



Evolution of the roulette wheel

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The exact origins of roulette are obscure, though it is widely accepted that it evolved from the games of hoca, even-odd and boule, before which the Greeks and Romans are known to have used spinning shields and chariot wheels for related games of chance. Roulette is reputed to have originated in France between the late eighteenth and early nineteenth centuries. According to certain authors, the game was formally introduced into Paris in 1765 by Gabriel de Sartine, a police lieutenant.

From Paris it spread to other European cities such as Spa and Baden-Baden, and also, notably, to Monte Carlo, where it became fashionable among the aristocracy who frequented the gaming tables. The very name 'roulette' derives from the French for 'small wheel'. At some stage, French-style roulette reached the shores of the USA, where the game was adapted for local use, with variations ranging from the 31 numbers (0 to 28, a double zero and an American Eagle) to the present form, commonly referred to as 'traditional' American roulette.

Variety of types

Over the centuries, the wheel has evolved into many different forms, shapes, colors and sizes. In addition, a plethora of ingenious devices has been constructed in attempts to emulate it.

In 1991, a Spielcasino in Frankfurt, Germany, offered a '24-roulette' as a game of skill. The 'wheel' comprised a



Figure 1. Nine on the dice.

heavy (about 250 kilograms) precision-machined solid steel bowl with a 26-receptacle center around which a solid 'billiard' ball was let roll. The player was expected to use so-called skill rather than chance to predict the outcome. The ball followed an elliptical path and, depending on its density and initial velocity, rolled to rest in one of the slots declaring the winning number.

A number of curious roulette 'wheels' (such as numbered balls, playing cards, the beehive) have also been used with much success on standard or modified roulette layouts. For example, at the Hellenic resort of Loutraki, in 1992, an unlicensed operator evaded legislation by offering roulette not as a game of chance but of skill. The wheel comprised a rectangular dartboard depicting the sequential version of the numbers shown on the roulette layout. A small target four meters away ensured that skill equalled chance. As a further example, a set of

dice – one conventional, the other special – has been used by the author to emulate the operation of the roulette wheel. The dice shown in Figure 1 depict the number 9.

The category of electronic wheels encompasses a wide range of mechatronic devices (such as electro-mechanical, video roulette, hybrid roulette) with a spectacular rate of growth and evolution.

Operator bias

Early roulette wheels were crudely made, and often modified to give the unlicensed operator a considerable advantage. The wheel could be rigged with magnets, special separators or other concealed cheating devices, or could even be mounted on a slant. According to *The Gamblers*, H C Evans & Company advertised a roulette wheel in 1909 with an integral lid, using which the dealer could direct the ball to the desired number simply by lifting the lid to reveal the winning number.

Players have often proved equally deceiving. Mistrust on both sides and superstition were characteristic of the old gaming days, until state regulation endeavored to restore confidence. This led to a different evolution, as important as that of the wheel itself: the evolution of gaming legislation whose provisions protect both sides at the gaming tables.



Figure 2. Horizontal and vertical ball-stops were redesigned in 1989.

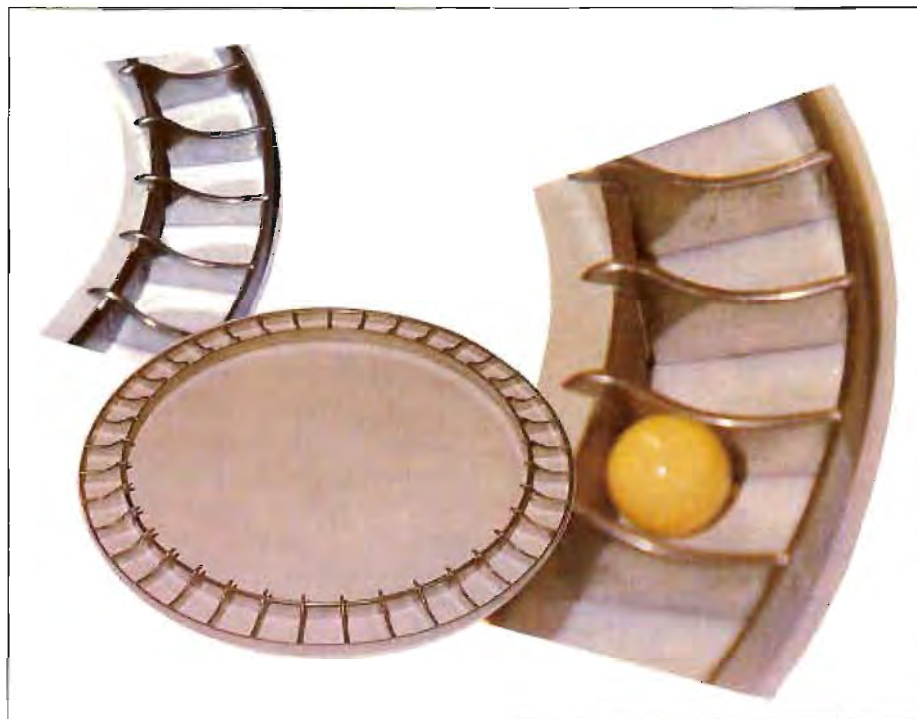


Figure 3. Early brass separator rings were fairly unstable

Behind the wheel

Over the years, control over the evolutionary process of the roulette wheel has been imposed by the players rather than by any other factor – marketing ploys excluded. The profit or loss at a table is influenced by several factors: the interaction between players and equipment defines the mode of player winning (or house losing) that not only features prominently in almost every publication on the subject, but has also been the thrust behind the evolution of the wheel.

Discerning players have often used a system, whether mathematical or physical, for playing at roulette. Physical systems refer to the behavior of roulette; the player follows gaming action for something unusual – for instance, a pattern, operational details, a natural system or a change in behavior. Any advantage that may change the odds against the house is of interest, however small. It was the prediction of a physical system's behavior by two players in the UK that proved successful, changed the odds against the house and triggered the recent evolution of the design of the (American-style) roulette wheel.

American version

The recent phase of evolution of the traditional roulette wheel may

conveniently be taken to have started in January 1982, when two gamblers consistently won a lot of money at the roulette tables of several casinos, including the Rubicon Sporting Club. When they were arrested for possessing a sub-miniature radio link they claimed to have invented an 'unbeatable' system for winning at roulette.

Having helped the police with their inquiries for two days in the cells of a Northampton Police Station, the gamblers were released and given the opportunity to repeat their performance under close supervision, but this time with no money at stake. It was reported in the newspapers at the time that the team picked the winning number on average four out of every five spins of the roulette wheel. The pair insisted that their system was based on complex mathematical workings.

The casino industry sought advice and help from the leading casino equipment manufacturer of the day, who directed the author to explain and to prove the success of the 'unbeatable' system. To fulfil these objectives the author devised several test procedures for assessing roulette wheels of various styles and from several manufacturers. The wheels were assessed both mechanically and in terms of their behavior.

The results of the research suggested that the gamblers took advantage of a natural phenomenon to predict a

deterministic system and then applied computer technology to speed up their calculations. Three years later, Nevada legislation outlawed devices that projected the outcome of the game.

The key aspects of their system centered on the observation that the last rotations of the roulette ball are very much alike on every spin (whether initially fast or slow) and that the dealer, instinctively spinning the rotor at a 'constant' speed, enables the wheel to be used as a clock to predict the ball's landing area. Hence the term 'clocking the wheel'. A small correction was made to the betting mode to allow for the effects of the ball; the direction of rotation was found to be unimportant.

Laboratory tests suggested that the inherent characteristics of the high-profile wheel under certain operational conditions would enable the deterministic behavior to be predicted, particularly with the dealer subconsciously causing the ball to exit the ball track consistently at the same place. The ball-stop was high enough to direct the ball (the 'directional' effect) straight into the pocket rather than deflect it. Following the results of this investigation, which highlighted the shortcomings of the high-profile wheel, John Huxley manufactured and marketed the first low-profile (Mk3) traditional American roulette wheel in 1982.

A detailed account of how the gamblers' 'unbeatable' system worked was published in 1985, and Doyme Farmer demonstrated the functions of his Newtonian algorithm on a foot-operated microprocessor for a television program two years later. In 1986, Y Gambol published details of the 'clocking' formula in *The Romeo Project*. In 1993, Steve Forte successfully demonstrated the system on a high-profile roulette wheel at a London seminar, without a computer. The house can, of course, elect to reduce or eliminate any advantage gained through 'clocking' by allowing only blind bets (placing of bets before the wheel is spun), by using the correct wheel/ball combination, or even by announcing the 'no more bets' at an earlier stage.

The winning number

The winning number is the outcome of the chance interaction of the behavior of the wheel, the ball and the dealer. The interaction between ball and wheel defines the suitability of a particular ball



Figure 4. The single solid-cast separator ring.



for a given wheel. The ball's properties (size, shape, weight, constitution, material) affect its dynamic behavior. Laboratory tests confirm that different balls produce different spreads of winning number patterns: narrow with a low-restitution ball (such as large PTFE) and wide with a high-restitution ball (such as nylon, ivorene). The interaction between the dealer and the wheel defines the speed of rotation (and direction) of the rotor: the faster the rotation of the rotor the more violent the collisions between the ball and the wheel and the wider the winning number pattern spread.

More evolution

In the past 20 years the evolutionary process has affected almost every

section of the roulette wheel (for example, the type and construction of wood, the choice and homogeneity of the engineering materials, the spindle assembly, the ball track, the number face, the cone, the plinth, the bowl liners). The following wheel components, however, have been of particular interest:

Ball-deflectors. The redesign of the ball-stops (or ball-deflectors, as they should be known), was another step in the evolutionary correct direction. Research evidence had suggested a correlation between the profile height of the ball-deflectors and the importance of the 'directional effect', particularly when the 'uneven' effect caused by the alternation of horizontal

and vertical ball stops was taken into account. Consequently, Huxley in 1989 introduced a new generation of ball-deflectors fitted to the Mk5 roulette wheel.

The separators. It is common practice to spin the American-style wheel by one (or more) of the separators, in alternating directions, in an effort to baffle the discerning player and thus make prediction more difficult, despite the evidence of the various accounts cited earlier that the direction of rotation is not important.

If a wheel has not been maintained properly its performance is compromised. Early separator or divider rings (Figure 3) were fairly unstable and were replaced by individually slotted chrome-plated brass separators in the late 1960s. The need to eliminate problems caused by lack of maintenance led to another evolutionary step: the single solid-cast separator ring (Figure 4). The separator ring of the Huxley Mk6/7 or Mk8 wheel is indexable through 37 (or 38) positions.

Conclusion

It has been shown that discerning players have been able to take advantage of a natural system to predict the outcome with the high-profile roulette wheel. The casino industry's reaction to this led to the design of the first low-profile American-style roulette wheel. The wheel's evolutionary process continued with the design of the Huxley ball-deflectors, the one-piece cast separator ring and the Mk6-8 roulette wheels. The evolution of the roulette wheel continues. ■

Author

George Melas has been a technical and scientific consultant to John Huxley (Casino Equipment) Limited, UK, since 1981. He is a chartered information systems practitioner, a chartered engineer, a European Engineer and a member of several institutions, including the British Computer Society.