

Institution: University of Sunderland		
Unit of Assessment: 24 Sport and Exercise Sciences, Leisure and Tourism		
Title of case study: The global impact of Sunderland's football research on scouting, training and player preparation in elite football		
Period when the underpinning research was undertaken: 2009-2017		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
David Archer	Senior Lecturer	2005-present
Paul Bradley	Senior Lecturer	2005-2014
Robert Hogg	Senior Lecturer	2003-present
Period when the claimed impact occurred: 1 August 2013-31 December 2020		
Is this case study continued from a case study submitted in 2014? N		
<p>1. Summary of the impact (indicative maximum 100 words)</p> <p>Research at Sunderland created the first detailed, large-scale, evidence-based picture of the physical and technical demands of elite football; specifically how these demands evolved over time and vary between matches. The research changed the intellectual zeitgeist on demands in football and the findings have become the accepted benchmark for elite football internationally, forming the basis of tailored investigation within clubs, national sides, and governing bodies including FIFA and UEFA. The work has given coaches, sports scientists and medical staff at topflight teams, including FC Barcelona and Liverpool FC, solid evidence on which to base their scouting activity, training and player preparation to improve performance and reduce injury, and has permeated thinking in elite sport more widely.</p>		
<p>2. Underpinning research (indicative maximum 500 words)</p> <p>Researchers at the University of Sunderland have studied the technical and physical demands of elite sport (in particular football), the factors that affect them and their evolution over time.</p> <p>It began in 2009 with the first large scale study of the patterns of high-intensity running in the English Premier League (EPL), breaking down the analysis per position [R1]. In 2011, the team carried out the first study comparing how the physical and technical demands on elite players changed with different team formations (e.g. 4-4-2 with 4-5-1) [R2].</p> <p>They then undertook a large-scale longitudinal analysis of data covering every player in every game of the EPL over 7 seasons (2006/7 to 2012/13), totalling some 20,000 player incidents. The dataset came from ProZone, a semi-automated player tracking system that uses a multiple camera set-up to automatically track individual player movements in combination with human operators. Specific technical elements (passes, tackles, etc.) were then tagged. This study (funded by Sunderland FC) looked at two aspects: first, the physical demands of match play on players, demonstrating conclusively for the first time the rapid evolution of the high-intensity aspects across all players over seven seasons (30-35% increase) [R3]; and second, the increasing technical demands on players with dramatic increases in both the number (40% increase) and successful percentage of passes (76% to 84%). In addition, the nature of these demands changed with a greater proportion of explosive sprints (short bursts of running with high acceleration that carry particular risk of injury) and a greater proportion of short range (rather than long range) passes [R3].</p> <p>This seminal study was followed by three further studies at Sunderland using the same data set. The first examined how these remarkable changes differed between playing position, finding that the physical demands increased to the greatest extent in players in wide and attacking positions, whereas the technical demands increased most in central defenders and midfield players [R4]. This enabled practitioners to develop tailored position-specific conditioning exercises. The EPL is highly competitive with clubs with a large variability in sporting success, club income and player nationalities. A second study examined whether the evolution observed was similar across teams finishing in differing positions. This research found that the changes were not evenly distributed across all EPL teams, and that the second 'tier' of teams (i.e. those positioned 5th-8th within the EPL) experienced more significant change than other teams [R5]. A related</p>		

study investigated the evolution of UK and non-UK players, finding small differences in the initial year which disappeared over the seven years analysed [R6]. A separate dataset explored the within-player match-to-match variability within the physical and tactical parameters of the EPL [R7]. This was the first paper to quantify technical variability and was important in establishing what constituted natural variation in key technical aspects of the game and what clubs should treat as a significant deviation from the norm.

3. References to the research (indicative maximum of six references)

- R1. Bradley, Paul**, Sheldon, William, Wooster, B, Olsen, P D, Boanas, P and Krusturup, P (2009) *High-Intensity Running in English FA Premier League Soccer Matches*. Journal of Sports Sciences, 27 (2). pp. 159-168. ISSN 0264-0414 **Quality indicators:** Peer-reviewed article in Q1-ranked journal. 941 citations.
- R2. Bradley, Paul**, Carling, Chris, **Archer, David**, **Roberts, Jennifer**, Dodds, Andrew, **Di Mascio, Michele**, Paul, Darren, Gomez Diaz, Antonio, Peart, Dan and Krusturup, Peter (2011) *The effect of playing formation on high-intensity running and technical profiles in English FA Premier League soccer matches*. Journal of Sports Sciences, 29 (8). pp. 821-830. ISSN 0264-0414 **Quality indicators:** Peer-reviewed article in Q1-ranked journal. 301 citations.
- R3. Barnes, Chris**, **Archer, David**, **Bush, Michael**, **Hogg, Robert** and **Bradley, Paul** (2014) *The Evolution of Physical and Technical Performance Parameters in the English Premier League*. International Journal of Sports Medicine, 35. pp. 1-6. ISSN 0172-4622 **Quality indicators:** Peer-reviewed article in Q2-ranked journal. 459 citations.
- R4. Bush, Michael**, Barnes, Chris, **Archer, David**, **Hogg, Robert** and **Bradley, Paul** (2014) *Evolution of Match Performance Parameters for Various Playing Positions in the English Premier League*. Human Movement Science, 39. pp. 1-11. ISSN 0167-9457 **Quality indicators:** Peer-reviewed article in Q2-ranked journal. 288 citations.
- R5. Bradley, Paul**, **Archer, David**, **Hogg, Robert**, **Shuth, Gabor**, **Bush, Michael**, Carling, Chris and Barnes, Chris (2015) *Tier-Specific Evolution of Match Performance Characteristics in the English Premier League: It's Getting Tougher at the Top*. Journal of Sports Sciences, 34 (10). pp. 980-987. ISSN 0264-0414 **Quality indicators:** Peer-reviewed article in Q1-ranked journal. 85 citations.
- R6. Bush, Michael**, **Archer, David**, Barnes, Chris, **Hogg, Robert** and Bradley, Paul (2017) *Longitudinal match performance characteristics of UK and non-UK players in the English Premier League*. Science and Medicine in Football, 1 (1). Pp 2-9 ISSN 0264-0414 **Quality indicators:** Peer-reviewed article in Q1-ranked journal. 10 citations.
- R7. Bush, Michael**, **Archer, David**, **Hogg, Robert** and Bradley, Paul S (2015) *Factors Influencing Physical and Technical Variability in the English Premier League*. International Journal of Sports Physiology and Performance, 10 (7). pp. 865-872 **Quality indicators:** Peer-reviewed article in Q1-ranked journal. 60 citations.

4. Details of the impact (indicative maximum 750 words)

This large-scale, detailed and evidence-based picture of the evolution of the modern game in terms of physical and technical demands on players is unprecedented. The massive sample size ensured that results were as conclusive as they were dramatic; the magnitude of change recorded over 7 EPL seasons was similar to the change seen in over 42 years of FIFA World Cup finals. As a result, the findings have become a key benchmark and reference for performance management and player preparation across elite football. The work changed the zeitgeist in football research, triggering a huge change in the thinking of practitioners at clubs and impacting the whole body of sport science in football.

R3 and **R4** generated considerable interest across the international elite football community, with the authors presenting at sports science practitioner conferences around the world. The papers quickly began to receive citations as interest multiplied. Clubs and sports associations launched their own studies inspired by the findings. Overall, the research has been cited in studies [S1] conducted by (or in partnership with) **64 football clubs worldwide**, including **13 Champions League teams** (of which 2 winners and 2 runners up) and **15 EPL teams**, and 6 of the top 30 clubs worldwide by trophies won. It has been cited by the **English Football Association (The FA)** and **9 other national football federations** from five continents. Its influence extends

beyond soccer to **4 national Olympic and Paralympic Committees**, as well as national Sport Institutes and associations in hockey, cycling, rugby, tennis and archery. Its impact transcends football codes, and is cited in research by **2 NFL (American football) and 4 Australian Rules football teams [S1]** and Gaelic sports teams. Of these studies, Sunderland findings have contributed particularly significantly to the key methodology, dataset or underpinning principles of research **[S1]** by Manchester United, Arsenal, Newcastle United, Paris St Germain, Everton, Lille, Red Bull Brazil, Coventry City, Southampton, Ipswich Town, Fleetwood Town, and Rochdale Town, Barcelona **[S2]**, Liverpool **[S3]** and Brighton & Hove Albion **[S4]**.

FIFA employed **Bradley** as consultant to conduct tailored studies inspired by the research. His physical analysis of the FIFA Women's World Cup 2019 **[S5]** is based entirely on the data gathering methodology developed and validated at Sunderland **[R1]**. As renowned manager Arsene Wenger explains in his introduction to the report, *"information is key to professionalise the sport even further. Only by making the most of data can we work effectively and sustainably on the development of the women's game and take it forward – whether through a tailor-made talent development approach or through targeted coach education. The insights gained can also be harnessed to optimise players' preparations and thus their performance. The third edition of the physical analysis is an important building block to improve and reach our goal"* **[S5]**. The report used analysis of every match and team at the tournament to identify trends and make practical recommendations for corresponding changes to training **[S5]**.

UEFA's expert group used the findings around the evolving demands on players as part of the justification for the update to their Consensus Statement on Nutrition in Elite Football published in 2020 (their first on the subject since 2010) and presented to sports professionals at the International Sports & Exercise Nutrition Conference. As detailed in the executive summary: *"The rapid evolution of the game itself, in addition to changes in our understanding of sports nutrition, has created uncertainty as to the appropriate nutritional decisions to make at specific moments in time and in specific contexts"* **[S6]**.

Injury has a significant impact on clubs' finances, with the estimated cost of a first team player injury being around €500,000 per month. **UEFA** use the team's research in their work to address and prevent injury **[S7]**, drawing on **R3** to understand previously unexplained changes in hamstring injury rates. They likewise use **R3** to demonstrate the importance of the UEFA Elite Club Injury Study (their injury monitoring process applied to elite leagues across Europe), saying *"Football has changed a great deal since ECIS was launched; there are more games per calendar year and objective data show that the players run farther than they used to, with more frequent high-speed efforts"* **[S8]**.

As well as its impact on clubs' and organisations' own research, the work has influenced selection, training and player preparation at club and national sides around the world, allowing them to develop mitigation strategies tailored to individual players to reduce the risk of injury. The knowledge and data generated by the Sunderland studies are so pervasive that it is hard to categorically quantify the extent to which it is influencing practice, but it is reasonable to suggest that those clubs **[S1]** using the Sunderland work as the basis for their own studies have incorporated the findings into their own practice to some extent. Some specific examples of how the research is being used in practice are given below. Where national teams and top-flight clubs lead, others can be assumed to follow.

- **The Football Association** use the research findings to underpin the training delivered in every training session for all sixteen England squads. The FA's Physical Performance Coach has confirmed that the studies inform dialogue with squad coaches about the physical determinants of the game, what players should be prepared for, and what they go through during a game, feeding into conversations with players and staff about how the game has changed and continues to change. The FA has replicated the research questions and methodology from the Sunderland studies to apply to their own specific problems, allowing them to get the answers they need faster and giving them greater confidence in their conclusions **[S9]**.

- **Liverpool FC's** Head of Elite Fitness Development and U23 Fitness Coach (previously at Newcastle United FC and Tottenham Hotspur FC) confirms that *"this body of work has been really instrumental in helping us to train the players optimally to ensure the physical and technical capacities of our players can meet the benchmarks highlighted in the Evolution of the Premier League papers [R4, R5]. For instance, we can modify training to include intense physical and technical periods to replicate what was found in these studies. This intense training ensures they can tolerate the high loads expected week in and week out at both a youth and senior level and the potential transition from one squad to another" [S3].*
- **FC Barcelona's** First Team Sports Scientist confirms that the Sunderland research [R3, R4, R5] *"helped us to shape the unique training methodology at FCB to fully prepare the players not only from a physical perspective but also from a technical point of view. The increases in high intensity running and passing metrics that were documented in the papers, especially helped us to adapt our training drills to include an overload in both of the above, so players were optimally prepared for the first team at FC Barcelona. Although the mechanism of injury occurrence is very complex, I believe that this training helped to improve the physical robustness of the players."* He confirms the research's potential to keep top players on the field for more of the season, with knock-on performance, health and financial implications for the club, as well as acknowledging its role in inspiring the club to do more R&D of their own to fully define the physical and tactical training loads of various teams at the club. He concludes that *"this evolutionary football research has helped significantly shape the physical and technical landscape of training preparation at youth and senior level at FCB" [S2].*
- The Head of Performance Analysis at the **Romanian Football Federation** reports that the Sunderland studies *"changed my expectations in regards to results of physical tests of players or when analysing technical data. It helped me in creating physical and technical profiles of players according to their playing position, in order to aid the scouting process. It also changed the thought process when analysing physical game data, now I look at the data of players and have in mind the physical demands for their position at the Premier League level as a comparison" [S10].* The Strength and Conditioning Coach at the **Hungarian Football Federation** also reports referring to the work often in presentations across the country and using the research on physical demands as a benchmark for the level international players should be aiming for [S10].
- **Sheffield United's** Head of Academy Analysis uses the research to shape data collection processes in terms of the key performance indicators selected for specific positions to enable comparison of players internally within the club but also to elite level competition. It has inspired the club's own very similar research project. He believes that *"as the research has highlighted certain trends in the evolution of parameters, it is key from a club perspective to investigate if we are developing players in line with those trends. Once established this will have a wider impact across the club in terms of the prescription of coaching sessions and their physical and technical content" [S10].*
- The Academy Performance Manager at **Brighton and Hove Albion** says that by giving a clear and detailed picture of the demands players will be exposed to during match play, the evolution studies [R3, R4, R5] have allowed the club to develop training drills and specific gym-based sessions to better prepare players to meet these demands and resist the most likely injuries. These changes to training apply to the professional development squads (U18 and particularly U23) who are preparing for their next transition to the first team, although the learning is disseminated to professionals across the club. The variability research [R6, R7] has led to more pragmatic and analytical post-match discussions between professionals and coaches. *"Sometimes, particularly when a match result isn't good, it can be easy to look at the physical stats and select players who are deemed to have 'underperformed', e.g. if their high speed distance was lower than usual. [The] research has helped us to establish what normal levels of variation are for these measures and technical measures and allowed us to interpret whether differences in outputs from match to match are meaningful or not" [S4].*

5. Sources to corroborate the impact (indicative maximum of 10 references)

- S1.** Complete list of organisations citing the research, with links to citing publications
- S2.** Statement of Support from First Team Sports Scientist, FC Barcelona
- S3.** Statement of Support from U23's Fitness Coach and Head of Elite Fitness Development, Liverpool FC
- S4.** Statement of Support, Academy Performance Manager at Brighton & Hove Albion
- S5.** [FIFA report: Physical Analysis of the 2019 Women's World Cup](#)
- S6.** Collins J, Maughan RJ, Gleeson M, *et al.* (2020) [UEFA expert group statement on nutrition in elite football. Current evidence to inform practical recommendations and guide future research.](#) *Br J Sports Med.* 10.1136/bjsports-2019-10196
- S7.** Ekstrand J, Waldén M, Hägglund M. (2016) [Hamstring injuries have increased by 4% annually in men's professional football, since 2001: a 13-year longitudinal analysis of the UEFA Elite Club injury study.](#) *Br J Sports Med.* 50(12):731-7. doi: 10.1136/bjsports-2015-095359
- S8.** Ekstrand J, Spreco A, Bengtsson H, *et al* (2021) [Injury rates decreased in men's professional football: an 18-year prospective cohort study of almost 12 000 injuries sustained during 1.8 million hours of play.](#) *Br J Sports Med* doi: 10.1136/bjsports-2020-103159
- S9.** FA Physical Performance Coach (available on request)
- S10.** Emails from Romanian Football Federation, Hungarian Football Federation, and Sheffield United