How Network Theory Is Revealing Previously Unknown Patterns in Sports

September 15, 2014

Analyzing the network of passes between soccer players reveals that one of the world’s most successful teams plays an entirely different type of football to every other soccer team on the planet.

If you’ve ever watched soccer, you’ll know of the subtle differences in tactics and formation between different teams. There is the long ball game, the pressing game, the zone defense, and so on. Many teams have particular styles of play that fans admire and hate.
Innovations are common, with teams constantly adopting or abandoning new tactics. And given the international nature of football, new ideas spread rapidly, as players and coaches move from one team and country to another.

So it’s easy to imagine that it’s hard to play a truly unique brand of football, using tactics and skills that no other team copies.

That’s not quite true, say Laszlo Gyarmati at the Qatar Computing Research Institute and a few pals. These guys have used a network theory approach to characterize the play of all the top teams in Spain, Germany, Italy, France, and England. And they say this metric reveals that while many teams share similar styles of play, one team stands out as truly unique, playing a style of football that no other team can match.

Football aficionados won’t be surprised to learn that that side is the Spanish team FC Barcelona, one of the most successful soccer teams on the planet. Barcelona have pioneered a type of football called tiki-taka that no other team has been able to master (with the notable exception of the Spanish national side, which generally has a large contingent of Barca players in its ranks).

Tiki-taka is characterized by rapid short passes and fast movement by the players. The idea is to dominate possession of the ball. That’s in sharp contrast to conventional tactics that focus on player formations.

But while the difference in play between Barcelona and other teams is relatively easy to see, it’s hard to characterize using in-game characteristics, such as goals, fouls, corners, and so on. In fact, characterizing the nature of soccer play from data gathered on the field of play has proved to be a frustrating business for sports scientists.

But in recent years, sports scientists have begun to collect much more fine-grained data such as the number of tackles, fouls, shots on and off target and so on. But it is the passes between players that have fascinated network theorists.

“The pass network of a soccer team consists of the players as vertices and the passes between the players as edges,” say Gyarmati and co. This creates a network that can then be studied for its unique characteristics.

Until now, network theorists have focused their analysis on the large scale properties of the passing networks, such as the strength of connections between specific player—how often they pass to each other, the betweenness centrality which measures a players importance within the network, and so on. That’s certainly useful and has provided some fascinating insights into the strengths and weaknesses of some teams.

But Gyarmati and co take this network approach to a much deeper level. These guys have instead focused on the sequence of passes that take place between players and then asked what kind of patterns emerge.

So they focus on sequences of three passes. There are five different patterns that a three-pass sequence can take: ABAB, ABAC, ABCA, ABCB, and ABCD. For example, the sequence ABAB occurs if player 1 passes to player 2, who passes back to player 1 who passes to player 2 again. And if the same sequence takes place between players 3 and 4, it is still denoted as an ABAB sequence.

Gyarmati and co begin their analysis using passing data of all 380 games played by the 20 teams in the top Spanish division.

They then plot the number of times each team uses the ABAB sequence, the ABAC sequence, the ABCA sequence and so on. The results are revealing—Barcelona stands out like a sore thumb.
It turns out that, apart from Barcelona, all Spanish teams make passes with a similar distribution of sequences. However, Barcelona clearly use more ABAB and ABCB sequences while using significantly fewer ABCA and ABCD sequences.

What’s more, when Gyarmati and co use cluster analysis to see which teams use similar patterns of sequences, various clusters emerge among teams with similar patterns of play. Barcelona, however, is in a class of its own.

And on a European scale, Barcelona’s uniqueness is even more remarkable. Gyarmati and co continue their analysis by studying all the other top flight teams in England, Italy, France, and Germany.

The results show a couple of other outliers that sit slightly away from the others, such as the Italian team Torino and the English team West Ham United. But again, Barcelona is a league apart, playing with a style no other team can match.

That’s a fascinating insight into the nature of soccer. And unlike many other metrics that measure sport, it gives a clear indication of exactly how Barcelona’s play differs from everyone else’s. So other teams have specific patterns to copy, if they dare.

And it opens the possibility that similar types of analysis might provide insights into other kinds of dynamics networks, such as metabolic networks, food webs, social networks and so on.

It’s taken years, if not decades, for Barcelona to perfect tiki-taka. But with this kind of analysis it might not be quite so long before somebody else is playing the same unique brand of soccer.