who moves first in Chess) has a 5% higher chance of winning than the competitor with the black pieces.

Countering the advantage the player with the first move gets can be difficult, but in turn-based games has been resolved with rather basic solutions. In the board game of Go, the player with the white pieces (black pieces go first) gets 7.5 points for free, as the developers and community of the game decided that this point buff was necessary. Not every turn-based game has this feature of first move advantage, however. Consider the international free market being a game: the video game company Atari made the first big move to establish the video game market, but despite putting their best foot forward, the now Japanese tech-giant Nintendo analyzed Atari’s flaws and strengths, and began to put out more impressive consoles.
of their own, wiping out Atari in the process. This strategy can be applied to normal turn based board games as well: noting the plethora of options the player’s first move has cut out and having a more defensive and observational strategy may turn out to help you in the long run.

Moving away from the invisible symmetry, we can analyze the advantages of having visual, physical symmetry in your boards/video game maps. The picture to the left is a map known as 2fort from Valve’s historically popular game Team Fortress 2. The overhead view of the capture the flag map contains X’s which represent the spawn rooms for players, and flags which represent the flags that either need to be captured or protected. The $C_2$ symmetry the two-dimensionally projected map holds assists players by giving them a sense of intuition shifting from an attacking position to a defensive position and vice-versa. Navigating the opposing side of the map after 5 minutes of defending your flag is done with ease, as each corridor you step through is the identical corridor you just ventured on your own side of the map. In addition, having both sides of the map be identical allows for true fairness: One side does not have more intense, narrower hallways that make defending easier than the other. Examining the map below (that has the same markers with the same meanings as 2fort) from Blizzard Entertainment’s newest game Overwatch, we can ponder the following transformation: pull the main objective in the center of the map 100 in-game meters closer to the blue team spawn. Of course, this transformation is
highly unfair seeing that newly spawned blue team members having a shorter distance to the objective. Having equal distance to the flag from both teams’ spawns along with an equal number of health packs on each side separated by the dotted blue line makes our game inherently fair.

What about the instances where games and maps have highly asymmetric designs, where the map, rules, and attributes each player holds share little to no symmetric qualities? Before jumping into the highly complicated examples, let’s examine the classic game of Fox and Geese. In Fox and Geese, one player controls the 17 black pieces while the other controls the one yellow fox. The goal for the geese is to corner the fox (“captures”) whereas the fox’s goal is to eat enough sheep to prevent being captured. Geese can only move one space forward, sideways, or diagonal per turn, and the fox can move one space in any direction per turn. Although the board is symmetric, the rules and number of pieces is different for each side. An extremely naïve developer would give each player one piece even though they have different abilities. The fact that it is impossible for one goose to pin the fox on this board immediately makes the game not playable. A relatively mediocre developer may give the player with the geese six pieces and the player with the fox one piece to now allow the game to be played, but the incident of one capture by the fox immediately ends the game. An expert developer, however, would notice the significant advantage the fox has in terms of strength and consequently give the opposing players enough pieces to have a fair match. This number of pieces evidently changes after rounds of trial and error, and a company that fully understands this process is the creators of the most recently reviewed video game map: Blizzard Entertainment.

In the game of Overwatch, 2 teams consisting of six players play a best 2 out of 3 series on one map to determine a winner. Each team has the chance to create a six-character cohesive composition and construct a plan to defeat the other team. All possibly playable characters have different abilities, giving them significant advantages when played in tandem with a supporting character, or controlling a certain point in the map. And, maybe to your surprise, even though each team picks form the same character pool, this game is considered to be highly asymmetric. Let us view the 3D blueprint of the map Watchpoint: Gibraltar. The Red Team must deliver a cargo-load through the curves of the map, while the blue team must defend each checkpoint and prevent the Red Team from reaching Checkpoint C – the green circle on the leftmost part of the map. I have marked the map with red circles to signify highly advantageous points, along with the red and blue X’s we have previously keyed as spawn points. To start off, there is no sign of any symmetry on the map, taking away the inherent fairness this game would have considering the player selection mentioned. Additionally, although each team can create the same exact composition of characters, one side can be notably weaker just due to physical map layout. For instance, the sniper in the game “Widowmaker” is more effective on the defensive side than offensive side due to her ability to
reach higher ground with much greater ease, giving her a wide view of the map and chance to freely pick-off (eliminate) unknowing players. Thanks to brilliant developing by the Overwatch team, this unfair advantage can be overcome! Devising a new team composition to take control of the marked advantage points and not give players like Widowmaker the opportunity to excel in a particular spot is typically the best solution. Overwatch, of course, doesn’t always make the correct implementations. However, they ask their community once every two weeks about the changes they want to see in the game, bringing about a positive user experience along with an exceptionally balanced game.

In conclusion, whether developers consciously think about the symmetry involved in their games, a game’s rules will correspond to the nature - in this case, how similar “opposing sides” are - of the game. Is it guaranteed that highly symmetric games will be more enjoyable than highly asymmetric games. No, but for game developers, finding the right balance in their game after analyzing the games symmetrical elements is very important.