



Roulette Balls: **THE INSIDE STORY**

Is it that players continue to place metal objects in roulette balls or is it mistrust of the electric cables that run down the side of roulette wheels — certainly, something still perpetuates the mystery that someone, somewhere is seeking an unfair advantage, says George Melas

A LOT OF MYSTERY and controversy has surrounded the roulette ball and its behaviour ever since roulette was introduced in Paris in 1765. Early roulette wheels were crudely made and were often modified to give the unlicensed operator a considerable advantage. The wheels could be rigged with magnets, special separators or other concealed cheating devices; they could even be mounted on a slant.

According to 'The Gamblers' — Time-Life Books Inc. 1978, page 175 — H. C. Evans & Co advertised a roulette wheel in 1909 with an integral lid, with 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 adept at deception, substituting or removing and then returning 'lost' roulette balls having inserted metallic objects within.

The majority of the roulette balls taken away by the players are never returned to the gaming floor; they remain 'trophyes', kept as mementoes of notable visits, perhaps produced in support of extraordinary stories. Certain casino operators have resorted to

silk screening serial numbers on the roulette balls as an additional security measure; others have installed compasses near the roulette wheel which can detect strong DC magnetic fields. The compasses also allow the dealer to partially authenticate a ball — if the ball were to contain a magnet, swiping it over the compass prior to use would cause the compass needle to deflect. Nowadays, however, most casino operators prefer to use 'ball verifiers'.

In the heady days of the old Wild West, there are accounts of dealers directing the ball to a certain wheel sector, perhaps even to a particular number, when, say, a prospector placed his pouch of gold dust on the layout. This may well have been true at the turn of the century when the 'dealers' could freely tamper with the crude roulette wheels of the time; they were at liberty to use the ball of their choice and free to operate the wheel according to their requirements.

Nowadays, however, this is very unlikely as the quality, construction and behaviour of roulette wheels are tightly controlled by both gaming procedures and legislation to ensure that the wheel

is used correctly. For added security there are frequent inspections by third parties to safeguard the interests of both the casino and the players.

To the author's knowledge there have not as yet been any reports of players complaining to the authorities that they have won too much money; the contrary, however, is often the case. Players, ignoring both the effects of random chance and their betting mode, often choose to blame their loss on 'house interference' as the following example clearly illustrates.

On April 17th 1996 the Hellenic newspaper 'Ethnos' reported that dealers at a casino in Greece "directed the roulette ball at numbers the players had not wagered their bets on".

The newspaper report was based on the allegations of a retired bank employee who lost two million drachmas (about £5,200) in "just a few days" according to the player, who chose to remain anonymous, the alleged "scam" was carried out by the casino operator using "electromagnetic means".

The report explained that in the player's opinion "a mechanical system had been installed in the roulette





wheels” of the casino in such a way “that the ball would be directed by electromagnetic means onto the ‘empty’ numbers on which no player had wagered their bets”. Notably, the player claimed that the dealer directed the ball to the ‘empty’ numbers “at least 90 per cent of the time”.

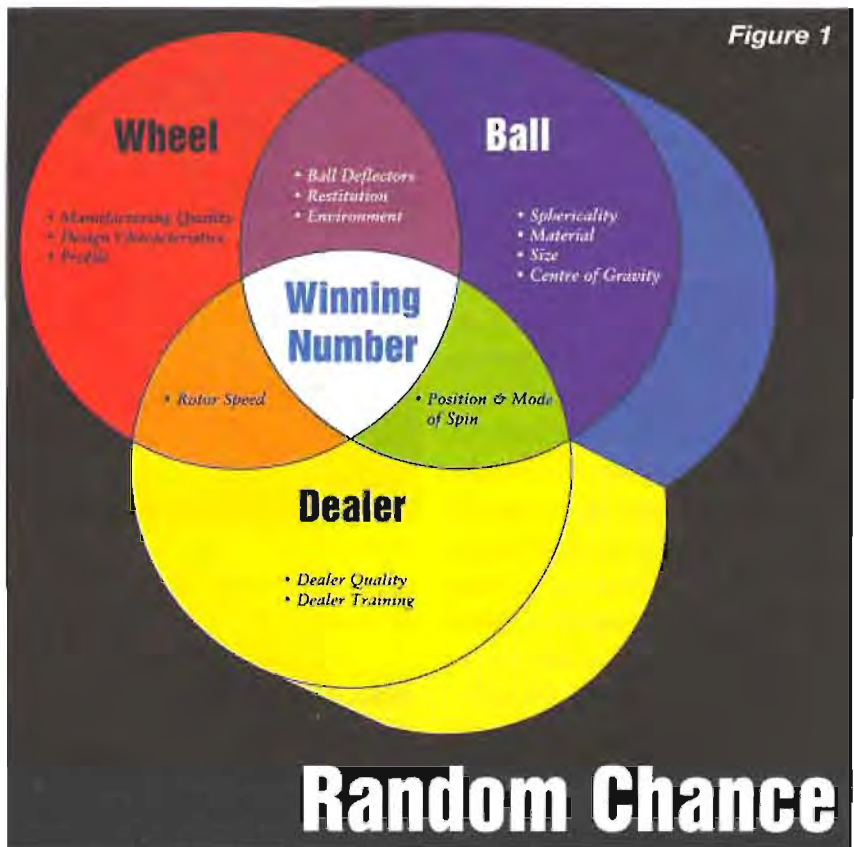
The player, having “noticed the electric cables running down the wheel” and alarmed by the unruly behaviour of the dealer was so “disgusted” that he “tried to steal one of the roulette balls to prove the scam”. According to the newspaper reporter, the casino operator confirmed that “no such thing was possible as there were several people observing the game, apart from the regular visits by government inspectors”.

WINNING NUMBER

With mistrust running high on both sides of the tables, perhaps an explanation that is open to scrutiny may help to separate fact from fiction. Analysis by the author of the process by which Roulette is played shows that the factors whose interaction influences the eventual outcome of the game ‘The Winning Number’ can be classified under the headings: ‘Wheel’, ‘Ball’ and ‘Dealer’ — see *Figure 1*.

The Winning Number is determined by the chance behaviour of the ball falling into a numbered wheel pocket spun in the opposite direction to the ball. When the ball falls into the pocket, the winning number is declared and the game is over.

The interaction between the ‘Ball’ and the ‘Wheel’ defines the suitability of a particular ball for a given roulette wheel. Heuristic data suggests that some types of balls behave in a more random fashion than others of different mechanical characteristics. The ‘ran-



domness’ of the ball’s behaviour can be assessed in terms of the width of the winning number pattern; the more random the ball’s behaviour, the greater is this width or spread and vice versa.

The term ‘restitution’ refers to the ‘bounciness’ of the ball. The term ‘environment’ includes all environmental factors affecting behaviour, for example, the accuracy with which the ball track is horizontally aligned. The interaction between the ‘Ball’ and the ‘Dealer’ encompasses the speed and the direction of the ball’s rotation around the ball track and the position of the start of the spin with respect to the position of the last winning number.

TYPES OF ROULETTE BALL

At the turn of the century, the most common materials used for the manufacture of roulette balls were the various animal bones, especially ivory.

Nowadays a wide range of synthetic polymer materials find use, the most common of which are:

- Teflon;
- Ivorene;
- Composition.

The polymer poly(tetrafluoroethylene) or PTFE, discovered by Dr. R.J. Plunkett in 1938, was first marketed under the Du Pont trade name ‘Teflon’ and has since kept its original name. The Teflon or PTFE ball is fairly dense, not very hard, of white appearance, slippery and ‘waxy’. The material is excellent for rolling and spinning on the polymer coating of the ball track, but has a low coefficient of restitution on most wheel surfaces. This ball is not recommended for use with traditional wheels unless the rotor speed is very high.

Ivorene is the polymer substitute for ivory. Ivory balls had been made of elephant’s tusks, ie, tooth bone. They were



PRODUCT PROFILE

of white creamy appearance, with white coloured streaks. They were of somewhat irregular shape (aspherical) in comparison to balls made from different materials; they were also prone to wear. After only a few hundred spins the shape of a typical ivory ball changes sufficiently not only to cause damage to the protective polymer lining of the ball track, but also even to change the characteristic sound of roulette.

Ivorene, on the other hand, is of a yellowish appearance and considerably more spherical and resilient than the ivory ball. It is made of phenolic resin with inorganic mixtures of sulphates and carbonates. It has a good coefficient of restitution and is suitable for the majority of traditional roulette wheels.

The composition ball displays behaviour akin to that of the Ivorene ball, but with a slightly lower coefficient of restitution. Spectrographic analysis of a sample from a composition ball suggests that the material is a styrenated poly(ester) containing phthalic acid. The ball is of a matte greyish appearance and of medium size. In general, polymer balls are available in two sizes — large (ø22mm) and small (ø19mm). Composition balls have a low dielectric constant and loss factor over a wide frequency band; this makes



Figure 2

them suitable to carry foreign body inserts and renders the presence of these inserts easy to detect.

BALL BEHAVIOUR

The ball's behaviour depends essentially on the chance interaction between the ball and the rotor; this interaction can be defined in terms of:

- Random Chance;
- Mechanical Properties of the Ball;
- Speed of the Rotor.

At low rotor speeds, the collisions between the ball and the rotor parts, eg, the separators, are not very violent; under these conditions the profile of the wheel and the mechanical characteristics of the ball exert great influence on the ball's behaviour. It is therefore

more crucial to use the correct ball at low rotor speeds. The salient mechanical characteristics, in order of importance, are:

- Material;
- Size;
- Sphericity;
- Centre of Gravity.

The ball material is the primary factor determining the value of the

coefficient of restitution which, together with random chance, governs the ball's behaviour. When the ball collides with an obstacle, it bounces back; this 'bounciness' may be assessed using:

$$e = - \frac{\text{(relative velocity of rebound)}}{\text{(relative velocity of approach)}}$$

where e is the coefficient of restitution of the material of which the bodies are made, ie, the ball and the rotor parts. The negative sign above recognises that the rebound must always be in the opposite direction to the approach. The coefficient of restitution is constant only for speeds low enough not to cause deformation of the materials involved through the pressure of impact; under these conditions it is independent of the velocities of approach prior to collision.

Research carried out by the author with ball roll tests on the original low profile roulette wheel — the Huxley Mk. 3 — indicates that the large Ivorene ball displays a more random behaviour than the large PTFE ball. For this reason, it is recommended that wheels based on the Huxley Mk. 3 design should not be used with the PTFE ball, with its lower coefficient of restitution at low rotor speeds. Asymmetry in either a ball's shape —



Figure 3



asphericity — or in the position of its centre of gravity may be observed 'in situ' even as the ball is rolling around the ball track. These types of anomaly induce a change in both the characteristic sound made by the ball and in its rolling behaviour.

Unless the utmost care has been taken, a foreign body embedded in a ball will disturb the position of the ball's centre of gravity; this is most noticeable at the end of a spin, when the ball's speed is low and it is about to roll down the ball face; a descent which 'wanders' down the ball face must cast suspicion upon the integrity of the ball.

As the speed of the rotor increases, the behaviour of the ball changes. The greater the speed, the more violent are the collisions and the more random the behaviour of the ball, up to a certain speed above which the ball will tend to leave the wheel! Although fast rotor speeds make for random behaviour, they are unpopular with players who don't like the ball jumping out of the number of their choice and also with operators as violent collisions prolong the game and thus reduce the Drop.

FOREIGN BODY INSERTS

It has been mentioned earlier that some players have been known to insert objects in roulette balls. This problem has been addressed by some operators by silk-screening a serial number on the balls or by placing perspex plates to cover at least three quarters of the wheel, so preventing players from tampering with the equipment or substituting balls. Other operators resort to the use of 'ball verifiers' or send their balls to the supplier for

testing. In 1993 Steve Forte, a Las Vegas-based expert on cheating techniques, successfully demonstrated at a seminar in London that a soft iron insert placed at the centre of the ball could cause the ball to roll down the ball face at a point on the ball track where a strong magnet had been placed, concealed inside a packet of cigarettes.

Under these conditions, the rotor of a high profile wheel or any wheel with a high 'Coefficient of Clocking' can be used as a 'clock', to predict the ball's landing area. A small correction in betting mode is made by the discerning player to allow for the effects of the rebound of the ball. It appears that the majority of the inserts placed by players can be classified as:

- Ferrous metals;
- Magnets.

Other inserts have included different metals as well as ceramic and polymer magnets.

DETECTION OF INSERTS

Metal inserts can easily be detected using standard electronic techniques. The first electronic detector of this type to be used on the gaming floor was designed by the author in 1983 and employed a tuned circuit whose frequency would change with the

proximity of metal or conductive material. The ball was placed inside a receptacle, whereupon an indicator showed the presence or absence of conductive material in the balls.

The units were marketed under the heading of 'ball verifiers' — see *Figure 2* — by John Huxley. Since then, with advancing technology, 'ball verifiers' have become smaller — see *Figure 3* — and more user friendly — see *Figure 4*. Recently John Huxley introduced a 'security kit' comprising several serialised roulette balls, a 'smart dolly', a 'ball verifier' and a patented anti push-bet bar.

It is often said that prevention is better than cure; indeed it is surely better for one to look after one's balls, protecting them from interference or tampering, rather than to resort to the detection of such unwarranted abuse. The first line of defence has for some time been the perspex plate over the wheel which prevents the players from touching the rotor or the ball.

Players, meanwhile, have endeavoured to take the initiative; there have been reports of players 'fooling' the old generation metal detectors by inserting polymer magnets, which are not detectable by standard detectors. However, with the advent of the 'new generation' verifiers employing Hall effect sensors, polymer or plastic magnets may be readily detected. Once again, the ball has been placed back in the operators' court.

ELECTRIC CABLES

It was natural for the retired Greek player to be alarmed at the presence of electric cables running down the roulette wheel, mistaking the signal wires from the



Figure 4





PRODUCT PROFILE



optical scanner — see *Figure 5* — and the electronic winning number display for something of a more sinister nature. With stories from the old Wild West era of unlicensed casinos and with the seeds of mistrust sown by certain publications such as Scarne's *New Complete Guide to Gambling*, it is hardly surprising that such an attitude of suspicion prevails.

Looking at the photograph on Page 423 of Scarne's book, it becomes evident that the roulette wheel appears to be a model and not an approved, regulation sized wheel with embedded solenoids, stating that "Scarne examines gaffed roulette wheel ... and showing the batteries and electromagnets which were hidden in the bowl behind the back track". To connect four solenoids and then to use either thermionic valve or foot operated switches to apply the current to them, would surely have been noticeable even in the 1950's.

This type of text helps only to deepen mistrust and to perpetuate the inadvertently bad publicity and myth associated with the subject. Present day legislation is very strict in specifying not only the type of games and the payouts that a casino can offer to its

players, but also in scrutinising both the casino operators and their suppliers prior to the award of a gaming licence from national and international regulatory and legislative bodies.

The most fundamental reasons why the alleged scam in the Greek casino or in any other licensed casino, could not be possible are listed below:

- Modern construction of roulette wheels from non-ferrous alloys allows for a very small gap between the solid rotor assembly and the bowl liner; this eliminates the need for security seals;
- Roulette wheels with factory installed security seals — see *Figure 6* — are inspected regularly by the casino security. The security seals are routinely broken by the manufacturer during maintenance or if the manufacturer wishes to confirm that no one has tampered with the wheels. If the seals are broken, for any reason, only the manufacturers have the means to replace them. It has been a standard procedure by reputable manufacturers to report broken security seals and to advise the management to withdraw the roulette wheel from the floor for further scrutiny;
- Reputable roulette wheel manufacturers are invariably licensed by national and international bodies. Every legislative body scrutinises not

only the manufacturers but also the manufacturer's staff, associates, suppliers and sub-contractors before they grant a manufacturing licence. The same applies to casino operators and it would be foolish for anyone to compromise their licence;

● Operators are constantly inspected by both the manufacturers and their local government inspectors. The wheels are normally inspected under very strict procedures on the casino floor and, more often than not, behind locked doors.

● At the end of gaming, it is to the operator's benefit that the roulette wheel should behave the way it has been designed to and that the selection process of the winning number should be random and subject to chance. It is only then that the operator would maintain, on average, the house advantage; only then will the odds the house has taken justify the payouts made to the players.

PLAYER CONFIDENCE

It is not to the advantage of the casino operator to resort to uncertain, risky, untried and uncontrollable methods of influencing the outcome of the game. Even if such an attempt were to be perpetrated, for it to remain undetected from their own gaming staff, the manufacturer's engineers, the government inspectors and the players is well nigh impossible.

Operators could, perhaps, attempt to dispel the uncertainty by allowing their players to inspect their roulette wheels or by showing how the roulette system works or how the roulette wheel has been assembled. If this were to be done, either before or after gaming, full confidence could be restored and the myths at last laid to rest. ■

