

Rock, Paper, Scissors



by **Marcio Luis Ferreira Nascimento**

By means of a simple and traditional game that uses hand gestures it is possible to define a decision matrix, that has mathematical origins in the 19th century. The rules are very simple: scissors cut paper, paper wraps rock and rock destroys scissors. Such a game also represents a curious theory, known as the Nash *equilibrium*, which succinctly states that for each strategy there is another that can determine a way to win. More recently, this classic game was expanded, renamed as rock-paper-scissors-lizard-Spock, with new added gestures and rules.

There is a beautiful poem that has become an unforgettable Brazilian song, named *The Clock* (“O Relógio”), by the Brazilian diplomat, journalist, playwright, lyricist and poet Marcus Vinicius de Moraes (1913–1980), which begins: *Pass, time / Tic-tac / Tic-tac, pass, time / Come*

soon, tic-tac / Tic-tac, and walk away ... This poetry is part of the album *The Ark of Noah*, released in 1970 and a great musical success ten years after. Most people recognize another worldwide hit by de Moraes and his close friend Antonio Carlos Brasileiro de Almeida Jobim (1927–1994), Brazilian composer, pianist, songwriter, arranger and singer: *The Girl from Ipanema*, a *bossa nova* song written in 1962. Bossa nova is a unique music genre which incorporated elements of Brazilian samba and African American jazz.

Hobbies are part of anyone’s life. One of the most simple and curious has a name derived from Japanese *jankenpon* or *janken*, and is thus well known everywhere. But most recognize it by the more common name: rock-paper-scissors.



Fig. 1 Painting by the Japanese artist Kikukawa Eizan (1787–1867), the *Geisha Playing the Hand-Game Kitsune-ken*, a precursor of the rock-paper-scissors game (c. 1820). In public domain

In this game, two people simultaneously do hand gestures symbolizing stone (closed hand), paper (flat hand) and scissors (only the index and middle fingers stretched). The rules are very simple: scissors cuts paper, paper wraps rock and rock destroys scissors.

Mathematically, the game can be described by a table, or by a decision matrix. This table consists of three lines (referring to player A) and three columns (referring to player B) called rock, paper and scissors. According to the rules, a positive (+) sign represents gain for the first player (A) and, since it is a zero-sum game, this means loss to the second player (B). The negative sign (-) means, on the contrary, loss for the first player, and consequent gain for the second, while zero (0) means a neutral result, or *draw*. The latter situation occurs in case both players independently do the same choice of stone, paper or scissors. Such situations therefore represent the three possibilities of game results: losing, winning or drawing, and can in principle influence each player certain choices using a random strategy. Historically, the modern matrix concept is due to the English mathematicians James Joseph Sylvester (1814–1897) and Arthur Cayley (1821–1895). More details can be found in the excellent book about games written by Eigen and Winkler (1993).

Apparently, the first mentions of the game are very old, from ancient China. In other cultures, as from India, the game is called *man-gun-tiger*, with the following rules: man uses weapon, weapon kills tiger, and tiger kills man. In Malaysia the game is called *water-bird-stone*, with the rules: bird drinks water, stone hits bird and water covers stone.

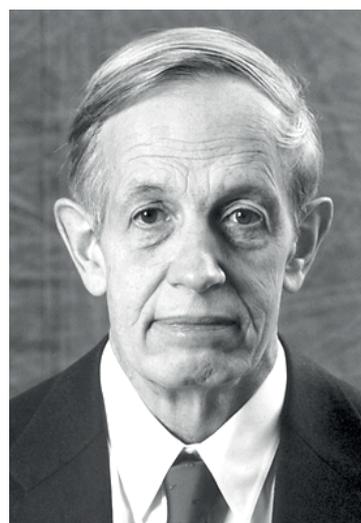
The first *Rock Paper Scissors Club* was founded in London, England, in 1842, and changed its name to *World Rock Paper Scissors Society* (WRPS: www.worldrps.com) in 1918. There are currently televised tournaments with official rules. However, exhaustive tests with this type of game have proven a curious theory, known as the *Nash equilibrium*, which succinctly states that for each strategy there is another that can determine a way to win.

		Player A		
		rock	paper	scissors
Player B	rock	0	+	-
	paper	-	0	+
	scissors	+	-	0

Fig. 2 Matrix representation of the rock-paper-scissors game

Quite briefly, the Nash theory ensures that winners often repeat their strategies, and losers change tactics every round. As an example, both players A and B start the game rock-paper-scissors with random strategies. If player A chooses scissors, and B rock, player A loses. In the next round, he (or she) may assume that B will pick rock again, then opts for paper, using a different tactic.

Thus, in a very simplified way, the Nash equilibrium represents a situation in which, in a game involving two or more participants, no player has to gain by changing his tactic unilaterally. Such a theory was proposed by the American mathematician John Forbes Nash Jr. (1928–2015), Nobel Prize in Economic Sciences in 1994. A successful biographical drama was released in late 2001 after a book published in 1998 entitled *A Beautiful Mind*. A subsequent film received four Oscars in the following year.



John F. Nash, Jr.

Fig. 3 Official portrait of John Forbes Nash Jr. (1928–2015), American mathematician, during award ceremony of the Nobel Prize in Economic Sciences in 1994. Figure in public domain

More recently, an improvement on this old game occurred. In the television series *The Big Bang Theory*, more precisely in the eighth episode of the second season, *The Lizard-Spock Expansion* (2008), the protagonist Sheldon Lee Cooper (in fact the excellent actor James Joseph Parsons, *b.* 1973) presented an expansion of the classic rock-paper-scissors game, invented by the computer scientist Samuel John Kass (*b.* 1973) and the publisher-writer Karen Beth Bryla (*b.* 1974). The gestures are the same as in the classic game, added only by the lizard (hand with the fingers half-open and joined by the tips) and Spock (greetings from the Vulcans on the famous television series *Star Trek*). The rules of rock-paper-scissors-lizard-Spock are: scissors cut paper; paper wraps rock; rock crushes lizard; lizard poisons Spock; Spock crushes scissors; scissors decapitate lizard; lizard eats paper; paper refutes Spock; Spock vaporizes rock; rock breaks scissors.

		Player A				
		rock	paper	scissors	lizard	Spock
Player B	rock	O	+	-	-	+
	paper	-	O	+	+	-
	scissors	+	-	O	-	+
	lizard	+	-	+	O	-
	Spock	-	+	-	+	O

Fig. 4 Matrix representation of the rock-paper-scissors-lizard-Spock game

The series approached such a game on at least one more occasion (*Rothman's Disintegration*, the seventh episode of the fifth season in 2012), always playing with the ingenuity or even incompetence of some characters in understanding the simple game rules or with the cleverness/wit of others as they seek to defeat opponents in hysterical disputes.

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