FOOTBALL VISUALISATION: CAPTURING CHAOS AND CULTIVATING CONTEXT

Article · November 2020

CITATIONS
0

READS
1,541

6 authors, including:

Wonwoo Ju
Liverpool John Moores University
6 PUBLICATIONS **1** CITATION

SEE PROFILE

FOOTBALL VISUALISATION: CAPTURING CHAOS AND CULTIVATING CONTEXT

FEATURE / DR PAUL BRADLEY, MR WONWOO JU, MR ANDY LAWS, DR ANTONIO GOMEZ-DIAZ, DR ANDRES MARTIN-GARCIA AND DR MARK EVANS

Introduction

Data visualisation or what is commonly referred to as 'data viz' is a tool that translates trends effectively using graphics (Weissgerber et al., 2015). This is an emerging area in science as data presentation as graphical figures is the most potent mode used to interpret findings (Weissgerber et al., 2015, 2019). Other aesthetically pleasing and immersive forms of visuals are available particularly using video. These include eye-catching video telestration graphics that can selectively draw attention to relevant information. Recently these have become popular as the amount of information people are presented with daily has increased exponentially, while the time to interpret it has decreased (Lacome et al., 2018). This is especially evident in elite football, as staff are expected to collapse the time to insight after each game using data and video as their primary vehicle of analysis and communication. This represents a risk of creating the problem of information overload, thus care must be taken to prevent already busy coaches from being exposed to an avalanche of data and video to view and interpret. So the implications of informative football visuals are huge, given the added value they provide.

Football Visualisation Technique 1: Data Viz

Applying data viz to a football context is easier in theory than in practice. Applied staff have to consider getting coaching staff 'on board'. This is particularly important as coaches are the end users and will ultimately decide if it is beneficial. As the modern coach has an array of commitments, time is an essential commodity. Thus, a general rule of thumb is that data viz must add the maximum value in the time available. Another consideration is the relevance of the data viz to the end user and a 'reverse engineering' approach is a potential option here. Specifically, approaching staff initially about particular performance elements. This will ensure 'buy in' has a higher chance of success and the coaches feel part of the process. Ideally, a coach may start the process off with a question. The data viz in Figure 1 is based on the Question: 'How does a change in the tactical system impact the physical-tactical profiles of selected players? Specifically, deploying wide defenders as attacking wing backs (WB) or using them as traditional full backs (FB). This example not only depicts the overall high-intensity running of this scenario but also breaks this down into the high-speed running and sprinting subsets via colours to delve deeper into the specifics. Additionally, the viz below depicts his high-intensity running frequency in relation to pitch zones as a heat map with the context of selected actions added. In an instant, this informs the coach of any differences between external defenders based on tactical shifts (e.g. some difference in absolute distances and number of efforts but particularly the area deployed and the context of technical/tactical actions). However, longitudinal data needs to be presented for a more complete picture and the match-to-match variation needs to be added to the narrative, so one can decipher the signal from the noise (Bush et al., 2015; Carling et al., 2016). This is important as our group have found the data trends below are different from a larger data set and patterns are specific to each match and team. We have experienced differing profiles for the two wide defenders in the same team. For instance, one covers substantial more high-intensity distance in possession while the other produces more out of possession. It is essential individual characteristics and synergies between teammates are identified and visualised for coaches.

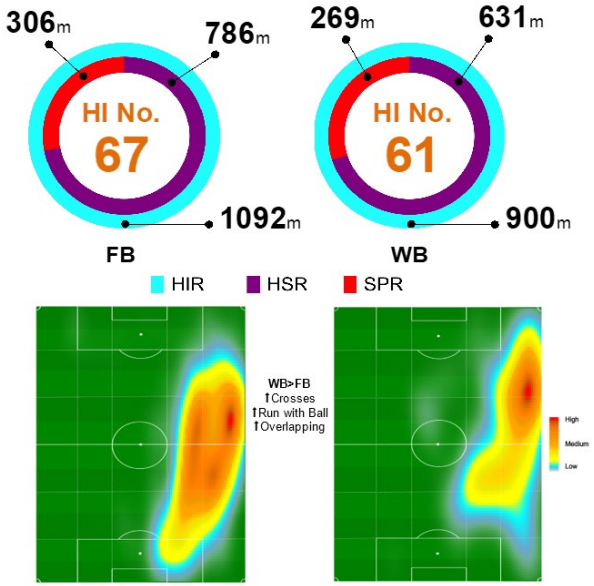

Figure 1. *Data viz details the impact of tactical changes in the English Premier League on a wide defenders' high-intensity activity. Data is visualised as a stacked donut chart (HI frequency in the centre and distances as circles) combined with heat maps (HI frequencies per pitch zone) and the context of selected actions as text. Heat maps are derived from raw tracking data (Kernel Density Estimate) using the ''ggplot2'' package for the R statistical programming language.*

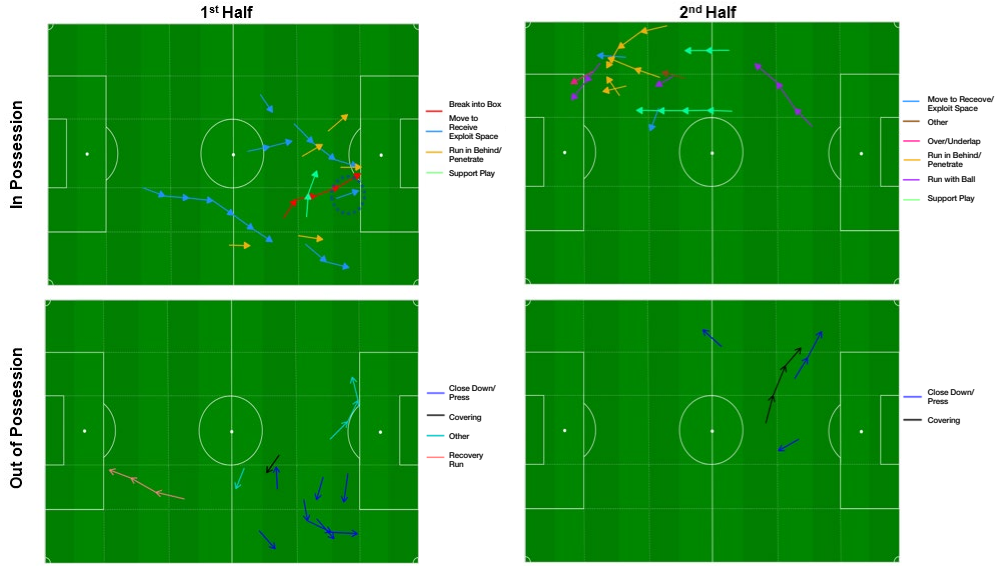

Figure 2*. A basic but effective integrated data viz example of an English Premier League forward's high-intensity actions combined with the colour coded 'primary' tactical context (some are hybrids). To gauge speed changes each arrow represents a 1 sec period. Please note the changes in the direction of play between halves. Raw tracking data were visualised using the ''ggplot2'' package for the R statistical programming language.*

Another question posed by applied staff is linked to the contextualisation of the physical metrics. Tracking data tends to be applied as isolated physical distances and this limitation has been mentioned previously (Bradley and Ade, 2018; Bradley et al., 2018, 2019). This type of vertical thinking as opposed to lateral thinking is widespread in science (De Bono, 2016). However, the latter is vital to create insights. The data viz in Figure 2 was based on the Question: 'Can we visualise not only 'WHAT' intense efforts players produce but more importantly 'WHY' they produce them?' Given the rapid turnaround of this type of work, this viz is particularly crude but effective as it colour codes an English Premier League forward's intense actions into their 'primary' tactical context (e.g. some are hybrids). This includes actions such as 'run in behind/penetrate', 'close down/press', and 'breaking into the box'. As these categories are based on coaching language and are universal actions in football, the outputs are well received. To help gauge changes in speed each arrow within Figure 2 represents a 1 sec period of high-intensity.

Figure 2 illustrates that the forward performed ~45% of his purposeful actions in the form of 'run in behind/penetrate' and 'close down/press' which are very desirable for his teams playing style. 'Closing down/pressing' high up the field in the first half is very evident. As he is a right sided forward you can visualise how he has attempted to 'pin' and delay the opposition player(s) into the corner to enable teammates to support the press. The majority of the efforts are very short and explosive in nature. 'Move to receive/ exploit space' made up ~20% of all his efforts and he produced his longest run of the game in this category. This occurred during a counter attack from an opposition corner in the first half in which he positioning himself to receive the ball before it was intercepted by the opposition. Interestingly, the 'move to receive/exploit space' action highlighted with a dotted blue circle led to him receiving a pass outside the box before shooting to score.

The forward only produced a single intense action in the category of 'break into the box' in which he switched the play by passing into an advanced wide area for the wing back to cross. After the pass he then accelerated rapidly towards the box but as he approached the area he slowed down in anticipation of the cross. Although only three bouts of 'running with the ball' at high-intensity were recorded for this player, two of the three are of interest, as the longest 'run with the ball' was again during another counter attack from an opposition corner. The most advanced 'run with the ball' action was when he dribbled into the box at high-intensity before unleashing a shot on goal. The applied staff would also be delighted about the forwards unselfish behaviour in the first half as he produced a long 'recovery run' to interchange for a teammate out of position. All of this adds a clear narrative to his performance by unveiling the running profile that exists due to his unique tactical role in the team, rather than one-dimensional 'blind' distances that have limited context (Bradley et al., 2018). This purposeful distance could be valuable to practitioners, as they do not necessarily want to determine which players cover the most/least distance, but rather how each performs their duties in relation to a specific opponent/team philosophy. Contextualised physical data that merges high-intensity running with the tactical purpose of the action may confirm that players are abiding to tactics. These visuals not only provide quick insights but can also be used to create specific training drills or return to play patterns of play (Ade et al., 2016).

Football Visualisation Technique 2: Video Telestration

Traditionally, telestration was a technique exclusively used by television broadcasters to draw freehand or overlay graphics onto video footage (Reiffel, 1968). The broadcasters' ability to selectively draw the viewers' attention to the most relevant information through graphics has made this modality indispensable (Pingali et al., 2001; Zhou and Liu, 2010). Due to success in broadcasting, video telestration has now trickled down into the performance analysis departments of most elite football clubs. An array of specialised software is used, such as VIZRT's Viz Libero, Chyron Hego's Coach Paint, Piero's Sports Graphics, RT's tactical Pro and KlipDraw's Animate.

These are an integral part of the video analysis sessions with players and coaches. This is especially true when insights in the form of scouting the opposition or post-match reviews are needed in an engaging visual way. Performance analysts will typically visualise team shape, player movement and tactical dynamics during phases of play using an array of customised telestration tools. All of this grabs the attention of players and coaches but ultimately this is to ensure some learning takes place to help individual and collective performances. Although most clubs intuitively feel with traditional video analysis that learning and reflection occur (Groom & Cushion, 2005), this has yet to be elucidated scientifically using telestration. While coach 'buy in' is usually universal as long as the visuals are adding value, the use of selected graphical features in the correct context is vital. Common features of one of the most advanced software offerings on the market (Viz Libero) can be found below.

Common Viz Features

The most powerful aspects of video telestration is the ability to integrate tactical, technical and physical performance elements simultaneously in a dynamic and visual manner. Research has identified how amalgamating these facets improves our understanding of football performance and the translation into practice (Bradley et al., 2019; Bradley & Ade, 2018; Ade et al., 2016). However, video telestration could develop our understanding of football performances to a greater extent compared to other techniques given that video is the medium coaches and players use and prefer most.

For example, Figure 3A depicts the forward's distance (technical and physical elements) while simultaneously tracking his teammates high speed movement into the box (tactical and physical elements). The shape of the back line is visualised using a defensive line tool (tactical element). Another example in Figure 3B illustrates the combined use of a defensive triangle to signify compactness, while a beam of light and red arrow depict offensive movement. A viable passing option wide is clearly visualised here with a black arrow

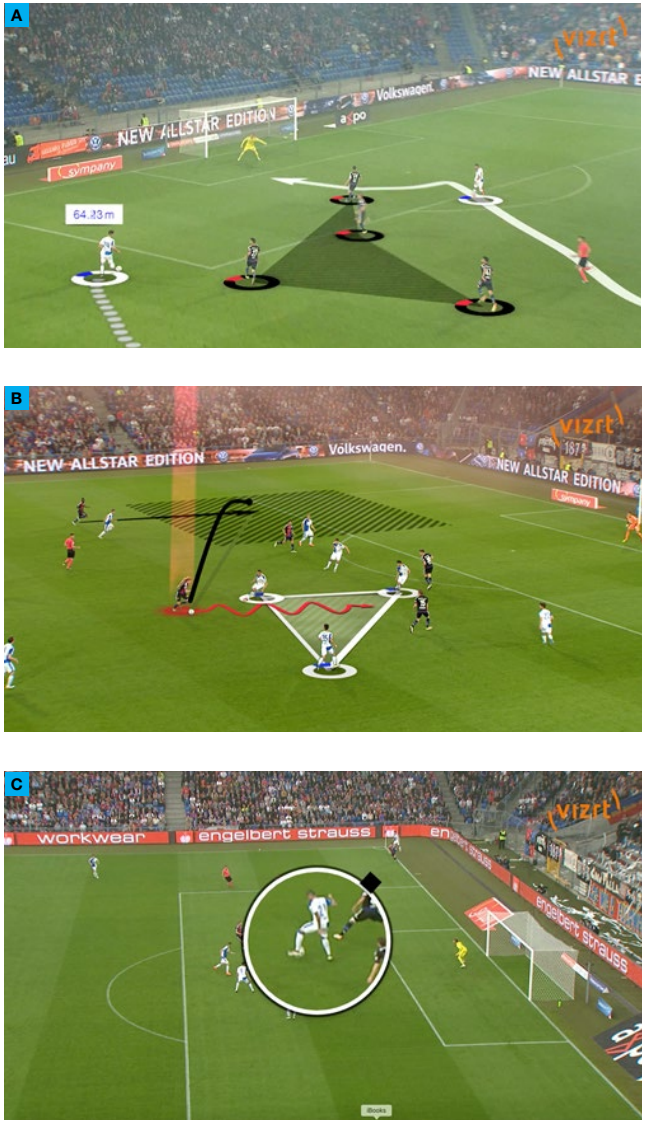

Figure 3. *The integration of performance facets using common functions. (A) Amalgamating player tracking, team shape and the distance measurement functions to depict offensive movement and defensive shape. (B) Fusing team space, player tracking and zonal functions to visualise viable attacking options. (C) Magnifier function captures subtle skill that creates an opportunity. Images used with the permission of VIZRT*

signifying the space along the channel. As most goal situations occur at speed (Fraude et al., 2012), these could be slowed and magnified to enable more information to be extracted. Figure 3C depicts a player controlling a ball skilfully. The magnifier captures the intricate flick to create an opportunity for a teammate. All these customised telestrations could provide multiple information sources depending on the context applied. In a scouting context, the coach and players gain insights into offensive team strengths, particularly attacking movement. In a post-match review context, the compactness of the defensive unit during quick transitions could be critiqued. Wright et al. (2012) demonstrated that traditional video analysis helped coaches with short and long term planning. Thus, as telestration adds graphics to aid selective attention, it is possibly superior to traditional video analysis.

Advanced Viz Features

The importance placed on video analysis by most clubs could be associated with an ability to aid the feedback process (Wright et al. 2012). Specifically, it has the ability to identify individual and collective limitations and feedback to correct them (Lyle 2002, Hodges & Franks 2004). Thus, the advanced telestration functions of player movement, 3D flight and data integration could enhance this process. Figures 4A-B depict multiple players and the movement they should have ideally made. For example, the back pass to the keeper results in a clearance. Potential passing options are highlighted in blue (Figure 4A) and the virtual positioning visualised (Figure 4B). This could potentially aid the feedback process as the incorrect and correct sequences are viewed one after the other.

Another advantage that telestration has over traditional video analysis is the 3D flight mode that can be employed while simultaneously using graphics. This can combine perspectives during various game situations and potentially aid learning and feedback. Figure 5A highlights a cross from a wide area and the defensive line is visualised. As the camera perspective changes in Figure 5B, it provides more insight into the cross trajectory in relation to the defensive shape, and the attackers movement.

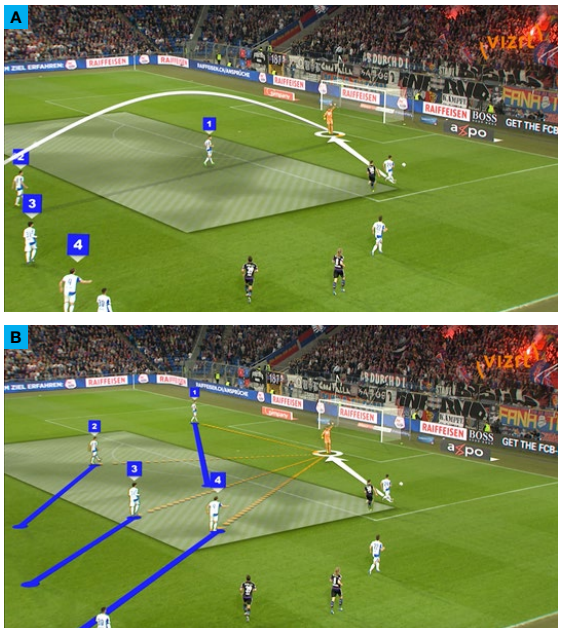

Figure 4. *Advanced functions highlight the movement the players should have made. (A) Back pass was cleared by the keeper despite potential passing options. (B) User highlighted an alternative position to receive the keepers pass. Images used with the permission of VIZRT.*

Figure 5. *Advanced functions such as 3D flight (A) Highlights the backline and player attempting a cross from a wide area (B) 3D flight enables the camera to change perspective to highlight more information to the coach and player. Used with the permission of VIZRT.*

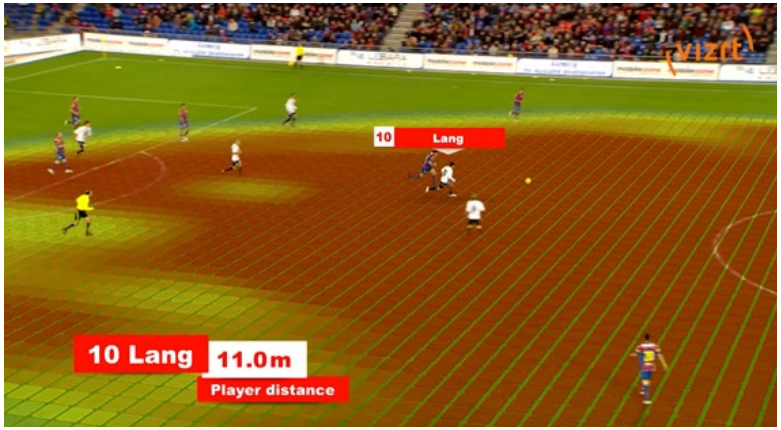

Figure 6. *Integrating tracking data alongside the video is a very powerful tool to generate heat maps. Used with the permission of VIZRT.*

The user can also integrate data into the video from external sources (tracking and event data). For instance, tracking data for players and the whole team can be used to generate heat maps (Figure 6). Using heat maps to provide more context can be valuable to practitioners, as hot spots of activity are highlighted across the pitch during the match that visually draw the attention to the eye and provide added context to players' movements and a team's collective positioning.

Summary

In modern football, various methods can be used by applied staff to improve the visualisation of data and/or video. Data viz is ideal for improving coach 'buy-in' as it can translate trends to the end user effectively. Moreover, it does this in a time efficient manner and adds a narrative to the numbers especially if a 'reverse engineering' approach is used. This is helpful when collapsing the time to insight and when data needs to be simplified but still informative. Video telestration could have an even greater role to play in football as video is the medium coaches and players use and prefer most. By adding common or advanced viz to video, it could improve the specific information extracted by players and coaches and improve the feedback process.

Dr Paul S Bradley:
Football Science Consultant (paulbradley94@yahoo.co.uk) and Associate Professor (Reader) at LJMU.

Mr Wonwoo Ju:
PhD Researcher in Football Science at LJMU

Mr Andy Laws:
Computer Scientist at LJMU

Dr Antonio Gomez-Diaz:
First Team Fitness Coach at FC Barcelona

Dr Andres Martin-Garcia:
U-19 Fitness Coach at FC Barcelona

Dr Mark Evans:
Computer and Data Scientist

This is piece was also published on the Barca Innovation Hub

Ade J, Fitzpatrick J, Bradley PS. (2016). High-intensity efforts in elite soccer matches and associated movement patterns, technical skills and tactical actions. Information for position-specific training drills. J Sports Sci. 34, 2205-2214.

Bradley, PS and Ade, JD. (2018). Are current physical match performance metrics in elite soccer fit for purpose or is the adoption of an integrated approach needed? Int J Sports Physiol Perform. 13, 656–664.

Bradley PS, Evans M, Laws A and Ade, J. (2018). 'Context is King' when Interpreting Match Physical Performances. Football Med & Perform. 24, 43-45

Bradley, PS, Martin-Garcia, A, Ade, JD and Gomez-Diaz, A (2019). Position Specific & Positional Play Training in Elite Football: Context Matters. Football Med & Perform. 29, 31-35.

Bush, MD, Archer, DT, Hogg, R, and Bradley, PS. (2015). Factors influencing physical and technical variability in the English Premier League. Int J Sports Physiol Perform. 10, 865–872.

Carling C, Bradley PS, McCall, Dupont G. (2016). Match-to-match variability in high-speed running activity in a professional soccer team. J Sports Sci. 34, 2215-2223.

De Bono E. (2016). Lateral Thinking: A Textbook of Creativity. London: Penguin General.

Faude O, Koch T, Meyer T. (2012). Straight sprinting is the most frequent action in goal situations in professional football. J Sports Sci. 30, 625-31.

Groom R & Cushion C. (2005). Using of Video Based Coaching with Players: A Case Study. Int J Perform Anal Sport. 5, 40-46.

Hodges, NJ, and Frank IM. (2004). The nature of feedback, In: Hughes MD and

Franks IM, (Eds.) Notational Analysis of Sport. London: E. & F.N.Spon.

Lacome M, Simpson BM, Buchheit M. (2018). Part 2: Increasing Coach 'Buy-in' with Good Data Visualisation. Aspetar Sports Med J. 16, 64-66.

Lyle, J. (2002). Sports coaching concepts: a framework for coaches behaviour, London: Routledge.

Pingali G, Opalach A, Jean Y, Carlbom I. (2001). Visualization of sports using motion trajectories: providing insights into performance, style, and strategy. Proceedings Visualization. VIS '01., San Diego, CA, USA. 75-544.

Reiffel L. (1968). Superimposed Dynamic Television Display System. United States Patent 3617630.

Weissgerber TL, Milic NM, Winham SJ,Garovic VD. (2015). Beyond Bar and Line Graphs: Time for a New Data Presentation Paradigm. PLoSBiol. 13, e1002128.

Weissgerber TL, Winham SJ, Heinzen EP, Milin-Lazovic JS, Garcia-Valencia O, Bukumiric Z, Savic MD, Garovic VD, Milic NM. (2019). Reveal, Don't Conceal: Transforming Data Visualization to Improve Transparency. Circulation. 140, 1506–1518.

Wright C, Atkin S & Jones B. (2012). An analysis of elite coaches' engagement with performance analysis services (match, notational analysis and technique analysis). Int J Perform Anal Sport. 12, 436-451.

Zhou Q, Liu D. (2010). Interactive visual content sharing and telestration: A novel network multimedia service. 14th International Conference on Intelligence in Next Generation Networks, Berlin, 1-6.