

# Quantitative analysis of game balance

## Evolution of board size and phase order

**1st iteration:** Initially our game had three phases and was on a 12 x 12 grid. The second phase only involved placing down path tiles, while the third phase involved playing the heist (moving around the board to collect food tokens). This made for a long game, and the third phase felt anticlimactic and boring.

**2nd iteration:** We tried a variation that had the opposite problem. The game was on a 5 x 5 grid making the game too short and decreasing the amount of strategy.

**3rd iteration:** In the end, we changed the board to a 10 x 10 grid. We also merged the second and third phases. This was a nice middle ground making the game the desired length (30-45 minutes), while still being very strategic.

## Analysis of the card drafting odds

Crafty Critters has a deck of 60 critter cards with 6 copies each of 10 critters. When deciding how to distribute critter cards, rather than dealing each player 5 cards, we wanted to give them more control on the composition of their hand. With a random deal, the chance of getting the particular card you wanted would have been 39%. We didn't think this was high enough. The drafting method we chose gives each player a higher chance of getting a particular card they like. With the assumption that every card is equally likely to be picked, your chance of getting a particular card is 99%. This assumption is quite generous though since even with perfect balance, players will decide what the best cards are and pick them first. In this scenario you still have a 66% chance of getting one copy of the card. So in reality if you want a particular card the chance of getting it is somewhere between 66% and 99%.

Even though our drafting system gives you more chances to get cards you want, it doesn't significantly increase the chance that you'll get the exact hand you want in every game. That chance is a low 2.3% making the game replayable.

Critter Card Drafting Probabilities		
Variables	# of cards	Assumptions
Number of card types:	10	1. We assume everyone is playing randomly; all cards are perfectly balanced. Thus the chance of any card being gone is equal to any other card being gone
Number of cards of each type	6	
Drafting hand size:	8	2. We assume that we don't know which card was taken when calculating the odds of getting more cards, letting us assume we took a random card.
Final hand size	5	
Total deck size:	60	

Scenario	Number of cards in the hand you are drafting from						
	8	7	6	5	4	3	2
Chance in % per hand size							
Getting the card you want	59.3	54.1	48.4	42.1	35.1	27.5	19.2
Getting a particular card if everyone takes	59.3	5.9	0.6	0.1	0.0	0.0	0.0

Scenario	Overall chance in %
Getting the exact hand you want	0.01
Getting a particular card	99.73
Getting the best card if everyone takes it	65.88

## Analysis of tile drawing odds

In our game, there are three types of tile: plain tiles, security tiles and trap tiles. Each type of tile comes in four different path configurations: single turn, straight, three-way or four-way. When placing tiles, we wanted players to have to make difficult decisions and sometimes be forced to place tiles in inconvenient ways. Initially, we had an equal number of each tile type and path configuration. Over time, we tweaked the numbers and have currently landed on these statistics.

Probability of Tiles						
Tile Types	# of Tiles	# of Exits on Tile	Chance of Drawing Specific Tiles			
Plain	29	1-4	Number of tiles drawn	1	2	3
Trap	22	1-4	Scenario		Chance in %	
Security	29	1-4	Plain, Trap or Security			
Straight path	25	1	A tile that lets you turn	68.8	90.2	96.9
Three-way path	25	2	A tile that lets you go straight	68.8	90.2	96.9
Single turn path	25	1	No Trap Tiles			
Four-way path	5	3	A tile that lets you turn	50.0	75.0	87.5
Totals			A tile that lets you go straight	50.0	75.0	87.5
Tiles in deck		80	No Security Tiles			
Exits		115	A tile that lets you turn	41.3	65.5	79.7
Average exits on a tile		1.4375	A tile that lets you go straight	41.3	65.5	79.7
			Only Plain Tiles			
			A tile that lets you turn	25.0	43.8	57.8
			A tile that lets you go straight	25.0	43.8	57.8

We reduced the number of tiles with security cameras and traps so that there would be more incentive to avoid them. Originally, there were so many of them on the board that they were near unavoidable, and therefore didn't play into players' strategies much. With fewer of them on the board, it became feasible to try to avoid them, and therefore more likely to play into a player's strategy. We also greatly reduced the

number of four-way and three-way tiles so as to make it harder for players to get tiles that would allow them to build a straightforward path to their destination.

## **Scores**

Theoretically, the maximum score is 34, but that score could only be achieved if your opponents purposely let you get all the loot. In a normal game the distribution of points depends on the players and how quickly someone chooses to end the game. Since the game can't end until the canned food is taken, and it is worth 8 points, a reasonable winning score is 8-14 points. Although in a two-player game, since there are less people, it's possible the score could be around 20 points if both players choose not to end the heist early.

Initially, the critter cards and trap cards didn't allow for much interaction between the players and we noticed that the first player tended to have a large advantage; they would get the canned food first. We put a lot of effort into revising the critter abilities and traps to mitigate this advantage by allowing players to play more strategically and have more interaction. We also added more loot tokens to the board and changed the point values to allow for more balanced play. As more tweaks of this kind were made, we saw the scores balance out. In our last several playtests, the winners were spread evenly amongst the player positions and the winning player rarely had a big lead