

Impact case study (REF3)

Institution: University of Bath		
Unit of Assessment: C24		
Title of case study: Reduction in selection biases and injuries in premier league academy footballers by optimising the assessment, monitoring and management of growth and maturation.		
Period when the underpinning research was undertaken: 2006-present		
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:
Sean Cumming	Reader, previously Senior Lecturer and Lecturer	July 2006 – present
Fiona Gillison	Head of Department, previously Senior Lecturer	April 2007 – present
Sean Williams	Lecturer	January 2015 – present
Darragh McGee	Lecturer	September 2013 – June 2015, August 2015 - present
Period when the claimed impact occurred: Aug 2013-present		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact		
<p>Research at the University of Bath directly informed changes in practice and policy on the assessment, monitoring, and management of growth and maturation in young athletes. This included more than 3,000 premier league football academy players, leading to a 89% reduction in maturity associated coach evaluation biases and a decrease of 16% in maturity associated player selection biases. This led to a significant reduction in time-loss injuries from 10.1 per 1,000 hours to 3.9 per 1,000 hours (62% decrease) in players undergoing a growth spurt. These impacts were facilitated by the design and implementation of (1) screening programmes and policies; (2) modules within athlete performance and data management systems; (3) certified educational programmes and learning resources; and (4) evidence-based strategies for managing growth and maturation in young athletes.</p>		
2. Underpinning research		
<p>Researchers from University of Bath contributing to these impacts include four members of academic staff (Dr Cumming, Dr Gillison, 2014-21; Dr Williams, Dr McGee, 2016-21). The aims of the research were to: 1) develop and validate non-invasive methods for assessing and monitoring growth and maturation in youth; 2) better understand the role of growth and maturation in talent identification and development; and 3) design and evaluate applied strategies for managing growth and maturation in young athletes, with specific emphasis on maturity associated selection biases and injury risk.</p>		
Challenges of Individual Variation in Physical Maturity		
<p>Variance in the growth and maturity of children adversely impacts the processes of talent identification and development in youth sports, presenting significant challenges for athletes, coaches and practitioners. In 2012, the Premier League and Football Association prioritised more effective assessment, monitoring and management of growth and maturity as a key strategy in their long-term athlete development strategy. In 2015, collaborating with the Premier League, its clubs, and industry partners, Bath academics conducted a programme of research that supported and enabled the achievement of these objectives.</p>		

Development of a valid non-invasive method of assessing and monitoring maturation

In a series of studies (from 2006 to 2020), Drs. Cumming, Gillison et al., integrated algorithms for predicting adult stature in youth with North American and UK growth reference standards, to create new techniques and protocols to estimate maturational status and timing, onset of the pubertal growth spurt, and 'biological age' in youth (2.1, 2.2, 2.3). Validated against gold standard measures (skeletal age, observed at peak height velocity) (2.1, 2.3), these non-invasive methods were found to afford more accurate and reliable estimates of maturation status, timing, and the onset of the pubertal growth spurt, than existing methods (2.1, 2.3).

Differences in maturation lead to selection biases and injury incidence

From 2012 to 2020, across multiple sports (football, rugby, dance, tennis), Drs. Cumming, McGee et al., identified maturity-associated selection biases that emerge at puberty, increase with age, and exist independent of related phenomena (relative age) (2.3, 2.4). Further studies, including Dr Williams, elucidated the many physical (size, speed, power, strength, momentum) and psychosocial (coach evaluations, self-perceptions) factors and mechanisms contributing toward the biases, establishing the evidence base for subsequent applied research. Notably, we were the first to demonstrate an 'underdog effect' in academy football, whereby late maturing players had to possess more adaptive learning strategies to survive in the system, how the timing of maturity and growth spurt adversely impacted coaches' evaluations of match performance, and how the growth spurt more than doubles injury incidence and burden in academy football (2.5).

Development, implementation and evaluation of strategies to counter maturity-associated biases and injury risks

In 2015, and in collaboration with the Premier League and its member clubs, we pioneered research on the practice of bio-banding; demonstrating that maturity matched game formats differentially benefitted early and late maturing players via the affordance of novel and developmentally appropriate challenges and learning opportunities (2.6). Research on the association between maturation status and injury incidence/burden, also provided the crucial evidence base for the application of bio-banding principles in training (2.5).

3. References to the research

2.1 Myburgh, G, **Cumming, S** & Malina, RM 2019, 'Cross sectional analysis investigating the concordance of maturity status classifications in elite Caucasian youth tennis players', *Sports Medicine - Open*, vol. 5, no. 1, 27. <https://doi.org/10.1186/s40798-019-0198-8>

2.2 Gillison, F, **Cumming, S**, Standage, M, Barnaby, C & Katzmarzyk, PT 2017, 'Assessing the impact of adjusting for maturity in weight status classification in a cross-sectional sample of UK children', *BMJ Open*, vol. 7, no. 6, e015769, pp. 1-6. <https://doi.org/10.1136/bmjopen-2016-015769>

2.3 Parr, J, Winwood, K, Hodson-Tole, E, Deconinck, F, Parry, L, Hill, J, Malina, RM & **Cumming, S** 2020, 'Predicting the Timing of the Peak of the Pubertal Growth Spurt in Elite Male Youth Soccer Players: Evaluation of Methods', *Annals of Human Biology*, vol. 47, no. 4, pp. 400-408. <https://doi.org/10.1080/03014460.2020.1782989>

2.4 Hill, M, Scott, S, Malina, RM, **McGee, D** & **Cumming, S** 2020, 'Relative Age and Maturation Selection Biases in Academy Football', *Journal of Sports Sciences*, vol. 38, no. 11-12, pp. 1359-1367. <https://doi.org/10.1080/02640414.2019.1649524>

2.5 Johnson, D, **Williams, S**, Bradley, B, Sayer, S, Murray Fisher, J & **Cumming, S** 2020, 'Growing Pains: Maturity Associated Variation in Injury Risk in Academy Football', *European Journal of Sport Science*, vol. 20, no. 4, pp. 544-552. <https://doi.org/10.1080/17461391.2019.1633416>

2.6 Cumming, S, Brown, D, Mitchell, S, Bunce, J, Hunt, D, Hedges, C, Crane, G, Gross, A, Scott, S, Franklin, E, Breakspear, D, Dennison, L, White, P, Cain, A, Eisenmann, J & Malina, RM 2018, 'Premier League Academy soccer players' experiences of competing in a tournament bio-banded for biological maturation', *Journal of Sports Sciences*, vol. 36, no. 7, pp. 757-765. <https://doi.org/10.1080/02640414.2017.1340656>

Grants

1. Football Association GBP41,222, 2020-21
2. Medical Research Council Proximity to Discovery Grant GBP8,994, 2015-2016
3. Southampton Football Club GBP30,362, 2016-2020
4. Lawn Tennis Association GBP17,600, 2013-2019

4. Details of the impact

Impact has been achieved at the levels of: (1) national screening programmes and policies; (2) modules embedded within athlete performance and data management systems; (3) certified educational courses and learning resources; (4) developmental strategies for managing growth and maturation in young athletes (bio-banding); (5) reductions in player evaluation and selection biases and (6) reductions in injury incidence. Beneficiaries include athletes, coaches, sports science/medical practitioners, governing bodies (Premier League, FA., US Soccer,) and professional sports teams (Manchester Utd, Southampton, AFC Bournemouth).

1: Policy and practice

University of Bath research directly informed practice and policy pertaining to growth and maturation assessment in young athletes. As part of the Premier League's Elite Player Performance Plan, Dr Cumming chaired (August 2013) an expert advisory panel to "*inform the league's policies and practice with respect to the assessment and monitoring of growth and maturation in academy footballers*" (4.1, 4.2, 4.3). Methods and protocols validated through our research were embedded within the league's subsequent Growth and Maturation Screening Programme and accompanying policy and guidance (Premier League Youth Development Rules, 106, 209.2, 209.5), impacting more than 3,000 registered players at Premier League academies (4.3). Compliance with league policies is required for all registered academies and monitored through an independent audit and accreditation process.

2: Assessment and monitoring of growth and maturation

"Dr Cumming has enabled us to identify a systematic bias towards early maturing players within our academy system, ...the mechanisms that underpin this bias ... and the most accurate methods predicting when players enter important phases of development" Dr Hawkins, Head of Physical Performance, Manchester United FC (4.8).

University of Bath research transformed how governing bodies and professional clubs document, monitor, communicate, and utilise information pertaining to growth and maturation, in football and also tennis (4.2, 4.4, 4.5, 4.8-4.10). Supporting the Premier League's 'Growth and Maturation Screening Programme', we collaborated with The Sports Office Ltd., (between December 2014 and September 2016), to design and embed a 'growth and maturation module' within the 'Player Management Application'; a performance and data management system monitoring all registered players in Premier League and Category one academies (4.2, 4.5). The module affords more reliable and accurate assessment of growth and maturity and is now routinely used to (1) assess growth and maturation status, (2) generate and access on-demand player and team audit reports, (3) group players by maturational bio-bands for training/competition, (4) inform training design and prescription, (5) evaluate player fitness and performance relative to age and maturational standards, and (6) identify developmental stages associated with greater injury risk (growth spurt) (4.8-

4.10). Launched in 2016, the module collected over 79,000 maturation data points from over 11,000 registered academy players aged 9 to 16 years (4.5).

3. Education

“As a club, we directly benefitted from Dr Cumming’s involvement in the Premier League’s Growth and Maturation Screening Programme.... our academy staff are now more knowledgeable and better-qualified to accurately assess, monitor the physical development of our players. ... make developmentally-informed decisions regarding the identification and assessment of talent, and the prescription of individualised training programmes” Academy Head of Sports Science, AFC Bournemouth (4.10).

Societal impact has been achieved through dissemination of maturity specific evidence-based educational programmes and learning resources for practitioners (4.1,4.2). Bath research informed the design of a certified professional development course on growth and maturation in academy footballers. Supporting the Premier League’s Growth and Maturation Screening Programme (4.1,4.2) this course has been completed by over 150 league-registered academy sports science and medical practitioners across 27 clubs. In 2016, we designed an equivalent evidence-based educational workshop for the Football Association as part of their Advanced Youth Award, which has been delivered to more than 800 professional coaches.

4. Improved coaching practices and lowered injury burden for athletes

“Dr Cumming worked with us to pioneer the concept of bio-banding....The success of the research collaboration led to the introduction of bio-banding within the Academy games programme in 2016” Head of Elite Performance, Premier League (4.2).

Research on ‘bio-banding’ led to the endorsement of this strategy by the Premier League, and its inclusion within the Academy Games Programme in 2015 (4.2). Players and coaches at multiple premier league clubs (Arsenal, Manchester United, Brighton, Southampton & Bournemouth) now benefit from this practice in training and competition (4.2, 4.8, 4.9, 4.10). AFC Bournemouth began to bio-band players’ conditioning programmes in the 2019-20 season, resulting in a reduction in the occurrence of time loss injuries from 10.1 per 1,000 hours to 3.9 per 1,000 hours for players during mid-growth spurt; **representing a 62% lower injury rate** (4.10). Southampton also integrated bio-banding across their games programme and player evaluation processes, observing 16% and 89% reductions in player selection and coach evaluation biases towards more mature players during the 2019-20 season (4.9). Bio-banding is now being expanded across the globe by professional clubs and governing bodies in USA, Switzerland, Scotland, Poland, France, Netherlands, Canada, and Australia, and also into other sports such as tennis. In 2018, US Soccer endorsed bio-banding as one of three innovative strategies within its high-performance programme, with investments of “\$1,500,000” [USD1,500,000] (4.6, 4.7).

5. Sources to corroborate the impact

4.1 Premier League Media releases, accessed 19 December 2019.

<https://www.premierleague.com/youth/elite-performance;>
<https://www.premierleague.com/news/58833>

4.2 Letter of support from Head of Elite Performance. Premier League, 30 January 2020.

4.3 Premier League Youth Development Rules, 2019/20. 212.5 P. 45, P.70.

4.4 Letter of Support from Head of High Performance Science & Medicine Lawn Tennis Association, 27 July 2020.

4.5 Letter of support from Head of Client Services at The Sports Office Ltd, February 2020.

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4.6 US Soccer: Media Release, 5 April 2018. <https://www.ussoccer.com/stories/2018/04/us-soccer-introduces-bio-banding-initiative>

4.7 US Soccer Annual General Meeting Book of Reports, 8-11 February 2018, p.12-13 <https://www.flipsnack.com/ussoccer/2018-u-s-soccer-agm-book-of-reports.html> - Publicly available.

4.8 Letter of support from Head of Performance. Manchester United FC. Growth and maturation, how does it inform the training. Les Parry, Elite Player Performance Manager, Manchester United FC, 1 February 2020. <https://fellows.aspire.qa/View.aspx?id=10497>

4.9 Letter of support from Head of Sport Science. Southampton FC, 28 December 2020.

4.10 Letter of support from Head of Academy Sports Science and Medicine. AFC Bournemouth, 11 February 2020.