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Features

Beckham in his prime number

by Marcus du Sautoy

BOOKMARK

In pubs and clubs, and on internet sites, there has been much debate over the mystical meaning behind Beckham's choice of the number 23 shirt to play for Real Madrid: we have 23 pairs of chromosomes, Michael Jordan wore the number 23 shirt, Caesar was stabbed 23 times, 23mph is the maximum speed of an American crow; and let's not forget AA23, the cell in which Princess Leia was held in the original Star Wars movie.

Marcus du Sautoy plays in the number 17 shirt for Recreativo FC in the Super Sunday League Division 2. Not quite 23, but another nice prime! The squad photo by Hugo Glendinning appears in a recent book "Science not Art", published by the Gulbenkian Foundation. The book contains 10 diaries kept by scientists for six months recording what it is a scientist does all day.

As a member of Oxford University's Mathematical Institute, and football fanatic, I feel moved to point out that many pundits seem to have missed the true significance of Beckham's choice: 23 is a prime number − the smallest with consecutive digits. Although many have said this in passing, few realise what a profound observation this is.

Prime numbers are those indivisible numbers. They are nature's most important numbers because they are the "atoms" of mathematics, the hydrogen and oxygen of the world of numbers. Every number is built by multiplying prime numbers together, a fact obviously not missed by Real Madrid.

A prime location for advertising − Siemens Mobile sponsor the Real Madrid kit. Siemens press picture

The key building blocks of Real Madrid's team are all prime numbers: Carlos, No 3; Zidane, No 5; Raul, No 7; Ronaldo, No 11. So giving Beckham the 23 shirt is a clear indication that Real's president, Florentino Pirez, is intending to build on Beckham.

But there are other more subtle reasons why Beckham might be seeking out another prime−number shirt to replace his No 7 at Man U. The Ancient Chinese believed each number had its own sexuality. Even numbers were feminine, odd numbers were masculine.

But of all the odd numbers, the primes were considered the most masculine. These numbers that can't be broken down into smaller numbers are the macho numbers of mathematics. Given the macho culture of Spanish football, perhaps Beckham felt the need to balance his feminine side by sticking a stonking great prime on his back.

Or perhaps it is his survival instinct coming to the fore. In nature, primes are the key to the survival of a strange species of insect. The prime−number cicadas hide in the ground for 17 years, then emerge en masse from the earth into the forest. They sing loudly, eat, have sex, lay eggs and then die after six weeks of intensive partying. The forest goes quiet again for 17 years.

The birth of a periodical cicada. Image courtesy of Magicicada

But why did the cicadas choose 17, a prime number, for their hibernation? Scientists believe there is a predator that likes to crash their party and also emerges periodically after a certain number of years. The cicadas found that by choosing a prime−number cycle for their party, they could keep out of step of the predator more often than if they'd chosen a non−prime such as 15.

For the cicadas, the primes aren't just some abstract curiosity, but the secret to their survival. Perhaps Beckham, too, hopes that a prime−number shirt might help him avoid getting another stray flying football boot in the eye.

Evolution might have helped the cicadas to find primes, but is there some pattern that can help Real Madrid to go on choosing primes for their growing selection of star players?

Despite 2,000 years of scrutiny, mathematicians are stumped by the task of predicting when the next prime will occur. Indeed, they have begun to suspect that there are no patterns. Two years ago a record big prime number with more than four million digits was discovered.

It will always be possible to beat the current record, since the Ancient Greeks proved there are infinitely many prime numbers. Yet mathematicians have found no method that will help them to predict where to look for the next record prime. Present techniques share more in common with astronomers randomly trailing the sky for new supernovae.

Is this how Nature chose the primes?
Image DHD Photo Gallery

Nature, mathematicians believe, has chosen the primes randomly as if playing some game of prime−number lottery: 23 is, therefore, one of nature's lucky numbers.

Despite all the evidence that primes look random, we aren't sure whether, as we count higher and higher, some strange pattern might emerge. The greatest unsolved problem of mathematics, called the *Riemann Hypothesis* (discussed in A whirlpool of numbers from Issue 25 of *Plus*), is to understand why there don't seem to be any patterns in the primes. And as if mathematical immortality were not enough, a proof of this enigma will win you $1 million courtesy of a businessman in America.

If you think all this stuff about primes is just some abstract game, then think again. The fact that we don't fully understand the primes is at the heart of a very real−world application of prime numbers.

Maths is the key... Image DHD Photo Gallery

Every time you use your credit card on the internet to buy a ticket to see Real Madrid play, your account is kept secret from hackers thanks to the power of prime numbers. Prime numbers have become the locks that

preserve the secrets that are racing through the electronic shopping mall.

Each e−business chooses two big primes, *p* and *q*, which they keep secret. The product of these primes, $N=p \times q$, is made public. A calculation using *N* encrypts your credit card, but the only way to undo the calculation and decrypt the secret message is to know the secret primes *p* and *q*. Cracking codes is the same as cracking the public number *N* into its prime building blocks. It's a bit like a chemist who wants to know the atoms inside a compound. Although chemists have solved their problem, mathematicians lack any fast way to do this prime−number spectroscopy − to the relief of internet cryptographers.

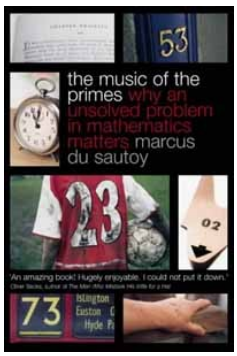
Perhaps Beckham is subconsciously seeking some security by his choice of a prime−number shirt. But any deeper understanding that we might gain about prime numbers could help to bring e−business to its knees.

Whatever his real reasons, Beckham isn't alone in choosing 23 as his favourite prime. It was also the choice of Nobel prize−winning economist John Forbes Nash, who was recently depicted by Russell Crowe in a Hollywood movie.

One of the first indications of Nash's failing mind was his claim that a picture on the cover of Life magazine of Pope John XXIII was in fact Nash in disguise, the proof being that 23 was his favourite prime.

Is Beckham's choice of the 23 shirt the beginning of the footballer's decline, or is it simply a case of a Beautiful Mind meets the beautiful game?

About this article



Professor Marcus du Sautoy is an Arsenal fan. His favourite primes are featured on the cover of his book *The music of the primes* (reviewed in this issue of *Plus*), including a picture of Sol Campbell's No 23 shirt. He recently scored the penalty to win the Clissold Cup for his seven−a−side team, Hackney's Hardest (click here for a match report).

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There is the chance to explore more about the exciting world of prime numbers in the interactive website www.musicoftheprimes.com. You can build a prime number fantasy football team and get it to play other teams. Will you be top of the prime number premiership?

And why not take the opportunity to do an experiment with prime number cicadas? By choosing different life cycles for the cicada and the predator, the game shows why primes became the key to the cicadas survival.

There is also the chance to contribute to the Prime Number Photo Gallery. Do you have a picture of your favourite prime number? Have you seen a prime number somewhere strange − like the date on a building? Can you find pictures for the missing primes in our gallery?

And there are more details about how to win a million dollars and prove the Riemann Hypothesis.

Plus is part of the family of activities in the Millennium Mathematics Project, which also includes the NRICH and MOTIVATE sites.