

DECONSTRUCTING SET

Set is a card game designed by Marsha Falco in 1988. At the time, Falco was studying as a population geneticist in Cambridge, England, trying to understand if German shepherds that get epilepsy actually inherit it. To help her understand the variables, she wrote information about each dog on file cards; she drew a symbol to represent a block of data, indicating different gene combinations. One day she found her kids playing with her research cards—they had made a game out of them. The game was so fun that they went on to publish it as a family business. The game became an instant classic, winning a number of awards, including the Mensa award.

The Rules of Set

The system of Set is quite elegant. The game is played with a special card deck made of 81 unique cards. The cards are the basic objects in the game, and each has a set of symbols with four properties: shape, number, and color; there are three options for each property. The diagram below shows how the number of properties and the options for each adds complexity to the deck, which is measured by the number of unique cards.

The procedures of Set are also quite simple. The deck is shuffled; 12 cards are then dealt out as shown in the next diagram (you will have to imagine color based on the shades of gray in the diagram, but in the original game, there are three colors). The players all look at the cards, searching for “sets.” A set consists of three cards in which each property is either all the same or all different. For example, in this layout, A1, A2, and A3 are a set because (1) shape = all the same, (2) number = all different, (3) pattern = all different, and (4) color = all different. A1, A4, and C1 are also a set because (1) shape = all different, (2) number = all the same, (3) pattern = all different, and (4) color = all different.

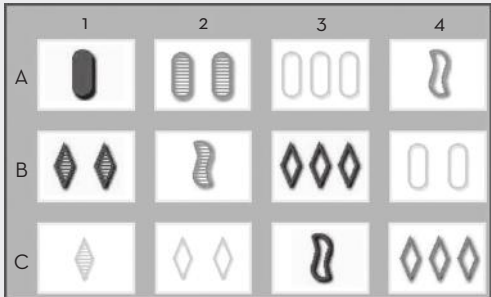
When a player sees a set, she calls out “Set!” and points out which cards she believes make a set. If she is correct, they take the cards; three more cards are dealt, and play begins again. If she is incorrect, she must give back one of her sets to the discard pile. When there are no more cards, the player with the most sets wins.

Analyzing Set

As we have said, the design of Set is quite elegant. If you look closely at the cards in this figure, you will see that for any two cards you choose, you can describe the third card you would need to create a set. For example, look at B2 and C4. What card would need to create a set including these two cards? First, these cards have different shapes, so you would need another card with a different shape: an oval. Second, these

	1	2	3	Unique Cards
Shape	Oval	Diamond	Squiggle	3
Number	1	2	3	9
Pattern	Solid	Clear	Striped	27
Color	Green	Red	Purple	81

Elements of Set and how they contribute to complexity



Set playing cards

cards have different numbers, one and three, so you need a card with two ovals. Third, these cards have different patterns, so you need a card with a different pattern: solid. Fourth, these cards have the same color, red (in this figure it is medium gray), so you need another red. To make a set with B2 and C4, you need a card with two solid red ovals—there is only one such card in the deck, and it is not shown, so we cannot make a set with these two cards.

Now, how did Marsha Falco decide on this system configuration for the game of Set? Why not more properties?

Or less? Why not more options for each property? As discussed in my analysis of Mastermind and Clue on page , the complexity of a system is greatly affected by the underlying mathematical structures. In Set, a deck of 81 cards provides a challenging, yet playable, number of possibilities. When learning to play Set, players often will remove the property of color to make the experience simpler. Without the property of color, the deck consists of only 27 cards, and it is much easier to find a set. After new players get the hang of it, they add back the remaining cards and the additional complexity that comes with a deck of 81 cards.

Imagine adding one more property—a background color, for example. As shown in the figure above, this would create a deck of 243 cards. If we add a background border, our deck has 729 cards. Let's say we are making a digital version of Set. Now we can add animation! Should we? Well, that would mean there are 2187 cards in our digital game of Set. For a player trying to apply the rules of the game, there are now seven properties to consider and about 30 times less probability that the card you need to make a set will be dealt to the current display. You can see that adding this level of complexity has probably *not* improved your player experience. In fact, it is likely that this version of Set is unplayable.

The next figure shows another possibility—adding another option to each of the original properties. This does not change things quite as much; at least the deck is only 256 cards, only three times more complex than the original game system. But the game is already quite difficult. If you want to see what this change does to the player experience, build your own Set deck with the new option and playtest it.

Conclusion

This analysis deals with a game that is, compared to many digital games, quite simple. However, as you can see, changing just a few of the system elements can exponentially change the complexity of that simple system and the player experience. It is critical to understand the mathematical structures of your own game design and to test differing levels of complexity by adding or deleting from your properties. One way to do this is the way we have done here with Set: build a matrix and calculate the level of complexity mathematically. And always keep in mind: A more complex mathematical solution might not offer the most satisfying gameplay result. The goal is always to build a system that is complex enough to delight and surprise your players but not to confound or frustrate them.

	1	2	3	Unique Cards
Shape	Oval	Diamond	Squiggle	3
Number	1	2	3	9
Pattern	Solid	Clear	Striped	27
Color	Green	Red	Purple	81
Background	White	Black	Grey	243
Border	Silver	Gold	Onyx	729
Animation	Still	Blinking	Rotating	2187

Elements of Set with added properties

	1	2	3	4	Unique Cards
Shape	Oval	Diamond	Squiggle	Square	4
Number	1	2	3	4	16
Pattern	Solid	Clear	Striped	Hatched	64
Color	Green	Red	Purple	Yellow	256

Elements of Set with added option to original properties