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Set Collection

Humans are pattern-seeking creatures, which perhaps explains why so many games incorporate some version of set collection. There's a nearly endless variety of types of sets to collect. Some sets are thematic, like Noah's pairs of animals, or the Three Little Pigs. Some are abstract, like Poker hands or melds in *Gin Rummy*, and some sets are arbitrary, like the compass, tablet, and gear science cards in *7 Wonders*. Even game concepts like contracts or tickets can be considered types of set. But no matter their variety and underlying commonality, all sets are built on the idea of synergy: the value or power of the set is greater than the sum of its parts.

The result of this characteristic of sets is that as players collect the components of a set, they will naturally diverge in their valuation of the remaining components. Picking up the fifth dumpling in *Sushi Go!* means much more than the first tempura—but for another player, that tempura completes their set and scores five points, while the first dumpling is worth only a single point. This value difference means that inter-player competition is no longer zero-sum. Players can set and achieve goals that are not in diametric opposition to their opponents, and the indirect conflicts that result engender a less aggressive dynamic that can appeal to players who may shy away from direct conflict.

Set collection can readily support multiple dimensions, and this is common to all but the simplest of games. Number-based sets can be collected in numerical order or in multiples of a single number. Add in colors or suits for yet another dimension. These orthogonal dimensions create choices and tension, as players consider which types of suits to collect based on their value, distribution of their components, and what their opponents might be trying to collect.

The rich math behind the set collection makes it a great tool for designers, but just as important for its popularity is the thematic consonance and

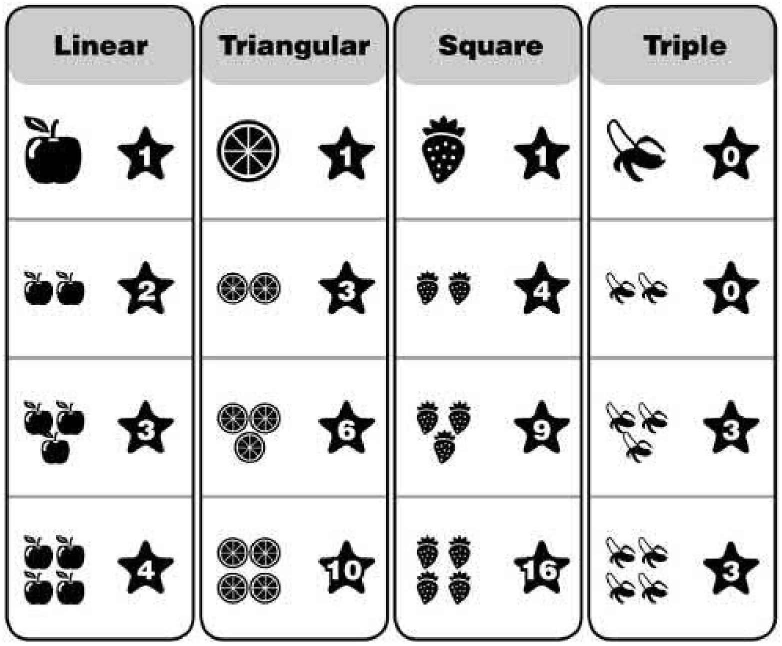
DOI: 10.1201/9781003179184-12

intuitiveness of the set collection. In *Ticket to Ride*, there's no imaginable reason why, at least from a simulation perspective, a set of four blue train cards can connect Chicago to Omaha, and also Helena to Winnipeg but not Winnipeg to Duluth, or Dallas to El Paso. Surely, the actual inputs of labor, capital, and raw materials are similar, and it's hard to think why, in practice, the blue tracks are any different from the green ones. And yet, through the set collection, these issues present no challenge to players, their understanding of the game, and their willingness to accept its conceits. Some tracks are green, and some are blue. Game on.

That's the real magic of the set collection. It is an incredibly versatile mechanism for abstracting a whole host of possible game activities. Sometimes, these sets feel richly thematic and representative of the activities being simulated, and other times, the sets are merely a veneer. But our human love for patterns and combinations means we'll accept quite a bit of abstraction in our set collection. Coupling this activity with clever scoring and collection dynamics, you have one of the fundamental building blocks of board game design.

While set collection can be implemented with many different kinds of components, by far the most common components are cards and tiles. For the sake of simplicity, we will refer to set elements generically as cards, unless referring to a specific game that uses some other component.

SET-01 Set Valuation



Description

Set Valuation is the logic or underlying mathematical model by which designers assign values to sets of game elements. Set Valuation can be in terms of currency, resources, or victory points.

Discussion

To paraphrase Jerry Seinfeld, it's one thing to *collect* the set, but something else entirely to *value* the set. Many other chapters in this book, like "Economics" (Chapter 7), "Auctions" (Chapter 8), and "Card Mechanisms" (Chapter 13), discuss how resources are allocated and acquired, but in this section, we'll discuss what those resources are actually worth. Implicit in this framing is that sets are nearly always converted into some benefit and consumed, turned in, or otherwise removed from play, even if only at game-end. Sets are not typically semi-persistent: either you complete them, and spend or score them right away, or they persist and are scored at game-end. However, some sets may be held in hand, and scored when a player chooses to do so for maximal effect.

In the introduction to this chapter, we described sets as being worth more than the sum of their parts. A more precise way to say that is that sets do not increase in value in a linear fashion. However, there are many shapes that the value curve can take, and each of these shapes will incentivize different behaviors.

The simplest valuation is that set elements are worth nothing on their own, but the set, when completed, has a value. *Ticket to Ride*, and its traditional forebear, *Rummy*, value sets in this fashion. A card may fit into more than one set, but on its own, it has only potential value—and often, it may be a wasting asset too. In *Ticket to Ride*, routes will get claimed over time, and cards of matching colors therefore decline in their utility. In *Rummy*, cards left in your hand at game-end typically count against your score or contribute to your opponent's score, depending on the specific variant. This scoring system creates something of a push-your-luck dynamic as to when to cash in a set for a reward and when to hold cards to attempt to increase the set size and payout.

A less-punishing valuation provides that singleton cards have some basic value of their own. Cards may also have unequal values so that there are more valuable and less valuable cards. *Sushi Go!* has some cards that are worth points on their own but are worth more in a set, like the nigiri cards that have a point value that can be tripled when paired with a wasabi card.

Another aspect of Set Valuation is termination. Some games define sets strictly as some number of elements, after which the set terminates. *Catan* defines sets in this fashion: you need one wood and one clay to build a road. No further cards fit into the set in any way, though another set of wood and clay can build another road segment. Other games offer escalating sets that terminate so they have a minimum and maximum valid size, with different payouts based on the size of the set. A similar mechanism is found In *Ethnos*, where bands—sets of the same creatures—are awarded points and allow markers to be placed on the board for area control (Chapter 11). Bands of six or more all score the same amount, no matter how large they get, but larger bands still gain their full on-board placement benefits. In *7 Wonders*, there is no maximum set size or set score for science cards of the same type beyond the maximum number of science icons of the same type in the deck (Illustration 12.1).

When sets have a maximum size and/or score, players are incentivized to diversify and collect multiple types of sets. When sets are not limited, players are wiser to specialize. However, these base dynamics can be influenced both by the specific valuation curve and the existence of orthogonal sets. *7 Wonders* science scoring is a great example. In *7 Wonders*, there are three types of science cards: tablets, compasses, and gears. Cards of the same type

Illustration 12.1 Sample cards from *Sushi Go!* Each type of sushi is scored in a different way, as shown on the card. Egg Nigiri are worth 1 point each. Each set of two Tempura is 5 points, and the player with the most Maki Rolls scores 6.

score the number of matching cards raised to the power of two, which is a sharply accelerating scoring curve that incentivizes collecting only one kind of science. However, the orthogonal set—that is, one of each type of science—offers a counterbalance. A set of three compass cards is worth nine points (three to the power of two), but a set of one of each science type is worth a base of one point per card and a set bonus of seven, for a total of ten points—actually outscoring the geometrically increasing set of the same size. Only when the monotype set has four cards does it begin to outscore diversity sets, 16 points to 13. Players leaning into a science strategy should seek to specialize, but the most efficient scoring for three cards is a diversity set. These varying incentives create interesting decisions and behavior patterns at the table—even aside from all the other types of sets and scoring in *7 Wonders*.

When sets can increase in size and value, a designer can use a variety of progressions to score increasingly larger sets. We had discussed squaring, which is one common progression that accelerates sharply and is most useful either for smaller sets or for creating a shoot-the-moon or push-your-luck dynamic, where a single large set can overwhelm other scoring strategies. However, designers have overwhelmingly opted for a different sequence when trying to preserve the greater balance among options: triangular numbers.

The triangular sequence, 1, 3, 6, 10, 15, 21, etc., has achieved nearly the status of a mantra or a koan among game designers. It is featured in an enormous number of games and proves incredibly versatile at providing escalating rewards for larger sets without overly incentivizing specialization to the exclusion of all other strategies. Triangular scoring also has a strongly intuitive property, which is that the second member of the set increases your marginal score by two points, the third increases that score by three, and so forth. If you're playing a game with triangular scoring and you're wondering how many additional points you'll score by adding the *n*th card to your set, the answer is *n*.

Not all scoring progressions slope up. Terminating sets are the most extreme example, but there are other possibilities too. In *Cacao*, players can move up a field-watering track. The track spaces are marked −10, −4, −1, 0, 2, 4, 7, 11, 16. Setting the track to start negative is mathematically uninteresting on its own. Instead, we will calculate the difference between values, which is to say, what is the actual point gain as you move from space to space. In this progression, the increase is 6, 3, 1, 2, 2, 3, 4, 5. As you can see, the first half is a declining sequence that scores well initially but yields sharply diminishing returns. The second half is a rising triangular sequence (you may notice that the 2, 4, 7, 11, 16 is our familiar 1, 3, 6, 10, 15, but with one added to each number). The marginal returns are highest at the beginning and the end of the curve, and the middle of the curve is least valuable. Players are incentivized to either water a little or a lot, but not a middling amount. This incentive is similar to the one in *Animals on Board*, in which players score a few points for singleton animals on their arks, and score maximum values for sets of three or more, but don't score anything for sets of two, which must be surrendered to Noah, who evidently holds the patent on pairing animals up.

Sample Games

7 Wonders (Bauza, 2010)
Animals on Board (Sentker and zur Linde, 2016)
Cacao (Walker-Harding, 2015)
Catan (Teuber, 1995)
Ethnos (Mori, 2017)
Rummy (Unknown, ~1850)
Sushi Go! (Walker-Harding, 2013)
Ticket to Ride (Moon, 2004)