

## The Science Behind The Football Boot – Part Two

**Ger Gilroy:** “Not that many kids, maybe, would go through that process of being in the car park. It reminded me of two people in particular – Johnny Wilkinson and David Beckham before he became the celebrity icon.

“When he was just a young footballer he used to spend hours practising his free kicks and Johnny Wilkinson tells almost the same story, you know, left foot, right foot, left foot, right foot, marking a system in his head. And it’s kind of ironic that both of those ended up wearing your football boot.

“And I just want to understand exactly how that circle gets squared? How does the football boot come into being? When do you start thinking, you know: ‘I’ve used my body and my brain as much as I can, but my football boots, they could get better.’ When did you start thinking like that?”

**Craig Johnston:** “Well, funny enough, we didn’t do the part, and maybe we should, about going to Liverpool. And maybe we’ll do that a bit later. But when I retired, I said to Liverpool I would never play football again. My sister got very sick when I was 27 and basically I had to go back to Australia and look after her. So I had to retire early. And I said I would never play football again. And I never did. And I never wanted to be involved in football again.

“Then, funny enough, minding my own business in Australia, some kids rock up to the front door, ball under the arm, and reminded me of my skateboard story. They said: ‘Mr Johnston, we’re the local soccer team, but we’re not very good. Can you come and coach us?’

“And I said: ‘Well, how not very good are you?’ And I went down and saw them play and I soon found out they were dreadful, which again reminded me of myself when I was young. So that was it. I was back in football.

“I was coaching them one day and I was actually saying to them: ‘This is how you swerve a ball’. And in order to swerve a ball you have to get grip on the ball and you have to give it effect, like a table tennis bat with a ping pong ball. And they said: ‘That’s fine Mr Johnston, but it’s raining and our boots are made of leather not rubber and they’re all slippery. That’s why we can’t swerve it’. And I went: ‘Oh, they’re right’.

“So when training was over, I rushed home and I pulled the tape off the tennis bat and I stuck it on my boot and tied it up with gaffer tape, went back out onto the road and kicked the ball. There was this dreadful squeal, like a pig and it was the rubber engaging on the ball and cutting through the water. And I thought: ‘What a great idea’. “And I got a patent on it and started designing different shapes and remembered when

I was in the car park and I wanted to bend a ball. We all know how to bend a ball, or do we? Well there's a science, believe it or not, behind bending a ball.

"Beckham's goal against Greece that got England into the 2002 World Cup finals been analysed time and time again. He was wearing Predators by the way. It's been advertised, and now it's sexy, but when I was doing it nobody had looked at the mathematics of what a swerve is.

"So just to answer your question about how does a soccer player then start designing soccer boots? Well, once I had the idea and the patent and the designs, I actually said: 'I need to take this to an Adidas, or a Reebok, or a Nike, because I've spent a lot of money on this.' I mean a real lot of money.

"At the time, because I've got a really weird mind and I think of strange things, believe it or not I had a television show. That was going really well. It was called 'The Main Event'. And actually it was on here, it was on in Ireland as well. It was called 'The Main Event' and the host was a guy called Chris Tarrant, you know, he went on and he did, what was it called?"

**Gilroy:** 'Who Wants To Be A Millionaire?'

**Johnston:** "Yes. Yes, but he actually was the host of the programme ['The Main Event']. That actually made a lot of money. And that money I took and I spent on the boots. And when I talked to Adidas they said: 'We like the idea, but it will never work'. I took it to Nike. I took it to Reebok. And they all said it will never work. And then I remembered when my teacher said: 'Well, you're not very good at soccer,' and my dad said it and Jack Charlton said it. And I thought: 'Right, I'm going to prove that it works'.

"So I went to Germany, and I went and I looked up Franz Beckenbauer, who was a very famous German player, right, for Bayern Munich, and I said: 'Please Mr Beckenbauer, my career and my life depends on this. I've got these new soccer shoes, can you please try them on, OK, and give the ball a kick?'

"It was in January, in Munich. It was about minus 15 degrees, and snowing. So himself and his coaching staff Karl-Heinz Rummenigge and Paul Breitner, the three of them put the shoes on and started kicking, and said something. And I had a camera, because I'm a mad camera freak, and I filmed what they said, and I had no idea what they said, because they're very particular, German people, when they're talking about something like this.

"So then I took that tape, I went back to Adidas and said: 'Remember me, Australian guy, you've never heard of me, blah blah blah, but I've got this tape for you,' at a board meeting. They looked at the tape, they all went, 'What?' and they all stood up and started clapping like this, 'Yes, yes!'

"They said we've got to do a deal immediately. And I said: 'What did they say? What did they say?' And they said: 'Never mind what they said, we have to do a deal'. And to this day, they've never given me the tape back and they never told me what they [Beckenbauer, Rummenigge and Breitner] said. But they [Adidas] said: 'How much did this cost you to develop?' I said: 'Half a million dollars'. They said: 'We'll give it to you straight away, before you leave. But don't go anywhere else'.

**Gilroy:** "Tell me about the science of the football boot then, because it's one of those things where there must have been a lot of cynicism and scepticism about: here's someone who thinks they know better than a hundred years of footballing tradition. It's hard to overcome that sometimes."

**Johnston:** "Well, this was the point. They just didn't believe me. At that stage, I called it the Super Boot – it was never called The Predator [when it was in development]. It had studs, special studs that are now called traction. Have you heard of traction? Well that was my invention too. And the upper was this table tennis bat material. So I took 'Das Super Boot', as it was called in German, and I said: 'That's it, the upper and the lower,' because, you know, studs need redefining as well.

"I said: 'But what we've got to do is prove to people that it's a better shoe, that it swerves the ball more, that when you kick it you can kick the ball faster and further and when you touch it you can feel the ball better'. So that was basically the scientific evidence that I was talking about.

"This is me talking to Adidas now, because I'm now a part of them. I said: 'To sell this, we need to take the human element away'. They said: 'Well, what do you mean?' I said: 'We have to create a robotic leg that actually kicks the ball on the inside, on the outside and replicates the human movement. Then we have to try different types of rubbers, polyurethanes and different types of grooves and all that stuff.'"

**Gilroy:** "Did you know about all this stuff before you started doing it or was it like just this massive learning experience curve, 'I need to make this better. I need to get information on how to make it better'?"

**Johnston:** "You know what? It was all of those things. I didn't know it then but I know it now. What I was doing, we were doing, was trying to quantify and analyse the kick of the ball. It's about the mathematical equation and reverse engineering it so that we can get the best rubbers and the best materials.

"If you want to swerve a ball like that [makes spiral motion] you have to grip it and spin it like that. And the spinning through the air, if you think about it, there's air rushing this way [towards him]. All you see is the ball going through the air but really it's hitting this force. So as it spins it creates high pressure and low pressure as it's going forward.

"This side [outside] because it's spinning is hitting this wall here [outside front] but this side [inside] is spinning the same way as the air is coming so there's high pressure [outside] and low pressure [inside] and that's why the ball starts to move [swerve].

"You know an airplane has got a flat bottom on the wing and a curve like that and the air has to go over there and flit that way which creates lift? So it's exactly the same as an airplane wing. When you kick the ball and swerve the kick, that's why the ball goes like that [curls in]. So it's high and low pressure and it goes like that.

"And what we did was look through the research and this effect is called the Magnus Effect. And it was called after a German physicist years ago who was looking at why bullets in the World War would go astray because they were spinning and the same principle works for anything spinning through the air.

"And I'll tell you what the other interesting thing is. Have you ever tried to swerve a ball into the wind? You have. And you see it's much better when you swerve it into the wind, it bends twice as much whereas if you swerve it and the wind is blowing from behind you it swerves half as much. Have you ever noticed that? And that's because there's more wind coming this way [towards him].

"There is an optimum way to swerve the ball. Put up your hands if you saw the David Beckham goal against Greece in 2001. Great, great. OK, so I'll propose to you now, that goal put England through to the World Cup. I just realised that you may not be happy about that. The English were delirious. I personally was extremely happy because he was wearing The Predator."

**Gilroy:** "It didn't end very well for him but..."

**Johnston:** "Yes well at least they got there. Just think about the mathematics if I'm David Beckham. The back of the wall there is how far away he was from the goal. Then he had to get the ball up and over the wall standing there. He had to calculate which way the wind was blowing and at what speed. He had to then look at the ball and say: 'What part of my foot do I put on what part of this ball?' in a millisecond. He has a millisecond to transfer. Just think about what the guy is doing, right, calculating this maths. 'Is it there? And if it is there it will have lift and drag like that. Is it there? It will have topspin and much more speed but it won't get over the wall. And what part of my foot? The inside? The outside? And how am I leaning? And what effect will the follow-through have on the way the ball behaves in the air?'

"And by the way, you have a goalkeeper there calculating the maths the other way: 'OK, I know David Beckham. I know he is a free kick expert. I know he's going to do this and that. I know the wind is coming'.

"Believe it or not, this is all going through a player's mind. Ask them to explain it, they can't. But Beckham will do that seven out of 10 times. To say he's a scientist or a genius mathematician – well he actually is, there's no denying it. And this was the fascination for us then."

**Gilroy:** "To be able to measure what goes on in his head, you kind of have to remove him from the equation to see the impact of the football boot. To take this back to the lab you mean?"

**Johnston:** "We were backwards and forwards to players, trying to actually talk to them in these terms, trying to get them to understand. But they talk about feeling, and for most people the feeling is the thing that really speaks to them at the end of the day."

"Our task was basically to look at the science of a kick and reverse engineer it because we wanted the best materials and the best geometry. And it was a process and procedure which I actually created called 'vast'. I call it 'vast technology'."

"The weird thing is when goalkeepers complain. Did you see the last World Cup in Germany? Did you see how the goalkeepers were struggling with the power of the ball? That was actually the velocity of the ball. And that's because they used a different football. It wasn't this one, which is your classic World Cup football for the last 80 years. It actually had different panels on it."

"And basically, do you know that a football never, ever accelerates? From the moment it leaves your foot, it's decelerating and because it was going like this [up and down] the players have understood that if you put less spin on the ball and hit it cleanly, then it goes straight through and it creates a laminent flow versus a turbulent flow. Swerve creates turbulence, which creates pressure, but a laminent flow has pockets where it goes like this [up and down] and the keepers are disorientated."

"The other reason it was going like that [up and down] was because you see those panels? Yes, the 32 panels. Well there were only six panels on the ball [for the 2006 World Cup finals], so therefore there was less drag because the drag is created by the corner pockets."

**Gilroy:** "And presumably the very best players, the elite players, can still do different things with the ball that they would always have been capable of doing. That marked difference is still there?"

**Johnston:** "Yes, well it always will be. Pros are pros and they've got a magic. And I've talked about how you can improve yourself but there's no doubt players like Thierry Henry and Wayne Rooney have a magic that's a gift. No matter how hard you try, some of the things they do with the football... you just think about again – what's going through their head to actually calculate how to play football."