A multidisciplinary investigation into the talent identification and development process in an English football academy

Submitted by Adam Leigh Kelly to the University of Exeter
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I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

Signature: …………………………………………………………..

I. ABSTRACT

Introduction The purpose of a player development pathway is to realise the most effective methods to support young individuals to maximise their potential (MacNamara & Collins, 2015). Within a modern football academy setting, the essential developmental characteristics are often termed environmental, psychological, sociological, physiological, technical, and tactical attributes (Sarmento *et al.,* 2018). Although these factors have been explained to independently facilitate the acquisition of expert performance, fully-integrated multidisciplinary evidence from an English context is unknown. Therefore, the aim of this study was two-fold; firstly, to analyse these respective features to determine what outcomes support greater age-specific performance within the Foundation Development Phase (FDP; under-9 to 11s) and Youth Development Phase (YDP; under-12 to 16s) at an English professional football academy. Following this investigation, this thesis examined what characteristics facilitated age-specific development across two football seasons within the same group. ***Methods*** During the first season, a total of 98 outfield academy players (FDP n=40; YDP n=58) participated. Two professional coaches from each age group (n=14) ranked their players from top to bottom in relation to current ability from a holistic perspective. This created a linear classification with a group of 'high-performers' (top third) and 'low-performers' (bottom third) within both the FDP and YDP. Results were standardised using z-scores and the assumptions were tested using a two-tailed independent samples t-test. A total of 87 outfield players who progressed into the second season were further analysed within their respective phase (FDP n=36; YDP n=51). A combination of 34 holistic factors, that discriminated high- and low-performers in the initial investigation, were measured at two time points across two football seasons with the Participation History Questionnaire (PHQ), Psychological Characteristics for Developing Excellence Questionnaire (PCDEQ), socio-economic status, growth and maturation data, physical performance, technical tests, match analysis statistics, perceptual-cognitive expertise (PCE), and game test situations. Development was measured by comparing the delta change between the overall player profile scores from two seasonal reports. Stepwise regression analyses were conducted to assess the predictive capability of these variables on overall development. ***Results*** Multiple factors from environmental, psychological, sociological, physiological, technical, and tactical examinations significantly discriminated high- and low-performers, within both the FDP and YDP. Following these initial findings, developmental results illustrated significant technical and tactical characteristics within the FDP, whilst significant environmental, physiological, technical, and tactical attributes were observed within the YDP. When focussing on these factors combined, total touches change (p=0.023), taking advantage of openings quality (p=0.003), and PCE 'post' score change (p=0.029) explained a combined 11.5% of the variance within the FDP. Within the YDP, PCE 'at' score (p=0.21), total sports played change (p=0.008), and total match-play hours (p=0.009) explained a combined 34.1% of the variance. ***Discussion*** Identifying talented players as young as 8 years of age is a complex and holistic process. Thus, academy coaches and practitioners must understand the significant features, such as practice history and multi-sport engagement, psychological characteristics, socio-economic factors, physical performance abilities, technical attributes, and tactical decision making when identifying and recruiting individuals. From a

talent development viewpoint, results from the FDP support the importance of technical and tactical development during middle childhood compared to other influential factors. From a YDP perspective, results support the significance of the environment players are exposed to, whilst also illustrating the importance of PCE as a key ingredient within adolescence, to support greater overall development. Therefore, professional football academies are encouraged to deliver technical and tactical specific developmental activities within the FDP, whilst offering a substantial games programme, alongside other opportunities to participate in multi-sport activities across both age phases, to support superior development. Further evidence is needed within an English context, through collaboration with other academy environments, to support these findings, whilst greater longitudinal data is also required to understand which of these characteristics are necessary to ultimately achieve senior professional status.

II. ACKNOWLEDGEMENT

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III. DEDICATION

To Grandad Mike, who is sadly not here to read this – I hope he would've been proud.

"Live, Love, Laugh"

IV. LIST OF CONTENTS

I. ABSTRACT 2
II. ACKNOWLEDGEMENT 4
III. DEDICATION 6
IV. LIST OF CONTENTS 7
V. LIST OF FIGURES 13
VI. LIST OF TABLES 14
VII. CONFERENCE PRESENTATIONS 15
VIII. JOURNAL PUBLICATIONS 17
1. INTRODUCTION 18
2. REVIEW OF LITERATURE 20
2.1. Models to support the talent identification and development process 20
2.2. The talent identification and development process in youth sport 22
2.3. The talent identification 25
2.4. Environmental factors associated with talent identification and development 34
2.4.1. Early specialisation 34
2.4.2. Early diversification 38
2.4.3. Early engagement 41
2.5. Psychological factors associated with talent identification and development 43
2.5.1. Psychosocial factors 43
2.5.2. Psychological characteristics 46
2.6. Sociological factors associated with talent identification and development 52
2.7. Physiological factors associated with talent identification and development 56
2.7.1. Physical performance and physiological development 56
2.7.2. The relative age effect 61
2.8. Technical factors associated with talent identification and development 64
2.8.1. Technical testing in football 64
2.8.2. Skill behaviour 68
2.9. Tactical factors associated with talent identification and development 71
2.9.1. Perceptual-cognitive expertise and decision making ability 71
2.9.2. Creativity and game intelligence 72

2.10. Summary 74
3. METHODOLOGY 78
3.1. Introduction 78
3.2. Participants 78
3.3. Procedures 79
3.3.1. Participation History Questionnaire 79
3.3.2. Psychological Characteristics for Developing Excellence Questionnaire 80
3.3.3. Postcode statistics 81
3.3.4. Physical performance tests 83
3.3.5. Anthropometric measures and maturation status 85
3.3.6. Relative age effect 86
3.3.7. Technical tests 87
3.3.8. Match analysis statistics 88
3.3.9. Perceptual-cognitive expertise tests 90
3.3.10. Game test situations 91
3.4. Talent identification procedures 94
3.5. Statistical analyses 94
3.6. Philosophical approach 95
3.7. Limitations and delimitations 96
4. ENVIRONMENTAL 99
4.1. Introduction 99
4.2. Rationale 100
4.3. Aims and hypothesis 105
4.4. Results 107
4.4.1. FDP PHQ 107
4.4.2. YDP PHQ 108
4.5. Discussion 111
4.5.1. Specialisation 112
4.5.2. Diversification 114
4.5.3. Early engagement 116
4.5.4. The 'early preparation' concept 117
4.6. Limitations 121
4.7. Conclusion 122
5. PSYCHOLOGICAL 123

5.1. Introduction 123
5.2. Rationale 124
5.3. Aims and hypothesis 127
5.4. Results 128
5.4.1. FDP PCDEQ 128
5.4.2. YDP PCDEQ 128
5.5. Discussion 131
5.5.1. Factor 1 – support for long-term success 132
5.5.2. Factor 2 – imagery use during practice and competition 132
5.5.3. Factor 3 – coping with performance and developmental pressures 134
5.5.4. Factor 4 – ability to organise and engage in quality practice 136
5.5.5. Factor 5 – evaluating performances and working on weaknesses 138
5.5.6. Factor 6 – support from others to compete to my potential 139
5.6. Limitations 139
5.7. Conclusion 141
6. SOCIOLOGICAL 143
6.1. Introduction 143
6.2. Rationale 144
6.2.1. Parents 144
6.2.2. School 146
6.2.3. Football-specific research 147
6.2.4. Reverse effects – the rocky road 149
6.3. Aims and hypothesis 150
6.4. Results 151
6.4.1. FDP residence and school social classification and financial risk 151
6.4.2. YDP residence and school social classification and financial risk 152
6.5. Discussion 154
6.5.1. Residence social classification and financial risk 154
6.5.2. School social classification and financial risk 157
6.6. Limitations 158
6.7. Conclusion 159
7. PHYSIOLOGICAL 161
7.1. Introduction 161
7.2 Rationale 162

7.2.1. Physical performance 162
7.2.2. Anthropometric measures and maturation status 164
7.2.3. The RAE 166
7.3. Aims and hypothesis 168
7.4. Results 170
7.4.1. FDP physical performance tests 170
7.4.2. YDP physical performance tests 171
7.4.3. FDP anthropometric measures and maturation status 174
7.4.4. YDP anthropometric measures and maturation status 174
7.4.5. FDP and YDP RAE 178
7.5. Discussion 178
7.5.1. Physical performance tests 179
7.5.2. Anthropometric measures and maturation status 184
7.5.3. The RAE 185
7.6. Limitations 188
7.7. Conclusion 189
8. TECHNICAL 191
8.2. Rationale 192
8.2.1. Technical testing 192
8.2.2. Skill behaviour 194
8.3. Aims and hypothesis 195
8.4. Results 197
8.4.1. FDP technical tests 197
8.4.2. YDP technical tests 197
8.4.3. FDP match analysis statistics 199
8.4.4. YDP match analysis statistics 200
8.5. Discussion 204
8.5.1. Technical tests 205
8.5.2. Match analysis statistics 207
8.6. Limitations 210
8.7. Conclusion 211
9. TACTICAL 214
9.1. Introduction 214
9.2. Rationale 215

9.2.1. PCE and decision making ability 215
9.2.2. Creativity and game intelligence 219
9.3. Aims and hypothesis 222
9.4. Results 223
9.4.1. FDP PCE tests 223
9.4.2. YDP PCE tests 224
9.4.3. FDP game test situations 225
9.4.4. YDP game test situations 225
9.5. Discussion 227
9.5.1. PCE tests 228
9.5.2. Game test situations 231
9.6. Limitations 234
9.7. Conclusion 235
10. A FULLY-INTEGRATED MULTIDISCIPLINARY INVESTIGATION 237
10.1. Introduction 237
10.2. Rationale 238
10.2.1. Multidisciplinary talent development research in elite youth football 238
10.2.2. Player profiling 243
10.3. Aims and hypothesis 244
10.4. Methods 248
10.4.1. Participants 248
10.4.2. Talent development measures 249
10.4.3. Player development profiling tool – 43 Progression Steps 250
10.4.4. Procedures 252
10.4.5. Statistical analyses 253
10.5. Results 253
10.6. Discussion 257
10.6.1. Fully-integrated multidisciplinary approach 257
10.6.2. Fully-integrated interdisciplinary investigation 258
10.7. Limitations 259
10.8. Conclusion 261
11. THEORETICAL & PRACTICAL IMPLICATIONS 264
11.1. Introduction 264
11.2. Theoretical implications 265

11.2.1. Environmental 265
11.2.2. Psychological 267
11.2.3. Sociological 268
11.2.4. Physiological 269
11.2.5. Technical 271
11.2.6. Tactical 273
11.2.7. Interdisciplinary approach 275
11.3. Practical implications 278
11.4. The Locking Wheel Nut Model 281
11.5. Future research 287
11.6. Summary 289
IX. REFERENCES 292
X. APPENDICES 338
1. Appendix 1 – Parent/Guardian Consent Form 338
2. Appendix 2 – Participant Assent Form 339
3. Appendix 3 – Information Sheet for Participants 340
4. Appendix 4 – Information Sheet for Parents and/or Guardians 342
5. Appendix 5 – Certificate of Ethical Approval 344
6. Appendix 6 – PHQ 345
7. Appendix 7 – PCDEQ 351
8. Appendix 8 – ECFC Academy Player Profiling Annual Report 358

V. LIST OF FIGURES

Figure 3.1. Physical performance tests 83
Figure 3.2. The four football-specific technical tests (adapted from Vaeyens et al., 2006) 88
Figure 3.3. Occlusion displays for PCE testing (adapted from Belling et al., 2014) 90
Figure 3.4. Taking advantage of openings and offering and orienting tests (adapted from Memmert, 2010a) 92
Figure 4.1. PHQ results (*p<0.050 **p<0.005 ***p<0.001) 111
Figure 5.1. PCDEQ results (*p<0.050 **p<0.005 ***p<0.001) 131
Figure 6.1. Residence and school social classification and financial risk results (*p<0.050 **p<0.005 ***p<0.001) 154
Figure 7.1. Physical performance results (*p<0.050 **p<0.005 ***p<0.001) 173
Figure 7.2. Anthropometric measures and maturation status results (*p<0.050 **p<0.005 ***p<0.001) 177
Figure 7.3. The RAE results (*p<0.050 **p<0.005 ***p<0.001) 178
Figure 7.4. Birth quarter distributions within the FDP and YDP 186
Figure 8.1. Technical test results (*p<0.050 **p<0.005 ***p<0.001) 199
Figure 8.2. Skill behaviour results (*p<0.050 **p<0.005 ***p<0.001) 204
Figure 9.1. PCE video simulation test results (*p<0.050 **p<0.005 ***p<0.001) 224
Figure 9.2. Game test situation results (*p<0.050 **p<0.005 ***p<0.001) 227
Figure 10.1. ECFC Academy's player development profiling tool – 43 Progression Steps . 251
Figure 10.2. Timeline of the data collection across two seasons 252
Figure 11.1. The Locking Wheel Nut Model – three player example 282
Figure 11.2. The Locking Wheel Nut Model – significant influencing characteristics for high-performance that are illustrated in this thesis 285
Figure 11.3. The Locking Wheel Nut Model – an example of the application of an interdisciplinary concept 287

VI. LIST OF TABLES

Table 3.1. The six factors of the PCDEQ (Adapted from MacNamara & Collins, 2013).......81
Table 3.2. Social classifications (adapted from Office for National Statistics, 2017).............82
Table 3.3. Birth quarters according to the RAE..87
Table 3.4. Technical definitions for match analysis statistics 89
Table 4.1. The anticipated factors of early specialisation, engagement, and diversification (adapted from Ford & Williams, 2017) 104
Table 4.2. The expected outcomes associated with early specialisation, engagement, and diversification (adapted from Ford & Williams, 2017) 104
Table 4.3. The anticipated factors of early specialisation, engagement, diversification, and preparation (adapted from Ford & Williams, 2017) 120
Table 10.1. Talent development measures that are applied to the statistical analyses 249
Table 10.2. YDP environmental regression model...254
Table 10.3. YDP physiological regression model 255
Table 10.4. FDP technical regression model 255
Table 10.5. YDP technical regression model..255
Table 10.6. FDP tactical regression model 256
Table 10.7. YDP tactical regression model 256
Table 10.8. FDP interdisciplinary regression model 257
Table 10.9. YDP interdisciplinary regression model..257

VII. CONFERENCE PRESENTATIONS

Kelly, A. L., Williams, C. A., & Wilson, M. R. (2018, September). *Technical testing and match analysis statistics as predictors for age-specific talent development in an English football academy*. Paper presented at the 12th annual World Congress of Performance Analysis of Sport (ISPAS), Opatija, Primorje-Gorski Kotar, Croatia. Abstract retrievable here: http://ispas2018.com/wp-content/uploads/2018/10/ISPAS-2018-5.pdf

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Kelly, A. L., Williams, C. A., & Wilson, M. R. (2017, July). *A fully-integrated multidisciplinary investigation into the talent development process in an English football academy.* Paper being presented at the 23rd annual Congress of the European College of Sport Science (ECSS), Dublin, Leinster, Republic of Ireland. Abstract retrievable here: http://ecss-congress.eu/2018/18/index.php?option=com_sppagebuilder&view=page&id=21&Itemid=650

Kelly, A. L., Williams, C. A., & Wilson, M. R. (2017, April). *Developing a football-specific interdisciplinary talent identification concept – The Locking Wheel Nut Model.* Paper presented at the inaugural 2018 Movement and Skill Acquisition Ireland (MSAI) Conference, Cork, Munster, Republic of Ireland. Abstract retrievable here: https://drive.google.com/file/d/17l4VHqJnHwnpOcmXS5My9tdzCnvJ8rWq/view

Kelly, A. L., Williams, C. A., & Wilson, M. R. (2017, December). *The geodemographic effect: Parental socio-economic classification, financial risk, and the ability to cope with performance and developmental pressures differentiate talent in academy football players.* Paper presented at the 2017 British Psychological Society Department of Sport & Exercise Psychology (BPS DSEP) Conference in Glasgow, Lanarkshire, Scotland. Abstract retrievable here: https://www.bps.org.uk/system/files/user-files/Division%20of%20Sport%20%2526%20Exercise%20Conference%202017/CYPF2017%20Programe%20v11.pdf

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Kelly, A. L., Williams, C. A., & Wilson, M. R. (2017, May). *The role of coach-led practice and sampling for talent identification in professional academy football: The early preparation concept*. Paper presented at the 7th annual Conference of the Expertise and Skill Acquisition Network (ESAN), Coventry, Warwickshire, England. Abstract retrievable here: https://blogs.brighton.ac.uk/esan/files/2017/05/ESAN-2017-Meeting-7-Coventry-Uni-Detailed-Programme_Abstract-2d3v2mf.pdf

VIII. JOURNAL PUBLICATIONS

Kelly, A. L., Williams, C. A., & Wilson, M. R. (2018). Developing a football-specific interdisciplinary talent identification concept – The Locking Wheel Nut Model. *Applied Coaching Research Journal, 2,* 32–41.

1. INTRODUCTION

How do talented children become adult professionals? Both the identification of talent and development of expertise among musicians, artists, academics, and athletes have interested researchers for many years (Gagne, 2011; Rostan, 2010; Kamin *et al.*, 2007; Holt & Dunn, 2004; Ericsson *et al.*, 1993). The identification of young individuals with the potential to develop and subsequently excel during adulthood in their specialist sport, remains one of the major contemporary challenges for national governing bodies, sports clubs, coaches, and practitioners (McCarthy & Collins, 2014). Within elite youth football, talent identification and development strategies have become pivotal discussion themes, with the pursuit for ideal science-based support systems ongoing (Forsman, 2016).

Whilst talent identification and development are often used interchangeably, they are different constructs; talent identification can be described as the process of recognising current participants with the potential to achieve expertise in a particular sport, while talent development can be considered as providing the most appropriate learning environment to realise potential (Vaeyens *et al.*, 2008; Williams & Reilly, 2000; Russell, 1989). The complex process of recognising, developing, and progressing elite youth football players through professional football academies into expert adult football players has enhanced over the last decade, with the implementation of contemporary multidisciplinary concepts being a mandatory requirement in England (Morley *et al.*, 2014; Premier League, 2013). In addition, the costs associated with purchasing players through the transfer market is continuing to increase. Therefore, the importance of identifying and developing young 'home grown' players has become a priority for many professional football clubs (Grossmann *et al.*, 2015; Elliott & Weedon, 2011; Darby, 2007a; Williams, 2000).

Academy philosophies are central to the talent identification and development process in elite youth football; their implementation – via coaches' and specialist support staff – have a significant impact on individual progression and achievement (Cushion *et al.,* 2012). As a result, the current focus of talent identification and development systems should be on providing young players the most appropriate learning environment to realise their potential (MacNamara & Collins, 2013). Previous research suggests entry to and progress in an academy setting is often achieved due to a number of physiological qualities, such as early maturity offset, physical dominance, and the relative age effect (RAE; Gonaus & Muller, 2012). Additionally, environmental, psychological, and sociological characteristics, such as opportunities to engage with elite coaches, access particular resources, and parental support, have been found to support the development of expert performers within football (Gonaus & Muller, 2012). However, the majority of this research often compares elite players to their non-elite peers, tends not to consider differences across age groups, and does not often focus on change over time. Consequently, the aim of this research is to investigate what multidisciplinary factors separate elite youth football players alone (i.e., what differentiates the 'very best' of the 'best'), whilst focussing on age-specific features.

Through reviewing relevant literature in the following chapter (Chapter 2), associated methods (Chapter 3) were subsequently applied to the multidisciplinary investigation into the talent identification (Chapters 4–9) and development (Chapter 10) processes within this thesis. It is important to highlight that this review is by no mean exhaustive, but rather is focused on the specific context of the sample population. As a result, the following review of literature explicitly supported the development of the rationale for the theory, concepts, and approaches that were consequently incorporated into each of the relevant 'disciplines'. Thus, the following chapter will address the first objective of this thesis, through a discursive study of the current literature to create the basis and reasoning for the resulting chapters.

2. REVIEW OF LITERATURE

2.1. Models to support the talent identification and development process

A holistic effort towards a sport development premise is Gagne's (2009; 2003) Differentiated Model of Giftedness and Talent (DMGT). This model presents a broad talent development process for transforming outstanding 'natural abilities' or 'gifts' into exceptional systematically developed skills, which define expertise or talent in a particular occupational field. Gagne (2004) defines the three types if catalysts that can facilitate or obstruct this developmental process; interpersonal catalysts (such as personal traits and self-management processes), environmental catalysts (such as socio-demographic factors and psychological influences), and chance (such as coach relationship and the possibility or access to certain opportunities). The DMGT includes a 5-level metric based system to operationalise the prevalence of gifted or talented individuals, with a basic top 10% threshold for mild gifted or talent, through successive 10% cuts for moderate, high, exceptional, and extreme levels (Gagne, 2004).

Henriksen *et al.* (2010a) subsequently developed the Athletic Talent Development Environment framework (ATDE) after examining the dynamics of the micro and macro athletic environment through practical application. The ATDE is also complemented by a holistic ecological approach to support young athletes making a successful transition from junior to professional level. Researchers have conventionally focused on the micro-environment (such as coaches, parents, and peers). Whereas, recent studies reveal macro-environmental factors (such as national culture and sporting organisations policies and philosophies) are important for a young athlete's progression (Henriksen *et al.*, 2010a; Henriksen *et al.*, 2010b). Additionally, the ATDE framework offers a strong methodology through its practical application in a number of sports, albeit limited to Scandinavian cohorts. Furthermore, its qualitative data through case studies, interviews, and document analyses provides a unique procedure through its applied observations (Henriksen *et al.*, 2010b).

Gulbin *et al.* (2013) developed an athlete development framework that applies a multidisciplinary approach offering practical implications. They recommend a combination of current theoretical research perspectives with broad empirical observations from the Australian Sports Commission. The Foundations, Talent, Elite, and Mastery framework (FTEM) proposes a pathway style system. The three 'Foundation' phases are associated with fundamental movement skills through applied learning and acquisition of basic movement foundations (F1), extension and refinement of movement foundations (F2), and sport-specific commitment and/or competition (F3). The four 'Talent' elements represent the process for those athletes who are categorised as talented. This is consistent with Gagne's (2009; 2003) DMGT where talent is an expression of systematically developed skills resulting from the interaction of both nature and nurture. Within this section, athletes must demonstrate potential (T1), be verified subjectively by expert coaches (T2), prove commitment to practice and thrive to achieve success (T3), and breakthrough and rewarded through scholarship or professional contract (T4). 'Elite' factors, including senior elite representation (E1) and senior elite success (E2), alongside sustained elite success or 'Mastery' (M1), provide expert benchmarks to define performance in professional sport.

Gulbin & Weissensteiner (2013) further identify current limitations surrounding the research of talent development. They argue there is limited understanding of the 'bio-psych-social' requirements at each developmental level across the full athlete development pathway, the aligned support needed for optimal talent development across the full athlete development pathway, the facilitators and barriers underpinning successful transition from one development level to another, the intrinsic and extrinsic factors that need to be considered and discussed when recruiting talented individuals, and the characteristics and attributes of world-class athletes and the requirements for consistent performance excellence at senior level.

Following these observations, Gulbin & Weissensteiner (2013) developed the 3D-AD 'beehive' conceptual model of expertise. This multidisciplinary model applies athlete factors (such as psychological attributes and technical capability), environmental factors (such as participation history, community, and coaching), system factors (such as strategic, policy, and philosophical decision making by specific national governing bodies), and chance factors (such as being born to a particular set of parents and access to coaching and facilities). This model has the adaptability to flow through all the developmental phases and can be applied to non-elite, pre-elite, and elite athletes. The advantage of the athlete factors is that they do not have an equal impact on development on any one individual, and are capable of contracting and expanding throughout the developmental phases. For example, the conceptual athlete factor of physiological capacity may have a larger influence compared to psychological features at a different time point along the developmental process, thus the model allows the relative weighing or importance to change along the pathway.

2.2. The talent identification and development process in youth sport

Martindale *et al.* (2007) discovered a number of concerns surrounding system-specific considerations during their research for United Kingdom (UK) Sport, which has been responsible for promoting and supporting sport across the UK since 1997. Using 16 coaches with significant experience and expertise in talent development across 13 different sports, Martindale *et al.* (2007) revealed support for five generic characteristics of effective talent development environments; 1) long-term aims and methods, 2) wide-ranging coherent messages and support, 3) emphasis on appropriate development (not early success), 4) individualised and ongoing development, and 5) integrated, holistic, and systematic development.

However, Martindale *et al.* (2007) also highlight issues with organisations effectively implementing these strategies successfully, through disclosing a lack of coherent aims between levels of development and clear long-term pathways, poor communication systems, lack of funding, potential detrimental effects of lifestyles, and a lack of cultural mentality for hard work, self-responsibility, and self-improvement. Thus, revealing the importance of identifying age-specific developmental strategies, identifying characteristics that are important for long-term development and not instant success, and applying a multidisciplinary method into the coaching and learning environment. Consequently, an effective individualised approach may be achieved, while organisations spend valuable time and resources more effectively.

From an applied perspective, governing bodies and sporting organisations have employed academic models and frameworks to support their talent development process. For example, the Long-Term Athlete Development (LTAD) model has been implemented by various national governing bodies, and thus practitioners, worldwide to offer an approach to develop children into elite athletes (Ford *et al.,* 2011). Other sporting organisations have attempted to develop their own talent selection and development instruments through ongoing projects with current athletes to maintain a contemporary approach (Fuchslocher *et al.,* 2013). For example, Fuchslocher *et al.* (2013) investigated the high performance unit within the Swiss Federal Institute of Sport Maggligen (SFISM), who is commissioned with supporting its national talented athletes. Drawing from the holistic expertise of practitioners specialising in sports medicine, strength and conditioning, physiotherapy, psychology, nutrition, and data management, Fuchslocher *et al.* (2013) present an interdisciplinary approach to improve the Swiss talent development process. They produced an assessment criteria for the selection and estimated prognosis for success in elite sport performance, which focuses on competition performance, performance tests, performance development, psychological factors, athlete's biography, and biological development. This provision supports a required collective ability of key stakeholders which influence and impact the talent development process in elite youth athletes to maximise their potential.

Interestingly, Phillips *et al.* (2010) reveal the performance paradigm shifts have evolved through equipment changes (e.g., the change from bamboo to fibre glass pole vaults, thus leading to the world record increasing from approximately 4.5 metres to 6.14 metres in 1993), playing surfaces (e.g., hockey moving from grass to artificial surfaces, thus increasing the ebb and flow of performance), and rule changes (e.g., the turnover law in rugby union). This constant evolution requires consistent academic research to co-adapt and support the progress of talent development structures. It is evident the reviewed talent development concepts surrounding sport often support a multidisciplinary approach (i.e., the DMGT, ATDE, FTEM, and the 'beehive' conceptual model of expertise). However, it is an often familiar concern that coaches and support staff managing elite development programmes may be unfamiliar with current research models, while they are regularly difficult to translate into the practical environment (Burgess & Naughton, 2010).

A large investment by national governments into elite sport development is increasingly apparent. As a consequence of their funding, they are able offer athletes with a superior talent development environment to challenge in international events and competitions. Furthermore, it is widely acknowledged that appropriate provision and training are necessary if young talented athletes are to fulfil their potential (Abbott & Collins, 2002). Therefore, practical application of suitable contemporary talent development models and frameworks by national governing bodies and sporting organisations are vital. Additionally, it is apparent that talent development environments must adopt a multidisciplinary approach to develop the athlete holistically. Thus, governing bodies and sporting organisations alike must implement contemporary approaches to constantly improve and develop their programme in-line with current research and performance paradigm shifts. Finally, models and frameworks need a greater representative design to enable coaches and practitioners to apply modern components with more simplicity into their talent identification and development programmes.

2.3. The talent identification and development process in youth football

Approximately 265 million people regularly play football worldwide, of which only 0.4% play in a professional league, demonstrating that reaching expertise specifically in football is challenging and highly competitive (Haugaasen & Jordet, 2012). The 'Bosman Ruling' by the European Court of Human Rights in 1995, which prevents professional football clubs from withholding a player's registration at the completion of their contract, has subsequently caused constant inflationary pressure on wages and transfer fees (Williams & Reilly, 2000). Moreover, the economic advantage of top European clubs, as a result of owner, spectator, media, and commercial investment and revenue escalating in recent years, has triggered an increase in player migration, at both academy and professional levels, from regions such as Africa, Asia, and South America (Elliott, 2009; Elliott & Maguire, 2008; Darby *et al.,* 2007a). Additionally, the evolution of physical and technical performance parameters are continuing to improve at the highest senior professional football level (Barnes *et al.,* 2014). Thus, the economic advantage of producing 'home grown' players, the increasing number of players available to English clubs, and the greater technical and physical capabilities required to compete at the highest levels, have consequently made the demands of achieving senior professional status frequently more challenging.

Further motives for researchers to examine elite youth football development strategies in England are the national team's failure at international tournaments. It has been well documented the England senior men's team have not won an international trophy since the

1966 World Cup (FIFA, 2013; UEFA, 2013). Thus, England's national team shortcomings in international tournaments provide reasoning behind the importance of improving youth football development in England. Nevertheless, the construction of the £100 million facilities at St George's Park, alongside the implementation of age appropriate youth coaching awards, further demonstrates the commitment and ambition of the Football Association (FA) towards improving of its player development, national teams, and coach education in England (The FA, 2013). Additionally, the recent success of English youth teams in 2017, including winning the under-20 World Cup, under-19 European Championship, and under-17 World Cup, reveals the potential impact of both the current ambition and recent investment of footballing governing bodies and clubs in England (Reuters, 2017).

Football academies in England are specialist training programmes established and funded by professional football clubs, with the primary objective of developing players towards the professional level (Elferink-Gemser *et al.*, 2012). Between the ages of 8 and 16 years, young players join an academy on schoolboy terms (i.e., part-time attendance), then at aged 16 years, those players who show continued progress are selected to undertake a two year full-time youth training scheme known as an academy scholarship. In the elite youth football development pathway, upon completion of the scholarship, players either sign a professional contract or are released (Mills *et al.*, 2012). As a result of the difficulties formerly presented, over 90% of players who join an academy fail to make it as a professional (Mills *et al.*, 2012). Therefore, it is in each individual academy's interests and responsibilities to provide their elite youth football player's the maximum opportunity to develop and reach their potential.

Traditionally, talent identification environments within academies would perform player selection and progression verdicts based on subjective analysis (Williams & Reilly, 2000). However, it is now widely accepted that the use of opinions alone can result in misjudgements and inaccurate decisions (Meylan *et al.*, 2010). Thus, from a more contemporary perspective, a young footballers' progression to an academy does not lay solely on a coach, manager, or scout's judgement. As a result, the current environmental, psychological, sociological, physiological, technical, and tactical youth football development techniques applied in English academies should be examined to support a holistic approach to talent identification and development methods (Sarmento *et al.,* 2018; Forsman, 2016).

Over the recent years, the use of science-based support systems offering a more multi-dimensional approach to talent development has been implemented within elite youth football (Unnithan *et al.,* 2012). Thus, tools and specialist practitioners have been developed and employed to reveal talented individuals that have potential to progress into professional football players. According to Williams & Franks (1998), key stages in the talent identification and development process begins with detection. This identification of talented youth football players initiates a pathway for them into a professional football academy where they are signed and become part of a singular clubs programme and philosophy. Williams & Reilly (2000) present established examples of characteristics professional football clubs traditionally identify to support key criteria for selection. However, original identification using these measures often applied a subjective interpretative approach (Webb *et al.,* 2016; Woods *et al.,* 2016a; Vrljic & Mallett, 2008; Williams & Hodges, 2005). Although the ability of coaches and practitioners to judge such measures should certainly not be underestimated, they should be implemented alongside contemporary objective sport science methods. Therefore, this thesis will review both subjective and objective investigations to help confirm coaches' initial intuition surrounding the multifaceted characteristics concerning talent identification and development.

Early research surrounding talent identification in youth football involved a multidisciplinary methodology to assess what distinguished elite and sub-elite youth football players. For example, Williams & Franks (1998) revealed potential predictors of talent in youth football by breaking down sport science strands including physical, physiological, psychological, and sociological characteristics. However, it may be argued this ‘four corner’ approach provides little consideration towards the coach relationship and subjective thinking surrounding player strength and weaknesses, which may also facilitate development. Additionally, the personality psychology (i.e., motivation and concentration) significantly differs to technical/tactical ‘psychology’ (i.e., motor/cognitive skills and decision making). Therefore, although this four corner method is effective due to its simplicity and practical application, Williams & Franks’ (1998) variables need to be clearly defined for its multidisciplinary purpose.

During further investigation, Reilly *et al.* (2000a) used 31 (16 elite and 15 sub-elite) young players matched for chronological age (aged 15 to 16 years) where physiological, psychological, and technical variables were assessed. These tests included anthropometric and physical fitness, psychology questionnaires, and anticipation and football-specific skill tests. They revealed the most influential discriminating factors in favour of elite players included agility, sprint time, ego orientation, anticipation skill, leaner, possessed greater power, and were more tolerant to fatigue (Reilly *et al.,* 2000a). However, it may be suggested this preliminary study surrounding multidisciplinary talent identification has a significant weakness surrounding its participant size. Additionally, they also only focus on one age group (under-16’s), thus future research concerning this holistic technique needs to concentrate on various age groups to identify what individual characteristics identify talented players across age groups. Therefore, this thesis will aim to extend the literature by using a larger sample size, whilst concentrating on various age groups across the elite development process in youth football through dividing them into relevant phases.

Holt & Dunn (2004) advanced knowledge surrounding player development following an initial investigation with English and Canadian youth players. They produced a qualitatively-derived theoretical model that indicates characteristics including discipline, commitment, and resilience, together with positive social support, facilitates the successful transition from youth to professional level. In a supplemental investigation, Holt & Mitchell (2006) enhanced the model through integrating hope theory, which revealed players with high hope had a greater chance of achieving professional status. Toering *et al.* (2009) support the role of self-efficacy when discriminating elite and non-elite players when investigating elite youth Dutch players. Van Yperen (2009) also attempted to distinguish elite and non-elite players, revealing goal commitment, engagement in problem-focussed coping behaviours, and social support seeking successfully differentiated players who reached professional level and those who did not.

Characterised by a highly pressurised environment, there is clearly a link between the need to develop psychological characteristics to progress from elite youth to professional level football (Finn & McKenna, 2010; Sagar *et al.,* 2010). However, this research only demonstrates the subjective psychological needs of players when transferring into a senior professional setting, therefore ignoring the needs of players during their development within an academy from under-9 to under-16, and also the requirements to develop such psychological factors. Additionally, this research also ignores the impact of combining these psychological characteristics with other variables that influence the talent development process.

Similarly, presented through Gagne's (2009) DMGT model, Mills *et al.* (2012) transcribed interviews with ten expert development coaches, who were qualified at UEFA 'A' or UEFA 'Pro' Licence level, to attempt to identify factors perceived to influence the development of elite youth football academy players. Interestingly, drawing from the six interrelated higher-order categories that represented the characteristics perceived to manipulate player development, Mills *et al.* (2012) revealed psychological characteristics have a significant influence. For instance, four of the six categories were psychological qualities including resilience, goal-directed attributes, intelligence, and awareness, together with sport-specific attributes and environmental factors. As a result, this notion combines physical and technical qualities, while separating psychological factors.

Although this concept provides extensive detail around the psychological attributes, when applied to a professional football academy, it lacks evidence and suggestions surrounding technical, tactical, and physical development. Additionally, during their subjective approach, similarly to a large number of other research papers concerning talent development in youth football, Mills *et al.* (2012) only concentrated on the progression from elite youth football to professional level. Albeit a crucial stage of development, solely concentrating on this transition eliminates evidence for the developmental needs for younger age groups. However, the stage-specific nature of the study provides further information surrounding the development process within the older academy age groups within the Professional Development Phase (PDP; under-17 to under-21). Moreover, a key strength of this research was that it was theoretically underpinned by Gagne's (2009) established theoretical model, which facilitated the investigation's purpose, procedure, data analysis, and framework. Therefore, it provides evidence that Gagne's (2009) DMGT is an effective protocol when examining talent development in elite youth football.

Similarly to the process of talent identification, talent development in academies previously adopted a deep-rooted and long-standing subjective approach. However, as a consequence of thorough scientific research and a lack of consistency in the historic process, academies now commonly apply a holistic methodology (Williams & Drust, 2012). The use of a range of control measures associated with greater performance outcomes have all been used, either in isolation or combined, to assist development and predict future individualities (Unnithan *et al.,* 2012; Meylan *et al.,* 2010). These current research trends surrounding talent development generally focus on this multidisciplinary approach using both subjective and objective methods, which is how this thesis will operate its investigation.

As the governing body for football in England, the FA is responsible for formulating and implementing current developmental strategies for coach education and the national training programme (The FA, 2013). Using a multidisciplinary approach, the FA has adopted the 'Four Corner Model' (FCM) into their syllabus, which considers technical/tactical, physical, psychological, and social factors by dividing them into the four corners. This method of talent development facilitates a 'player centred' approach which identifies specific characteristics that relate to each of the four factors, allowing the coach or practitioner to identify certain weaknesses which creates individual learning objectives to assist player development (The FA, 2013). Thus, outlining a range of factors that may need to be addressed if a young player is to reach their potential. This simplistic framework has the appropriate theoretical context and simplicity for both clubs and coaches to apply to their practical environments. Although isolated age-specific investigation is not uncommon, combined research considering the whole development pathway within each of the four corners is limited. Furthermore, the FA FCM isolates technical/tactical into one corner, whereas it may be argued these two factors have relatively different meanings and outcomes.

Therefore, this thesis has divided its research population into two categories; the Foundation Development Phase (FDP; under-9 to under-11) and Youth Development Phase (YDP; under-12 to under-16). In addition, the FA FCM has also disregarded the environmental factors within their framework, thus this current study has incorporated it into its investigation as an additional research focus. Therefore, this study will apply a multidisciplinary approach, through investigating environmental, psychological, sociological, physiological, technical, and tactical factors, to examine the whole elite youth football development pathway at Exeter City Football Club (ECFC) Academy, by combining holistic assessments to measure age-specific needs.

Age-specific needs refers to the explicit requirements of players at various age groups across the development process (Tredrea *et al.*, 2017; Honer & Votteler, 2016b; Reeves & Roberts, 2013; Wolfenden & Holt, 2005), or as Suppiah *et al.* (2015) describe it; 'different strokes for different folks'. For example, using the LTAD model as a physical developmental guide to support the training programme of age-related differences in physical capacities, such as acceleration and sprint ability (Mendez-Villanueva *et al.*, 2011; Balyi & Hamilton, 2004). Through the implementation of the Elite Player Performance Plan (EPPP), the Premier League (2013) have divided their player pathways from ages 5 to 21 into three distinct phases; the FDP, YDP, and PDP. Subsequently, The FA (2013), who is responsible for coach education in England, has also defined age groups within the same phases.

Additionally, the FA has developed an advanced and age appropriate coaching qualification, named the FA Advanced Youth Award, to produce specialist coaches within each phase (The FA, 2013). Due to ECFC Academy's age groups ranging from under-9 to under-18, leaving only two age groups and limited participants in the PDP, this research will focus solely on a sample population of players aged 8 to 16 years. Corresponding with the EPPP's elite player pathway, ECFC Academy have divided their age groups accordingly within the two suggested earlier development phases; under-9 to under-11 (FDP) and under-12 to under-16's (YDP).

The Premier League's EPPP has had an influential role of the application, investment, construction, and assessment of the academy structure in England. The EPPP aim to improve youth football development in England by proposing to modernise talent identification and recruitment including research in such areas as physiological parameters, RAEs, psychological profiling, motivation, decision making, technical ability, and attainment rates (Premier League, 2013). The six fundamental principles of the EPPP include; 1) increasing the number and quality of home-grown players, 2) create more time for players to be coached, 3) improve coaching provision, 4) implement a system of effective measurement and quality assurance, 5) positively influence strategic investment, and 6) seek significant gains in every aspect of player development (Premier League, 2013). They aim to do this through four main capacities; coaching, classification, compensation, and education (Premier League, 2013).

The new academy category system is part of the EPPP, where academies are reviewed every three years and categorised between 1 and 4, with categorisation the result of an independent audit. ECFC Academy is Category 3, with 127 players signed from under-9 to under-18 and eight full-time members of staff, alongside part-time coaches and sport science support staff (recorded in July 2014 prior to initiating this investigation). The implementation of the EPPP has reformed ECFC Academy's multidisciplinary approach through the development of their training programme and contact hours. A standard under-9 to under-16's week would include three training sessions lasting 2.5 to 3 hours with a game at the weekend. This includes a holistic coaching approach and a hybrid programme with a local school (St Luke's College), where the players are offered additional training through school release.

The most notable rule changes from the previous system is the abolition of the 90-minute rule, where clubs could only sign players aged under-18 if they live within 90 minutes travel of the training facility, and the fixed tariff for transfers of players under-18, which replaces the independent tribunal compensation system (Premier League, 2013). For example, players aged 9 to 11 years have a fixed fee of £3,000 per year spent at an academy, and £12,500 to £40,000 per year spent at an academy (depending on category) for players aged 12 to 16, with further fees available on appearances in the clubs first team (Premier League, 2013). As a result of increased revenue for the Premier League clubs, there is a rise in the transfer fees paid for players. Due to the increasing expenditure on players, larger clubs have begun sourcing talented players at a young age by buying them from fellow academies. By doing so, it may be suggested the top clubs will eventually have the best youth player's, with future hope of them becoming skilled enough to help their team reach their optimal goals of trophies, European qualification, or sustaining higher league status (Grossmann *et al.*, 2015; Elliott & Weedon, 2011; Darby, 2007a; 2007b). Therefore, professional youth development systems spend years and large sums of money attempting to develop players that are talented enough to help their team achieve these goals, or in many cases, to gain financial profit from future transfer fees (Mann *et al.,* 2017; Morris *et al.,* 2016; Hill, 2007).

Thus, developing a player capable of playing in the Premier League can be profitable for Category 3 academies or lower league football clubs, by selling them to Category 1 and 2 academies or Premier League and Championship clubs respectively. Consequently, this not only sustains the smaller clubs youth academy, but in many cases the entire football club (Relvas *et al.,* 2010). Furthermore, the larger clubs benefit from having the best youth players in the country which, if they become top professionals, have been bought at a cut down price. Additionally, producing young players that eventually make a professional clubs first team can escalate the price, particularly due to the Bosman Ruling. For example, ECFC Academy have sold academy graduates such as, Ethan Ampadu (Chelsea FC), Ollie Watkins (Brentford FC), Tom Nicholls (Peterborough United FC), Sean Goss (Manchester United FC), George Friend (Wolverhampton Wanderers FC), Dean Moxey (Derby County FC), and Danny Seaborne (Southampton FC), to larger clubs for substantial sums which has subsequently supported the sustainability of the entire football club.

2.4. Environmental factors associated with talent identification and development

2.4.1. Early specialisation

An attempt towards a sport development concept is the Development Model of Sports Participation (DMSP), which considers a development interaction between the required characteristics needed for expertise and participation engagement (Cote & Vierimaa, 2014; Cote & Fraser-Thomas, 2007; Cote *et al.,* 2007; Cote, 1999). Cote *et al.* (2007) aim to explain the developmental pathways from the age at which athletes first engage in sport, in either elite performance or recreational participation. According to this model, it is possible to achieve expertise through two pathways; 1) early specialisation, or 2) early diversification and later specialisation. The first pathway applies the theory of deliberate practice by Ericsson *et al.* (1993). According to this inquiry into nonspecific talent development, it is not necessarily the amount of practice that differentiates whether or not someone becomes an elite performer, but more precisely the deliberate practice completed (Ericsson *et al.*, 1993). From a sporting perspective, this theory illustrates the significance of domain-specific practice, which means a focus on one sport from an early age. This early specialisation approach suggests athletes, who participate in domain-specific deliberate practice from an early age, will have an advantage in developing certain skills over later specialising counterparts, and ultimately reach elite levels within their respective sports (Haugaasen & Jordet, 2012; Ericsson, 2008; Cote *et al.*, 2007).

Ericsson *et al.*'s (1993) data on violinists suggest that this approach, surrounding effortful and intense deliberate practice, takes a minimum of 10 years before a level of expertise is achieved. Subsequently, the 10 year or 10,000 hour guidelines have received criticism surrounding their somewhat unreliable evidence, while the quality of training (e.g., structured versus non-structured practice) is arguably more important than the quantity (Davids & Baker, 2007; Baker, 2003). Therefore, it is suggested further longitudinal research is necessary surrounding the amount of time that is required to achieve expertise, before it is formally applied within a professional environment.

Nevertheless, when compared to early diversification and early engagement, the main rationale applied to support early specialisation is the significant relationship between duration spent practicing a task and a superior level of competence (Ford & Williams, 2017; Falk *et al.*, 2004; Baker *et al.*, 2003a). For example, early specialisation increases the amount of time spent practicing a specific sport throughout the development process, which consequently leads to higher levels of ability and achievement in the adolescent years, compared to participants who engage in early sampling or with a later start age (Ford & Williams, 2017; Fahimi *et al.*, 2016). Furthermore, compared to inactive individuals, research reveals that time spent in purposeful practice or training leads to skill acquisition and greater competency, alongside improved physical fitness (Kenney *et al.*, 2015; Schmidt & Lee, 2011). For example, Archer *et al.* (2016) revealed technical proficiency and physical ability influences team selection in children as young as aged 3 to 5 years. As a result, Sieghartsleitner *et al.* (2017) suggest this concept as the 'early specialised bird catches the worm', by identifying the advantages gained through engaging in a particular sport at a young age.

One of the central methods applied to investigate the theory of early specialisation is through a retrospective recall questionnaire, to highlight the number of hours' individuals have practiced within certain activities since they began participating (Ford & Williams, 2017). As a result, several researchers have found the number of hours accumulated by senior expert athletes in specialised practice activities are greater compared to control groups, such as non-athletes, lesser-skilled, or dropouts (Zibung & Conzelmann, 2013; Law *et al.*, 2007).

For instance, Law *et al.* (2007) applied this method when assessing Olympic and international standard adult female rhythmic gymnasts. They found their started training age was 6 to 8 years, competing at regional level aged 7 to 8 years, and started spending all their leisure time training solely in gymnastics aged 11 to 12 years. Furthermore, during their childhood, gymnasts accumulated a mean average of 2,000 hours of sport-specific practice alone, while engaging in an average of one other sport (Law *et al.*, 2007). As a consequence of expert performance required at mid-adolescence within gymnastics, the early specialised approach appears to be a suitable concept (Trimble *et al.*, 2010; Law *et al.*, 2007). However, when compared to football, where expert performance is not necessary until up to the age of 21 years, an early specialised approach may not be as suitable as a result of the extended time available, and arguably the time required, towards achieving expertise (MacNamara *et al.*, 2016; Taylor

& Bruner, 2012). Consequently, this supports Evans *et al.*'s (2017) suggestion that different activities and experiences vary from a sport-specific context.

Also, from a childhood physical activity perspective, according to Gilbin *et al.* (2014), participation in structured physical skill development during the early years facilitates the development of psychological factors and movement skills to support lifelong physical activity. However, this concept, known as 'deliberate preparation', only offers a subjective viewpoint (Gilbin *et al.,* 2014). Therefore, these assumptions clearly need further investigation to highlight longitudinal implications on its impact on long-term participation (Pesce *et al.,* 2016b). Nevertheless, deliberate preparation is supported by subject leading researchers and should not be disregarded (MacNamara *et al.,* 2015). Consequently, the educated practice approach of the deliberate preparation theory may be supported by early specialisation through participating in greater coach-led hours during childhood. Arguably, the athletes who have completed more deliberate practice will have had more time to develop essential psychological characteristics and fundamental movement skills, consequently leading to greater performance.

While assessing the negative outcomes for early specialisation, there appears to be a number of possible setbacks, such as overuse injuries (Pasulka *et al.*, 2017; Post *et al.,* 2017; Feeley *et al.,* 2016; Jayanthi *et al.,* 2015), burnout and overtraining syndrome (Myer *et al.,* 2016; 2015), long-term psychological problems (LaPrade *et al.,* 2016; Horn, 2015; Hendry *et al.,* 2014), and decreased social development (Sheridan *et al.,* 2014; Carlson, 1988). For example, Law *et al.* (2007) found Olympic rhythmic gymnasts reported more overuse injuries and lower health across their development when compared to their lesser-skilled counterparts. Both groups highlighted more injuries during their adolescence compared to their childhood, thus suggesting a positive relationship between training load and injury incidence as a consequence of increased training during this period (Law *et al.,* 2007). Furthermore, increased workloads, alongside other aspects of early specialisation within an elite youth development context, have been associated with greater overuse injuries in youth baseball pitchers (DiFiori *et al.*, 2014; Lyman *et al.*, 2002). Moreover, higher training loads, as a consequence of early specialisation, have been connected with an increased likelihood of burnout, dropout, and overtraining syndrome in other sports such as tennis (Gould *et al.*, 1996a; 2006b), swimming (Fraser-Thomas *et al.*, 2008), and golf (Cohn, 1990).

From a football perspective, according to Read *et al.* (2016), the associated increased risk of injury and suggestions that single sport specialisation is a risk factor are independent of age, growth, biological maturation, and training volumes (Myer *et al.*, 2016; 2015). Consequently, Read *et al.* (2016) offer a modification towards the current early specialised approach adopted by English academies, through reducing the volume of football-specific activities at key stages of growth and maturation, alongside guidelines for a greater variety of physical activities that are integrated within other programme components. Consequently, although Read *et al.* (2016) suggest reducing the volume of current football-specific hours and increasing additional activities, this is nonetheless within a specialised environment, thus offering a valuable solution towards a contemporary early specialised approach.

2.4.2. Early diversification

As a consequence of the negative effects of early specialisation that have been previously highlighted, several researchers recommend early diversification as an alternative pathway towards expertise (Fahimi *et al.*, 2016). For example, Cote *et al.*’s (2007) second DMSP pathway suggests early sampling within a variety of sports followed by later specialisation can lead to adult expertise. In this instance, the athlete participates in multiple sports, a high amount of play activity, and little to no deliberate and structured practice. Cote *et al*. (2009b) summarised their investigation into sampling sports during childhood by suggesting only a small portion of children achieve expertise, thus the advantages of psychosocial development are important to consider. Furthermore, Cote *et al*. (2009a; 2009b) highlight children aged 11 to 16 years that participate in significantly more extracurricular activities achieved greater academic results and stronger peer relationships, compared to those who compete in fewer. Cote *et al*. (2009a) suggest this association exists as a result of the social experiences and various skills gained from participating in a greater amount of activities.

Bridge & Toms (2013) continued to investigate the specialising or sampling debate to identify whether early specialisation or sporting diversification, throughout both childhood and adolescence, could influence performance levels prior to adulthood. An online retrospective recall approach was applied with a total of 1,006 UK sport participation histories included, which were then compared using the DMSP (Bridge & Toms, 2013; Cote *et al.,* 2007). They found a significant association between the total number of sports participated at the ages of 11, 13, and 15 years and the standard of current competition between the ages of 16 to 18 years. Consequently, individuals who competed in three sports age 11, 13, and 15 years were significantly more likely to compete at a national standard compared with club standard players at the ages of 16 to 18 years (Bridge & Toms, 2013). This study offers an insight, through a reliably high participant figure, into the impact of sampling to facilitate the development towards national youth participation.

However, it may be suggested the participants in Bridge & Toms (2013) and Cote *et al*. (2009b) have still not achieved adult expertise within their relevant domains, thus further longitudinal evidence is required to support the application of sampling to achieve adult professional status. Accordingly, Hornig *et al.* (2016) offer a retrospective recall response from the developmental activities of 52 professional football players competing in the first German Bundesliga. In-line with the results of Bridge & Toms (2013), they found senior national team players competed in more multi-sport activities compared to amateurs during adolescence.

The early diversification pathway has been promoted by several researchers, which has been demonstrated to support the attainment of senior professional status in sport, while eliminating the negative consequences of early specialisation (Gullich *et al.,* 2017; Cote *et al.,* 2009a; 2009b). For example, Ford & Williams (2017) state the main evidence to support the early diversification pathway towards professional status in adulthood is twofold. Firstly, it protects against overuse injuries, burnout, and dropout, while also facilitating the development of key social skills (Ford & Williams, 2017; Myer *et al.,* 2016; 2015). Secondly, retrospective recall studies investigating developmental activities reveal early diversification has the ability to support the progress to attain later expert status in adulthood (Ford & Williams, 2017; Gullich, 2017).

Ford & Williams (2017) display the necessity to provide data on the start age in a primary sport and start age in a talent development programme in a primary sport. Furthermore, the amount of peer-led play, coach-led practice, individual practice, and match-play should also be investigated to highlight the specific activities participants have engaged in (Ford & Williams, 2017). Additionally, the amount of participation within other activities alongside their primary sport should be highlighted (Ford & Williams, 2017). Through applying this criterion, Ford & Williams (2017) summarised published studies that investigate athletes playing at the highest adult professional standard within their sport. Consequently, many papers examining adolescent athletes, such as Cote *et al.* (2009b) and Bridge & Toms (2013) were ignored as a result of the uncertainty of which participants will eventually achieve adult professional status. In addition, studies that have analysed senior participants that did not achieve adult professional status were overlooked as a result of that confounding factor (Ford & Williams, 2017). While this disregarded research offers knowledge surrounding the advantages of early diversification, it was Ford & Williams' (2017) aim to identify childhood experiences of current professionals.

2.4.3. Early engagement

Following Cote *et al.*'s (2007) DMSP, Ford *et al.* (2009) proposed the early engagement theory as part of a developmental pathway. Early engagement involves athletes participating in a significant amount of singular sporting involvement during childhood through deliberate play activities, whilst also investing time in other sports alongside their favoured activity (Ford *et al.,* 2009). Following a re-examination of Ward *et al.*'s (2007) data on participation histories from elite youth football players four years later, Ford *et al.* (2009) distinguished 11 players from the original number of 33 participants that had gone on to achieve full-time professional status. The purpose of this study was to identify what developmental activities differentiated the players that progressed and the ones that didn't, while applying Cote *et al.*'s (2007) DMSP. They revealed the elite players that attained professional status accumulated more hours per year in deliberate football play activities, but not in deliberate football practice, competition, or other sports, between the ages of 6 to 12 years, compared to those who did not progress. Thus, although mixed support was found for both the early specialisation and early diversification pathways suggested by Cote *et al.* (2007), the data was consistent with an alternative hypothesis. Consequently, Ford *et al.* (2009) proposed the early engagement model, where a high volume of deliberate play in football, alongside sampling other sports, between the ages of 6 to 12 years contributes to the expert performance in English professional football.

In the context of both perceptual-cognitive expertise (PCE) and perceptual-motor skill development in sport, time spent in what has been termed 'deliberate play' across a diverse range of physical activities during childhood is a significant factor (Ford *et al.,* 2009; Cote *et al.,* 2007). Deliberate play is engaged by the individual for purposes of enjoyment and has rules that have been adapted by the children themselves (Ford *et al.,* 2009; Cote *et al.,* 2007). Gradually, the athlete engages in a greater amount of deliberate practice and focuses more on one sport during adolescence, until they specialise in one sport through further increased deliberate practice at around the age of 16 years (Haugaasen & Jordet, 2012; Cote *et al.*, 2007).

Additional research has shown players who engaged in greater amounts of football-specific play-like activity during childhood have been shown to possess superior tactical intelligence and creativity, including advanced PCE, anticipation, and decision-making ability compared to those who engaged in less (Roca *et al.*, 2012; Williams *et al.*, 2012; Memmert, 2011a; 2010a). Williams (2000) explains how advanced PCE in football is facilitated through the intricate and astute long-term memory structure which is crucial to anticipation. This capability is built up over time through repetition of occurrence which gives experts knowledge of situational probabilities (Ward & Williams, 2003). Therefore, it may be suggested, when compared to early diversification, individuals may develop superior PCE, anticipation, and decision-making ability through a greater amount of engagement in a particular sport from a young age (Memmert *et al.*, 2010a; 2010b; Memmert & Roth, 2007).

Whilst all three suggested pathways propose conflicting activities within the FDP, they all recommend the same concept of an increased specialised approach within the YDP. Wrigley *et al.* (2014) compared three year changes in physical performance between 27 players selected in a professional football academy quantified at ages 12 to 16 years, alongside 17 age-matched controls. Results indicated a three year programme of training in a professional football academy is associated with greater changes in physical performance indicators, including counter-movement jump (CMJ), 10 m sprint, 20 m sprint, agility, repeated sprint, and intermittent endurance capacity, thus highlighting the advantage of superior physical development of specialising at ages 12 to 16 years. Although this reinforces the advantage of specialising within adolescence, there is little debate surrounding these individuals compared to participants within childhood.

Finally, an observation surrounding early specialisation and engagement in a particular sport appears to have a cultural influence; for example, football in Europe and South America, rugby in New Zealand, cricket in India, and American football in America (Baker & Horton, 2004). Thus, expert performance as a professional may require early specialisation or engagement to accumulate the amount of particular practice time required to achieve expertise within ones particular environment (Williams & Ford, 2008).

2.5. Psychological factors associated with talent identification and development

2.5.1. Psychosocial factors

Whilst the player and coach relationship is a significant external factor that can influence talent development in football, there are also other people that impact a young athlete's journey throughout the development process. Optimal interactions with parents, siblings, peers, and teachers all support the talent development process as a result of their interrelations, which in-turn may directly or indirectly influence key psychological and behavioural characteristics (Witte *et al.,* 2015; Kavussanu *et al.,* 2011; Sapieja *et al.,* 2011; Ullrich-French & Smith, 2009; 2006). For example, there is a large amount of research that confirms parents are often the ones who initiate or support opportunities for children to engage and maintain football participation through tangible support during childhood (Holt & Dunn, 2004).

Professional football players often cite their fathers as the most prominent parent regarding their tangible support provision, whilst mothers tend to be the more prominent emotional support provider (Gledhill & Harwood, 2014; Holt & Dunn, 2004). For example, from a female elite youth football perspective, Gledhill & Harwood (2014) initiated the idea of 'football fathers', who are fathers who have played or had experience of playing and/or coaching professional football. They revealed players interpreted the idea that this football experience was a crucial developmental resource as it facilitated the development of desired qualities, such as reflection and self-awareness. Furthermore, the football father's experience within the sport was also interpreted by the players to be important for enhancing coach-player relationships, reinforcing coach advice, and being able to modify football-specific supervision in relation to the player's developmental stage (Gledhill & Harwood, 2014). It is also suggested that elite level football players often have parents who create an environment of appreciation of success through hard-work and learning (Kavussanu *et al.,* 2011). Consequently, this may support the talent development process in elite youth football through player-level task-oriented and self-determined motivation associated with an effective parenting environment (Ullrich-French & Smith, 2009). Moreover, this may also develop a culture of unconditional self-acceptance and an increased self-awareness in elite youth football players (Hill *et al.,* 2008).

Mills *et al.* (2012) revealed coaches believe self-acceptance as a key psychological skill in talent development, as it is perceived to foster a realistic goal-commitment. Furthermore, during their longitudinal prospective research, Van Yperen (2009) also found goal-commitment as a psychological characteristic that differentiates elite youth football players who achieve professional status and those who do not. Thus, goal-commitment is likely to influence the talent development process in elite youth football through its effect on behaviours and engagement in quality practice, which will consequently enhance the overall quality of football performance (Haugaasen & Jordet, 2012).

Further literature surrounding parenting in football also supports the potential developmental benefits of authoritative parenting (Sapieja *et al.,* 2011). This parenting style expresses high expectations of children, although not so high that they feel pressured or obliged to meet those (Neumeister, 2004). For example, Sapieja *et al.* (2011) found that a more authoritative parenting style may support the development of healthy perfectionist orientations, or at the very least, may decrease the probability of developing unhealthy perfectionist orientations in youth football players. Consequently, this illustrates the potential benefits of authoritative parenting in the development of perfectionist behaviours, thus supporting both the performance and well-being of elite youth football players (Larkin *et al.*, 2016b; Hall *et al.*, 2014; Hill *et al.*, 2008).

The dual career demands of participating in academy football whilst engaging in academic practice have also gained recent attention (Jonker *et al.*, 2010; Konter, 2010), which appears to offer parents an opportunity to facilitate the development of their child (Gledhill & Harwood, 2015; 2014; Christensen & Sorenson, 2009). From a female perspective, Gledhill & Harwood (2014) revealed parent-teacher relationships and interactions and player-teacher interactions concerning football and academic careers, can influence whether dual career demands either positively or negatively impact a players psychological development. Furthermore, from a male perspective, Christensen & Sorenson (2009) highlight the dual career challenge is compounded by the strong competition for professional careers in Danish football, whereas Gledhill & Harwood (2014) revealed parents' and teachers' perceptions of a professional career in female football in England is not viable. This can be interpreted as providing both a gender and national comparison surrounding the prospects of dual career challenge, with further ongoing research required to reinforce these findings in-line with current developments surrounding female football in England and support the national differences regarding English male elite youth football players.

Alongside the influence of the coach, parent, and teacher on developing key psychological skills, peers and siblings have also been identified as significant providers in the talent development process (Gledhill & Harwood, 2014; Elliot & Weedon, 2011; Elliott, 2009; Van Yperen, 2009; Elliott & Maguire, 2008; Ommundsen *et al.*, 2005). Peers can have an impact on psychological factors through supporting enjoyment, motivational orientation, and perfectionist tendencies (Ullrich-French & Smith, 2009; 2006; Ommundsen *et al.*, 2005). Consequently, a greater relationship with peers in youth football has been associated with superior intrinsic, self-determined, and task-oriented motivation (Ullrich-French & Smith, 2006; Ommundsen *et al.*, 2005), which offers a greater probability of football continuation and progression through international age group football (Zuber *et al.*, 2015; Ullrich-French & Smith, 2009). Whilst peer relationships can have a positive impact on developing positive psychological qualities, Ommundsen *et al.* (2005) suggest they may also represent a protective mechanism against negative psychological skills through greater peer relationships associated with maladaptive perfectionism. Additionally, further research highlights that peers can both encourage and discourage adaptive lifestyle behaviours, thus suggesting that peers can affect a player's discipline level, which is frequently illustrated as a prerequisite for talent development in football (Morley *et al.*, 2014; Mills *et al.*, 2012; Holt & Dunn, 2004).

Van Yperen (2009) investigated the possible influence of siblings, revealing that elite players that progressed into professional football had significantly more than those who did not progress. It may be suggested that siblings have an influence on elite players' development, as a result of children with one or more sibling found to develop better socials skills than those without siblings (Downey *et al.*, 2015), with greater social skills also directly associated with facilitating effective team cohesion (Bruner *et al.*, 2014). Furthermore, Gledhill & Harwood (2014) revealed their elite female youth football participants had at one older brother who had been involved in high level football, consequently serving as a source of informational support for development while supporting them with football-specific activities.

2.5.2. Psychological characteristics

Coach practice design and the activity type have been highlighted as important factors that influence the development of key psychological characteristics, such as motivational orientation, that distinguish elite youth football players from their non-elite counterparts (Zuber & Conzelmann, 2015; Zuber *et al.*, 2015; Ward *et al.*, 2007). For example, Ward *et al.* (2007)

identified the significance of motoric, cognitive, perceptual, social interactions, and match-play activities on enjoyment. Alongside the importance of enjoyment to increase motivational orientation, match-play is also an activity to support the development of appropriate challenge and competition for young players (Singer & Janelle, 1999). Consequently, an increased challenge is associated with greater levels of intrinsic motivation and task-oriented behaviours, which have previously established a relationship with international age group progression within elite youth football players (Zuber *et al.,* 2015; Abuhamdeh & Csikszentmihalyi, 2012).

Alongside motivation, challenging players through an appropriate coaching manner as a result of a facilitated design during match-play has demonstrated the development of resilience, an increased self-awareness, social interaction skills, and an increase in problem-focussed coping behaviours (Collins & MacNamara, 2017a; 2016; 2012). Accordingly, these abilities have been highlighted in football literature through qualitative research as significant factors in order to achieve expertise (Morley *et al.,* 2014; Mills *et al.,* 2012; Van Yperen, 2009; Holt & Mitchell, 2006; Holt & Dunn, 2004). The ability to engage in problem focussed coping behaviours and seek social support distinguished Dutch players who made it onto an elite level compared to those who failed to do so (Van Yperen, 2009). Furthermore, Holt & Mitchell (2006) revealed the deficiency of coping behaviours of professional football players near to being released in English clubs.

Coping strategies are also correlated with moderating fear of failure through reducing its negative effect (Sagar *et al.,* 2010). Furthermore, effectively seeking social support from parents through coping resource was construed as a valuable tool for talent development (Holt & Dunn, 2004). Additionally, recent research illustrates an appropriate amount of challenge contributes to an effective learning situation for young players to develop, which Gledhill & Harwood (2014) associate with greater psychological wellbeing, a drive to succeed, need satisfaction, and self-regulation.

Toering *et al.* (2009) support these findings through revealing elite youth football players scored higher on reflection and effort when matched against non-elite players, demonstrating they have a superior awareness of their strengths and weaknesses, and are more prepared to exert effort in training and match-play to improve themselves to a greater extent. Morley *et al.* (2014) also established professional coaches expressed the importance of 'possessing a determination to succeed' as crucial for successful talent development, thus demonstrating the importance of possessing the ability to reflect, as a result of effort and determination to improve is vital for achieving expertise in professional football.

A desire to achieve professional status and succeed through adopting greater volitional behaviours is a result of superior commitment (Gledhill & Harwood, 2014) and seeking more high quality practice activities (Toering *et al.*, 2011). However, previous research reveals coaches often expect a compliant dedication to their instructions (Holt & Dunn, 2004), and often view players who do not follow instructions and any subsequent mistakes as weaker (Toering *et al.,* 2011). However, similarly to previous observations, this dated research requires reinvestigation as a result of the constant evolution of the professional academy environment. Nevertheless, there may be a difference between preferred and actual coach behaviours, consequently reducing an individual's opportunity to self-regulate and act in a volitional manner (Gledhill & Harwood, 2015; Holt & Mitchell, 2006).

According to Gledhill & Harwood (2015), autonomy-thwarting coach behaviours, such as an inability to provide a rationale for decisions, not valuing player input, or not applying player decision making, are associated with failed attempts by players to pursue a professional football career with greater levels of behaviour disengagement (Stebbings *et al.,* 2011). On the contrary, autonomy supportive coaching has been previously connected to superior levels of behavioural engagement (Curran *et al.*, 2013), enjoyment, and decreased dropout (Quested *et al.*, 2013). Consequently, this illustrates that through working with players in an autonomy supportive style, coaches are more likely to assist the psychological and behavioural talent development process of young athletes (Gledhill & Harwood, 2015; Toering *et al.,* 2011; Ford *et al.,* 2010b; 2010c; Sagar *et al.,* 2010; Ward *et al.,* 2007).

While supporting individuals has an important role in the talent development process in elite youth football, it is clearly not the sole responsibility of one person (Relvas *et al.,* 2010). Thus, a collective responsibility of the whole environment, to facilitate psychological characteristics for developing excellence, has been outlined as a significant factor towards expertise (Mills *et al.,* 2014a; 2014b; Larsen *et al.,* 2013; 2012). For example, Larsen *et al.* (2013) state that a successful talent development environment in Denmark is characterised by a strong, open, and cohesive organisational structure that considers the player from a holistic perspective (i.e., considering the whole person as opposed to focussing solely on football ability).

Similarly, Mills *et al.* (2014a) reported opinions from academy football coaches in England, revealing a successful talent development environment requires nine components; 1) a coherent philosophy and clear values, 2) promoting whole person development, 3) empowering key stakeholders, 4) forming positive relationships, 5) prioritising player well-being, 6) maintaining well-integrated personal links with clear links to senior progression, 7) having clear communication, 8) being adaptable and committed to innovation, and 9) constructing an achievement focussed climate with explicit opportunities to progress. Collectively, these studies highlight the consistent viewpoint concerning successful talent development environments for optimum psychological development in elite youth football.

Currently, there is limited literature surrounding these quality factors of a talent development environment against measurable outcomes that facilitate a successful talent development setting, such as player progression from academy status to a senior professional (Henriksen *et al.,* 2010a). However, there is growing evidence that examines players' perceptions concerning their talent development environments in youth football (Mills *et al.,* 2014b), and despite these previously cited qualities, player evidence illustrates that both male and female talent development environments do not necessarily demonstrate these perceived prerequisites (Gledhill & Harwood, 2015; Mills *et al.,* 2014b; Larsen *et al.,* 2012).

An effective talent development environment in elite youth football highlights the clear progression from youth team to senior level (Relvas *et al.*, 2010). However, Mills *et al.* (2014b) revealed 65% of their 50 UK-based male academy players felt they were 'written off' before having the opportunity to achieve their full potential. Furthermore, although a holistic approach is recognised as a vital factor concerning talent development in youth football, as highlighted earlier in this literature review, findings from both Christensen & Sorenson (2009) and Gledhill & Harwood (2015) illustrate the potential negative impact of mismanaging dual career challenges. Thus, when managed in this way, the challenges during the investment years appear to be a threat to multidisciplinary player development, consequently impacting youth to senior transitions, whilst also impacting psychological well-being by increasing perceptions of phenomena such as role strain (Gledhill & Harwood, 2015; Christensen & Sorenson, 2009).

While coach opinions have been applied to qualitative studies regarding the talent development environment, they have also been used to identify key psychological characteristics that are required to achieve adult expertise in professional football (Cook *et al.,* 2014; Elferink-Gemser *et al.*, 2012; 2011; Mills *et al.*, 2012; Toering *et al.*, 2009; McAuley & Tamrnen, 1989). For example, Mills *et al.* (2012) interviewed ten expert development coaches regarding player development at the critical stage during progression from youth team into professional level. Analysis of their data revealed six interrelated higher-order categories that represented the factors perceived to either positively or negatively influence player development. These included awareness, resilience, goal-directed attributes, intelligence, sport-specific attributes, and environmental factors. These findings show the process of talent development in youth football is multi-faceted and the need to identify stage-specific factors for gifted young players to translate their potential into excellence (Mills *et al.,* 2012).

Moreover, Cook *et al.* (2014) undertook an in-depth qualitative investigation of coaches and practitioners' perceptions surrounding mental toughness and its role in the development of youth football players at an English Premier League football academy. Following their analysis, four general dimensions of mental toughness emerged, including competitiveness with self and others, mind-set, resilience, and personal responsibility. Furthermore, Cook *et al.* (2014) explain how coaches foster independence and resourcefulness, through creating a challenging but supportive learning environment, to enhance mental toughness. Additionally, although Cook *et al.* (2014) highlight how mental toughness is readily acknowledged as a crucial factor in securing a professional contract, it was reported that academy coaches possess a lack of knowledge concerning how to effectively nurture this quality in players. Consequently, further investigation is required to apply psychological development strategies into academy environments (Harwood *et al.,* 2015; Pain & Harwood, 2008).

Another key psychological characteristic associated with positive performance outcomes in football is imagery, which is defined as creating and recalling experiences mentally (Morris *et al.,* 2005). For example, a football player could rehearse how he will take a penalty in their forthcoming game; imagining where they will shoot, how they will strike the ball, and on a specific type of surface. Studies have shown that almost all elite athletes intentionally employ imagery to their personal performance routine (Munroe-Chandler *et al.,* 2008; 2007; Morris *et al.,* 2005). It has also been found to be used by football players on a daily basis, irrespective of position (Munroe-Chandler & Hall, 2004). Furthermore, imagery training has been consistently found to have a positive effect on performance throughout various playing levels from professional to novices (Munroe-Chandler *et al.,* 2008; Shearer *et al.,* 2007; Munroe-Chandler & Hall, 2004; Reilly & Gilbourne, 2003).

While confidence remains one of the most consistent factors that differentiate elite athletes from their non-elite counterparts (Gould *et al.*, 1981), imagery has been highlighted as a mental skill to enhance confidence (Bandura, 1997). For example, Munroe-Chandler *et al.* (2008) illustrate the relationship between imagery use, self-confidence, and self-efficacy in youth football players, through revealing it as a significant predictor for both recreational and competitive participants. Consequently, as a result of the evidence regarding the application of imagery and elite performance, it is necessary to include this characteristic within psychological research concerning talent identification and development in elite youth football.

Gledhill *et al.* (2017) recently produced a systematic review of the psychosocial factors associated with talent development in football. Through sourcing 43 relevant studies that met their detailed inclusion criteria, with a cumulative total of 14,977 participants, Gledhill *et al.* (2017) illustrated a total of 48 psychosocial factors associated with talent development in football. While psychological factors can distinguish performance levels of football and are positively associated with career progression to a senior professional level in football (Cook *et al.*, 2014; Mills *et al.*, 2012), Gledhill *et al.* (2017) highlight the need for further research to advance the knowledge of psychological skills for developing excellence, through a diversification of participant groups, longitudinal, prospective designs, and testing the predictive validity of existing grounded theories.

2.6. Sociological factors associated with talent identification and development

Goulstone (2000) states how football historians and sociologists often recognise the pre-modern sport as a brutish mob-activity of the peasantry, which highlights the working class origins of football. For example, football in England had been played as a street game by the working class for many centuries before the formation of the Football Association in 1863 (Seddon, 1995). This form of football, known as ‘folk’ football, recorded as early as 1314, contained little rules and unlimited players' (Russell, 2007; Dunning & Sheard, 2005; Giulianotti, 1999). The survival of folk football came to an end as it had fallen foul to the civilised society process in the eighteenth- and nineteenth-century, as a result of an increasing number of people regarding the violence of folk football with revulsion (Dunning & Sheard, 2005; Dunning, 1999). Nevertheless, this evolution has supported the development of the structured modern game.

Unlike other talent development methodologies within this research, the investigation into the socio-economic factors of elite youth football players is scarce (Turnnidge *et al.,* 2014; Cote *et al.,* 2006). However, from a geographical viewpoint, it has been proposed that a young athletes' birthplace as a major factor concerning participation (Steingrover *et al.,* 2017; Balish & Cote, 2014; Turnnidge *et al.,* 2014; Bruner *et al.,* 2011; Baker & Logan, 2007). For example, Cote *et al.* (2006) revealed there was a significant over-representation of elite athletes within North American hockey, baseball, basketball, and golf associations, who were born in small cities (with a population of less than 500,000) when compared with larger cities (with a population over 500,000) who had an under-representation. This suggests the opportunity, economic volume and facilities, development, and performance are based on a number of socio-economic and geographical factors (Bailey *et al.,* 2010).

Furthermore, Rees *et al.* (2016) suggested the birthplace offers an advantage regarding the development of super-elite performance in sport. Consequently, Rees *et al.* (2016) recommend policy makers and practitioners consider the birthplace effect when designing talent identification methods, alongside its application when profiling athletes to support subsequent development. In addition, previous international (Pabayo *et al.,* 2014a; 2014b; Lammle *et al.,* 2012; Vandendriessche *et al.,* 2012b; Maher & Olds, 2011; Carlson, 1988) and UK populated studies (Evans *et al.,* 2013; Rowley & Graham, 1999; Yang *et al.,* 1996) have highlighted the impact of lower social classification increasing the risk of lower participation and drop-out compared to their higher class equivalents.

These implications advocate the importance of applying socio-economics into a development model, as place of birth may have a significant influence upon the opportunities available for participation (Finnegan *et al.*, 2017; Hasbrook, 1986). Additionally, many sports in the UK have concentrated on urban areas with traditionally poor participation rates to try and identify talent (De Knop *et al.*, 1999). On a worldwide scale, the interest in young talent from professional football clubs in the UK and Europe is now global in continents such as Asia and Africa, which highlights the worldwide search for potential (Bale, 2003).

For example, Elliot & Weedon (2011) illustrate foreign migrants into the English Premier League are perceived to have a greater technical competency by official representatives of the league, while English players were deemed to be more physical. Elliot & Weedon (2011) consequently created the concept of 'feet exchange', suggesting that foreign players with diverse abilities offer a learning resource for English players, thus supporting talent development. However, it is important to highlight this notion was not reported through the players' perception, while it was not clear from the reported method whether behavioural observations were adopted. However, Davids & Baker (2007) reveal the need for future research surrounding the process of skill acquisition and the role of various environmental constraints, while the mechanisms for the 'birthplace effect' remain unknown.

The migration of African players may also support the working class perception of football. For example, Darby *et al.* (2007b) state how the transit of African football players to Europe, and the role of football academies in this process, as a form of neo-colonial exploitation and impoverishment of the developing world by the developed world. The number of players recruited abroad by top-level clubs in eleven European countries (England, Scotland, Holland, Belgium, France, Germany, Switzerland, Austria, Spain, Italy, and Portugal) has more than doubled, increasing from 882 to 1803, making the average amount of foreign players 4.8 per team in 1995/1996 and 9.8 per team in 2004/2005 (Poli, 2006).

Moreover, the squad rosters of participating teams at previous African Cup of Nations provides evidence that the majority of African's elite football players ply their trade in Europe, and that this trend is increasing year by year. For example, the 2000 tournament, co-hosted by Ghana and Nigeria, had over 50% of players signed to a European clubs, while two years later at the same competition in Mali it had increased to 66% (Darby, 2007b). Furthermore, it is not only the top clubs that import African players; lower level and less wealthy clubs recruit African players because they are cheaper, through demanding less wages and are easier to negotiate short-term contracts with, and are also vulnerable as a result of not wanting to return to their country (Poli, 2010; 2006).

The effects of migration can be observed by donor nations (so-called 'brain-drains' or 'brawn-drains'), such as Ireland, Mozambique, and Angola, and in host locations where these migrant workers are employed, such as England, Spain, and Portugal (Elliott & Maguire, 2008). Milanovic (2005) explains how poor countries capture 'leg-drain', that is the improved skills which their players have acquired playing for better foreign clubs. This provides a stronger national team but also inequality by developing countries unable to grow and develop their leagues as developed countries leagues get better. Maguire & Pearton (2000) revealed the most popular destination for 1998 World Cup players to ply their trade was England, Italy, Spain, and Germany. In contrast, Paraguay, Norway, and Cameroon had between 2 to 3 players while Nigeria had none. Consequently, this further highlights the association between socio-economic status and football performance.

2.7. Physiological factors associated with talent identification and development

Recognising and promoting potential professional football players at a young age are crucial objectives for many practiced academies to source both sporting and financial success (Gonaus & Muller, 2012). Therefore, identifying early predictors for long-term success ensures that the most highly talented youth football players receive the greatest quality training available from a young age (Stratton *et al.,* 2004). Consequently, physiological characteristics, such as physical performance (Rowat *et al.,* 2017; Woods *et al.,* 2017; Buchheit & Mendez-Villanueva, 2014; Waldron & Murphy, 2013; Strauss *et al.,* 2012; Mendez-Villanueva *et al.,* 2011; Buchheit *et al.,* 2010), anthropometric measures and maturation status (Woods *et al.,* 2017; Gouvea *et al.,* 2016; Perroni *et al.,* 2015; Buchheit & Mendez-Villanueva, 2014; Gil *et al.,* 2014a; McCunn, 2014; Hirose & Hirano, 2012; Strauss *et al.,* 2012; Lago-Penas *et al.,* 2011; Hirose, 2009; Mohamed *et al.,* 2009; Chibane *et al.,* 2008; Gravina *et al.,* 2008), and the RAE (Skorski *et al.,* 2016; Gil *et al.,* 2014a; McCunn, 2014; Grossmann & Lames, 2013; Augste & Lames, 2011; Hirose, 2009; Mujika *et al.,* 2009; Jimenez & Pain, 2008; Wei-Min & Dan, 2008; Vincent & Glamser, 2006; Vaeyens *et al.,* 2005; Barnsley *et al.,* 1992), have been outlined as key developmental and performance indicators within elite youth football, and must accompany contemporary talent identification and development research.

2.7.1. Physical performance and physiological development

Physical performance measures provide an objective evaluation of young football players' athletic development (Durand-Bush & Salmela, 2002). Consequently, the observation of these physiological characteristics has received great interest from researchers concerning talent development (Robertson *et al.,* 2015; Hammani *et al.,* 2013; Le Gall *et al.,* 2010; Reilly *et al.,* 2000a). For example, Williams *et al.* (2011) conducted a three year study assessing the speed and jump performances of elite youth football players, revealing the monitoring of these variables facilitates the prediction of progression in an academy setting. They discovered sprint changes increased beyond the 'worthwhile' effect of 1% for 10 m and 30 m sprints, and 1.8% for jump performance during the early teenage years. Similarly, Mirkov *et al.* (2010) concur by suggesting explosive muscle power, agility, and coordination are characterised by chronological age in elite youth football players aged 11 to 14 years. This corresponding data reveals the effect of age on physical performance within a developmental environment in elite youth football. Consequently, this highlights the importance of investigating biological age-specific physical characteristics as part of a holistic talent identification and development programme.

There have been certain attempts to distinguish the physical development process in young athletes (Lloyd & Oliver, 2012; Balyi & Hamilton, 2004; Balyi, 2001). Previous youth athletic development models have identified distinct sport-specific stages of development classified by chronological age. For example, the LTAD model was produced by Balyi & Hamilton (2004), which is designed fundamentally upon physiological principles. This is due to the maturation and anatomical, neurological, hormonal, and musculoskeletal changes that must be integrated into any physical training (Ford *et al.,* 2011). The LTAD model was constructed on the basis that combines successfully employed training methods alongside a greater scientific basis for children and adolescents, whilst taking into consideration the impact of growth and maturation on athletic performance (Ford *et al.,* 2011; Balyi & Hamilton, 2004). This is employed through identifying key 'windows of opportunity' for optimum physical development (e.g., peak strength velocity and aerobic trainability) at specific ages. These continuous chronological development categories include 'Fundamentals', 'Training to Train', 'Training to Compete', and 'Training to Win' (Smith, 2003; Balyi, 2001).

From an applied perspective, governing bodies and sporting organisations alike have employed academic models and frameworks to support their talent development process. For example, the LTAD model has been implemented by various national governing bodies worldwide to offer an approach to develop children into elite athletes (Ford *et al.,* 2011). For example, in England, national governing bodies for cricket, badminton, and gymnastics have adopted the LTAD method into their development programmes (Ford *et al.,* 2011). However, recent research has underlined the flaws in this model, highlighting the differential rates of development of chronological age and biologic maturity throughout childhood and adolescence (Ford *et al.*, 2011).

Consequently, Lloyd & Oliver (2012) provided a contemporary physical development framework. In contrast to the LTAD model, the Youth Physical Development model (YPDM) establishes an athlete’s physical development at specific biological ages, rather than chronological age. Thus, the YPDM considers the maturational status of the child and arguably offers a more strategic approach to youth athletic development. The YPDM identifies at which maturational stage the training of specific fitness components should be emphasised, providing evidence-based reasoning to support its recommendations (Lloyd & Oliver, 2012). As aforementioned, focus on physiological performance characteristics and anthropometrical measures alone, to identify talent within elite youth football, can be misleading. Thus, physical development models should inform a multidisciplinary investigation into elite youth football development.

Ultimately, physiological characteristics appear favourable for initial talent identification, although their ability to successfully predict a succeeding professional career is inconclusive (Le Gall *et al.,* 2010; Carling *et al.,* 2009). Nevertheless, due to the physical nature of football and its importance at professional level, physiological data still provides valuable information and should be monitored within football academies as part of a multidisciplinary talent development approach. The current research presented surrounding physiological characteristics demonstrates early maturation is generally associated with greater physical performance. Additionally, with the possible exception of goalkeepers, there is no typical size and physique required to be a successful professional football player when compared to other sports such as basketball or gymnastics (Gil *et al.,* 2014b; Rebelo *et al.,* 2013; Hoare, 2000).

While growth and maturation are used interchangeably, they have separate definitions. Growth refers to the development of measurable changes in body size such as height, weight, and body fat percentage (Malina *et al.,* 2004). Maturation refers to qualitative system changes, both structural and functional, in the body's progress to maturity such as appearance of pubic hair and menstruation (Carling *et al.,* 2012). Differences in growth and maturation can be widespread, with regular terms described as very early, early, on-time, late, or very late 'developers' (Pearson *et al.*, 2006). For example, within an under-13 age group, it is possible to have players as much as five years different in biological age (Malina *et al.,* 2015). Therefore, physical performance spurts, such as speed, power, agility, and endurance, may occur at different chronological ages (Lloyd & Oliver, 2012; Balyi & Hamilton, 2004). Thus, advanced growth and maturity can create advantages in physiological performance measures and lead to systematic selection and progression of more mature players (Meylan *et al.*, 2010). Consequently, they may be more successful than their younger and less mature counterparts, who may be regarded as less gifted or talented during the talent selection process, or drop out due to low confidence or lack of success (Figueiredo *et al.,* 2009b).

Arguably, older players or early maturers are at an advantage due to their physical size at an early age. However, once each player's maturation starts to plateau towards adulthood, the preconceived physical advantage may be eliminated (Malina *et al.,* 2000). Therefore, it could be questioned whether identifying players at an early age through growth and maturation parameters is futile, as a result of the differentiation once players have gone through their pubertal phase and achieved adult height. Nevertheless, growth and maturation data offers an additional tool to facilitate developmental procedures, particularly surrounding physical loading and strength and conditioning training, due to the diverse period youths go through their growth spurt and achieve their peak height velocity (PHV).

Although there is no way to predict exactly how tall a child will become, the Khamis-Roche method can be used to provide an accurate estimate (Khamis & Roche, 1994; Khamis & Guo, 1993). As well as being used to predict adult height, the Khamis-Roche method also illustrates the percentage of predicted adult height attained and PHV status (pre-, circa- post-PHV). This provides a 90% confidence of approximately 10.5 cm error, and a 50% confidence of approximately 4 cm error (Khamis & Roche, 1994). The Khamis-Roche formula (Chapter 6 – section 6.4.3) is widely applied within the football development environment to monitor growth and maturation and facilitate individual training programmes (Malina *et al.,* 2015; Khamis & Roche, 1994). Therefore, the Khamis-Roche method offers a useful tool for measuring predicted adult height, percentage of predicted adult height attained, and PHV status, to assist a physical approach concerning talent identification and development in elite youth football (Malina *et al.*, 2015; Khamis & Roche, 1994).

According to Goncalves *et al.* (2012) accurate observation from expert coaches or scouts remains the main instrument to identify potential talent among youth players. As a result, Goncalves *et al.* (2012) proposed the objective approach of using growth and maturation as a concept to support selection and progress in a talent development environment. There appears to be a number of studies to support the suggestion of applying the use of anthropometric measures to evaluate the application of growth and maturation as a tool for recognising and developing talented youth football players (Ford *et al.,* 2011; Malina *et al.,* 2005).

It is evident the variation in size, function, and skill associated with growth and maturation status within the same age group can be considerable (Figueiredo *et al.,* 2010). Previous research has shown greater anthropometric measures, through advanced timing and tempo of maturation, can contribute to the overall success in elite youth football (Valente dos Santos *et al.,* 2012; Figueiredo *et al.,* 2010; 2009a; Malina, 2010; Malina *et al.,* 2004). This talent identification predisposition may result in late maturing players, albeit still potentially talented, dropping out of the game at an early age and consequently not achieving their full potential at adulthood (Malina *et al.,* 2000). Problematically, talented late maturers may possess the potential to be superior football players at senior level, if supported with high quality coaching and given the correct time to allow their physical maturity to catch up (Burgess & Naughton, 2010; Pearson *et al.,* 2006).

2.7.2. The relative age effect

Whilst variances concerning chronological age of less than 12 months have little significance on adult physiques, they have a large influence on young athletes during their development (Helson *et al.,* 2012; Barnsley *et al.,* 1985). Barnsley *et al*.'s (1985) early research showed that the RAE is a historic issue whilst observing its influence in ice hockey. Their results revealed a strong linear relationship between the month of birth (from January to December) and the proportion of players in the youth leagues studied. That is, the number of players with birthdates in January was the highest, followed by a steady decline throughout the remainder of the section year. Despite these early findings, this trend appears to have continued into the current talent development environments throughout various sports.

More recently, Delorme & Raspaud (2009) found the existence of the RAE whilst studying young male and female French basketball players from aged 7 to 18 years. Results indicated players born in the first and second quarter of the selection year were significantly over represented than players born in the fourth quarter. Likewise, this phenomenon has been established in other sports including athletics (Hollings *et al.,* 2014) Australian Rules football (Van Der Honert, 2012), baseball (Nakata & Sakamoto, 2013; Grondin & Koren, 2000), cricket

(Edwards, 1994), dance (Van Rossum, 2006), and tennis (Ulbricht *et al.*, 2015; Dudink, 1994), amongst others (Musch & Grondin, 2001; Baxter-Jones, 1995).

The majority of RAE research in youth football has revealed birthdate distribution having a significant impact on player identification and development (Votteler & Honer, 2017; 2014; Gonzalez-Villora *et al.,* 2015; Massa *et al.,* 2014; Helson *et al.*, 2012; 2005; 2000; Meylan *et al.,* 2010; Glamser & Vincent, 2004; Musch & Hay, 1999). For instance, early RAE research in a football context from Barnsley *et al.* (1992) titled their study 'Family planning: Football style', to illustrate the benefits of being born earlier in a chronological year.

Vandendriessche *et al.* (2012a) demonstrated how, following these consistent findings, the Royal Belgian Football Association installed, besides their normal national youth teams (under-16 and under-17), two future national teams comprising of on-time and late maturing players (under-16 Futures and under-17 Futures). This initiative aimed to develop the potential of these players according to their biological age and subsequently support issues with drop-out within the 'Futures' groups. Vandendriessche *et al.*'s (2012a) research into this initiative found growth and maturation status affects physical and motor performance, thus highlighting the benefits of avoiding a one-dimensional chronological approach through analysing biological performance.

Further strategies to support the development of later maturing players include the incorporation of banding players based on their biological age compared to the fixed chronological age groupings (Cumming *et al.,* 2017). This grouping approach, commonly known as 'bio-banding', clusters players based on their percentage of predicted adult height attained (Cumming *et al.*, 2018; 2017). Therefore, players are playing against opponents with a similar growth and maturation status, and thus levelling out physical requirements and increasing the technical and social demands (Cumming *et al.*, 2018; 2017). Together, Vandendriessche *et al.* (2012a) and Cumming *et al.* (2017) provide useful examples of strategies to support the development younger and less mature youth football players.

Mann & Van Ginneken (2017) produced the first piece of evidence to reduce the RAE through applying an age-ordered shirt numbering system. They discovered supporting talent scouts with the knowledge that the numbers on the playing shirts corresponded with the relative age of the players eliminated age bias. Therefore, this demonstrates the selection preconception associated with the RAE can be reduced if information surrounding each player's age is presented appropriately (Mann & Van Ginneken, 2017). Consequently, unique concepts should be researched and suitably applied within a talent identification and development environment in elite youth football to support chronologically younger players.

McCarthy & Collins (2014) identified a disproportionate opportunity for young rugby players to achieve academy status in relation to their birth quarter. Interestingly, they also revealed an advantage for quartile four birth dates through highlighting a 'reverse effect' where late-birth players were more likely to achieve senior professional status. They suggest this may be due to the greater psychological skills they have gained through additional challenges they have experienced by being initially younger players. Furthermore, McCarthy *et al.* (2016) support these findings through illustrating a greater number of young athletes converting into professional status from birth quarter's three and four compared to birth quarter's one and two in both rugby union and cricket. Jones *et al.* (2018) describe the reverse effect at 'super-elite' level as the resilient and mind-set that birth quarter four's acquire throughout their development process, as a consequence of being younger and less mature compared to birth quarter one's. As a result, similar research should be applied to football, and other sports, before it is accepted within the same context.

2.8. Technical factors associated with talent identification and development

2.8.1. Technical testing in football

Attempts to design multifaceted technical tests in football have been developed to incorporate the sequential manner of football (Vanderfold *et al.,* 2004; Abt *et al.,* 1998). For example, Zelenka *et al.* (1967) developed a combined football test consisting of sprinting, changes of direction, jumping, crawling under a 90 cm net, slalom dribble of the ball, and passing the ball into target areas where appropriate. However, it may be argued this holistic method creates an advantage to physical proficiency (i.e., sprinting and directional change) and therefore weakens the outcome of technical proficiency (i.e., passing and dribbling) alone. Additionally, the researchers performed no statistical analysis surrounding its validity and reliability, while the application of crawling under a net remains questionable.

More recently however, researchers have attempted to create football-specific technique tests that replicate actions performed in a competitive match. For example, a heading technique test, quantified by Rosch *et al.* (2000), instructs an examiner to throw the ball to the participant where they have to head the ball into the goal to achieve a certain number of points for accuracy. Furthermore, the wall-volley test requires the participant to pass the ball through the air against the wall, control the rebound, and make further air-borne passes against the wall (Vanderfold *et al.,* 2004; McMorris *et al.,* 1994). Additionally, two tests assessing football technique, the Loughborough Soccer Passing Test and the Loughborough Soccer Shooting Test, have been developed and applied to football research (Ali *et al.,* 2007a; 2007b). Unlike Zelenka *et al.*'s (1967) multifaceted test, both the Loughborough football technique tests have been validated and applied to various intervention studies (Gant *et al.,* 2010; Stone & Oliver, 2009; Ali *et al.,* 2007a; 2007b). Although technical tests are generally applied through a holistic approach in talent identification and development research, for the purposes of this literature review, they will firstly be examined in isolation to apply a critical assessment for each individual technical test.

The ability to effectively and proficiently dribble the ball past the opposition is often an indication of a talented player, and therefore a regularly measured skill factor in football (Hoare & Warr, 2000; Reilly & Holmes, 1983). Practical research methods surrounding dribbling are often drawn from traditional coaching methods where the ball is dribbled around cones placed 2 to 4 m away from each other in a figure of eight design. For example, McGregor *et al.* (1999) used university players of varying ability levels as participants for their slalom dribble testing procedure. As a result, McGregor *et al.* (1999) reported validity coefficient variables of r=78 (p<0.01) and 95% confidence intervals, therefore proposing this type of dribble test is a valid and reliable indicator of football technique. Arguably however, there may be a similar reliance on sprinting ability when focusing on the motor skill of dribbling, as physically quicker participants may be able to dribble the ball quicker compared to their slower counterparts, which may disregard the technical element of dribbling (Ali, 2011). On the contrary, an advantage of sprint ability could be recognised as part of the technical ability and skill element to dribble with increased efficiency in a match, and therefore should be recognised as part of the slalom dribble test.

Accurately and reliably passing the ball to a teammate is a vital skill football players require, with the correct timing, angle, and weight necessary (Davids *et al.*, 2000). A small number of researchers have devised tests to observe the accuracy and ability of the football pass (Haaland & Hoff, 2003; Rosch *et al.*, 2000). For example, Hoare & Warr (2000) instructed players to pass the ball over distances of 5 m for 15 minutes, then highly qualified coaches would then analyse the performance ability. However, there would need to be a number of coaches to analyse the passing sequences to allow for reliable coefficient variables, while the same coaches would need to observe all the passes completed by all the participants for dependable analysis, leading to an impracticable applied measure of passing with large coach participant numbers. Rostgaard *et al.* (2008) used a target based test to examine the accuracy of passing. Participant's attempted ten long passes (30 m) in the air into a target measuring 10 m x 5 m, with points awarded (3, 2, and 1) for the precision of the pass inside the area. This objective approach appears to be more reliable and constructive compared to Hoare & Warr's (2000) subjective method, while the test is more efficient for researcher's timescale and analysis.

The ultimate aim of a football match is to score more goals than the opposition, thus one of the most highly valued technical factors for a player is the ability to shoot accurately and effectively. Similarly to the technical tests formerly mentioned, shooting ability is usually part of a battery of technical tests to assess the overall technical performance in football (Haaland & Hoff, 2003; Rosch *et al.*, 2000; Reilly & Holmes, 1983). All the shooting tests observed require multiple attempts, using both feet, with aggregate points scored to determine overall performance, while points are scored for hitting certain targets (Haaland & Hoff, 2003; Rosch *et al.*, 2000; Reilly & Holmes, 1983). One argument of this technical test is that they do not measure the pace of the shot, and therefore players could have hit the ball at speeds slower than they would compared to match-play to gather more points (Ali, 2011). Nevertheless, shooting tests with targets seem to provide an accurate and reliable tool for measuring shooting accuracy in football.

Unlike the high frequency of other technical actions during a football match, such as dribbling, passing, and shooting, ball juggling occurs rarely (Ali, 2011). However, the juggling test has been commonly applied among technical research as an assessment of football coordination and technical ability (Vanderfold *et al.*, 2004; Hoare & Warr, 2000; Rosch *et al.*, 2000). Ball juggling tests typically involve keeping the ball off the floor and in the air using appropriate body parts (Vaeyens *et al.*, 2006). Ali (2011) argues ball juggling tests have a lack of ecological validity as such movements are rarely performed in competitive games. Additionally, Ali

(2011) states elite players do not necessarily need to possess good ball juggling ability to be a good football player, therefore the tests may also show poor construct validity. However, it may also be claimed these are naive judgments rather than practical observations, as research has previously revealed elite players possess superior ball juggling ability compared to non-elite players (Vaeyens *et al.,* 2006). This offers a positive relationship between football performance and ball juggling ability, and thus the use of ball juggling as a technical test in football may be perceived as both practical and reliable. Moreover, there is no evidence to reveal elite youth football players do not need to possess greater ball juggling skills to achieve greater perceived ability from expert coaches. Therefore, ball juggling may have a constructive purpose in analysing motor skill and coordination that is transferable to other football actions during match-play.

Typically, technical tests in elite youth football are part of a sequence of assessments designed for examining talent identification and development or applied as control measures (Ali, 2011; Vaeyens *et al.,* 2006; Vanderfold *et al.,* 2004; Hoare & Warr, 2000; Rosch *et al.,* 2000; Reilly & Holmes, 1983). For example, Rosch *et al.* (2000) analysed the F-MARC technique tests designed to closely relate to a football players' customary activity. Alongside common physical tests, they conducted technical tests, including ball juggling, speed dribble, long passing, shooting from a dead ball, shooting from a pass, and heading, in 588 participants. They supported the suggestion that analysing a players' physical and technical performance provides the opportunity to create an individual profile and training programme surrounding their needs, in relation to mean values from a similar age group, to facilitate developmental and monitoring approaches. Additionally, their participant numbers reveal the convenience of large scale research using technical tests in football research.

Furthermore, Hoare & Warr (2000) assessed the effectiveness of physical and technical attributes on the selection process of female Australian football players aged 15 to 19 years (*n*=59). They applied ball juggling, ball control, and passing and receiving technical tests to their study, combined with general anthropometric and physical tests. Their findings correspond with Rosch *et al.* (2000), suggesting it is possible to select football players based on their anthropometric, physiological, and technical features. In addition, Vanderfold *et al.* (2004) agree with this proposal after applying technical tests alongside physiological measures to their research. They concluded by recommending suggestions for physiological characteristics and technical ability to be addressed at an elite youth level, to support a greater interdisciplinary talent identification and development process.

2.8.2. Skill behaviour

When analysing the skill behaviours of football players during match-play for research purposes, it is important that the software used is appropriate to review the techniques for data analysis (Hughes *et al.*, 2007). Winners and errors, or successful and unsuccessful, are the most common indicators of technical competence and are often applied in research (Hughes & Bartlett, 2002). However, there are dangers of misinterpreting a skill due to dissimilar judgment. Therefore, each skill must have a technical definition through a generic glossary from an expert to be scientifically applied (Carling *et al.*, 2007). Video footage of players performing technical skills, such as passing, shooting, and tackling, can be used to evaluate quantity, success rates, and technique, which can support research analysis and individual feedback (Carling *et al.*, 2007). There are specialist software packages, such as Gamebreaker© and Dartfish©, to assist academics and performance analysts to investigate skill behaviours (Carling *et al.*, 2007).

Contrary to these traditional notational analysis methods, the development and application of sophisticated analysis systems, such as Sportscode©, Focus X2©, Prozone©, and Amisco©, have advanced the ability to objectively analyse sporting variables (Mackenzie & Cushion, 2013). For example, Prozone© and Amisco© have been validated to observe technical productivity alongside physical performance variables, thus offering a valuable data collection tool, while combining a resource for coaches and sport scientists (Castellano *et al.,* 2014). However, these approaches prove a costly expense for professional football clubs, and therefore cause a trade-off surrounding the monetary outlay and the applied usefulness of the software. Therefore, it may be argued computerised notational analysis systems can be applied to research with minimal expense to gain basic, albeit significant, objective statistics compared to expensive analysis systems. Additionally, the implications of this technical assessment method have been appreciated by modern development research within national governing bodies and large sporting organisations, through its applied practice concerning both development and performance (Thomas *et al.,* 2015; Groom *et al.,* 2011; Lupo *et al.,* 2010; Fenoglio, 2004a).

For example, Thomas *et al.* (2015) collaborated with the England Rugby Football Union to identify an appropriate introduction to rugby union for under-9 players. They filmed 89 games across five counties; two governed by the previous rules and three governed by the pilot rules. Using Dartfish© notational software, they revealed 25% more ball in play time, 55% more runs with the ball, more than twice as many successful passes, and nearly twice as many tries scored during the pilot rules games. As a result, this initiated a change in the format of youth rugby union in England by reducing player numbers and increasing individual ball contact and technical actions. In football, computerised notational match analysis research in football has been regularly used in studies to measure football-specific skill behaviours during controlled games to assess playing surface, playing position, pitch size, futsal, task constraints, and small-sided games (SSGs; Kolati *et al.,* 2016; Nicholls & Worsfold, 2016; Carling *et al.,* 2014; Wright *et al.,* 2012; Tessitore *et al.,* 2012; Di Salvo *et al.,* 2007).

Research surrounding SSGs, within both youth and adult football in elite and non-elite ranks, has applied skill behaviours as significant variables (Kolati *et al.*, 2016; Katis & Kellis, 2009; Fenoglio; 2004a; 2004b). For example, Katis & Kellis (2009) examined the effects of player numbers on skill behaviours during SSGs in young football players (age 13 ± 0.9 years). The SSGs included 3 vs. 3 and 6 vs. 6 matches consisting of 10 bouts of 4 minutes duration, with 3 minutes active recovery in between. Each game was filmed to measure the skill behaviours which were categorised into six categories; short passing (distance less than 10 m), long passing (distance more than 10 m), dribbling, heading, shooting, and tackling. The figures revealed the number of short passes, long passes, tackles, dribbles, and goals scored were significantly higher during the 3 vs. 3 SSGs compared to the 6 vs. 6 SSGs. Conversely, players performed more long passes and headed the ball more often during the 6 vs. 6 SSGs.

Fenoglio's (2004a; 2004b) research agrees with these results, after proposing a project with the Manchester United Academy under-9 squad. Their layout had five different pitches which all had different rules, including a 2-goal game (4 vs. 4), 4-goal game (4 vs. 4), line-ball (4 vs. 4), goalkeeper game (4 vs. 4 plus goalkeepers), and a standard 8 vs. 8 game. The overall aim of this research was to compare the number of individual skill behaviours used in each of the matches, particularly between the 4 vs. 4 scenarios and the 8 vs. 8 games. Fenoglio (2004b) involved ten English Premier League academy teams and analysed three eight minute segments from each of the 4 vs. 4 and 8 vs. 8 formats. Results revealed, on average, that the 4 vs. 4 games increased the number of passes by 135% (585 more), the number of scoring attempts by 260% (481 more), the number of goals scored by 500% (301 more), the number of 1 vs. 1 encounters by 225% (525 more), and the number of dribbling skills used by 280% (436 more), compared to the 8 vs. 8 games. This evidence shows that computerised notational analysis is a common and reliable tool used to assess skill behaviours during football, and can be applied to youth football for development and research purposes.

2.9. Tactical factors associated with talent identification and development

2.9.1. Perceptual-cognitive expertise and decision making ability

Although the contemporary viewpoint is elite athletes have developed superior perceptual-cognitive skills via experience, early research concerning PCE failed to consistently distinguish a difference between skilled and less-skilled performers (Muller *et al.,* 2006). For example, Helson & Starkes (1999) investigated expert and intermediate adult football players surrounding a variety of non-specific visual processing and information abilities. Although intermediate players had slightly better dynamic acuity and faster movement velocities, while experts displayed broader peripheral visual range in the horizontal dimension, no reliable variances were observed between the groups. However, the sample size was limited (*n*=28) while the expert football players were semi-professional rather than professional, therefore it appeared evident that further comprehensive research was required. In addition to this early study, Williams (2000) stated in his talent identification and development review of elite youth football, that the current research supports the consensus that skilled football players do not possess enhanced visual information compared to their lesser skilled counterparts.

However, more recent research has revealed more consistent results that support the hypothesis of elite athletes possessing superior decision making skills compared to their non-elite counterparts (Williams *et al.,* 2012; Wilson *et al.,* 2012; Mann *et al.,* 2007; Abernethy *et al.,* 2005; Ward & Williams, 2003; Savelsbergh *et al.,* 2002; Goulet *et al.,* 1989). For instance, there are now numerous studies that provide evidence that elite athletes have an advanced PCE compared to their non-elite peers within numerous sports, including badminton (Abernethy & Zawi, 2007), baseball (Ranganathan & Carlton, 2007), rugby (Jackson *et al.,* 2006), and volleyball (Canal-Bruland *et al.,* 2011; Wright *et al.,* 1990), among others (Mann *et al.,* 2007; Muller *et al.,* 2006; Renshaw & Fairweather, 2000). For example, both Renshaw & Fairweather

(2000) and Muller *et al.* (2006) compared three distinct standards of cricket batters. They reinforced the importance of ACI by showing highly-skilled players have a refined information extraction and use kinematic relevant sources compared to their intermediate and low-skilled equivalents. This notion is also evident in both senior and youth football (Chapter 8 – section 8.2.1.; Belling *et al.*, 2014; Roca *et al.*, 2012; Williams *et al.*, 2012; Mann *et al.*, 2007; Ward & Williams, 2003).

2.9.2. Creativity and game intelligence

A wide focus of attention is important for enabling players to recognise a diverse number of opportunities in a practical sport environment (Aquino *et al.*, 2016; Memmert, 2010b; McPherson, 1994). According to Memmert & Furley (2007), creative individuals set themselves apart during competitive situations. For example, although player A may actually intend to pass the ball to player B, they are able to identify at the last moment that player C is suddenly unmarked and better positioned, thus consequently passing the ball to them instead. Failure to spot player C is called 'inattentional blindness', with practical tests demonstrating children with greater ability and creativity being less prone to this blindness compared to children with lower ability and creativity (Memmert & Furley, 2007).

Although it is currently during its early stages, research shows that focus of attention could be a strong predictor for developing advantages in creative thinking in team ball sports (Pain, 2013). Interestingly, experiments in handball demonstrate that more tactical instructions from the coach can lead to a narrower breadth of attention, thus increasing inattentional blindness, whereas fewer tactical instructions widen the breadth of attention (Memmert, 2007). Therefore, it may be suggested that certain vocal commands from a coach may have a detrimental effect to the development of elite youth football players, through increasing the possibility of inattentional blindness and consequently decreasing creativity and game intelligence.

However, this assumption needs investigating appropriately before accurately revealing particular outcomes in elite youth football development.

The early diversification pathway from the DMSP suggests that a varied sport involvement facilitates the development of creative thinking (Cote *et al*., 2007; Memmert & Roth, 2007). Memmert *et al.* (2010) investigated this concept by exploring the practice histories of 72 professional players from various team sports, including football. Coaches selected the most creative and the least creative players from their teams, with creative behaviour defined in terms of 1) unusualness, innovativeness, statistical rareness, or even uniqueness of tactical solutions to a game related task, and 2) varying and flexible tactical solutions over different complex game situations (Memmert *et al.*, 2010). Both groups of players then provided information about the quantity and type of sport-specific and other related practice activities undertaken throughout their careers from aged 5 years upwards. Results presented a significant difference between the two groups for time spent in play-like activities and a significant difference for total time spent in training activities for their main sport. In both cases, more creative players accumulated greater hours than their less creative counterparts. Overall, these results demonstrate that deliberate practice and unstructured play-like involvement both have crucial roles for the development of creative behaviour in team sports. This unstructured activity results in deliberate play, which coincides with Ford *et al.*'s (2009) theory of early engagement.

Memmert (2006) also completed two intervention studies surrounding deliberate play and deliberate practice in children, and whether this will facilitate creativity. The first study focussed on the impact of playful, self-determined, and diverse environments. Thirty-three children (aged 8 to 9 years) participated in a training programme to improve creative behaviour in team ball sports. The programme consisted of one hour a week of game-based (playful) and discovery learning activities (self-determined) across four sports, including football, basketball, handball, and hockey (diverse). Memmert (2006) suggests during each of these activities, the coaches only offer the players an indication and the rules of the games, nothing more (i.e., no special tactical advice or any kind of feedback). Results revealed the participants that played the game-test scenarios, designed to assess creativity in off the ball movement and identification of space, displayed a significant increase in creative thinking compared to a control group. The second intervention study observed whether creativity could be improved by an attention-broadening training programme. The six month intervention focused on the type of instruction given by the coach. In the broadening condition, no explicit tactical advice or information relating to focus of attention was given. In the narrowing condition, explicit tactical advice and correctional feedback was given, which inhibited children from directing their attention to different kinds of stimuli that could inspire unique and original solutions to game related problems. Consequently, the attention-broadening group showed greater divergent thinking and creativity in subsequent game-test scenarios.

2.10. Summary

This thesis has reviewed the influential characteristics, including environmental, psychological, sociological, physiological, technical, and tactical factors, which have been previously associated with the talent identification process and the development of expertise (Ivarsson *et al.*, 2015; Baker *et al.*, 2003b).Subsequently, whilst this list is not exhaustive, with further literature provided within each chapter's respective rationale, this review of current research has informed the hypotheses' that will be applied to the following chapters. For example, although there is a large amount of research to consider (such as the DMSP; Cote *et al.,* 2007), the environmental research hypothesis (Chapter 4) is formulated through Ford *et al.*'s (2009) early engagement theory, as a result of being specifically developed for a football environment. Next, the psychological research within this thesis (Chapter 5) is developed and hypothesised through MacNamara & Collins' (2011) Psychological Characteristics for Developing Excellence Questionnaire, as it appears to offer a more comprehensive psychological approach from a talent development perspective compared to others that focus their enquiry into specific psychological factors. Furthermore, although there are various suggestions concluded from previous research amongst diverse sports, the sociological hypothesis (Chapter 6) is articulated through the sole example available within football, provided by Bourke (2003), where their findings illustrated football maintains a traditional and stereotypical divide between socio-economic status and participation, with young players in Ireland subsequently targeted from working class families.

From a physiological perspective, the hypothesis for the physical characteristics (Chapter 7) is generated from Gouvea *et al.* (2017), Emmonds *et al.* (2016), Deprez *et al.* (2015b), Gil *et al.* (2014; 2007b), Gonaus & Muller (2012), Le Gall *et al.* (2010), and Mirkov *et al.* (2010), who all reveal discriminating differences between elite and sub-elite populations across a variety of age groups resembling both development phases within this study. For anthropometric measures, the hypothesis for the anthropometric measures and maturation status (Chapter 7) is generated from Malina *et al.* (2010; 2004; 2000), Figueiredo *et al.* (2010; 2009b), Le Gall *et al.* (2010), Nevill *et al.* (2009), and Vaeyens *et al.* (2008), who collectively reveal an association between enhanced anthropometric measures and maturation status, including body height, body mass, BMI, body fat percentage, predicted adult height, percentage of estimated adult height attained, and PHV status, and a greater likelihood of being identified and developed as an elite youth football player across both development phases within this study. Also, the RAE hypothesis (Chapter 7) is generated from Gonzalez-Villora *et al.* (2015), Massa *et al.* (2014), and Helson *et al.* (2005), who together reveal birth quarter 1 and 2's are significantly overrepresented compared to birth quarter 3 and 4's in elite youth football.

Moreover, the technical testing hypothesis (Chapter 8) is articulated through Vaeyens *et al.*'s (2006) findings, which have applied the same particular measures to their study. Although there is no direct research within paediatrics regarding match analysis statistics and performance outcomes, this skill behaviour hypothesis (Chapter 8) is articulated through both Liu *et al.*'s (2016) and Rampinini *et al.*'s (2009) findings, which have already been highlighted. In addition, from a tactical viewpoint, the hypothesis for the PCE investigation (Chapter 9) is based upon the findings of Ward & Williams's (2003), who found advanced PCE in elite youth players between the ages of 9 and 17 years in comparison to sub-elite players during their video based simulations. Finally, this chapter also offers an original insight into the tactical ability of academy players using football-specific game test situations, through applying Memmert's (2010a) findings to form the hypothesis (Chapter 9).

The following chapter (Chapter 3) will focus on the methodology of these measures, and how they were applied to this particular thesis. Then, using these influential characteristics, the next six chapters (Chapters 4 to 9) individually explore these outcome measures for predicting potential expertise respectively, through illustrating what attributes discriminate high- and low-performing players within an English football academy. Furthermore, these features were analysed from an age-specific viewpoint, through observing players within both the FDP and YDP. Following the illustration of characteristics that are associated with talent identification, this thesis then analysed the significant ($p<0.050$) and near significant ($p<0.150$) factors over two football seasons, to reveal what influenced the talent development process within the same environment from an age-specific perspective (Chapter 10). Following the detection of these attributes from a fully-integrated multidisciplinary standpoint, these features were subsequently analysed from an interdisciplinary viewpoint, thus indicating the greatest predictors for holistic development in elite youth football within particular age phases.

The bridge between contemporary research and applied coaching practice is frequently questioned, through coach education often remaining ‘fixed’ while research continues to evolve (Cushion *et al.*, 2012; Helsen *et al.*, 2012). Similarly, researchers often fail to generate clear guidelines for practitioners to simplify the practical enactment, while there is often a lack of coherence in the understanding of talent development systems and processes between key stakeholders and researchers (Pankhurst & Collins, 2013). Thus, following the illustration of these original findings from an English football academy perspective, both applied practical implications within ECFC Academy and the ‘Locking Wheel Nut Model’ have been outlined and created respectively, to facilitate ideas and a user-friendly application for an applied football-specific talent identification and development environment (Chapter 11).

3. METHODOLOGY

3.1. Introduction

Following the broad review of literature, this thesis has divided the appropriate talent identification measures into individual chapters; Environmental (Chapter 4), Psychological (Chapter 5), Sociological (Chapter 6), Physiological (Chapter 7), Technical (Chapter 8), and Tactical (Chapter 9). As a result of consistent similarities in methods between these chapters this particular chapter has been created to simplify the layout of each of the chapters outlined above to avoid repetition. Additionally, this chapter also includes a discussion of the philosophical standpoints on which decisions to adopt certain methods were made.

3.2. Participants

This project assessed ECFC Academy under-9 to under-16 squads, with a total of 98 participants providing data from the PHQ, the Psychological Characteristics for Developing Excellence Questionnaire (PCDEQ), postcode statistics, physical performance tests, anthropometric and maturation status', the RAE, technical tests, match analysis statistics, PCE tests, and game test situations. Participants were analysed within their age phase; Foundation Development Phase (FDP; under-9 to under-11; *n*=40) and Youth Development Phase (YDP; under-12 to under-16; *n*=58). Only outfield players were used for this study, due to the contrasting development pathway for goalkeepers and their position specific requirements (Gil *et al.,* 2014b; Rebelo *et al.*, 2013). Written consent was gained from parents or guardians (Appendix 1) and assent gained from the players (Appendix 2) prior to the study. All participants (Appendix 3) and participants' parents or guardians (Appendix 4) received an information sheet explaining the project and why consent and assent forms were required. The Sport and Health Sciences Ethical Committee, based at the University of Exeter, approved the study (Appendix 5).

3.3. Procedures

3.3.1. Participation History Questionnaire

The PHQ (Appendix 6) was applied to Chapter 4 (Environmental) for its data collection. The PHQ is a retrospective recall questionnaire, which is used to elicit information regarding the activities in which players have engaged in during their development, and has been previously applied to literature regarding elite youth football development (Ford & Williams, 2012; Ford *et al.,* 2012). Additionally, the test-retest reliability and the concurrent validity of the PHQ have been established (Ford & Williams, 2012; Ford *et al.*, 2012; 2010a; 2009). The PHQ contains three sections including milestones within football, engagement within football activities, and engagement in other sport activities.

Initially, the football-specific milestones include both the age at which the player first engaged in football and the age they began participation in a professional football academy. The second section of the PHQ is designed to elicit information from four football-specific activities; match-play, coach-led practice, individual practice, and peer-led play. The participation in these activities is included in this questionnaire to test developmental concepts such as deliberate play, practice, and early engagement. The hours per week and months per year in each of the football activities, as well as the number of weeks the player was injured, are recorded in the PHQ for each year from the current season back to the year the participant stared playing football. Finally, the third section of the PHQ is designed to produce information concerning engagement in other sport activities. It contains a list of sports from which players were required to indicate those in which they have participated in regularly for at least a total minimum period of three months. Players are not required to record other sport activities engaged in during Physical Education (PE) classes in school (Ford *et al.*, 2012). Each under-9 to under-16 participant was given one hour to complete the PHQ under supervision from the researcher, while allowing questions to facilitate individual understanding. It was completed by the participants in December 2014 during the 2014/15 season.

3.3.2. Psychological Characteristics for Developing Excellence Questionnaire

MacNamara & Collins (2011) developed the PCDEQ (Appendix 7) which was applied to Chapter 5 (Psychological) for its data collection. The PCDEQ was developed to connect the theory-practice divide, to assess the possession and distribution of important psychological characteristic of developing excellence. According to MacNamara & Collins (2013), building on numerous qualitative studies, a multi-stage method to the development of the questionnaire was employed and exploratory factor analysis revealed a six-factor structure, with 59 items in total. The 59-item PCDEQ examines six significant categories of psycho-behavioural measures that influence effective psychological development in sport (Table 3.1.).

Factors 1 and 6 measure how performers employ PCDEs as a consequence of encouragement from others, while the further factors measure how individuals perform these skills independently. Thus, the questionnaire does not only assess whether the athlete possesses these important skills, but also their ability to perform them appropriately depending on the particular challenge they face within their performance environment (MacNamara & Collins, 2013). Each of the questionnaires 59 items applies a six-point Likert scale with a similarity response method from 1 (very unlike me) to 6 (very like me). This ensures participants were not allowed to remain neutral and therefore encouraged them to think more carefully about whether they agree or disagree with the statement leading to greater accuracy. Additionally, a mixture of positively and negatively worded items is included to minimise the danger of acquiescent bias (MacNamara & Collins, 2013).

Table 3.1. The six factors of the PCDEQ (Adapted from MacNamara & Collins, 2013)

Factor	Sample items
Factor 1: *Support for long-term success (17 items)*	• My coach/teacher encourages me to seek advice from appropriate others. • My coach/teacher and I plan on the basis of my future success, not just for today.
Factor 2: *Imagery use during practice and competition (12 items)*	• I use imagery to correct my physical performance. • I imagine myself handling the arousal and excitement associated with competition.
Factor 3: *Coping with performance and developmental pressures (11 items)*	• When I make a mistake I find it difficult to get my focus back on task. • My coach/teacher doesn't push me to overcome my difficulties I find difficult to overcome my feelings of anxiety when I perform.
Factor 4: *Ability to organise and engage in quality practice (7 items)*	• In practice, I really think about and focus on what I have done in the session. • I set myself challenging goals that I have to work hard to achieve.
Factor 5: *Evaluating performances and working on weaknesses (5 items)*	• I analyse my performances to find out what I did well and what I did badly. • I consider my weaknesses and work hard on these in practice.
Factor 6: *Support from others to compete to my potential (7 items)*	• People around me help me to accommodate the demands of my activity. • I listen and learn from the people around me.

The under-9 to under-16 participants were given one hour to complete the PCDEQ under supervision from the researcher, while allowing questions to facilitate the individual understanding. The participants completed the PCDEQ in April 2015 during the 2014/15 season.

3.3.3. Postcode statistics

These postcode statistics were applied to Chapter 6 (Sociological). The postcode provides data surrounding the participant's level of deprivation using the online website http://www.checkmyarea.com. This offers information using the UK General Registrar Classification system and average credit rating, applying the Cameo™ geodemographic database. This reveals a social classification (A, B, C1, C2, D, and E), produced by the UK's Office for National Statistics (2017), and an average credit score (out of 999), of where the participant lives (Table 3.2.). In Addition to using the participant's home address postcode, their school postcode is also applied to gain a complete investigation into the participants' environmental status.

Table 3.2. Social classifications (adapted from Office for National Statistics, 2017)

Social classification	Example
A (1)	Professionals such as doctors, lawyers, dentists, chartered architects, and engineers. Individuals with a large degree of responsibility, such as senior executives and senior managers, higher grade civil servants, and higher ranks of the armed services.
B (2)	University lecturers, heads of local government departments, executive officers of the civil service, middle managers, qualified scientists, bank managers, police inspectors, and senior ranks of the armed forces.
C1 (3)	Nurses, technicians, pharmacists, salesmen, publicans, clerical workers, clerical officers within the civil service, police sergeants and constables, and senior non-commissioned officers within the armed services.
C2 (3)	Skilled manual workers who have served apprenticeships; foremen, manual workers with special qualifications, such as long distance lorry drivers, security officers, and other non-commissioned officers within the armed services.
D (4)	Semi-skilled and unskilled manual workers; labourers and people serving apprenticeships, clerical assistants in the civil service, machine minders, farm labourers, laboratory assistants, postmen, and all other members of the armed forces.
E (5)	Pensioners, casual workers, long term unemployed people, and others with relatively low or fixed levels of income.

Each under-9 to under-16 participants' home and school postcodes, for both average credit rating score and social classification in August 2014, during the 2014/15 season, were provided. These were subsequently entered into http://www.checkmyarea.com, using the UK General Registrar Classification system and average credit rating, applying the Cameo™ geodemographic database, and recorded for analysis.

3.3.4. Physical performance tests

Physical performance tests were applied to Chapter 7 (Physiological). These tests were conducted with the participants to measure specific physiological parameters including acceleration, sprint, agility, and jump abilities (Figure 3.1.). These tests have been previously applied to talent development research in youth football (e.g., Wong *et al.*, 2009; Pearson *et al.*, 2006; Philippaerts *et al.*, 2006).

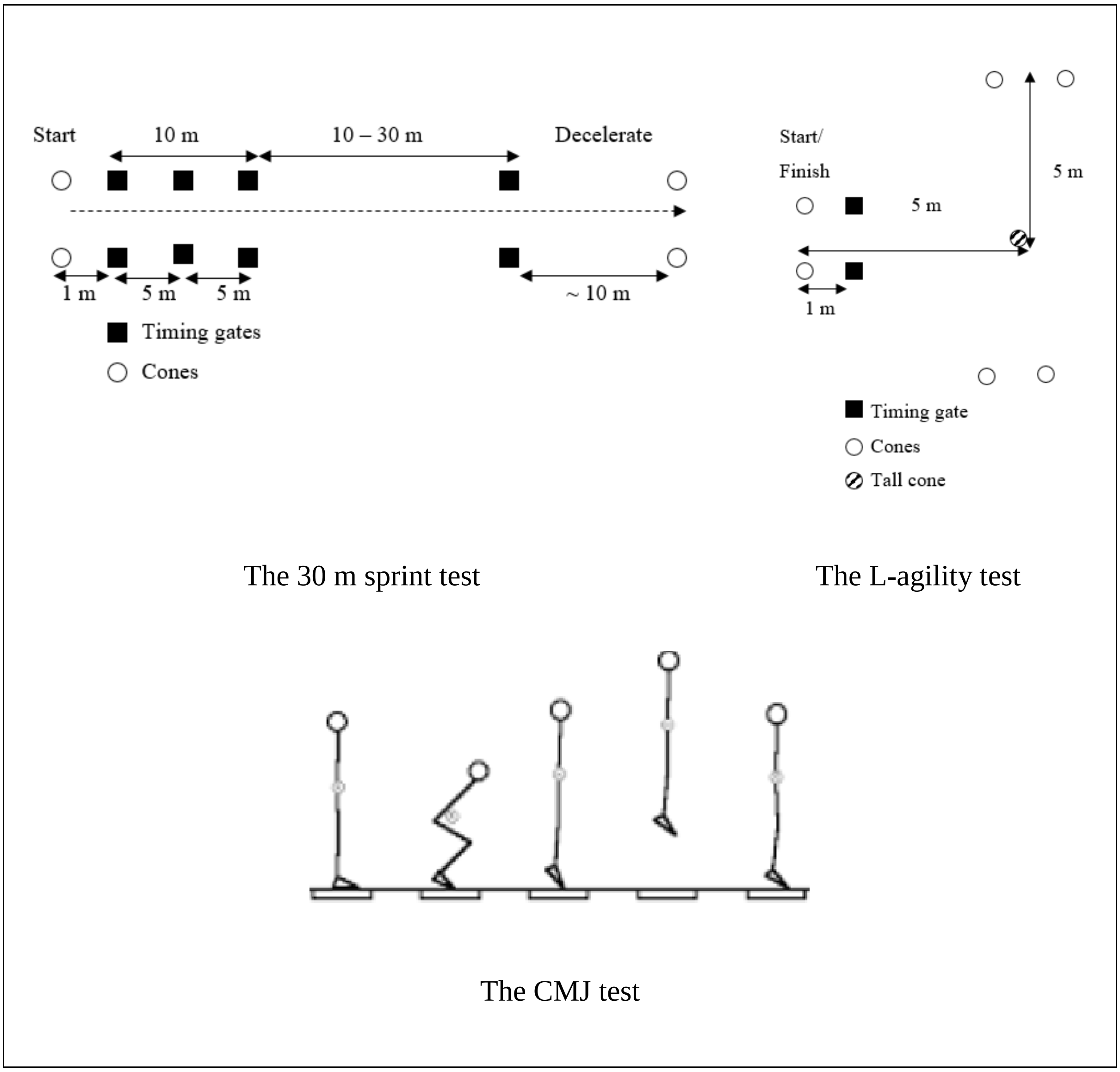


Figure 3.1. Physical performance tests

The 30 m sprint test started 1 m behind the first set of timing gates (Brower TC Timing System, Draper, Utah, USA). Participants sprinted until passing the final set of timing gates. Timings for 0–10 m, 10–30 m, and 0–30 m were taken to observe acceleration, maximum sprint, and total sprint respectively. It is important the participant kept sprinting past the final set of timing gates, therefore a set of cones were placed approximately 10 m from the end of the sprint, which the players decelerated through. Participants were instructed that they have plenty of recovery time, and once they have finished the sprint they should decelerate and then walk slowly back to the start position. Three trials were completed with the fasted result taken for investigation.

The L-agility test required participants to start 1 m behind the first set of timing gates (Brower TC Timing System, Draper, Utah, USA), then run forwards 5 m around the tall centre cone, run 5 m to the left hand cones and place one foot between the two marker cones, and then turn and follow the same path back to the start. In the second trial players performed the same test but this instance running 5 m to the cones on the right hand side. Players were instructed to run around the tall centre cone (not over it) and to follow a tight path around the cone (not a wide arch). Emphasis of the importance of getting one foot between the marker cones at the side was instructed. Where a participant failed to reach the marker cones on the turn, it was discounted, with another attempt provided at the end of the test session. If required, participants could perform low intensity activity between attempts (i.e., walk/slow jog to the touchline and back), thus sufficient recovery between attempts was provided. Three trials were completed on both the left and right (six in total), with the fasted combined mean from the left and right taken for investigation.

During the CMJ test (Probotics Inc. 8602 Esslinger CT, Huntsville, Alabama, USA) the most important concern was to ensure correct form, thus a demonstration jump was provided. Players were instructed on the importance of using a countermovement and the need to take-off and land with straight legs. Any jumps where the correct form was not maintained were discounted. Sufficient recovery between attempts was also provided. Additionally, players could perform low intensity activity between attempts (i.e., walk/slow jog to the touchline and back) if required. The jump height (cm) was recorded for analysis. Three trials were completed with the result calculating the greatest jump height taken for investigation.

Each participant completed the physical tests three times during the 2014/15 season (September 2014, January 2015, and April 2015). As a result of other measures in this study only being taken once during the season, only the January 2015 (mid-season) results are applied this physiological research. Players completed these tests in an indoor sports hall with a hard-wood floor, with generic academy training kit being worn (Francioni *et al.*, 2016).

3.3.5. Anthropometric measures and maturation status

Standard anthropometric measurements were applied to Chapter 7 (Physiological). These measurements examined in the current study included each participant's height, body mass, BMI, and body fat percentage. Height measures were recorded to the nearest 0.1 cm (Seca 213 Leicester Height Measure). Body mass measures were recorded to the nearest 0.1 kg (Tanita BF-350 Body Composition Monitor). BMI was calculated through dividing weight (kg) by height (m) and dividing that number by height (kg/m^2). Body fat percentage was also estimated (Tanita BF-350 Body Composition Monitor).

Each participant's anthropometric results were measured seven times during the 2014/15 season (July 2014, September 2014, November 2014, January 2015, February 2015, April 2015, and May 2015), and recorded by the same researcher at each time point. Corresponding with the physical performance tests, only the January 2015 measures of the anthropometric tests during the season are applied this research. Players completed this procedure bare footed with their training shorts and t-shirt on.

The Khamis-Roche method (Khamis & Roche, 1994) was used to analyse the participants predict adult height, percentage of predicted adult height attained, and PHV status. The Khamis-Roche method is based on a mathematical calculation using the child's gender, current height and body mass, and the height of both parents. The formula applied to predicted height in inches is; = ((age factor) * (age in years)) + ((height factor) * (height in inches)) + ((body mass factor) * (body mass in pounds)) + ((parental height factor) * (parental height in inches)) + (beta coefficient). The participants predicted adult height then allows the researcher to also identify the percentage of predicted adult height attained. Additionally, the growth curve attained from monitoring their growth and maturation supports this study by identifying the participants PHV status; pre-, circa-, and post-PHV. Each participant's anthropometric measures facilitate the Khamis-Roche predictions, and correspond with the physical performance tests and anthropometric measures, with the January 2015 results applied to this research.

3.3.6. Relative age effect

The RAE was applied to Chapter 7 (Physiological). The simple procedure of assessing the RAE consists of dividing the twelve months of the year into four quarters, conforming to the strategy applied to distribute chronological age groups (Helson *et al.*, 2012). Due to the start of the section year beginning in September in England, this is recognised as 'month 1' while August is 'month 12' (Table 3.3.). All the under-9 to under-16 ECFC Academy players provided their birth dates in August 2014 during the 2014/15 season, and were subsequently allocated into the correct birth quarter ready for examination.

Table 3.3. Birth quarters according to the RAE

Birth quarter 1	Birth quarter 2	Birth quarter 3	Birth quarter 4
September (month 1) October (month 2) November (month 3)	December (month 4) January (month 5) February (month 6)	March (month 7) April (month 8) May (month 9)	June (month 10) July (month 11) August (month 12)

3.3.7. Technical tests

These technical tests were applied to Chapter 8 (Technical). The four football-specific technical tests applied have been utilised in multidisciplinary talent development research previously (Vaeyens *et al.,* 2006). The slalom dribble test (Figure 3.2.) requires the player to control the ball through nine cones (2 m apart) from the start to the end line and return. The timings are recorded using timing gates (Brower TC Timing System, Draper, Utah, USA), with each player completing two trials and the quicker of the two recorded for analysis. Furthermore, the lob pass test (Figure 3.2.) requires the player to kick the football from a distance of 20 m into a target area divided into three concentric circles (3 m, 6 m, and 9.15 m in diameter). Each kick is scored by the circle in which the ball initially landed (3, 2, and 1 point respectively). Ten attempts (five with each foot) are attempted with a maximum of 30 points available. Moreover, the shooting accuracy test (Figure 3.2.) requires the player to kick the ball at a 16 m wide goal target from a distance of 20 m. The goal was divided into five parallel zones; centre, 2 m wide (3 points), two areas 3 m on each side of the centre (2 points), and two areas 4 m wide at each extreme (1 point). Ten attempts (five with each foot) are attempted with a maximum of 30 points available. Additionally, the ball juggling test (Figure 3.2.) requires players to keep a football off the ground with the total number of touches recorded. Two trials are completed, with a maximum of 100 touches per attempt permitted, allowing a maximum number of 200 touches.

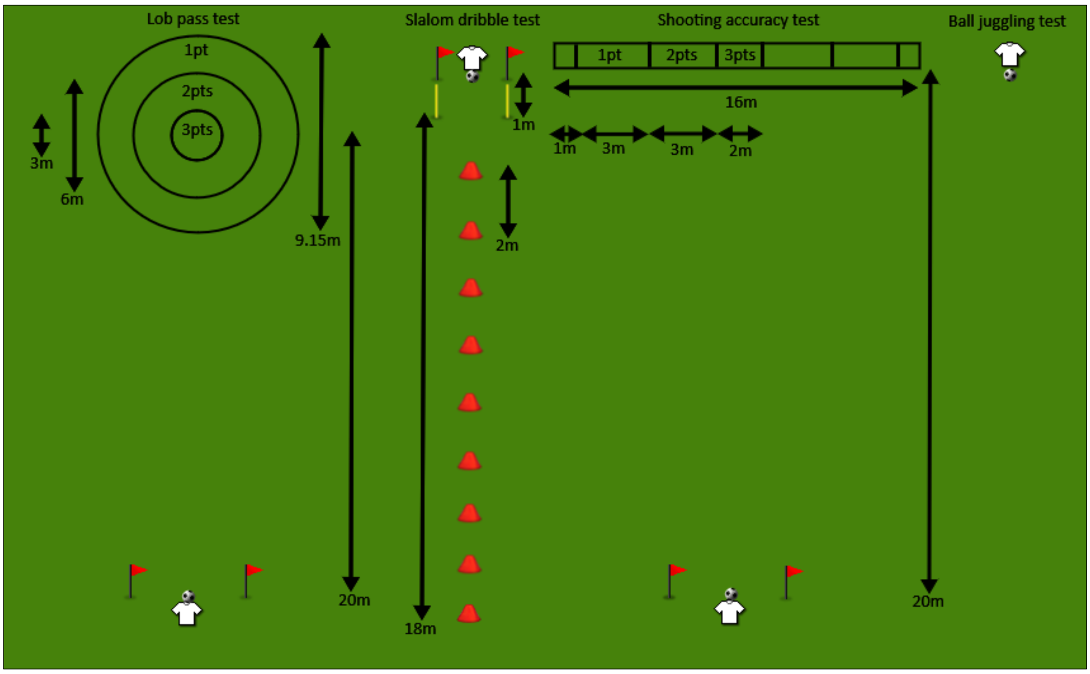


Figure 3.2. The four football-specific technical tests (adapted from Vaeyens *et al*., 2006)

Players completed these tests in an indoor sports hall with a hard-wood floor, with generic ECFC Academy training kit being worn. In addition, age-specific balls were used for the test in-line with the FA regulations; size 3 for under-9's, size 4 for under-10 to under-13's, and size 5 for under-14 to under-16's. The technical tests were completed in February and March 2015 during the 2014/15 season.

3.3.8. Match analysis statistics

These match analysis statistics were applied to Chapter 8 (Technical). Data collection used video footage of ECFC Academy players taken during competitive games as they performed technical actions. An average is computed from across the season from skills including reliability in possession percentage, pass completion percentage, number of tackles, blocks, loose balls retrieved, successful dribble percentage, total touches, and goals scored. The specialist software Gamebreaker© is used to perform participant analysis for each game, with trained match analysts using technical expert definitions to practically apply (Table 3.4.).

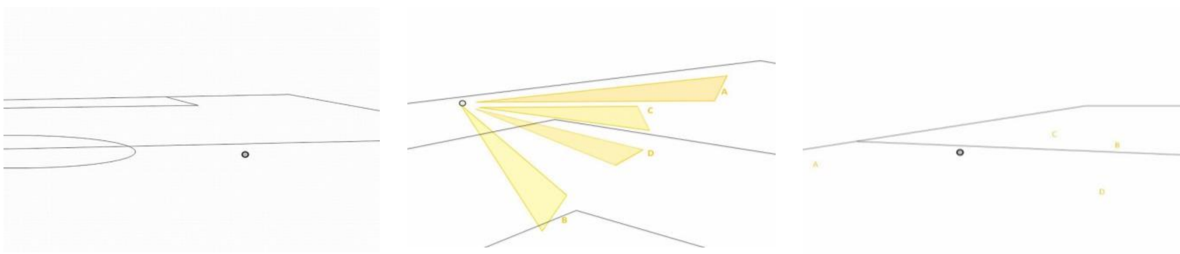
Table 3.4. Technical definitions for match analysis statistics

Technical action	**Definition**
Reliability in possession	Formula of positive actions divided by the total number of touches, which provides an accurate percentage of reliability in possession.
'Successful' pass	The ball is received and retained by the player it was intended to go to. This formulates the players average pass completion.
'Unsuccessful' pass	The ball does not reach the intended player or the ball played was not suitable for the receiver to be able to control and retain it. This formulates the players average pass completion.
Tackle	An action that is intended to dispossess the opposition regardless of success.
Block	A player diverts the intended path of the ball legally with any part of their body, whether it is an opposition shot/cross/pass.
Loose ball	A ball that is under neither team's possession has been reclaimed by the player.
'Successful' dribble	A player travels with the ball in their control without being dispossessed. This formulates the players average dribble completion.
'Unsuccessful' dribble	A player travels with the ball but is dispossessed or loses control of the ball during the movement. This formulates the players average dribble completion.
Touches	An action which is performed when the player receives the ball by a pass, tackle, block, loose ball, dribble, or shot.
Goal	A player shoots the ball and it crosses over the goal line.

Due to logistics, only home games were filmed and analysed unless an away team provided appropriate footage. During the 2014/15 season, the under-9 to under-16 ECFC Academy age groups had a varied number of games filmed and analysed ranging from seven to 14. Understandably, although all matches analysed were performed on grass, weather and surface quality varied depending on the time of the season. Additionally, as a result of age-specific development, match formats varied throughout the season, with the under-9 and under-10's playing four periods of 20 minutes with 5 vs. 5, 6 vs. 6, or 7 vs. 7, the under-11's played four periods of 20 minutes with 9 vs. 9, the under-12's played four periods of 20 minutes with 9 vs. 9 or 11 vs. 11, the under-13 and under-14's played four periods of 20 minutes with 11 vs. 11, and the under-15 and under-16's played two periods of 40 minutes with 11 vs. 11. Age appropriate pitches and football size (see section 3.3.7.) were also applied. Each participant played a minimum of 320 minutes and a maximum of 960 minutes, equating to a mean number of 640 minutes throughout the 2014/15 season, thus equalling a total average of eight 80 minute games.

3.3.9. Perceptual-cognitive expertise tests

These PCE tests were applied to Chapter 9 (Tactical). Film-based simulations were applied to examine the players' perceptual-cognitive ability, which have been previously applied to the OASSIS decision making research (Belling *et al.,* 2014). Action sequences were selected from live football match footage. The video footage featured national-level inter-academy players aged 18 to 19 years engaging in a competitive game filmed from an elevated angle above and behind the goal. Following general build-up play, the clips unexpectedly occlude immediately prior to a critical decision moment, with each clip being 5 to 10 seconds in duration. At this point, an occlusion display appears that shows the pitch lines (i.e., boundaries, 18 yard box, and half way line) and the location of the ball on a white screen (Figure 3.3.). This screen is frozen for 7 seconds and the participant has to select their answer on the response sheet.



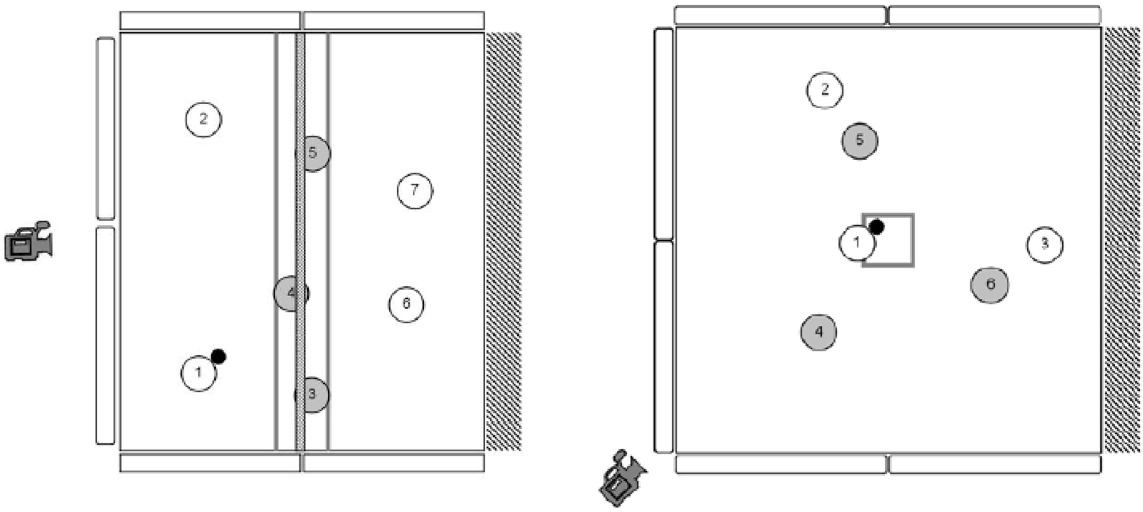
'Select action' occlusion display — 'Select direction' occlusion display — 'Select pass recipient' occlusion display

Figure 3.3. Occlusion displays for PCE testing (adapted from Belling *et al*., 2014)

Forty-five clips are created for two different phases ('at' and 'post' execution), thus ninety clips are viewed by the players in total. 'At' clips are considered more difficult as the occlusion happens as the action is executed, as opposed to the 'post' clips that are occluded after the execution with a duration 0.5 seconds longer. Consequently, clips are viewed in this order, with a response sheet completed separately and collected before the next batch of clips begin, to prevent players changing their answer when they see the longer clips. The 45 video simulations are distributed into three decision making skills, including ‘select action’, ‘select direction’, and ‘select pass recipient’, thus creating 15 clips for each. Select action requires the participant to choose one of three techniques they think the player on the ball is going to complete. Select direction requires the participant to choose one of four directions they think the player is about to play the ball. Finally, select pass recipient requires the participant to choose one of four teammates they think the person on the ball is going to pass to. Techniques are nominated from the answer sheet (pass, dribble, or shoot) for the select action clips, while options appear on the occluded white screen (A, B, C, and D) for the select direction and select pass recipient clips. The participants viewed all 90 video simulations (45 ‘at’ and 45 ‘post’ clips) through a high-definition video projector (Sony VPL-DX221). Players were seated separately and were unable to engage with each other; similar to generic examination conditions. Participants completed these tests in November 2014 during the 2014/15 season.

3.3.10. Game test situations

These game test situations were applied to Chapter 9 (Tactical). According to Memmert (2010a), game test situations provide a standardised tactical examination for a practical method. The two game test situations applied within this research are used to examine football-specific creativity and game intelligence through taking advantage of openings and offering and orienting (Figure 3.4.). These game test situations are simple practical exercises with clearly defined game ideas, a fixed number of players, specific rules, and consistent environmental conditions. The player’s tactical behaviours are assessed without trying to standardise the ball direction and actions of their teammates. Clearly allocated roles and consistent conditions allow many repetitions for the players. Additionally, rotation of the players systematically changes the allocation of tasks, thus after three minutes the positions change according to a specific sequence, allowing each player to play an offensive position twice during the game test situations.



Taking advantage of openings

Pitch dimensions = 8 m x 7 m; width of the midsection = 1 m; height of the line above the midsection = 1.5 m; distance between video camera and pitch = 8 m

Offering and orienting

Pitch dimensions = 9 m x 9 m; size of the starting square = 1 m x 1 m; distance between video camera and pitch = 4 m

Figure 3.4. Taking advantage of openings and offering and orienting tests (adapted from Memmert, 2010a)

Taking advantage of openings gauges the management of tactical tasks that depend on the individual exploiting the openings for the opportunity of a pass or goal confrontation with opponents. The design includes two attacking teams, with two players each (team A; players 1 and 2, and team A+; players 6 and 7) located in the two outer zones. The defending team (team B; players 3, 4, and 5) consists of three players acting as the defenders or ‘block’. Team B are positioned in an area between team A and A+ and are unable to leave, with team A and A+ not allowed entry. The objective is for the attacking teams to play the ball past team B, underneath waist height, into the opposite half of the pitch. The players must stay in their respective positions (i.e., to the left or to the right of the attacking zones) and are not allowed to run with the ball. Depending on possession, team B faces towards either team A or A+, with the intent of intercepting forward passes. If the ball goes out of play or is successfully defended, it is returned to the opposite attacking team.

Offering and orienting is characterised by tactical scenarios that depend on taking the optimal position on the football pitch at the right time. Players are selected on either attacking team A (players 1, 2, and 3) or defending team B (players 4, 5, and 6), consisting of three players each. The objective for team A is to pass the ball as often as possible (not being allowed to run with the ball), while team B tries to prevent the passes. At the beginning of the game, when team B intercepts a pass, or when the ball goes out of play, one attacker must initiate the game in the starting square with the ball while the other players select any position on the pitch.

In order to analyse the tactical actions demonstrated during the game test situations, the technical measuring instrument usually applied in standardised tests that directly survey decision making times and quantity cannot be used. Thus, the divergent and convergent tactical behaviours in both the game test situations are assessed by three examiners using four different scales respectively (gauge 1 to 10) using footage of the game test situations that are recorded using a Panasonic HC-V210 video camera. The examiners, who are trained football experts (UEFA Pro, ‘A’, and ‘B’ licenced alongside either the FA Advanced Youth Award or FA Youth Award), viewed the recorded game test situations on a high definition projector (Sony VPL-DX221). The twelve performance measures for creativity and game intelligence available for each player (3 examiners x 2 rotations x 2 game test situations) are summarised into one divergent and convergent parameter. Each examiner will judge each player for the 6 minutes per game test situation.

These game test situations have been developed and applied to talent identification and development research within elite youth football, and have been formally validated by Memmert (2010a). Players completed these tests in an indoor sports hall with a hard-wood floor, with generic ECFC Academy training kit being worn. Additionally, age-specific footballs are used for the test in-line with the FA regulations (see section 3.3.7.). These tests were completed in February and March 2015 during the 2014/15 season.

3.4. Talent identification procedures

Two coaches, who are deemed suitable assessors (UEFA Pro, 'A', or 'B' Licenced alongside either the FA Advanced Youth Award or the FA Youth Award) from each age group (under-9 to under-16), were asked to rank their players from top to bottom in relation to current ability from a holistic perspective. They ranked the players in May 2015 at the end of the 2014/15 season, creating a linear classification of high-performing players down to their low-performing counterparts, with each age group then split into thirds using tertiles. This created a group of 'high-performers' who represent the top third, and a group of 'low-performers' who represent the bottom third. This enabled a distinct comparison between the high-performers and low-performers within each age group, with the middle third discarded from the study (*n*=34). For the purpose of this research, the high- and low-performers from the under-9 to under-11 were grouped together within the FDP (*n*=26), and the high- and low-performers from the under-12 to under-16 were grouped together within the YDP (*n*=38).

3.5. Statistical analyses

Due to the differing results between age groups as a result of their chronological age, such as older players generally having had more time playing, and subsequently have higher hours of engagement, data have been standardised using Z-scores within their respective age group, to allow an unbiased grouping of players in both the FDP and YDP within Chapter 4–9. The assumptions were tested by examining high- and low-performers within the FDP and YDP using a two-tailed independent samples *t*-test. The *t*-test is used to compare the values of the means from the high- and low-performers, to test whether it is likely that the samples from the populations have different mean values, with an alpha level set at $p<0.050$. All analyses were conducted using IBM SPSS Version 23 (IBM Corp, 2015).

Regarding the statistical approach that was selected, *t*-tests were applied for their simple identification of whether there lies a true difference between and whether one variable is higher or lower. It is also important to highlight that there is no ‘golden standard’ to talent identification data analyses, as it remains a complex and under-researched area from a multidisciplinary perspective. Thus, a *t*-test provides a simple analysis technique to make this already multifarious process less complicated.

3.6. Philosophical approach

As a British Association of Sport and Exercise Science (BASES) accredited Sport & Exercise Scientist and Registered Supervisor who specialises and practices from an interdisciplinary approach, this thesis has followed and applied a similar method. As a result, the terms ‘multidisciplinary’ and ‘interdisciplinary’ have been applied throughout this thesis, to signify the approach of the methodology to analyse a complete range of detection and developmental characteristics within their respective disciplines. A ‘multidisciplinary approach’ may be regarded as a process whereby research from different disciplines focus on their field independently from a discipline-specific perspective, to address a common topic (Buekers *et al.*, 2017; Jones, 2009; Szostak, 2007; Youngblood, 2007). Whereas an ‘interdisciplinary approach’ can be explained as a consequence of the research from each discipline combining and working in conjunction to develop and apply a shared conceptual framework, that integrates discipline-specific concepts and methodologies to address a common research focus

(Buekers *et al.*, 2017; Jones, 2009; Szostak, 2007; Youngblood, 2007). A multidisciplinary approach is applied throughout each chapter of this thesis, whilst Chapter 10 also utilises an interdisciplinary approach, through integrating relevant factors for analyses.

The epistemological approach to this thesis was that used by a Frequentist, as a result of drawing conclusions from the relevant sample data by emphasising the frequency or proportion of the data. As such, the use of probability was applied through analysing whether something is more likely to happen or not, through recognising, and subsequently hypothesising, based on current knowledge in the associated literature base. From a data analyses perspective, this is set through a hypothesis for a dependent variable to test the effect of an independent variable. Subsequently, t-tests were used to support this simplistic approach, with the p value demonstrating whether there is a significant difference between two groups of means. In addition to the epistemological rationale, this further supports the statistical approach that was applied.

3.7. Limitations and delimitations

Professional coaches were asked to rank their age group from top to bottom with regards current ability level from a holistic perspective, in order that players could be subsequently categorised. It may be argued that coaches have differing views surrounding current ability level, and may also have different preferences on a holistic standpoint. However, coach observation and opinion is central to the subjective nature of professional football. Additionally, it is also important to mention the modern objective information that is readily available to professional coaches to support judgement, such as physical performance and maturation data, psycho-social profiling, match analysis statistics, and in-depth individual learning objectives concerning technical and tactical development. Therefore, it may be suggested coach ratings provide a beneficial tool to highlight current performance levels from a multidisciplinary viewpoint.

Furthermore, although players were categorised on current performance levels, this by no means represents the players who are going to become professional football players within that age group. MacNamara & Collins (2011) suggest how talent is often generalised as the ability to perform as an age group ‘elite’, leaving little consideration to the characteristics that influence to the ultimate realisation of professional status. For example, an under-12 player may be regarded as the best player in his age group within a professional academy system, however, this does not mean that because he is the ‘elite’ player at under-12, he has the characteristics to develop towards achieving professional status. However, it is precisely this difficulty in determining future success that makes categorising players on their ability to become elite difficult. Therefore, observing players on current ability, through differentiating high- and low-performers, offers the current best (albeit limited) approach regarding talent identification in elite youth football (Tangalos *et al.*, 2015; Williams *et al.*, 2012).

Moreover, through assessing a football academy in isolation to discriminate high- and low-performers from practice history perspective, compared to using a sub-elite control group to associate, it inevitably reduced participant numbers. Therefore, collaborating with other academies to compare high- and low-performers would be one approach to minimise this effect. However, it is difficult to get clubs to work collaboratively as a consequence of the sensitivity of data, thus this research offers a unique insight into the practice histories of high- and low-performers within an English football academy environment.

In addition, the external validity to other academies may also be questioned as a result of the unique location of ECFC Academy. For instance, whilst ECFC Academy are a category 3 academy, they are also isolated in the South West of England, with competing Category 1 and

2 academies too far to formally sign players before the age of 16 years. In contrast for example, a category 3 academy in London may be struggling to sign the most promising players within that particular area as a result of category 1 and 2 academies also being able to sign these players. Thus, it may be suggested ECFC Academy often get to sign the most promising players within their allocated region because of their location. Subsequently, whilst this research provides a unique insight into the talent identification and development processes in an English category 3 academy, similarly categorised academies are suggested to act with caution regarding the applied implications as a result of this questionable external validity due to the geodemographic factors highlighted.

4. ENVIRONMENTAL

4.1. Introduction

Football activity in childhood takes place in both formal and informal environments (Ford & Williams, 2017; Li *et al.*, 2014). Formal settings involve organised training and competition through adult coaching and delivery, while informal activities include child-led play without adult intervention in surroundings such as playgrounds, parks, streets, and gardens (Ford & Williams, 2017). Various concepts, such as early specialisation, early diversification, and early engagement, have attempted to structure these activities within developmental strategies for elite youth athletes', in order to maximise potential to achieve senior expertise (Ford *et al*., 2009; Cote *et al*., 2007; Ericsson *et al.*, 1993).

Early specialisation considers a child to engage solely in one sport during childhood (aged 5 to 11 years) through specialised talent development programmes, such as professional football academies (Read *et al.*, 2016; Kirk, 2005). This involves engaging in a large amount of deliberate practice and competition with a relatively high volume and intensity (Haugaasen *et al.*, 2014a; Ericsson *et al.*, 1993). At the opposite end of the continuum from an early specialised approach is early diversification (Ford & Williams, 2017). Early diversification encourages multi-sport involvement during early childhood through participating in a number of different sports, in mainly informal settings, with later or delayed specialisation into formal activity in a single primary sport (Ford & Williams, 2017; Cote *et al*., 2007). Finally, early engagement offers an alternative proposition through encouraging participation in a large amount and variation of informal activities in a recreational manner, whilst engaging in a significant amount of deliberate play in one particular sport (Ford *et al*., 2009). These activities are less structured and are often engaged in more informal settings with the intention of fun and enjoyment (Haugaasen *et al.,* 2014a). During adolescence (aged 12 to 16 years), these three pathways converge to highlight the increased specialisation for talented athletes in one sport, through an increased involvement in deliberate practice and competition (Haugaasen *et al.,* 2014a).

Although a number of studies continue to support the suggestion of early specialisation (Sieghartsleitner *et al.,* 2017; Zibung & Conzelmann, 2013; Haugaasen & Jordet, 2012), contemporary research commonly recommends that elite youth football players should engage in a high amount deliberate play and sampling between ages 5 to 11 years within the FDP, and then later specialise at around age 12 years when the player enters the YDP for optimum development (Haugaasen *et al.,* 2014b) and limited injury risk (Post *et al.,* 2017). However, as a result of football academies adopting an early specialised approach following the introduction of the EPPP, clubs have the capability of signing players as young aged 8 years, thus these theories offer limited suggestions around this contemporary process (Read *et al.,* 2016; Ford *et al*., 2009). Therefore, the aim of this research is to attempt to offer an alternative concept surrounding elite youth football development in England, to support young players to invest time specialising and engaging at a young age, while continuing to gain additional appropriate developmental skills through sampling other sports.

4.2. Rationale

Recognising the accumulative hours of particular activities, such as coach-led practice, individual practice, match-play, and peer-led play, are significant elements during talent development research. Also, the age at which participants started playing football, from both a deliberate play and academy status perspective, is also important to align certain pathways. In addition, the participation history in other activities provides relevant findings from a sampling and diversification viewpoint.

Such research into football practice histories from Ford *et al.* (2012), through applying a validated retrospective Participation History Questionnaire (PHQ; Cote *et al.,* 2005), found engagement in football activity, competition, and development systems vary between countries. For example, players in Brazil engaged in an average of 124 hours a year of football training during childhood, whereas Mexico engaged in an average of 240 hours a year. Interestingly, the elite youth players from Brazil, a global producer and exporter of professional football players (Ford *et al.,* 2012), engaged mainly in deliberate football-specific play and futsal activities during childhood rather than coach-led deliberate practice and competition, and did not enter academy status until the age of 13 ± 1.38 years (Ford *et al.,* 2012). Furthermore, Ford & Williams (2012) found that children in English football academies participate in more football-specific match-play activity than the majority of other countries that were part of their study. Thus, it may be argued that perhaps engaging in too much competition at a young age may lead to negative consequences later in life (Cote & Vierimaa, 2014), which may subsequently lead to ongoing migration of foreign talent (Elliot & Weedon, 2011).

Further examination surrounding the role of sport-specific play and practice during childhood was investigated by Forsman *et al.* (2016a). They examined 15-year-old males within the three top Finnish sports including football (*n*=141), ice hockey (*n*=204), and basketball (*n*=96), through applying a multidisciplinary analysis (Forsman *et al.,* 2016a). They discovered athletes with more sport-specific play and practice during childhood also had more sport-specific play and practice during adolescence, alongside superior technical, tactical, and psychological skills, whilst also being more likely to be selected for national teams (Forsman *et al.,* 2016a). Consequently, Forsman *et al.* (2016a) highlight importance of both early specialisation and early engagement, through high-performing participants completing more football-specific activities from a young age compared to their low-performing counterparts. However, similarly to Bridge & Toms (2013), it may be recognised these athletes have still not achieved proficient expertise within their sport, thus further evidence required to support the application of combining sport-specific play and practice to achieve senior professional status (Forsman *et al.,* 2016a).

Ford & Williams (2017) illustrate how current research demonstrates the most common developmental pathway for team sport athletes that achieved professional success is a combination of early diversification and early engagement (Ford *et al*., 2009; Cote *et al*., 2007). Thus, athletes competing at the highest level in these team sports started their engagement in childhood and participated in a various amount of activities in their primary sport, whilst also engaging in other sports (Ford & Williams, 2017). Furthermore, Ford & Williams (2017) reveal the other sports these athletes were involved in during childhood were similar sports to their primary one, therefore suggesting the benefit of transferring skills (Zibung *et al.,* 2013; Waldron & Worsfold, 2010).

However, these studies also illustrate some of the players were also involved in talent development systems during childhood, which may also indicate the importance of early specialisation as a facilitating factor for sampling towards adult expertise (Ford & Williams, 2017). Additionally, results between sports also varied (Bjorndal *et al.,* 2016; Pesce *et al.,* 2016a). For example, Australian Football League players had the lowest training volume in their primary sport during childhood, while their involvement in other sports was also low to medium (Berry *et al.,* 2008). In contrast, ice hockey players had the highest amount of time spent in their primary sport during childhood (Soberlak & Cote, 2003), whereas Canadian triathletes started their primary sport during adulthood (Baker *et al.,* 2005). From a football perspective, when compared to these other studies, German players had the lowest amount of time spent in other sports during childhood (Hornig *et al.,* 2016). This demonstrates the varying start age and developmental pathways that exist, both between and within sports, to achieve expertise in particular activities.

During their research, Hornig *et al.* (2016) examined the developmental activities of 52 professional football players competing in the first German Bundesliga. They discovered a mean value of 4,264 hours of organised football-specific practice were accumulated over approximately 16 years before debuting in the German Bundesliga, while senior national team debuts were preceded by 4,532 mean hours of football-specific practice over approximately 17 years. Furthermore, national team players differed from amateurs by participating in more non-organised football-play activities during childhood, more engagement in other sports during adolescence, while only engaging in more structured football activities at the age of 22+ years. Consequently, these findings support the application of early engagement in childhood, sampling other sports throughout adolescence, and specialising in adulthood, which are arguably later timings when compared to Cote *et al*. (2007).

Moreover, converse to Ericsson *et al.* (1993), who suggests it takes 10 years of deliberate practice to achieve expertise, it took these players significantly longer to make their German Bundesliga debut (approximately 16 years) and senior national team debut (approximately 17 years). Additionally, this differs from the rather subjective approach of participating in 10,000 hours of deliberate practice to achieve expertise, through individuals accomplishing their German Bundesliga debut (4,264 mean hours) and national team debut (4,532 mean hours) with less than half of that suggestion. The anticipated factors of the early specialisation, diversification, and engagement pathways are highlighted in Table 4.1. (Ford & Williams, 2017), while the expected outcomes associated with these pathways are outlined in Table 4.2. (Ford & Williams, 2017).

Table 4.1. The anticipated factors of early specialisation, engagement, and diversification (adapted from Ford & Williams, 2017)

Anticipated factors	Early specialisation	Early diversification	Early engagement
Childhood			
Start age in a primary sport	Childhood	Not specified	Childhood
Start in football academy	Yes	No	No
Play in a primary sport	Low	Low – medium	High
Practice in a primary sport	High	Low or no	Low – medium
Competition in a primary sport	High	Low or no	Low or no
Other sports	Low	High	Low – medium
Adolescence			
Play in primary sport	Decreases to zero	Decreases to zero	Decreases to zero
Practice in primary sport	High	Increases to high	Increases to high
Competition in primary sport	High	Increases to high	Increases to high
Other sports	Decreases to zero	Decreases to low	Decreases to low

Table 4.2. The expected outcomes associated with early specialisation, engagement, and diversification (adapted from Ford & Williams, 2017)

Expected outcomes	Early specialisation	Early diversification	Early engagement
Positive outcomes in primary sport			
Performance improvement	Yes	Possibly transfer	Yes
Expert performance	Yes	Yes	Yes
Other positive outcomes			
Continued participation	Some	Yes	Yes
Intrinsic motivation	Lower	Increased	Increased
Enhanced social skills	Lower	Increased	Possibly medium
Negative outcomes			
Overuse injury incidence	Higher	Lower	Possibly medium
Burnout and dropout	Higher	Lower	Possibly medium

Football in England had been played as a street game for many centuries before the formation of the FA in 1863 (Seddon, 1995). Interestingly, this basic tradition appears to support the development of expert performance in elite youth football through the concept of deliberate play (Ford *et al.*, 2009). Additionally, the traditional perspective of South American players, noticeably from Brazil and Argentina, applies a large emphasis on deliberate play through street football and futsal due to their high levels of poverty (Ford *et al.*, 2012). Many models have expressed ideological pathways for children to develop towards expertise, including early specialisation, diversification, and engagement, through activities such as deliberate practice, sampling, and deliberate play respectively.

As a result of analysing a players' participation history, it will enable this chapter to support such theories, or perhaps offer an alternative route towards superior performance. Through observing current research, it is apparent there is greater support towards the pathways of early diversification and early engagement to support the development of expertise in football. However, despite its possible negative influences, an association continues to appear between early specialisation and the development of expertise within football too. Consequently, the aim of this chapter is to investigate the impact of early specialisation, diversification, and engagement to facilitate the development towards high-performance within a professional football academy.

4.3. Aims and hypothesis

The purpose of this chapter is to compare the high- and low-performers within both the FDP and YDP for their start football age and start academy age, whilst identifying hours spent participating in four football-specific activities including match-play, coach-led practice, individual practice, and peer-led play, alongside investigating hours spent participating in other sports and total sports played. Although there is a large amount of research to consider, this hypothesis is formulated through Ford *et al.*'s (2009) early engagement theory, which was specifically developed for a football environment.

The specific aims of this chapter are:

1. To assess the starting ages, at both initial football engagement and academy status, to identify whether high performance is associated with an early starting age, in both the FDP and YDP.
    a) It is hypothesised high-performers will have initially engaged in football significantly younger compared to their low-performing counterparts, in both the FDP and YDP.
    b) It is hypothesised that there will be no significant difference between high- and low-performers regarding their starting ages for academy status, in both the FDP and YDP.
2. To illustrate the football-specific activities that discriminates high- and low-performers, in both the FDP and YDP.
    c) It is hypothesised high-performers will spend significantly more time participating in peer-led play compared to their low-performing counterparts, in both the FDP and YDP.
    d) It is hypothesised there will be no significant difference between high- and low-performers concerning time spent participating in match-play, coach-led practice, and individual practice, in both the FDP and YDP.
3. To determine whether participating in other sports differentiates high- and low-performers, in both the FDP and YDP.
    e) It is hypothesised that high-performers will spend significantly more time participating in other sports and engage in a greater number of other sports compared to their low-performing counterparts, in both the FDP and YDP.

4.4. Results

4.4.1. FDP PHQ

In the FDP, there was a significant difference between high-performers (M=0.29, SD=1.04) and low-performers (M=-0.53, SD=0.85) for total coach-led hours (Figure 4.1. d)), with high-performers having a greater total mean compared to low-performers (t(24.00)=2.21, p=0.037).

No significant difference was established between high-performers (M=0.18, SD=1.04) and low-performers (M=-0.53, SD=0.79) in the FDP for total sports played (t(24.00)=-1.95, p=0.063; Figure 4.1. g)). Similarly, there was no significant difference between high-performers (M=-0.40, SD=1.12) and low-performers (M=0.29, SD=0.60) in the FDP for started academy age (t(18.36)=-0.93, p=0.070; Figure 4.1. b)). Furthermore, there was no significant difference between high-performers (M=0.72, SD=1.28) and low-performers (M=-0.13, SD=-0.04) in the FDP for total multi-sports hours (t(17.17)=-1.76, p=0.096; Figure 4.1. h)).

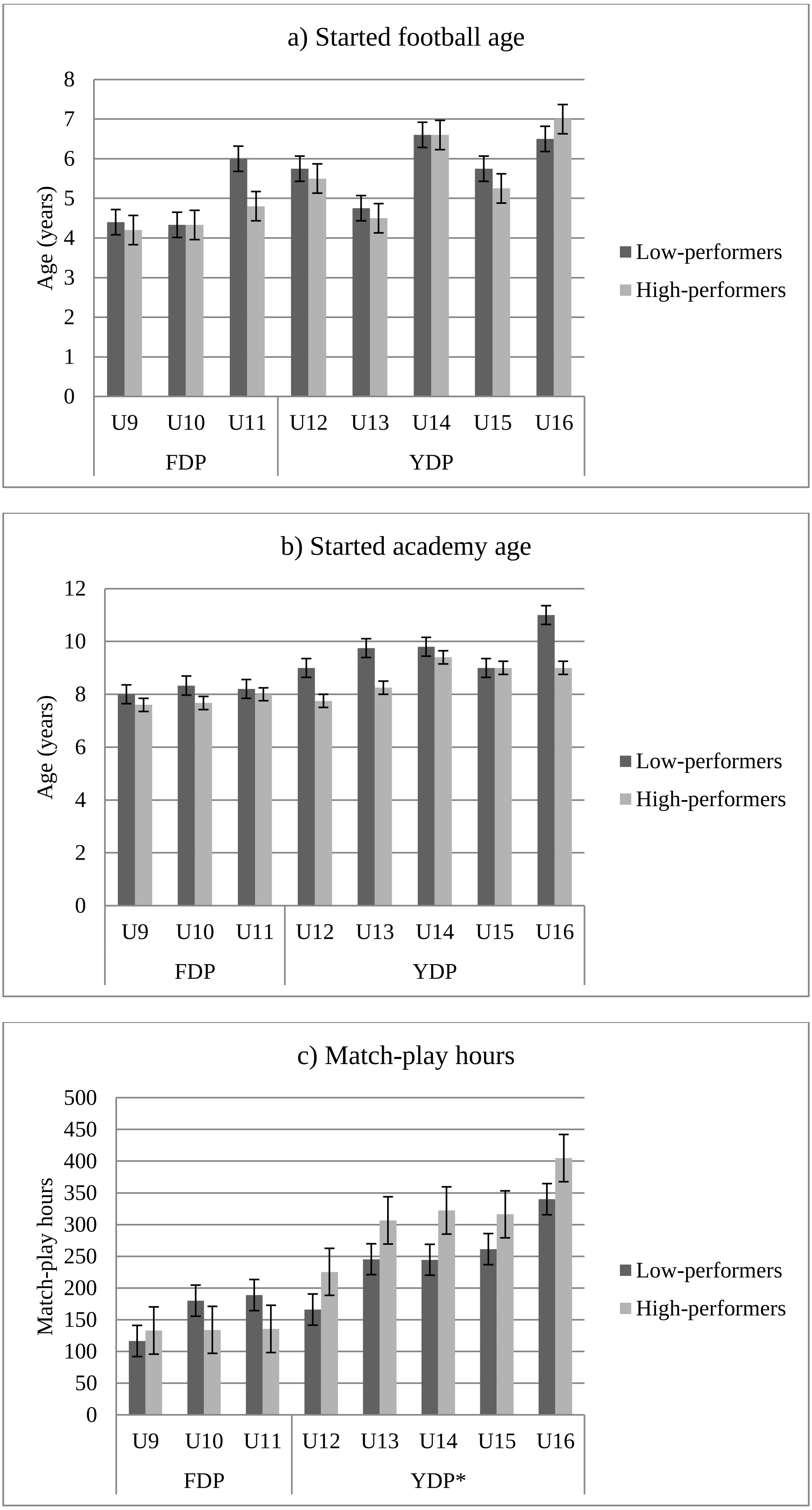
Moreover, there was no significant difference between high-performers (M=0.05, SD=0.84) and low-performers (M=-0.40, SD=1.01) in the FDP for started football age (t(24.00)=1.23, p=0.229; Figure 4.1. a)). Additionally, there was no significant difference between high-performers (M=-0.14, SD=1.00) and low-performers (M=0.31, SD=1.02) in the FDP for total match-play hours (t(24.00)=-1.14, p=0.266; Figure 4.1. c)). Also, there was no significant difference between high-performers (M=0.17, SD=1.15) and low-performers (M=0.10, SD=1.07) in the FDP for total individual practice hours (t(24.00)=0.16, p=0.874; Figure 4.1. e)). Finally, there was no significant difference between high-performers (M=0.07, SD=1.06) and low-performers (M=-0.22, SD=0.73) in the FDP for peer-led play hours (t(24.00)=0.81, p=0.424; Figure 4.1. f)).

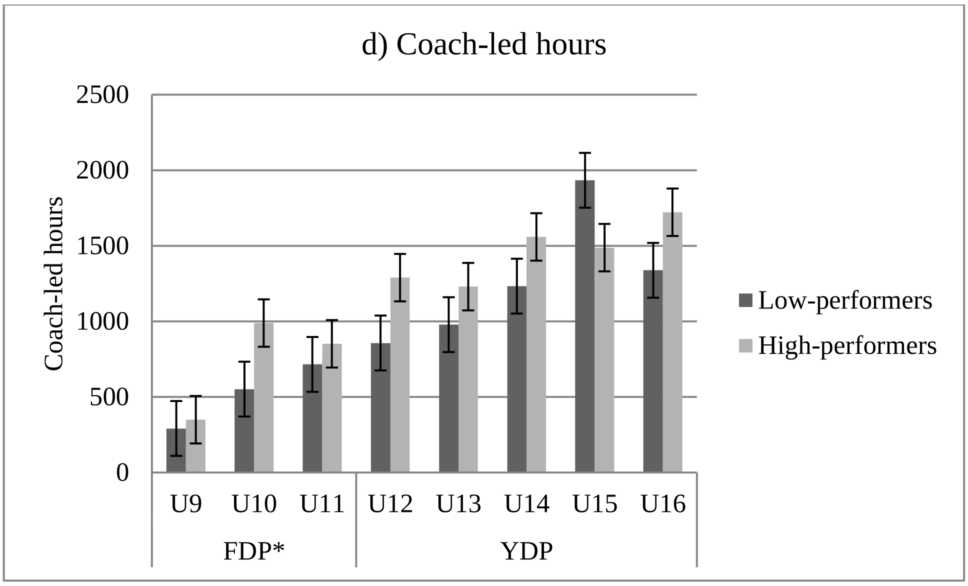
4.4.2. YDP PHQ

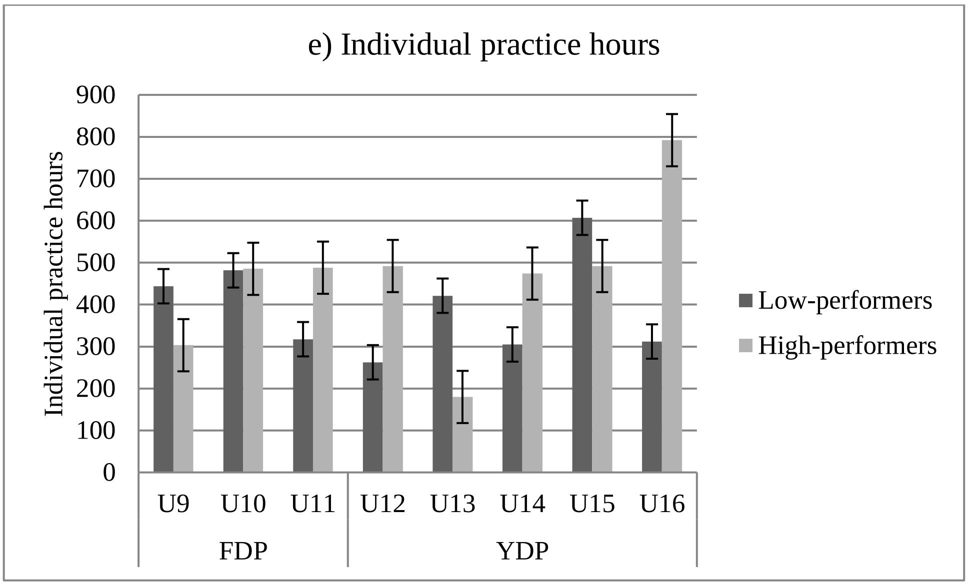
Within the YDP, there was a significant difference between high-performers (M=0.39, SD=0.90) and low-performers (M=-0.37, SD=0.85) for total match-play hours (Figure 4.1. c)), with high-performers demonstrating a greater total mean compared to low-performers ($t(36.00)=2.69$, $p=0.011$). Moreover, there was a significant difference between high-performers (M=0.19, SD=0.94) and low-performers (M=-0.38, SD=0.73) in the YDP for total multi-sports hours, with high-performers having a greater total mean compared to low-performers ($t(36.00)=2.09$, $p=0.044$; Figure 4.1. h)).

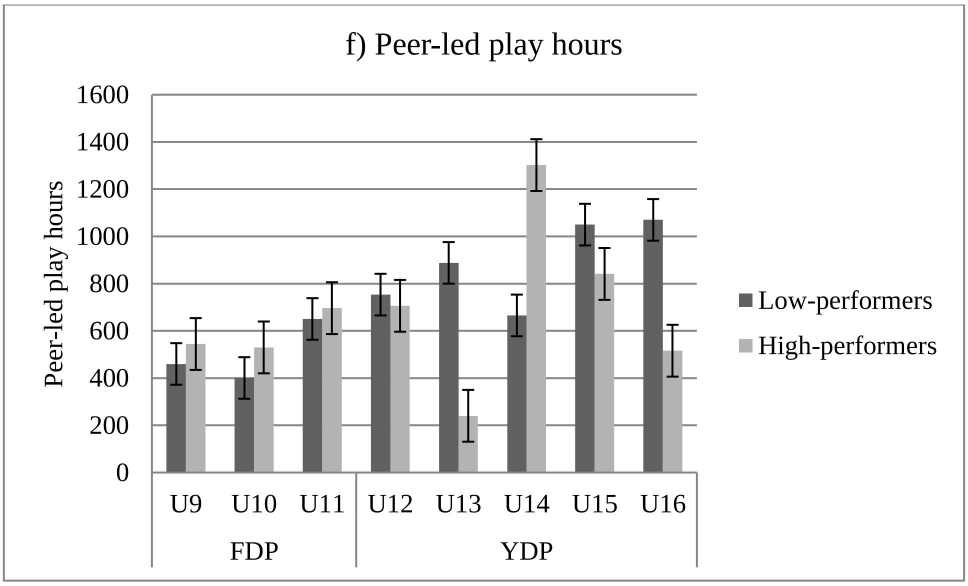
No significant difference was established between high-performers (M=0.10, SD=1.01) and low-performers (M=0.23, SD=0.94) in the YDP for started academy age ($t(36.00)=-1.89$, $p=0.067$; Figure 4.1. b)). Similarly, there was no significant difference between high-performers (M=0.45, SD=1.03) and low-performers (M=-0.17, SD=1.01) in the YDP for total coach-led hours ($t(36.00)=1.88$, $p=0.068$; Figure 4.1. d)). Furthermore, there was no significant difference between high-performers (M=0.15, SD=0.87) and low-performers (M=-0.33, SD=0.97) in the YDP for total sports played ($t(36.00)=-1.63$, $p=0.113$; Figure 4.1. g)).

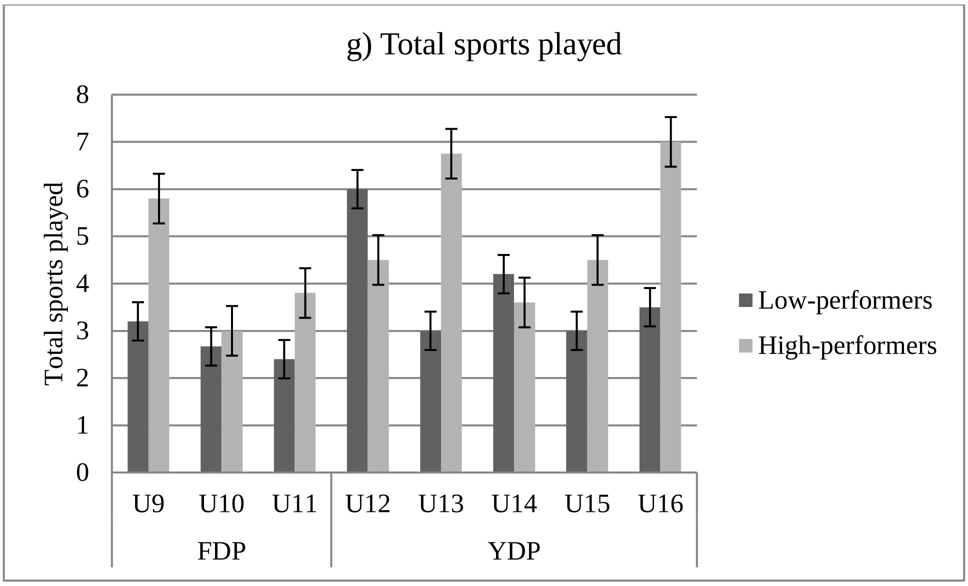
Moreover, there was no significant difference between high-performers (M=0.15, SD=0.88) and low-performers (M=-0.01, SD=1.21) in the YDP for started football age (t(36.00)=.47, $p=0.645$; Figure 4.1. a)). Additionally, there was no significant difference between high-performers (M=-0.14, SD=0.97) and low-performers (M=-0.26, SD=1.00) in the YDP for total individual practice hours ($t(36.00)=0.37$, $p=0.711$; Figure 4.1. e)). Finally, there was no significant difference between high-performers (M=-1.00, SD=1.11) and low-performers (M=0.08, SD=0.86) in the YDP for total peer-led play hours ($t(36.00)=-0.84$, $p=0.407$; Figure 4.1. f)).


a) Started football age
Age (years)
0
1
2
3
4
5
6
7
8
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers
b) Started academy age
Age (years)
0
2
4
6
8
10
12
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers
c) Match-play hours
Match-play hours
0
50
100
150
200
250
300
350
400
450
500
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP*
Low-performers
High-performers


d) Coach-led hours
Coach-led hours
2500
2000
1500
1000
500
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP*
YDP
Low-performers
High-performers


e) Individual practice hours
Individual practice hours
900
800
700
600
500
400
300
200
100
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers


f) Peer-led play hours
Peer-led play hours
1600
1400
1200
1000
800
600
400
200
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers



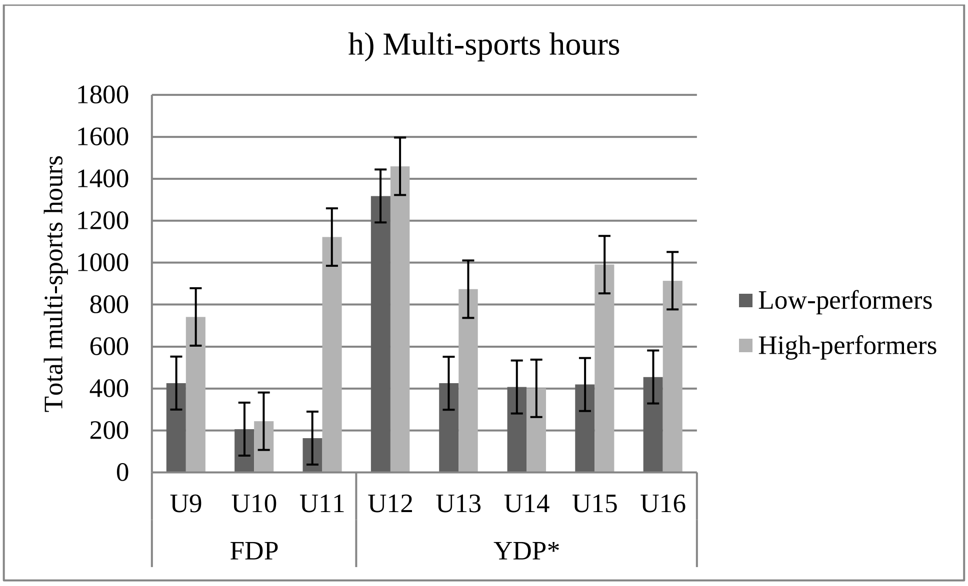


Figure 4.1. PHQ results (**p*<0.050 ***p*<0.005 ****p*<0.001)

4.5. Discussion

The PHQ distributed in this research has been widely employed to talent identification and development research throughout football and other sporting environments, to facilitate the classification of the most appropriate development methods (Ford *et al.*, 2009; Ward *et al.*, 2007). Through applying the PHQ to this research, it provides the opportunity to identify the practice histories of both high- and low-performers within an elite training setting. Thus, offering the opportunity to recognise any differences between both the performance groups and age phases, while comparing current development pathways relevant to talent identification and development in academy football.

Key findings demonstrate, within the FDP, high-performers participated in significantly more coach-led hours compared to low-performers. Additionally, although it was not statistically significant, high-performers within the FDP participated in a greater mean total number of sports, total multi-sports hours, and had an earlier started academy age compared to low-performers. Within the YDP, high-performers participated in significantly more match-play hours and multi-sports hours compared to low-performers. In addition, although it was not statistically significant, high-performers within the YDP engaged in a greater mean total number of coach-led hours, total sports played, and had an earlier started academy age compared to low-performers.

Consequently, there appears to be a consistent pattern between the FDP and YDP of high-performers starting academy football younger, participating in a greater amount of football-specific formal activity (coach-led practice and match-play), and being involved in more multi-sports hours outside of the academy environment. Consequently, this current study fails to fully support one theory independently, therefore offering an alternative explanation of for talent identification and development in youth football through early sampling alongside a significant amount of early specialisation through coach-led practice and later specialisation through match-play.

4.5.1. Specialisation

When observing the total coach-led hours within the FDP, high-performers (730 hours) had a significantly greater total compared to low-performers (520 hours). Furthermore, while the difference only approached significant for the YDP players, high-performers (1458 hours) also had a greater mean total of coach-led hours compared to low-performers (1268 hours). The fact that the high-performers also started their journey in the academy earlier (albeit only marginally significantly so) may partially explain how these additional hours are accumulated. The mean started academy age was 7.8 years in the FDP and aged 8.7 years in the YDP for high-performers, compared to aged 8.2 years in the FDP and aged 9.7 years in the YDP for low-performers. This provides substance towards the wide-held view that it is important to specialise in football at young age, in order to get into an academy to gain access to the best coaching, resources, and opportunities development. Taken together, the results are also supportive of Ericsson *et al.'s* (1993) postulation that deliberate practice activities designed by a coach are important for progression, and that early specialisation provides more opportunity to accumulate hours of deliberate practice.

The results related to the importance of coach-led practice resonate with those of Kenney *et al.* (2015) and Schmidt & Lee (2011), who compared recreational youth athletes to in-active individuals, and showed that time spent in purposeful practice or training leads to skill acquisition and greater competency, alongside improved physical fitness (also see Gilbin *et al.*, 2014). While these results suggest that more input from coaches is beneficial, it may be that the better performers simply received additional coaching time, or that the players that coaches viewed most frequently received higher holistic ratings from them in this study. Additionally, any benefits of increased coaching input clearly require further longitudinal investigation to highlight implications for long-term physical activity and participation (see Cote *et al.*, 2007).

The educated practice approach of the deliberate preparation theory may be supported by this research through high-performers participating in significantly more coach-led hours compared to low-performers during childhood. Thus, this may suggest players who have completed more coach-led hours have had more time to develop essential movement skills, specifically within a football context, consequently leading to greater performance (Haugaasen *et al.*, 2014a). However, these assumptions clearly need further longitudinal investigation to highlight implications on its impact on long-term physical activity and participation from an elite viewpoint.

The importance of spending more time in relevant, formal football activities was also supported by the findings in the YDP; high-performers accumulated significantly more total match-play hours (315 hours) than low-performers (251 hours). Again it is difficult to tease apart the direction of this effect, as not only will more competitive game time provide more opportunity to develop, but better players may be selected for more match time. While the effect was not apparent for FDP participants, this is not too surprising as the focus tends to be on relatively shared game time within these age groups. What is interesting is that when taken together, it is possible that – even within an academy setting – better players may receive more support from coaches early in their development (FDP) and are provided more opportunities to express their learning in matches later in their development (YDP).

4.5.2. Diversification

The findings revealed that high-performing academy players within the YDP have participated in significantly more total multi-sports hours (928 hours) compared to low-performers (605 hours). There was a similar (though non-significant pattern) for the FDP, with high-performers accumulating a greater total (702 hours) compared to low-performers (265 hours). These results are more supportive of Cote *et al.*'s (2007) early diversification pathway, which encourages individuals to participate in sampling sports throughout childhood before later specialising within adolescence. While these results and others (see Bridge & Toms, 2013) demonstrate that multi-sport involvement is associated with superior performance in adolescence, even stronger support for the benefit of multi-sport involvement is provided by Hornig *et al.* (2016). These authors found that senior German national team players competed in more multi-sport activities compared to amateurs during adolescence.

Findings also revealed that the number of sports played (as opposed to the number of multi-sport hours accumulated) revealed a similar (though not as significant) relationship. The mean was 4.2 sports in the FDP and 5.3 sports in the YDP for high-performers, compared to 2.8 sports in the FDP and 3.9 sports in the YDP for low-performers. These results suggest that completing more hours in fewer sports may be more beneficial, even though this is in disagreement with Ford & Williams' (2017) analysis of Hornig *et al.*'s (2016) study. They suggested that while German senior national team players had the lowest amount of time spent in other sports, they participated in more multi-sport activities compared to amateurs during adolescence. Therefore, the type, total, and volume of multi-sports to support the development of football-specific expertise outside an academy environment require additional investigation.

Cote *et al*. (2009b) summarised their investigation into sampling sports during childhood by suggesting only a small portion of children achieve expertise, thus the advantages of psychosocial development are important to consider, and this is relevant for a football academy. As a result, it is suggested professional football academies encourage their players to participate in other sports, particularly within the FDP, which has previously been discovered to facilitate the development of key physical and social skills (Fahimi *et al.*, 2016; Haugaasen *et al.*, 2014b). Furthermore, Cote *et al*. (2009b) highlighted children aged 11 to 16 years that participate in significantly more extracurricular activities achieved greater academic results and stronger peer relationships compared to those who compete in fewer. Cote *et al*. (2009b) suggested this association exists as a result of the social experiences and various skills gained from participating in a greater amount of activities. Therefore, it may be suggested engaging in other sporting activities supports holistic development through both intrinsic and extrinsic benefits.

4.5.3. Early engagement

Interestingly, it appears as though time spent in individual practice and peer-led play (i.e., activities that are not supervised or regulated by adults) did not discriminate ability in the current study. Accordingly, the mean peer-led play hours was 590 in the FDP and 720 in the YDP for high-performers compared to 504 in the FDP and 885 in the YDP for low-performers. This is contrary to Ford *et al.* (2009) who revealed the elite players who attained professional status accumulated more hours per year in deliberate football play activities, but not in deliberate football practice, competition, or other sports, between 6 and 12 years of age, compared to those who did not progress. Additionally, Hornig *et al.* (2016), revealed that German national team players participated in a greater amount of non-organised football play activities during childhood compared to amateur players. As these studies were retrospective in nature, it is difficult to argue against the potential importance of peer-led play, despite these non-significant findings.

However, although Ford *et al.* (2009) and Hornig *et al.* (2016) have shown peer-led play to be a significant aspect for the development of adult expertise within football, MacNamara *et al.* (2015) express deliberate play in the early years alone is unlikely to provide experiences to develop the broad range of fundamental skills required for subsequent development at elite level. For example, the mean start academy age for the players that achieved adult professional status in Ford *et al.*'s (2009) study was aged 9.5 years, suggesting that early specialisation alongside early engagement supports the long-term development towards adult expertise. However, it is important to understand the existing environment that is created for FDP players within professional football academies may differ to the one that occurred 10 to 20 years ago, as a result of ongoing research into practice activities to support age appropriate learning (Gilbin *et al.*, 2014).

When identifying the starting age of academy football players, the age children first engaged in football also had no statistical significance on their current performance levels in both the FDP and YDP. Accordingly, the mean was aged 4.4 years in the FDP and aged 5.8 years in the YDP for high-performers compared aged 4.9 years in the FDP and aged 5.9 years in the YDP for low-performers. These result clearly varied between age groups throughout the FDP and YDP, with no visible patterns associating started football age and high performance. This also demonstrates, although the total number of hours spent engaging in football-specific play does not discriminate ability, the participants as whole are engaging in football during early childhood. When compared to Ford *et al.*'s (2009) early engagement pathway, their current professional participants started engaging in football at the mean age of 5.5 years, thus offering similar started football ages during early childhood, which subsequently appears to be associated with both academy level and professional status.

4.5.4. The 'early preparation' concept

Both Cote *et al.* (2007) and Ford *et al.* (2009) fail to support the proposition of a combination of early specialisation, diversification, and engagement as a suitable talent development method in elite youth football. However, as a result of the current findings, this study offers an alternative interpretation of 'early preparation', to incorporate the necessary development skills of early specialisation, diversification, and engagement illustrated in this investigation. This involves players specialising in football early as a result of being part of a professional football academy through engaging in a large amount of coach-led practice, however continuing football-specific play while sampling and participating in other sports in collaboration. This allows individuals within the FDP to participate in their favoured sport through significant amounts coach-led practice, while enjoying the opportunity to partake in various other sports.

It is important to once again mention the modern outlook of academy environments; historically, coach-led practice would perhaps be regarded as closed practice design together with a command coaching style, which creates a setting for little player development (Balaguer *et al.,* 2012; Mageau & Vallerand, 2003). However, a contemporary viewpoint often involves player ownership through facilitated practice design and developing a fearless atmosphere for individuals to be creative and expressive (Larsen *et al.,* 2014). This arguably allows players within the FDP to engage in a specialised playful environment that is suitable for age appropriate learning, compared to structured practice design that has previously overwhelmed professional football academies (Aalberg & Saether, 2016).

The early preparation theory has been created to support the development of elite youth football players towards adult expertise. Through highlighting important developmental factors that have been illustrated through this current research, activities have been broken down into childhood and adolescence, to support the age-specific progress of players within the FDP and YDP. A comparison between the early preparation activities, alongside early specialisation, diversification, and engagement pathways, are available in Table 4.3.

According to this model, academy status should be achieved in childhood through demonstrating superior ability and potential. Furthermore, while peer-led play in football remained an insignificant factor in this research, as a result of high- and low-performers displaying a similar started football age and started academy age when compared to Ford *et al.*'s (2009) still-elite participants, it is important to recognise this as an influential part of a players' development. Therefore, although it did not discriminate performance outcomes, as a result of both high- and low-performers engaging in a relatively high amount of peer-led play, it is recommended individuals engage early in football through participating in a medium amount football-specific play during childhood.

Moreover, a high volume of practice within academy football during childhood is recommended to facilitate the development of superior technical proficiency (Haugaasen *et al.*, 2014a) and greater physical ability (Wrigley *et al.*, 2012). Also, whilst it may suggested the non-significance of match-play hours between performers in the FDP is a result of the shared game time within these age groups, it is recommended players participate in a low amount of competitive match-play during childhood. Additionally, a high amount of sampling other activities within the academy environment and being involved in other recreational sports externally is suggested during childhood. This may support injury prevention and the holistic development of key psychosocial and transferable skills as previously highlighted (Horn, 2015; Haugaasen *et al.*, 2014b; Zibung & Conzelmann, 2013). Finally, similarly to the early specialisation, diversification, and engagement pathways, the early preparation concept promotes a specialised approach in adolescence compared to childhood, however whilst also continuing to engage in a high amount of multi-sport activities. Therefore, it is recommended participants are involved in a high volume and intensity of both practice and competition.

Table 4.3. The anticipated factors of early specialisation, engagement, diversification, and preparation (adapted from Ford & Williams, 2017)

Anticipated factors	**Early specialisation**	**Early diversification**	**Early engagement**	**Early preparation**
		Childhood		
Start age in a primary sport	Childhood	Not specified	Childhood	Childhood
Start in football academy	Yes	No	No	Yes
Play in a primary sport	Low	Low – medium	High	Medium
Practice in a primary sport	High	Low or no	Low – medium	High
Competition in a primary sport	High	Low or no	Low or no	Low
Other sports	Low	High	Low – medium	High
		Adolescence		
Play in primary sport	Decreases to zero	Decreases to zero	Decreases to zero	Decreases to zero
Practice in primary sport	High	Increases to high	Increases to high	High
Competition in primary sport	High	Increases to high	Increases to high	Increases to high
Other sports	Decreases to zero	Decreases to low	Decreases to low	High

However, it is essential to highlight the importance of further research surrounding this early preparation concept, as a result of expertise yet to be achieved by individuals that were examined. Nevertheless, other research has similarly failed to fully support a single pathway, through illustrating the combination of both deliberate play and practice activities during childhood to support the long-term development of elite youth football players (i.e., Hornig *et al.,* 2016; Haugaasen *et al.,* 2014a; 2014b; Ford & Williams, 2012; Ford *et al.,* 2009). Therefore, the early preparation pathway aims to offer an alternative solution to support the professional academy football development process, as a result of preparing players during childhood through engaging in a combination of activities.

Furthermore, research into the practice history profiles of academy football players is ongoing through EPPP requirements as a result of its holistic support (Roe & Parker, 2016). Consequently, due to its longitudinal approach, as a result of gathering greater objective individual practice history data throughout the development process until expertise in adulthood is achieved, it may take some time before a more accurate reflection of what activities support an effective developmental pathway. Nevertheless, it is important researchers, across all sports, continue to investigate what activities support superior development towards adult expertise through both short- and long-term research methods.

4.6. Limitations

According to Ford & Williams (2017), retrospective recall studies have two methodological boundaries that limit their results concerning the specific question. Firstly, they only describe the current youth development systems in place for each sport within respective countries surrounding those who remained in the process. Therefore, it may not follow a system that is optimal, thus many other potential athletes may have dropped out or not been selected within the existing structure (Ford & Williams, 2017). Secondly, retrospective recall studies only demonstrate the activities that preceded the attainment of expert performance; they do not show the activities that caused fulfilment of elite status (Ford & Williams, 2017). Furthermore, it is important to appreciate the difficulty in recalling activities that were participated many years ago, particularly for players within the YDP. Therefore, incorporating the ability to discuss ones previous activities within groups during the completion of the PHQ attempts to facilitate this shortcoming. Additionally, practice history profiles of academy football players is constantly evolving through EPPP requirements, thus a more accurate reflection of what activities support the most suitable developmental pathway may be processed during this longitudinal approach.

4.7. Conclusion

With academies permitted to start recruiting players' at the age of 8 years, early specialisation, diversification, and engagement theories alone are rather impractical within the professional football industry in England due to its early specialised approach, thus eliminating the benefits of diversification and engagement. The early preparation concept allows elite youth football players to invest time specialising, through engaging in academy football at a young age, while continuing to participate in other sporting activities during childhood to gain additional developmental skills. It is also important to state the modern outlook of academy environments, with a contemporary viewpoint often involving player ownership through a facilitated practice design. (Cushion *et al.*, 2012; Ford & Williams, 2012; Ford *et al.*, 2010a; 2010b). This arguably allows players within the FDP to engage in a playful setting through coach-led practice, suitable for age appropriate learning, compared to structure practice design that was previously invested in youth football. Therefore, the early preparation concept allows academies to invest in signing elite youth football players during childhood, while applying a research driven model to gain optimum individual development through supporting the participation of multisport activities throughout the FDP and YDP.

5. PSYCHOLOGICAL

5.1. Introduction

Early talent identification and development research revealed talented youth football players possess superior personal characteristics that facilitate greater learning, training, and competition compared to their less-talented counterparts (Williams & Reilly, 2000). Consequently, over the last two decades there has been a growth in research directly related to sport psychology concerning elite youth football (Godfrey & Winter, 2017; Harwood & Knight, 2015; Pain & Harwood, 2004; Morris, 2000). As a result, it is well established that players who attain elite status consistently apply psychological skills that optimise development, while applying the capability to successfully overcome possible challenges they will face throughout the development process (Gledhill *et al.*, 2017; Cook *et al.*, 2014; MacNamara & Collins, 2013; Mills *et al.*, 2012).

Many authors, such as Cook *et al.* (2014), Cushion *et al.* (2012), Larsen *et al.* (2012), and Pain & Harwood (2004), report that the attention to the psychological development of young players is inadequately addressed in comparison to other multidisciplinary aspects of performance, such as technical skill or physical conditioning. Not only does this illustrate the significant lag for evidence based practice between research findings and their incorporation into the applied environment (Christensen *et al.*, 2011), it also highlights the importance of developing psychological characteristics as part of a holistic approach, while emphasising a need to analyse and assess the necessary psychological characteristics to realise expertise from an early age (Gledhill *et al.*, 2017; Reilly & Gilbourne, 2003).

Although there are number of studies that show elite youth athletes elicit superior psychological skills compared to their non-elite counterparts, there is limited research examining the discriminating benefit of psychological characteristics for developing excellence (PCDEs) within a professional football academy environment (MacNamara & Collins, 2011). MacNamara & Collins (2013) have found PCDEs distinguish good developers from their poor developing equivalents in elite youth football development within the YDP, albeit in a combination with other sports. However, there is no current research focussing on PCDEs that differentiate high- and low-performers in elite youth football alone within the FDP & YDP. Therefore, the aim of this chapter is to investigate discriminating PCDEs between high- and low-performers in a professional football academy in England, while also identifying any variations between age phases.

5.2. Rationale

Although it is relevant to distinguish psychological differences between elite and non-elite youth performers, for the purpose of this study, it is more noteworthy to recognise the psychological characteristics that differentiate elite performers independently within a football development environment. MacNamara & Collins (2011) state how talent is often specified as the ability to accomplish elite status at academy level, leaving little thought surrounding the characteristics that support the subsequent achievement of expertise as a senior athlete. Therefore, since the purpose of talent development should be to identify and then develop towards future performance proficiencies of young football players, attention should preferably concentrate on those characteristics to manage the course of development (Abbott & Collins, 2004). This contemporary developmental method focuses on the importance of an individual's ability to learn and progress, rather than concentrating on what they already know or how they are performing at a particular time (MacNamara & Collins, 2011).

For example, the role of psychological skills for performance, such as high levels of commitment, goal-setting, imagery, and effective preparation, have been found to distinguish successful performers from their less successful counterparts (Dohme *et al.,* 2017; Feichtinger

& Honer, 2015; Honer *et al.,* 2015; MacNamara & Collins, 2011; Reeves *et al.,* 2009; Boixados *et al.,* 2004). Moreover, characteristics for underachievers often include unrealistic beliefs and expectations, little aspirations, or low perseverance (Zuber & Conzelmann, 2014; MacNamara & Collins, 2013; Nadori & Szilasi, 1976). MacNamara and colleagues (MacNamara & Collins 2011; MacNamara *et al.,* 2010a; 2010b) have also investigated the stages of development of successful talent development athletes to identify key psychological factors that contribute to the conversion of potential into successful development. Similarly to those found at professional levels of performance, these PCDEs include imagery, goal-setting, and the attitudes and behaviours needed to deal with the challenges, stages, and transitions that epitomise development (MacNamara & Collins 2011; MacNamara *et al.,* 2010a; 2010b).

These PCDEs facilitate young athletes to optimise their development opportunities, adapt to setbacks, and effectively negotiate key transitions along the pathway of developing excellence (MacNamara & Collins, 2011). These factors include coping with first time appearances at a new level of competition, handling significant losses, slumps in performance and coach criticism, and recovering from injuries, selection, and demands for increased training or commitment levels (MacNamara & Collins 2011; MacNamara *et al.,* 2010b). Consequently, these PCDEs appear to effectively assist individual development by improving acquisition of skills, gaining the most from each training session, and having the ability to invest the requisite time to practise (MacNamara & Collins 2011; MacNamara *et al.,* 2010a; 2010b). However, applying these psychological skills alone are no guarantee for success since there are numerous noteworthy deciding factors that can lead to elite performance. Nevertheless, equipping elite youth athletes with PCDEs will likely assist in the development of reaching their potential, while the absence of such skills will increase the chances of falling at one of many hurdles along the developmental pathway to expertise (MacNamara & Collins, 2011). To simplify, young athletes who are committed, determined, and driven to succeed are more likely to overcome barriers or limitations during their development compared to similarly able peers without these characteristics (MacNamara & Collins, 2011).

MacNamara & Collins (2011) developed a tool, named the Psychological Characteristics of Developing Excellence Questionnaire (PCDEQ), to assess the possession and application of PCDEs. MacNamara & Collins (2011) found that the validation of the PCDEQ showed it to correctly classify between 67% and 75% of good and poor developers among youth athletes from both team sports (mean age 15.9 years) and individual sports (mean age 16.7 years). Measures derived from the PCDEQ should enable players to receive psychological feedback and indicate areas for immediate attention, improvement, and maintenance (MacNamara & Collins, 2013; 2011). Consequently, MacNamara & Collins, (2013) found significant differences in team sport athletes in three factors; support for long-term success (Factor 1), coping with performance and developmental pressures (Factor 3), and evaluating performances and working on weaknesses (Factor 5). Individual sports performer's revealed significant differences in Factor 1, imagery use during practice and competition (Factor 2), and Factor 5. No significant differences were revealed in both groups for ability to organise and engage in quality practice (Factor 4) and support from others to compete to their potential (Factor 6).

There are other questionnaires that have been applied to elite youth football research to analyse psychological skills, such as the Talent Development Environment Questionnaire (Li *et al.,* 2015; Martindale *et al.,* 2010). However, although it has previously been recognised as an ecologically valid resource to measure perceptions of talent development environments (Li *et al.,* 2015; Martindale *et al.,* 2013), Gledhill *et al.* (2017) highlight their concerns over the psychometric properties of the measure and its lack of sensitivity to football environments during their systematic review (Mills *et al.,* 2014b). Furthermore, although Toering *et al.*'s (2013) football-specific self-regulation questionnaire and Van Rens *et al.*'s (2016) Role Strain Questionnaire for Junior Athletes successfully differentiate elite and non-elite performers, they are limited to investigating specific psychological skills compared to the PCDEQ. Therefore, MacNamara & Collins' (2011) PCDEQ appears to offer a more comprehensive psychological approach from a talent development perspective compared to others that focus their enquiry into specific psychological factors.

Although MacNamara & Collins (2013) have previously applied the PCDEQ to research within team sport athletes, these players were solely from the YDP age, while football players were also combined with rugby and hockey players, which may arguably provoke different results. Therefore, this research offers an original insight into the PCDEs within the FDP, and also presents a comparison within the YDP, albeit with elite youth football players alone, whilst offering observations between age phases.

5.3. Aims and hypothesis

The purpose of this research is to compare PCDEQ scores between high- and low-performers within both the FDP and YDP. This questionnaire observes the six categories of psycho-behavioural factors that impact the development of sports expertise as validated by MacNamara & Collins (2013).

The specific aim of this chapter is:

1. To assess football-specific PCDEs that discriminates high- and low-performers, in both the FDP and YDP.
    a) It is hypothesised that high-performers will have significantly higher scores in Factor 1, 3, and 5 compared to their low-performing counterparts, in both the FDP and YDP.
    b) It is hypothesised that there will be no significant difference between high- and low-performers scores in Factor 2, 4, and 6, in both the FDP and YDP.

5.4. Results

5.4.1. FDP PCDEQ

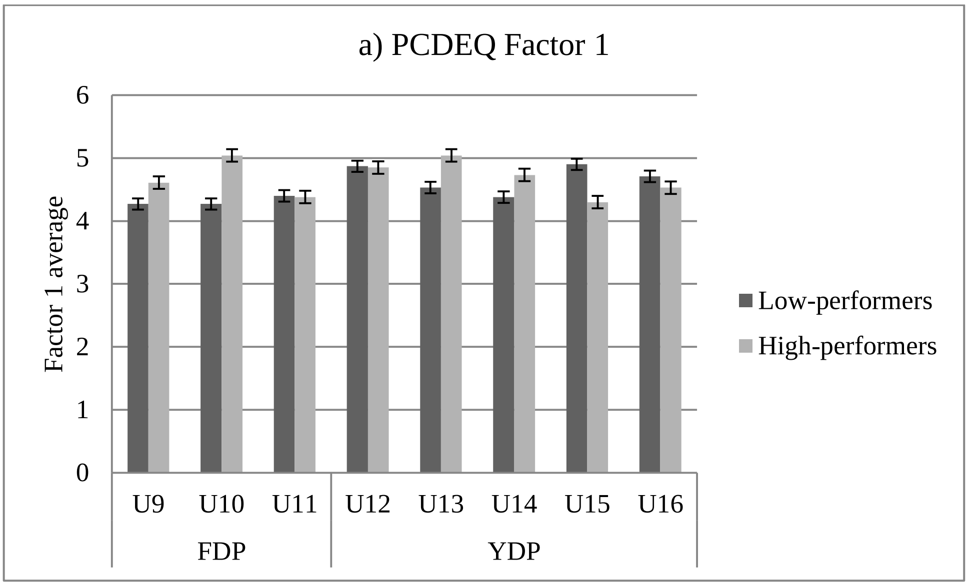
In the FDP, there was a significant difference between high-performers (M=0.22, SD=0.81) and low-performers (M=-0.47, SD=0.81) for Factor 4 – ability to organise and engage in quality practice, with high-performers demonstrating a greater mean score compared to low-performers ($t(24.00)=2.16$, $p=0.041$; Figure 5.1. d)).

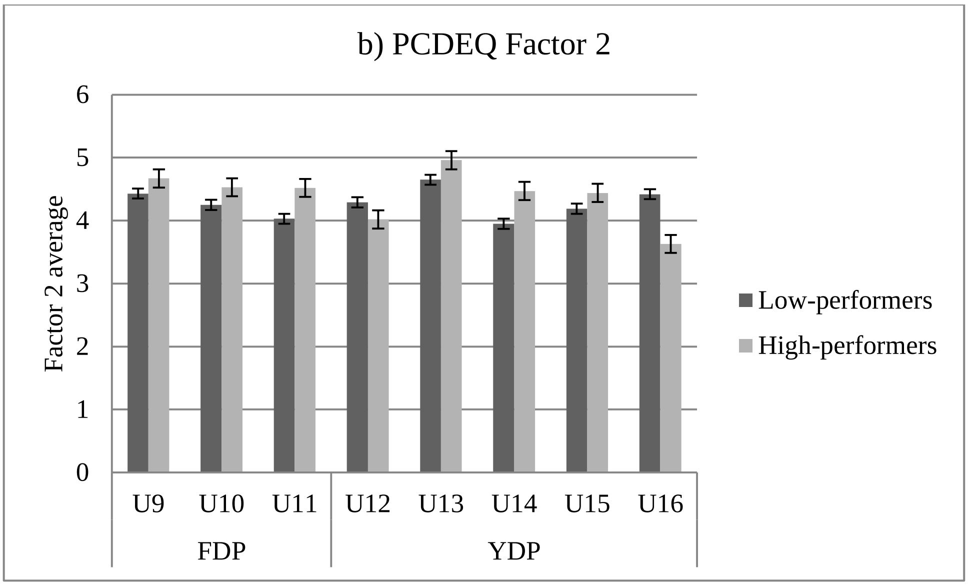
No significant difference was established between high-performers (M=0.09, SD=0.60) and low-performers (M=-0.43, SD=0.93) in the FDP for Factor 1 – support for long-term success ($t(24.00)=1.69$, $p=0.103$; Figure 5.1. a)). Likewise, there was no significant difference between high-performers (M=0.19, SD=0.79) and low-performers (M=-0.36, SD=1.00) in the FDP for Factor 2 – imagery use during practice and competition ($t(24.00)=1.57$, $p=0.131$; Figure 5.1. b)). Similarly, there was no significant difference between high-performers (M=0.11, SD=0.98) and low-performers (M=-0.36, SD=0.97) in the FDP for Factor 3 – coping with performance and developmental pressures ($t(24.00)=1.25$, $p=0.224$; Figure 5.1. c)). Furthermore, there was no significant difference between high-performers (M=0.00, SD=1.14) and low-performers (M=-0.03, SD=0.90) in the FDP for Factor 5 – evaluating performances and working on weaknesses ($t(24.00)=0.09$, $p=0.930$; Figure 5.1. e)). Also, there was no significant difference between high-performers (M=0.13, SD=0.62) and low-performers (M=-0.29, SD=1.00) in the FDP for Factor 6 – support from others to compete to my potential ($t(24.00)=1.29$, $p=0.210$; Figure 5.1. f)).

5.4.2. YDP PCDEQ

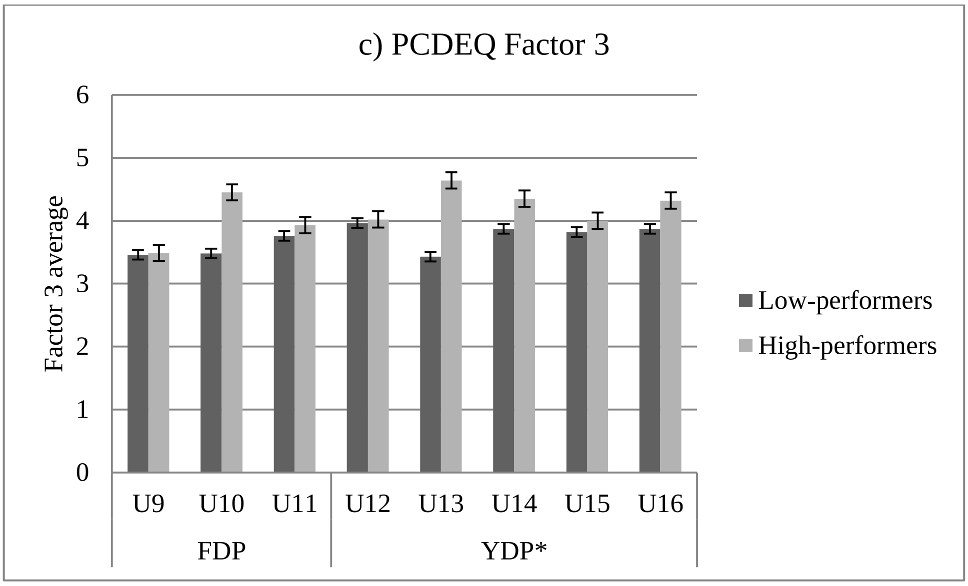
Within the YDP, there was a significant difference between high-performers (M=0.47, SD=0.73) and low-performers (M=-0.26, SD=0.86) for Factor 3 – coping with performance and developmental pressures (Figure 5.1. c)), with high-performers demonstrating a greater mean score compared to low-performers (*t*(36.00)=2.86, *p*=0.007).

No significant difference was established between high-performers (M=0.31, SD=0.90) and low-performers (M=-0.23, SD=0.90) in the YDP for Factor 4 – ability to organise and engage in quality practice (*t*(36.00)=1.86, *p*=0.071; Figure 5.1. d)). Furthermore, there was no significant difference between high-performers (M=0.05, SD=0.83) and low-performers (M=0.03, SD=1.02) in the YDP for Factor 1 – support for long-term success (*t*(36.00)=0.07, *p*=0.946; Figure 5.1. a)). Moreover, there was no significant difference between high-performers (M=0.04, SD=0.86) and low-performers (M=-0.15, SD=1.01) in the YDP for Factor 2 – imagery use during practice and competition (*t*(36.00)=0.60, *p*=0.552; Figure 5.1. b)). Additionally, there was no significant difference between high-performers (M=0.06, SD=1.04) and low-performers (M=-0.03, SD=0.99) in the YDP for Factor 5 – evaluating performances and working on weaknesses (*t*(36.00)=0.29, *p*=0.776; Figure 5.1. e)). Lastly, there was no significant difference between high-performers (M=-0.06, SD=1.06) and low-performers (M=-0.07, SD=1.02) in the YDP for Factor 6 – support from others to compete to my potential (*t*(36.00)=0.03, *p*=0.979; Figure 5.1. f)).

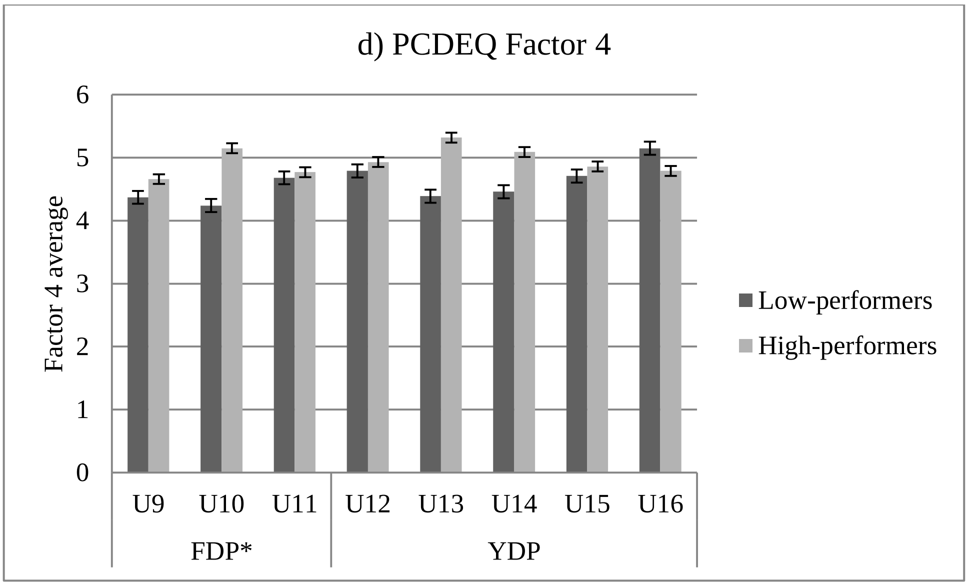




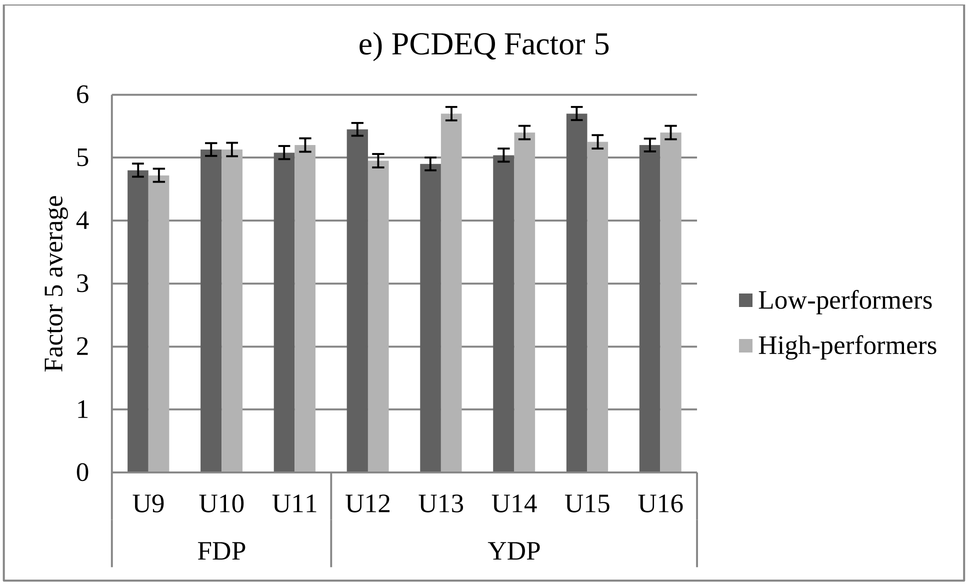
b) PCDEQ Factor 2
Factor 2 average
0
1
2
3
4
5
6
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers



c) PCDEQ Factor 3
Factor 3 average
0
1
2
3
4
5
6
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP*
Low-performers
High-performers



d) PCDEQ Factor 4
Factor 4 average
0
1
2
3
4
5
6
U9
U10
U11
U12
U13
U14
U15
U16
FDP*
YDP
Low-performers
High-performers



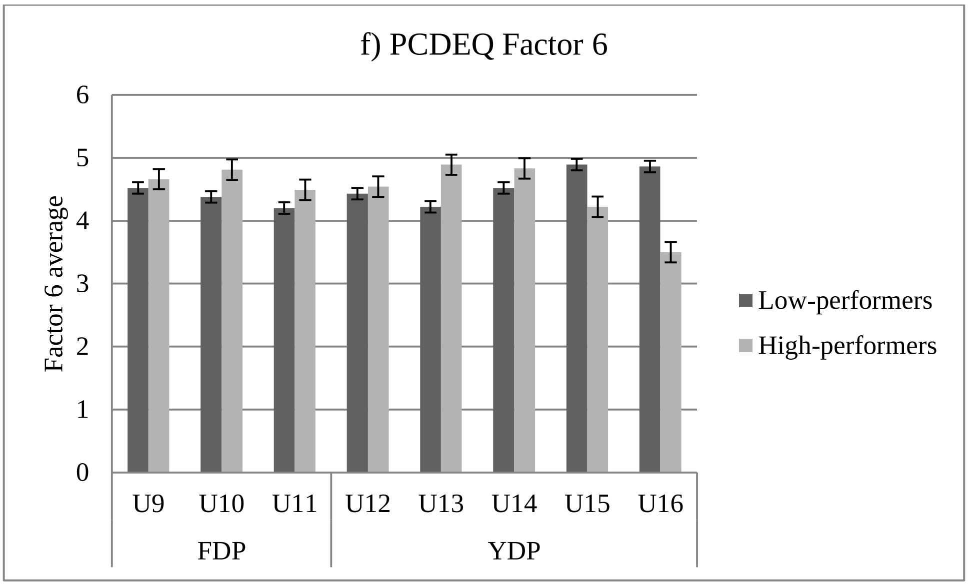


Figure 5.1. PCDEQ results (**p*<0.050 ***p*<0.005 ****p*<0.001)

5.5. Discussion

The PCDEQ has formerly discriminated good and poor developers in elite youth sport, which provides a useful tool to identify the mental skills, attitudes, and emotions to cope with the challenges young athletes encounter within talent development systems (MacNamara & Collins, 2013). Key findings from this study highlight, within the FDP, high-performers scored significantly higher for Factor 4 – ability to organise and engage in quality practice compared to low-performers. Within the YDP, high-performers scored significantly higher for Factor 3

– coping with performance and developmental pressures compared to low-performers. As such, the hypotheses were only partially supported, through no significant discriminating function for Factors 1 and 5.

5.5.1. Factor 1 – support for long-term success

This present study offers an original viewpoint from a specific team sport alongside an extensive variation of ages throughout the development process. No significant differences were observed for Factor 1 when comparing high- and low-performers within both the FDP and YDP. A number of questions for Factor 1 focus on the players' coach, which may explain the lack of any differences. In contrast to MacNamara & Collins (2013) who applied the questionnaire to athletes from different clubs and associations, the players from each age group in this current study were coached by the same two coaches. Clearly, individuals can react differently to the same coach behaviours, and coaches may act differently with certain players, however results did not reveal such effects in the current study.

Previous research also illustrates coaches regularly presume a dedication to their instructions (Holt & Dunn, 2004), and often view players who do not follow instructions and any subsequent mistakes as weaker (Toering *et al.,* 2011). Consequently, it may be suggested players that are less obedient may be placed lower in the coaches' holistic rankings, which may be argued a limitation of this current study. However, as previously stated and similar to former comments, this observation requires further investigation as a result of the constant evolution of the professional academy environment.

5.5.2. Factor 2 – imagery use during practice and competition

Although previous research has distinguished elite and non-elite youth football players surrounding the use of imagery, to the researcher's knowledge, no current study has offered discrimination between high- and low-performers within an academy environment alone. Therefore, this research offers an original insight in the understanding and application of imagery within an academy setting within specific age phases. Similarly to MacNamara & Collins (2013) findings regarding good and poor developers in youth team sport athletes, there was no significant difference in Factor 2 when comparing high- and low-performers in both the FDP and YDP. Consequently, this supports the proposition that the application of imagery does not differentiate both development and performance in youth team sport athletes respectively.

However, in contrast to the findings of the current chapter, MacNamara & Collins (2013) found a significant difference between good and poor developers from individual sports. While there are benefits for applying imagery to both team and individual sports, the execution of imagery for competitive match-play between the two differs significantly (Munroe-Chandler *et al.,* 2007; Morris, 2000). For example, the same football player may be able to achieve greater success with their club compared to their country as a result of a superior supporting cast (Munroe-Chandler *et al.*, 2008; Munroe-Chandler & Hall, 2004). Thus, there is a recognisable reliance on teammates in football, as although a football player may be a high-performer, they may still lack technical support from their teammates. Furthermore, from a team perspective, football promotes the importance of working together, with a group of players performing towards the same goal; without a collective effort, the team performance will ultimately falter (Munroe-Chandler *et al.*, 2008; Munroe-Chandler & Hall, 2004).

The psychological application of imagery has long been associated with positive performance outcomes in football throughout various playing levels from professional to novices (Shearer *et al.*, 2007; Munroe-Chandler & Hall, 2004; Reilly & Gilbourne, 2003). For example, Munroe-Chandler *et al.* (2008) illustrate the relationship between imagery use and self-confidence and self-efficacy in youth football players, through revealing it as a significant predictor for both recreational and competitive participants. However, this current research provides evidence that imagery does not discriminate high- and low-performers within an elite environment alone. Therefore, it may be suggested that if the participants were not previously exposed to imagery exercises as part of their psychology training within their academy setting, they may be naive to this practice, thus it is possibly just their inexperience that is explaining no difference.

5.5.3. Factor 3 – coping with performance and developmental pressures

Results for the YDP players are consistent with MacNamara & Collins (2013), who found good developers had a significantly greater perceived ability to cope with performance and developmental pressures (e.g., such as overcoming struggles, set-backs, injury, or a decline in performance, and the ability to balance their dual careers) compared to poor developers. Moreover, these findings are also comparable with qualitative examinations of football coaches (Thelwell *et al.*, 2005). First, Mills *et al.*'s (2012) analysis of ten expert coaches revealed six factors, including resilience, that are perceived to either positively or negatively influence player development. Second, Cook *et al.* (2014) examined coaches and practitioners perceptions of mental toughness and its role in the development of youth football players. They reported four general dimensions of mental toughness, including competitiveness with self and others, mind-set, resilience, and personal responsibility, that are subsequently inextricably associated with the ability to cope with the performance environment and the pressures inherited with effective development.

Furthermore, Cook *et al.* (2014) explained how coaches integrate independence and resourcefulness, through creating a challenging but supportive learning environment, to enhance mental toughness. However, Cook *et al.* (2014) also highlight that, although mental toughness is readily acknowledged as a crucial factor in securing a professional contract, academy coaches have a lack of knowledge of how to effectively develop this psychological characteristic in players. Consequently, both this current study and Cook *et al.* (2014) reveal mental toughness is accepted as a crucial factor for greater performance and achieving adult expertise respectively.

Cruickshank & Collins (2015) also suggest illuminating and applying 'the dark side' to promote practitioner sensitivity to develop leadership behaviours, such as ruthlessness, performance-focussed behaviours, and social dominance. Consequently, it may be suggested academy coaches promote these characteristics within the YDP environment to facilitate the development of coping with performance and developmental pressures that are associated with 'the dark side'. In addition, according to Oliver *et al.* (2010), coping was one of eight important practice behaviours for the development of high-level youth athletes when exploring the perspectives of elite coaches, thus further supporting the importance of possessing this particular characteristic.

Contrary to the YDP results, there was no significant difference for Factor 3 when comparing high- and low-performers in the FDP. This is perhaps a result of the player-led or facilitated approach that is often implemented within coach-led practice in the FDP, as a form of age appropriate learning (Balaguer *et al.*, 2012; Stebbings *et al.*, 2011). This age-specific coaching style, through a playful and engaging form of teaching and learning, arguably reduces the performance and developmental pressures that increase as players' progress through the pathway. Nevertheless, this suggestion requires further investigation, to understand the learning environment created for both FDP and YDP players, to highlight the differences for developing coping strategies for overcoming performance and developmental pressures.

Although previous research has highlighted mental toughness and resilience as psychological attributes required to progress from academy to professional status (Cook *et al.*, 2014; Mills *et al.*, 2012; Coulter *et al.*, 2010), to the researchers knowledge, no investigation has discriminated high- and low-performers within both the FDP and YDP surrounding the ability to cope with performance and developmental pressures. Therefore, this research offers an original examination into the psychological skills that have been previously highlighted as essential for achieving adult expertise, through differentiating high- and low-performers to observe whether they exist within an academy environment. Furthermore, as a result of the early specialised approach of academy football, it may be suggested pressures often arise, thus creating an opportunity for players who have greater coping mechanisms to outperform others. Nevertheless, this research highlights the ability to cope with performance and developmental pressures differentiate high- and low-performers within the YDP but not in the FDP, thus revealing age-specific requirements for greater performance.

Consequently, professional academies and coaches alike must invest more time and resources into psychological development, to promote an increased awareness of psychological evidence-based practice, which can be achieved through knowledge-transfer partnerships between university departments and associations (Cushion *et al.,* 2012). Therefore, contemporary research can be applied into practice sooner to give academies a greater advantage of developing players who are talented enough to reach professional level.

5.5.4. Factor 4 – ability to organise and engage in quality practice

Although no differences were hypothesised in Factor 4, high-performers in the FDP had significantly higher scores than their low-performing counterparts. This psychological characteristic is visibly associated with the ability to effectively participate in coach-led practice, through an individuals' willingness to apply them self intrinsically to focus on developing personal learning objectives. Chapter 4 focussed on the activities that underpin learning (e.g., practice, competition, and play) and interestingly, the only significant factor that discriminated between the groups at FDP was time spent in coach-led practice. Furthermore, although it was not statistically significant, high-performers also started academy football at an earlier age and had a greater total mean score for the number of sports played. Perhaps the need to manage multi-sport training necessitates improved engagement in quality practice. However, as similar effects for multi-sport participation were also found for the YDP, and while Factor 4 discriminated groups in the YDP (albeit statistically insignificant), this link is perhaps tenuous.

Similarly, although the early specialisation pathway proposes an early start age in structured practice in a primary sport, it does not support deliberate play or practice in other sports (Ford *et al.,* 2009). Arguably, both deliberate play in football and engagement in other sports may facilitate the ability to organise and engage in quality practice (Ford *et al.,* 2009; Cote *et al.,* 2007). Thus, the early preparation concept, that has been suggested in Chapter 4, is recommended in a professional football academy setting to support developmental factors, including an early start age and practice in a primary sport, which may support a greater ability to organise and engage in quality practice.

While previous research from MacNamara & Collins (2013) has focussed on differentiating good and poor developers' ability to organise and engage in quality practice in adolescents, from both team and individual sports, this current study has focussed on discriminating high- and low performers within the FDP and YDP from a football academy perspective. Consequently, this original viewpoint suggests that these findings support the concepts of both early specialisation and preparation, through FDP high-performers possessing a greater ability to organise and engage in quality practice. Furthermore, it is also suggested that teaching strategies should be incorporated into academies to assist the improvement of individual learning (Haimovitz & Dweck, 2017), and as a result, acquiring a greater ability to organise and engage in quality practice. As a result of these contentions, future research in talent development should continue to identify the activities underpinning the ability to organise and engage in quality practice, while generating effective coaching methods and intervention strategies.

5.5.5. Factor 5 – evaluating performances and working on weaknesses

Contrary to the hypothesis, results from the present study revealed no significant differences between high- and low-performers within both the FDP and YDP for Factor 5. Additionally, there appears to be no difference between phases for their perceived ability to evaluate performance and work on weaknesses. While differences between sports might explain why these results did not support MacNamara & Collins' (2013) findings, results are also in contrast to Van Yperen (2009), who found goal-commitment differentiated elite youth football players who achieved professional status from those who did not. Additionally, these current findings are also at odds with Mills *et al.* (2012), who revealed goal-directed attributes as one of six interrelated higher-order categories that influence player development within the PDP. Cook *et al.* (2014) also found competitiveness with self, mind-set, and personal responsibility were three out of four general dimensions of mental toughness, which is considered to be important in the development of youth football players transferring into professional status.

This particular study offers a similar insight, through assessing FDP and YDP academy player's ability to evaluate performances and work on weaknesses, although revealing no significant differences between high- and low-performers. This conflicts with previous research, regarding the importance of evaluating performances and working on weaknesses, during the latter part of the development pathway in the PDP (Cook *et al.*, 2014; MacNamara & Collins, 2013; Mills *et al.*, 2012; Van Yperen, 2009). As a result, evaluating performances and working on weaknesses within the FDP and YDP may not be as significant to the development of expert performance in a football academy setting as previously thought when compared to the PDP.

5.5.6. Factor 6 – support from others to compete to my potential

Similarly to MacNamara & Collins (2013) results, there was no significant difference in Factor 6 when comparing high- and low-performers in both the FDP and YDP. Consequently, both the current findings and MacNamara & Collins' (2013) results illustrate support from others, such as parents, peers, and siblings, to compete to their potential do not significantly differentiate both high- and low-performers and good and poor developers respectively.

The findings related to Factor 6 do not mean it is not unimportant; when compared to previous research, it has been suggested that elite level football players often have parents who create an environment concerning an appreciation of success through hard-work and learning (Kavussanu *et al.,* 2011). This may suggest academy football players possess similar parenting environments, perhaps through the increasing awareness of strategies and guidance as a result of workshops and resources provided by academies. Consequently, this may support the talent development process in elite youth football through increasing psychological skills such as player-level task-orientation, self-determined motivation, unconditional self-acceptance, and an increased self-awareness (Ullrich-French & Smith, 2009; Hill *et al.*, 2008).

5.6. Limitations

Due to the substantial comparisons with their study within this discussion, it is important to highlight the mean age of team sport participants in MacNamara & Collins' (2013) study (age 15.94 years). As a result of the considerably lower mean age of the participants in this current study, particularly within the FDP, it may be argued that because MacNamara & Collins' (2013) initial validation does not include comparably younger participants, it may be an inappropriate measure for these age groups. However, due to the participants being involved in an elite youth football academy, and thus part of a professional talent development pathway, the questions are arguably related to all that are participating in this study.

Also, the complexity of some questions within the PCDEQ might have been too difficult for some participants within the FDP to understand. However, this was not believed to be an important confounding factor, as the researcher was present during the completion of each questionnaire, and was readily available to answer or explain any questions that participants had or did not understand. Additionally, MacNamara & Collins (2013) focused on their coaches or talent development managers to rate the players on a 5-point Likert scale based on their perception of the athlete's potential to develop to elite levels in their sport, whereas the current study allowed coaches to rank their age group on current performance levels which creates high and low performing groups. This viewpoint considered the fact that MacNamara & Collins (2013) focused their attention on talent development and discriminating good and poor 'developers', whereas the current study investigated talent identification and recognised the discriminating factors between high and low 'performers'. Nevertheless, both participant status methods provide suitable techniques for separating athletes for their relevant research. Therefore, the perspective of this study is that the questionnaire is a suitable method for measuring PCDEs for each participant within the study, and provides reliable findings for each factor within the FDP and YDP.

MacNamara & Collins (2013) stated that the PCDEQ does not offer the perfect psycho-behavioural profile for athletes, although it does facilitate the recognition of psychological weaknesses (e.g., like fitness testing indicates physical limitations). Furthermore, MacNamara & Collins (2013) also state the questionnaire is limited by respondent biases, such as interpretation, recall, and social desirability. Additionally, MacNamara & Collins' (2013) highlight cultural specific requirements may influence the deployment of PCDEs, which requires further investigation from a multidisciplinary viewpoint.

5.7. Conclusion

Previously, researchers have highlighted psychological skills in a professional football academy are often overlooked compared to other factors such as technical ability or physical development. However, the increasing amount of literature in youth football has emphasised the importance of identifying and developing psychological skills, to prepare individuals for the professional environment and to optimise their opportunity to reach personal expertise (Gledhill *et al.,* 2017; Cook *et al.,* 2014; MacNamara & Collins, 2013; Mills *et al.*, 2012). Although previous research has illustrated certain psychological attributes are required to progress from academy level to professional status (Gledhill *et al.,* 2017; Cook *et al.,* 2014; MacNamara & Collins, 2013; Mills *et al.*, 2012), to the researchers knowledge, no investigation has discriminated high- and low-performers within both the FDP and YDP in an academy environment. Consequently, this research provides a unique insight into an academy setting, to highlight the age-specific discriminating PCDEs between high- and low-performing players in both the FDP and YDP.

Results of the current study reveal the ability to cope with performance and developmental pressures significantly differentiates high- and low-performers within the YDP. These results show that high-performers may possess greater coping mechanisms to outperform others, thus strategies to develop psychological skills, such as mental toughness and resilience, should be a central developmental characteristic within the YDP. Furthermore, present findings found the ability to organise and engage in quality practice significantly discriminated between high- and low-performers within the FDP. These observations support the concepts of both early specialisation and preparation, through FDP high-performers possessing a greater ability to organise and engage in quality practice. Thus, it is suggested that teaching strategies should be incorporated into academies to assist the improvement of individual learning, and as a result, acquiring a greater ability to organise and engage in quality practice (Freitas *et al.*, 2013).

Other PCDEQ factors within this research, including support for long-term success, imagery use during practice and competition, evaluating performances and working on weaknesses, and support from others to compete to my potential, did not significantly differentiate high- and low-performers within both the FDP and YDP. These findings do not negate their importance, as previous research found that these characteristics can influence the talent development process within elite youth football, and should continue to be implemented and developed.

Finally, while it is important to instil PCDEs when working with aspiring young athletes, providing them solely with these psychological skills may not necessarily result in expert performance. Since there are a number of variables that can influence the likelihood of reaching elite levels of performance at adulthood, it is necessary to use the PCDEs alongside other relevant factors within a talent development model.

6. SOCIOLOGICAL

6.1. Introduction

The socio-economic factors that can influence sport participation are essential in the consideration of any development strategy (Bailey *et al.,* 2010). In comparison to other characteristics that potentially influence talent identification and development, the socio-economic status of residence and school social classification and financial risk are often overlooked (Winn *et al.,* 2017; Burgess & Naughton, 2010). For example, Taylor & Collins (2015) state how talent identification and development literature has only recently started to consider the family environment as an important factor. Elite youth athletes are regularly placed under pronounced time pressures as a consequence of having to manage a dual career challenge of an extensive training programme and their academic careers (Jonker *et al.,* 2011; Christensen & Sorenson, 2009). Thus, it may be argued parental support is vital to combine time consuming requirements of training schedules and academic provision, amongst other daily parental roles and responsibilities (Gledhill & Harwood, 2015; Taylor & Collins, 2015). Consequently, socio-economic factors, such as social classification and financial risk, may impact the amount of support parents are able to supply, from both financial and time logistic standpoints.

Through supplying an individual's postcode, socio-economic classification, using the UK General Registrar Classification system, and average credit rating, applying the Cameo™ geodemographic database, can be revealed. Although there are a number of studies that apply these research methods in their studies surrounding physical activity and health (Eime *et al.,* 2017; 2013; Payne *et al.,* 2013; Nezhad *et al.,* 2012; Kamphuis *et al,* 2008; Scheerder *et al.,* 2005; Estabrooks *et al.,* 2003), there is no current research focussing on the effect of socio-economics on the development of elite youth football players in an academy environment

(Winn *et al.,* 2017). Therefore, the aim of this study is to determine discriminating socio-economic factors of both home and school social classification and financial risk between high- and low-performers in a professional football academy in England, while identifying any age differences between the FDP and YDP.

6.2. Rationale

In academia, there is a regular concern about the plight of high-potential children who suffer from socio-economic deprivation (Gagne, 2011). Efforts to identify and assist these children require an understanding surrounding the socio-economics that form barriers to talent development (Davids *et al.,* 2013; Araujo & Davids, 2011). Over a decade ago, Ambrose (2002) revealed the need to identify hidden socio-economic influences on aspirations, motivation, and talent development within research. Following this investigation, the British Government has engaged in critical activism for deprived high-potential children (Department for Culture, Media & Sport, 2015). However, objective data concerning the influence of socio-economics on the talent identification and development in elite youth football remains unknown (Winn *et al.,* 2017).

6.2.1. Parents

Socio-economic factors are inextricably associated with parents and have a significant influence upon participation from a young age, with the cost associated with membership, training, equipment, kit, and transport having an impact on participation outside school (Bailey *et al.,* 2010). Indeed, a number of empirical studies have found that active sports participation is correlated with social class characteristics in countries such as the United States of America (Pabayo *et al.,* 2014b; Payne *et al.,* 2013; Nezhad *et al.,* 2012; Kamphuis *et al.,* 2008; Voss *et al.,* 2008; Scheerder *et al.,* 2005; Estabrooks *et al.,* 2003), Canada (Pabayo *et al.,* 2014a), Germany (Lammle *et al.*, 2012), Australia (Maher & Olds, 2011), and Belgium (Vandendriessche *et al.*, 2012a).

Although there has been limited research from an elite sporting perspective, it has been previously suggested that many winter sports are selected from largely Northern European and white North American populations with relative access to wealth (Travers, 2011; King, 2007). Furthermore, Lawrence (2017) documented the distribution of socio-demographic markers, such as race and relative access to wealth, in athletes participating the summer and Winter Olympic Games. Lawrence (2017) collected data from 568 winter and 1,643 summer competing athletes from Canada, United States of America, Great Britain, and Australia. It was revealed racial and socio-economic biases were identified in both summer and winter Olympic sports, as a result of predominantly favouring white and privately educated athletes.

Similar biases are also reflected in UK national statistics where participation in sport by different income groups is highlighted (Hylton & Totten, 2001). For example, Yang *et al.*'s (1996) longitudinal study discovered athletes from the middle class received additional tangible support from their family members. Moreover, Rowley & Graham (1999) revealed a greater drop-out rate from sport participation in lower-income families. Additionally, Evans *et al.* (2013) illustrated the relationship between low levels of sport participation in areas of high deprivation, as a result of public facilities remaining at a similar cost throughout all socio-economic categories.

The cost of participation is both monetary and time consuming, consequently creating a possible burden on the economic outgoings and income respectively, thus generating potential participation barriers between income and social classifications (Elling & Claringbould, 2005; Collins & Buller, 2003; Kirk *et al.*, 1997a; 1997b). Winn *et al.* (2017) described two types of obscurities for children living in deprived areas concerning sport participation; 'practical' and ‘knowledge’ barriers. Practical barriers include not being able to afford the costs associated with certain sports, restricted access to facilities, parents unable to devote enough time towards taking their children to sport, and safety-associated risks of potential crime in the area (Winn *et al.,* 2017). Knowledge barriers can also effect sport participation through the lack of understanding surrounding the health benefits associated with physical activity (Winn *et al.,* 2017).

6.2.2. School

Within a UK educational framework, there is a wealth of research that identifies the importance of the education sector on sports participation (Bailey *et al.*, 2010). Similarly to the impact of socio-economic status on participation in sport and physical activity, the type of school attended (socio-economic status), geographical location (access to facilities and community), and educational attainment levels (school grades) all highlight a comparable trend (Bailey *et al.,* 2010; Cote *et al.,* 2006). Schools are institutions that can encourage sport and physical activity, promote participation and talent development, and provides a social arena for young people to interact with peers (Bailey *et al.,* 2009; Bailey & Morley, 2006). The interaction children face at school is vital regarding the influence of sport participation, while the geographical location of the school has also been identified as a key indicator of cultural practice (Wright *et al.,* 2003; Weiss *et al.,* 1996). Thus, similarly to the location of birth, those who attend school in a certain area may be provided with superior opportunities to develop talent.

In addition, the issues surrounding the educational policy concerning the opportunity and types of schools available are varied (Houlihan & White, 2002). For example, Roberts (1996) found children in state secondary schools receive approximately two hours a week of physical education, while children in independent schools received four to six, which are often increased with the provision of after-school activities. Furthermore, Bailey *et al.* (2010) also revealed how the number of actual coaching hours is significantly higher in private schools compared to public sector schools. Additionally, the traditional use of competitive sport in independent schools provides a positive and esteem indicator within a closed society compared to public sector schools (Bailey *et al.*, 2010; Kay, 2000; Marsh, 1993). This is a reflection on the socio-economic status and income which offers greater opportunity concerning sport development for families who are able to afford private schooling for their children.

Although there appears to be a robust association between social deprivation, physical activity, and sport participation, exploration concerning the impact of socio-economic status in an elite youth sport context is scarce. Winn *et al*. (2017) present an initial study within this particular focus, investigating the effect of deprivation on the developmental activities of elite youth rugby union players in Wales. The authors found that elite players with greater deprivation had fewer hours in rugby activities and engaged in less sports compared to their least deprived equivalents. Winn *et al*. (2017) also highlight the need for further investigation into the association between deprivation and sports performance from an elite context, consequently supporting this current chapters initial aims. Furthermore, this supports Hayman *et al.*'s (2011) publicised concept of 'social exclusion', to explain the phenomenon surrounding under-participation in talent development programmes amongst athletes that derive from low-income families.

6.2.3. Football-specific research

According to Williams *et al.* (1999), an individuals' sociological background must be taken in to consideration when identifying talent in football. In Ireland for example, young football players continue to be targeted from the working class (Bourke, 2003). Bourke (2003) studied the career choice, social networks, and key contributing factors to the outward mobility of elite youth Irish football players. Bourke’s (2003) insight into the career development options displays the complexity, pressure, and power relationships of all involved, from family to professional club. Consequently, this research suggests football upholds a traditional and stereotypical divide between socio-economic status and participation, while also suggesting that a large amount of players associated with the game perceive academic qualifications as unimportant (Bourke, 2003). Additionally, Hodkinson & Sparkes (1997) contend that few opportunities for industrial working-class people provide the prestige, enjoyment, and satisfaction for acquiring and exercising valued skills and abilities that are expressed within football, thus highlighting how football may be a greater prospect for young players who derive from lower social classifications.

While the financial costs are low regarding participation in a professional football academy, it is important to highlight there are both time and social considerations for both players and parents, while travel expenditures may also be customary for players who live far from the facilities (Green & Chalip, 1997; Kirk *et al.*, 1997a; 1997b). Rowley & Graham (1999) support these findings and explain, from their sample of 282 children in the UK, that the cost of intense training, such as academy football, led to drop out, particularly children from working-class and single-parent families. Furthermore, Holt *et al.* (2011) highlighted time management and scheduling demands as part of the barriers and constraints that are often associated with children involved in elite sport.

However, Bourke (2003) argue that there is an anti-education culture within elite development systems in sport. For example, football is perceived to attract low academic achievers, while inside academy level there is a significant divide between football and education (Parker, 2000). Due to this traditional conception, and the fact a low number of academy graduates achieve professional status, the EPPP provision insists each professional academy in England requires a qualified full-time 'Head of Education' to sustain and promote the young players' education and not let football training disrupt it (Premier League, 2013).

6.2.4. Reverse effects – the rocky road

Contrary to the data on deprivation and lower participation (Morgan & Giacobbi, 2006), situational factors may facilitate talent development through acquiring psychological characteristics associated with facing and overcoming adversity, such as commitment, motivation, self-esteem, mental toughness, and resilience (Savage *et al.*, 2017; Collins *et al.*, 2016; 2015). Collins & MacNamara (2012) have proposed that 'talent needs trauma' to facilitate the talent development process, through developing these essential psychological characteristics. It may be debated that players from families with a lower social classification may face more recurrent trauma through an increased likelihood of being involved in lower household income and a higher financial risk, thus consequently having to battle for what they want rather than it being giving to them (Winfield, 1994; Masten *et al.*, 1990).

Research has revealed that social support is an important moderator of this link between trauma and subsequent success (MacNamara *et al.*, 2010a; 2010b; Gullich & Emrich, 2006). For example, Rees & Hardy (2000) conducted 10 interviews with elite athletes and identified four dimensions of social of social support; emotional (i.e., comfort and security), esteem (i.e., confidence), informational (i.e., advice), and tangible (i.e., resources). Interestingly, Rees & Hardy (2000) revealed how these four dimensions of social support were associated to both sport and non-sport related challenges. Thus, the environment that young athletes live and learn are important in both sporting and non-sporting terms for developing talent, through gaining feedback and responding to coaches, teachers, family members, and significant others surrounding performance issues, help with interpersonal problems, and life direction concerns (Rees & Hardy, 2000).

While it is apparent there are many factors associated with the development of talent in young athletes, social-contextual factors remain the least studied (Rees *et al.,* 2016). In sport, limited research has investigated the geodemographic effect on talent identification and development. For instance, research has not delved into the socio-economic status of young talented athletes to identify the differing characteristics they may possess in relation to their varying geographic status (Lawrence, 2017; Winn *et al.,* 2017). It may be suggested, similarly to proposals in academia, that young players' socio-economic status may influence aspirations, motivation, and skill acquisition, which could consequently impact the development process and progress within an academy environment into professional status.

Additionally, corresponding with research surrounding constraints on participation, socio-economic status may lead to a decline in training and participation, thus hindering opportunity to develop and progress (Dagkas & Stathi, 2007). Conversely, the hardship of dealing with deprivation may develop resilience or other psychological qualities that are transferable to football, and therefore compliment the development process (Collins & MacNamara, 2012). Thus, research within talent identification and development in elite youth football needs to investigate any differing characteristics surrounding young players' social classification and financial risk. Additionally, as a result of the differing effects on participation of both home and school status, this research will also observe both these outcome measures. Therefore, this study will initiate an investigation into the social classification and financial risk of elite youth football players' residence' and schools, concerning whether these socio-economic characteristics distinguish high- and low-performers within the FDP and YDP.

6.3. Aims and hypothesis

This study will assess both the social classification and credit rating of the participants' home, to highlight whether these discriminate high- and low-performers in both the FDP and YDP.

Furthermore, the study will investigate both the social classification and credit rating of the participants' school, to identify whether these differentiate high- and low-performers in both the FDP and YDP. Although there are various suggestions concluded from previous research amongst diverse sports, this hypothesis is articulated through the sole example available within football, provided by Bourke (2003), where their findings illustrated football maintains a traditional and stereotypical divide between socio-economic status and participation, with young players in Ireland subsequently targeted from working class families.

The specific aims of this chapter are:

1. To assess whether high performance is associated with residence social classification and financial risk, in both the FDP and YDP.
    a) It is hypothesised high-performers will have a significantly lower residence credit rating score and social classification compared to their low-performing counterparts, in both the FDP and YDP.
2. To assess whether high performance is associated with school social classification and financial risk, in both the FDP and YDP.
    b) It is hypothesised high-performers will have a significantly lower school credit rating score and social classification compared to their low-performing counterparts, in both the FDP and YDP.

6.4. Results

6.4.1. FDP residence and school social classification and financial risk

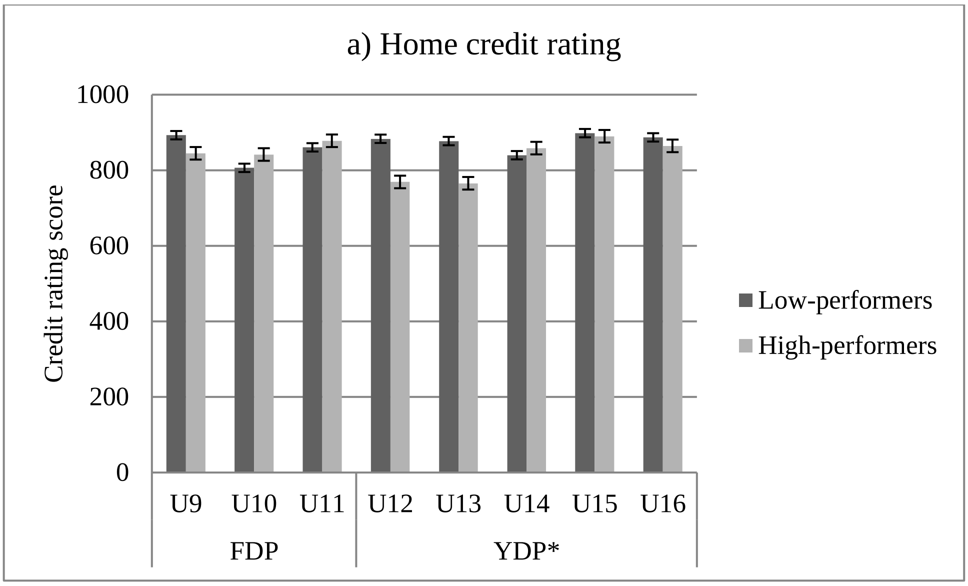
In the FDP, there was no significant difference between high-performers (M=0.16, SD=1.18) and low-performers (M=0.07, SD=0.75) in the FDP for their residence financial risk

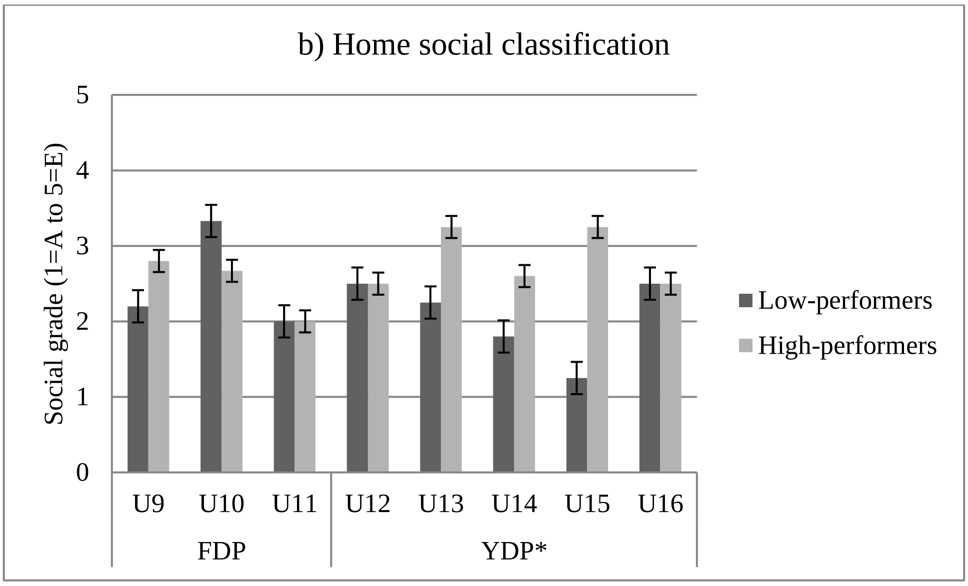
(t(24.00)=0.23, p=0.821; Figure 6.1. a)). Similarly, there was no significant difference between high-performers (M=0.13, SD=0.92) and low-performers (M=0.04, SD=0.97) in the FDP for their residence social classification (t(24.00)=0.22, p=0.828; Figure 6.1. b)). Furthermore, there was no significant difference between high-performers (M=-0.01, SD=0.97) and low-performers (M=-0.16, SD=1.07) in the FDP for their school financial risk (t(24.00)=0.37, p=0.715; Figure 6.1. c)). In addition, there was no significant difference between high-performers (M=0.04, SD=0.89) and low-performers (M=-0.05, SD=0.87) in the FDP for their school social classification (t(24.00)=0.25, p=0.806; Figure 6.1. d)).

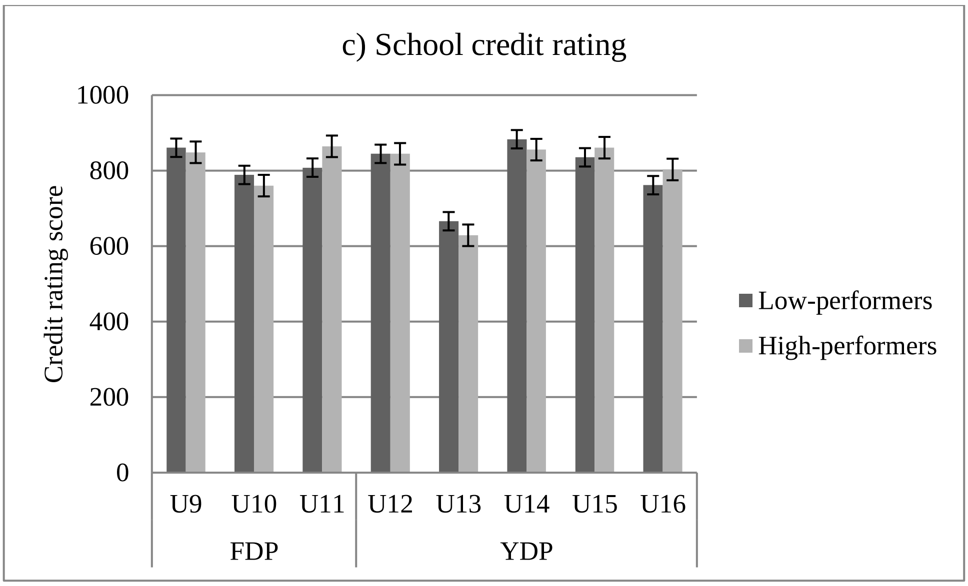
6.4.2. YDP residence and school social classification and financial risk

Within the YDP, there was a significant difference between high-performers (M=-0.19, SD=1.11) and low-performers (M=0.37, SD=0.47) for their residence financial risk, with high-performers having a lower credit rating, thus greater financial risk, compared to low-performers (t(36.00)=-2.04, p=0.049; Figure 6.1. a)). Moreover, there was a significant difference between high-performers (M=0.46, SD=0.90) and low-performers (M=-0.29, SD=1.03) in the YDP for their residence social classification, with high-performers having a higher mean score, thus lower social classification, compared to low-performers (t(36.00)=2.38, p=0.022; Figure 6.1. b)).

There was no significant difference between high-performers (M=0.03, SD=0.76) and low-performers (M=-0.02, SD=1.02) in the YDP for their school financial risk (t(36.00)=0.16, p=0.873; Figure 6.1. c)). Lastly, there was no significant difference between high-performers (M=0.24, SD=1.03) and low-performers (M=0.07, SD=1.04) in the YDP for their school social classification (t(36.00)=0.53, p=0.600; Figure 6.1. d)).


a) Home credit rating
Credit rating score
1000
800
600
400
200
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP*
Low-performers
High-performers


b) Home social classification
Social grade (1=A to 5=E)
5
4
3
2
1
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP*
Low-performers
High-performers


c) School credit rating
Credit rating score
1000
800
600
400
200
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers

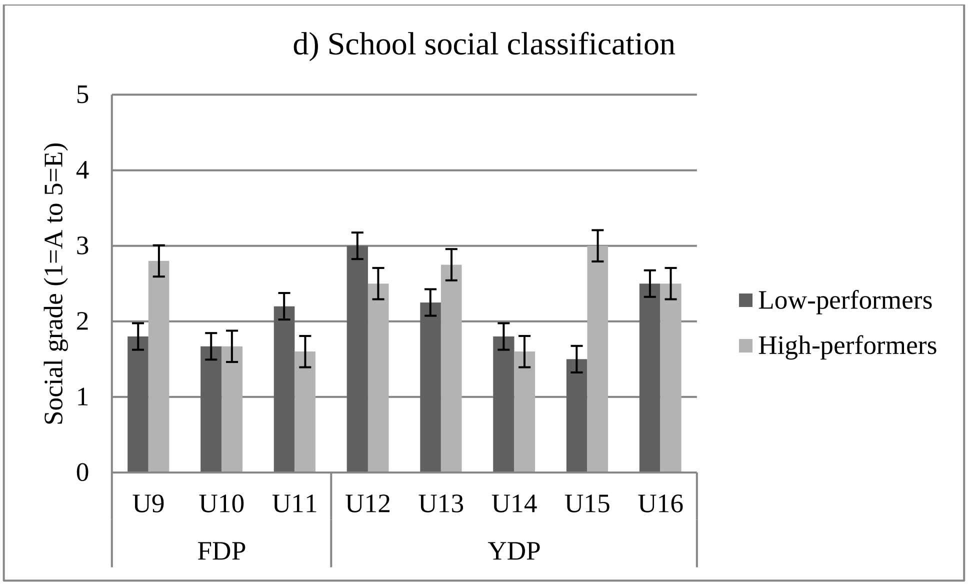


Figure 6.1. Residence and school social classification and financial risk results (**p*<0.050 ***p*<0.005 ****p*<0.001)

6.5. Discussion

This chapter sought to investigate possible influences of socio-economic factors on playing status. The main findings of this study were that only residence social classification and credit rating for the YDP group distinguished between current ability; high-performers came from families with a significantly lower social classification and greater financial risk compared to low-performers. School social classification and credit rating for YDP players did not differentiate ability, and neither residence nor school social classification differentiated high- and low-performers in FDP.

6.5.1. Residence social classification and financial risk

To the best of the author's knowledge, no other study has been published where such data has been applied and analysed within academy football (Winn *et al.*, 2017). The results of high performance relating to lower social classification and higher financial risk in the YDP coincide Bourke's (2003) findings, which support the long standing tradition of football being a sport participated by individuals with lower socio-economic status. This indicates an association between higher ability in an English football academy and the socio-economic effect of lower social classification and greater financial risk for players aged 11 to 16 years from a home perspective.

The findings also reinforce the application of identifying social characteristics as part of holistic talent identification model (Williams *et al.*, 1999). This may be performed through reporting scouts to target greater deprived areas, applying relevant socio-economic data to support contract decisions as part of a multidisciplinary approach, facilitating player-centred development within an academy setting through empathising with an individual's social background, and protecting players who are clearly talented, although struggling financially, through providing them and their family additional support.

However, whilst these current findings support Bourke's (2003) study from a football standpoint, they are converse to Lawrence's (2017) data from winter and summer Olympic competing athletes, who revealed racial and socio-economic biases towards white and privately educated participants. Therefore, it may be suggested that football provides greater accessibility through participation in the streets, playground, park, or local grassroots clubs, compared to winter Olympic sports, such as skiing, snowboarding, and ice-skating, alongside summer Olympic sports, such as shooting, sailing, and equestrian, which appear exclusive, costly, and less accessible. Consequently, this highlights the potential opportunities that support superior involvement in youth football in England for participants from lower socio-economic backgrounds. Furthermore, it also suggests the potential barriers for participation, for individuals from a lower socio-economic status, into a number of youth sports that are associated with the summer and Winter Olympic Games.

These current findings also differ to Winn *et al*. (2017), who found players with greater deprivation had fewer hours in rugby activities and engaged in less sports compared to their less-deprived equivalents. Consequently, Winn *et al*. (2017) illustrated the barrier to rugby participation in Wales from an elite population. However, this contemporary viewpoint from a football context in England reveals the benefit of being from a family with greater deprivation. When related to Chapter 4 of this current study, results show high-performing academy players within the YDP have participated in a significantly greater amount of multi-sports hours compared to low-performers, in converse to the findings of Winn *et al*. (2017). Consequently, further research is required to examine the developmental activities and levels of deprivation among elite youth athletes to highlight discriminating factors concerning specific sports.

When associated with lower social classification and greater financial risk, it is argued that situational factors have a positive interaction by facilitating talent development, through the psychological characteristics developed (MacNamara *et al.*, 2010a; 2010b; Gullich & Emrich, 2006; Morgan & Giacobbi, 2006; Rees & Hardy, 2000). It may be suggested that players from families with a lower social classification may face more recurrent setbacks, through an increased likelihood of being involved in lower household income and a higher financial risk (Winfield, 1994; Masten *et al.*, 1990). This arguably creates a natural 'rocky road' alongside the development process which allows certain individuals to gain key psychological characteristics (Collins & MacNamara, 2012). Consequently, the development of these psychological characteristics may facilitate high-performers to navigate their way through the ups and downs of the development process within an academy environment (Savage *et al.*, 2017; Collins *et al.*, 2016; 2015).

Interestingly, whilst observing the results for Factor 3 of the PCDEQ within the YDP in Chapter 5, high-performers had a significantly greater ability to cope with performance and developmental pressures compared to their low-performing counterparts. This observation highlights the importance of overcoming struggles and set-backs, injury or decline in performance, and the ability to balance a dual career (MacNamara & Collins, 2013). However, this reasoned concept requires further investigation before it forms part of a talent development process.

It is important to highlight that this research is an initial investigation within one academy, and that there was no effect for the FDP group. There are no prior reasons for why results across both phases would differ, so findings are not able to be generalised. However, one suggestion for the lack of an effect at FDP may be that players have accumulated fewer developmental years to accrue the required support that is important to develop the relevant psycho-social skills associated with successful outcomes for individuals from a lower socio-economic background. Additionally, there are fewer pressures on players in the FDP, as children are provided with an age appropriate playful learning environment, where socio-economics perhaps offer less impact compared to YDP players (Bailey *et al.,* 2010).

6.5.2. School social classification and financial risk

In this present study, the relationship between performance level and the socio-economic effect were non-significant in both the FDP and YDP for school social classification and financial risk. This reveals no relationship between higher ability in an English football academy for players aged 8 to 16 years and lower socio-economic scores from a school viewpoint. As previously stated, further observational studies have demonstrated young people from higher social classes are more likely to participate in sport compared to their counterparts from lower social classes (Scheerder *et al.,* 2005; Hylton & Totten, 2001). Arguably, as a consequence of participating in an elite training programme, the participants of this study are already provided with a superior amount of football training. Therefore, though it is possible players in an academy who are from private schools may partake in more physical activity from a schooling perspective, from a football development viewpoint, the current participants engage in a relatively similar amount of football training within an academy.

Consequently, although residence social classification and financial risk influence talent identification within the YDP, current results reveal school social classification and financial risk do not significantly impact talent identification in academy football players aged 8 to 16 years. Furthermore, it may also be argued this factor is minimised through players partaking in hybrid or day release training programmes, which significantly increases football coaching time through football club and school collaborations (Premier League, 2013). Additionally, it may be suggested the school environment may positively influence player performance through offering multi-sport activities, therefore supporting the football development process through engaging in other sports, thus gaining significant additional skills that accompany participation (see Chapter 4 – Figure 4.1. PHQ results h) Multi-sports hours).

Nonetheless, similarly to the previous comparisons, it is challenging to make a realistic assessment due to the difference in competition levels, with many of the previous studies engaging with participation and drop-out from a physical activity stance, whereas this current study features an elite performance viewpoint. As a consequence of this being the first study focussing on the socio-economic effect in elite youth football, these results provide further understanding regarding the discriminating socio-economic factors between high- and low-performers in a professional football academy in England.

6.6. Limitations

It may be argued that data could have been analysed in its original format rather than applying standardised Z-scores. However, as a result of applying a consistent methodology throughout each chapter within this study, the researcher employed standardised Z-scores to allow an unbiased approach in both the FDP and YDP. Also, although postcodes for both residence and school social classification and financial risk provide accurate and discriminative segments of player locations, naturally there will be some participants that live within certain areas that do not fully recognise an individual's family situation. For example, although a family may live in a postcode with a high social classification and low financial risk, they may essentially be struggling from a wealth perspective, thus being unable to provide sufficient financial support to their son during their academy journey.

Additionally, while socio-economic status may impact on certain developmental characteristics, it is also acknowledged that parental role modelling and support plays a crucial role in youth participation (Gledhill & Harwood, 2015; Christensen & Sorenson, 2009). Consequently, further research is required to investigate the association between effective parenting skills and socio-economic factors. Nevertheless, this initial investigation highlights the importance of applying socio-economic features within a multidisciplinary talent identification method in an academy environment.

6.7. Conclusion

The amount of research on the influence of a family's socio-economic status on talent identification and development in elite youth football is limited when compared to the other topics within this thesis, such as environmental, psychological, physiological, technical, and tactical characteristics (Rees *et al.,* 2016). Consequently, this research is the first study to investigate the association between socio-economic factors and current ability of elite youth football players within an academy setting.

This current chapter revealed partial (but limited) evidence for an association between social classification and credit rating and playing ability within later stages in an academy. When these results were reviewed in relation to data from Chapter 5, it makes an initial (albeit tenuous) link to a natural 'rocky road' alongside the development process, which allows certain individuals to gain key psychological characteristics (Collins & MacNamara, 2012). However, this proposal requires further investigation to research the impact of socio-economic factors, such as social classification, financial risk, and PCDEs.

7. PHYSIOLOGICAL

7.1. Introduction

Football is a physically competitive sport that is characterised by varying intermittent runs, including sprinting, jogging, walking, and backpedalling, whilst comprising explosive actions, such as jumping, tackling, kicking, and turning (Malina *et al.,* 2004). These high-intensity activities have a critical influence on match performance and need to be developed from a young age (Verburgh *et al.,* 2016; Goto *et al.,* 2015a; 2015b; Bangsbo *et al.,* 2006). Additionally, Barnes *et al.* (2014) illustrates the evolution of physical attributes has increased in the English Premier League from 2006/07 to 2012/13, including sprint distance (+35%), number of sprints (+80%), actions (+50%), and high-intensity running distance (+30%). Therefore, the talent identification and development process within football academies must consider physical performance measures (i.e., acceleration, sprint, agility, and jump attributes), to identify and develop athletic ability.

Together with physical performance statistics, anthropometric measures, such as height, sitting height, leg length, and body mass, are examined to observe individual growth and maturation status using the Khamis-Roche formula (Khamis & Roche, 1994). This assessment has become a common precedence within football academies to estimate the stage of maturation, PHV, and predicted adult height (Khamis & Roche, 1994). Not only is it advantageous to gather such evidence to facilitate individual training programmes, but it also assists coaches' and practitioners' understanding of individual needs.

Whilst the understanding of physical performance, anthropometric measures, and maturation status are contemporary features within football academies, the occurrence of the longstanding RAE continues to present an issue within professional development environments (Skorski *et al.,* 2016; Gil *et al.,* 2014a; McCunn, 2014; Grossmann & Lames, 2013). Indeed, whilst there are contemporary methods emerging to support younger and less developed chronological and biological aged peers (Cumming *et al.,* 2017; Mann & Van Ginneken, 2017; Vandendriessche *et al.,* 2012a), there is still a prevalence of national youth teams and football academies selecting players born earlier in the selection year compared to the ones born later (Skorski *et al.,* 2016; Gil *et al.,* 2014a; McCunn, 2014; Grossmann & Lames, 2013).

Consequently, the aim of this chapter is to identify physiological characteristics, including physical performance, anthropometric measures and maturation status, and the RAE, that discriminate high- and low-performers in a professional football academy in England, while identifying age appropriate differences within the FDP and YDP.

7.2 Rationale

7.2.1. Physical performance

Gil and colleagues have been at the forefront of examining the relationship between physical performance and talent identification and development in football. For example, Gil *et al.* (2007b) indicated agility was an important factor when selecting talented young Spanish football players, whilst also observing that players promoted to the under-14 age group were faster in a 30 m sprint test compared to non-promoted peers. Le Gall *et al.* (2010) also proposed that several fitness characteristics, including measures assessed by the countermovement jump (CMJ) and 40 m sprint, may determine the likelihood of players proceeding to higher standards of football in international elite youth football players at under-14 and under-16 age groups. Additionally, Gil *et al.* (2014) found that pre-selected under-10 outfield players from a professional football academy performed better in velocity (i.e., 30 m sprint) and jumping (i.e., CMJ) tests compared to non-selected players.

Moreover, Gonaus & Muller (2012) designed a ten year longitudinal study using physiological data to predict future career progression in 14 (*n*=410), 15 (*n*=504), 16 (*n*=456), and 17-year-old (*n*=272) Austrian academy soccer players. They revealed a combination of physiological variables are useful for discriminating 'drafted' national youth team players against their 'non-drafted' peers, with football-specific speed and upper limb power appearing to be the greatest predictors, through successfully classifying 62.7 to 66.2% of the players. More recently, Deprez *et al.*'s (2015b) retrospective study on 388 Belgian youth football players found contracted participants jumped further and had faster 5 m sprint times compared to non-contract players. Thus, Deprez *et al.* (2015b) summarised the importance of including the evaluation of physical performance characteristics to distinguish high-level football players further succeeding within an academy environment between the ages of 8 to 16 years.

Likewise, Emmonds *et al.* (2016) investigated whether speed and endurance characteristics influence obtaining a professional contract at aged 18 years. Their longitudinal study measured physical characteristics in 443 academy football players over a seven year period, revealing significant differences were only observed between professional and academy players for the 10 m and 20 m sprint at under-16 and under-18's, while intermittent endurance was also a discriminating factor at under-18's. Consequently, Emmonds *et al.* (2016) suggest physical assessments should be used for monitoring physical development rather than talent identification purposes.

In addition, Gouvea *et al.* (2017) used the dribbling skill test and shuttle dribble test to divide 62 skilled and less-skilled youth football players aged 11 to 17 years. They discovered skilled performers possessed a higher practice time, greater sit-up performance, squat jump, CMJ, and Yo-Yo test compared to their less-skilled peers. These results suggest technical performance is associated with a greater time of practice and physical capabilities. Consequently, this collection of research highlights the importance of applying sprint, agility, and power characteristics to a battery of physical performance tests in both the FDP and YDP.

Conversely to the research that illustrates superior physical characteristics are associated with greater performance and progression within a youth football context, other research has reported similar physical performance capacities between elite and non-elite populations. For example, Carling *et al.* (2012; 2009) reported comparable physical characteristics, including vertical jump and speed, in future professionals and non-professionals when tested at aged 13 years. In addition, Martinez-Santos *et al.* (2016) focussed on the final moments of a player's progression to professional football in Spain, illustrating sprint and jump performances did not determine the promotion to professional status.

Nevertheless, although data collection regularly varies within physical performance studies concerning specific characteristics that facilitate talent identification and development (Hirose & Seki, 2016), the general consensus frequently supports the discrimination of greater physical ability in highly regarded athletes compared to their lesser equivalents, thus reinforcing the importance of recognising and promoting talented youth football players physical abilities (Hammani *et al.,* 2013).

7.2.2. Anthropometric measures and maturation status

In general, youth football players present greater values for height and body mass, whilst also tending to possess advanced biological maturity status with increasing age during adolescence, within elite development programmes (Malina *et al.,* 2004; 2000). Previous research has investigated the difference between performance level in elite youth football and growth related variables (Wong *et al.,* 2009; Malina *et al.,* 2004). For example, Malina *et al.* (2004) illustrated how inter-individual differences in physical growth, biological maturation, interactions with peers, and behavioural changes persuaded youth coaches, clubs, and federations to identify and recruit youth football players with advanced growth and maturation status.

Moreover, lower baseline anthropometric measures have generally been associated in youth football players who either drop out (Figueiredo *et al.,* 2009a) or who were not selected to play at the next level (Gil *et al.,* 2007b), compared to their higher baseline peers who move to a higher playing standard. Likewise, Le Gall *et al.* (2010) highlight similar findings in elite youth football players after reporting graduates from an academy who achieved professional status had advanced maturity status, body mass, and height compared to those who did not. It is important to highlight these physical attributes are not necessarily retained throughout maturation or guaranteed to translate into expert performance during adulthood (Vaeyens *et al.,* 2008). The overall outcome is that physically advanced or 'talented' young football players are entering academy programmes every year compared to physically less advanced equivalents, thus providing early maturers or physically stronger athletes greater opportunities through their entry into a talent development environment (Carling *et al.,* 2012).

In contrast, early research from Franks *et al.* (1999), who investigated key factors concerning English national schoolboys who had achieved professional status or not, found no discriminating differences for anthropometric characteristics (i.e., height, body mass, and body fat percentage). Furthermore, Malina *et al.* (2007b) demonstrated how adolescent youth football players aged 13 to 15 years classified by skill did not differ in age or body size. However, this contrasting research appears to be limited compared to the large quantity of opposing evidence (Carling *et al.,* 2012; Le Gall *et al.,* 2010; Figueiredo *et al.,* 2009a; Vaeyens *et al.,* 2008; Gil *et al.,* 2007a; 2007b; Malina *et al.,* 2004).

Previous studies have also discovered that senior professional football players were early maturers at a young age, suggesting further discriminating related maturational issues (Deprez *et al*., 2015a; Malina *et al.*, 2000). However, latest evidence from Ostojic *et al.* (2014) has shown football excludes early maturing boys and favours late maturing boys as level of age increases, after following 48 boys aged 14 years playing in Serbian youth football Division One over an eight year period. Consequently, Ostojic *et al.* (2014) demonstrated, out of the 16 players that achieved professional status in one of the top five European leagues, 60.1% were late maturers, 38.1% were normal maturers, while 11.8% were early maturers.

Nevertheless, this collective research demonstrates talent identification and development in elite youth football is often characterised by a biased maturation related difference between young players (Carling *et al.,* 2012; Le Gall *et al.,* 2010; Figueiredo *et al.,* 2009a; Vaeyens *et al.*, 2008; Gil *et al.*, 2007a; 2007b; Malina *et al.*, 2004). However, while these factors regularly discriminate late maturing players during childhood and adolescence (Malina *et al.,* 2000), it appears to support greater long-term development if they are recognised and facilitated throughout the development process appropriately compared to their early maturing peers (Ostojic *et al.,* 2014). It may also be suggested using a child or adolescents' biological and physical variables alone to predict elite senior performance is naive. Therefore, physical characteristics remain an important measure as part of a multidisciplinary development pathway (Reilly *et al.,* 2000b). It is necessary that further research continues to monitor the growth and maturation of elite youth football players throughout their academy development into senior professional status, whilst strengthening the support for the talent identification process regarding late maturers.

7.2.3. The RAE

While differences in chronological age of less than 12 months have little relevance on adult physiques, they have a major impact during childhood and adolescence athletes (Gonzalez Bertomeu, 2018; Padron-Cabo *et al.*, 2016). The bias influence of selection and progression through birth date distribution is known as the RAE. This signifies that children born in the first six months of the selection year are significantly over represented in team selection (Helson *et al.,* 2012). Research has continually shown youth athletes who are born early in the selection year have a significant advantage of being bigger, stronger, faster, and have a greater longevity in sport (Helson *et al.,* 2012).

Youth football has been at the core of RAE research, with the majority of studies establishing birthdate distribution having a significant effect on player selection and progression (Helson *et al.,* 2000). For example, Glamser & Vincent (2004) discovered that, out of 147 American male elite youth football players, almost 70% were born in the first half of the year. A strong RAE in elite youth football has also established in Germany, Australia, Brazil, and Japan, providing evidence that the effect is independent of different cut-off dates, such as January to December and September to August (Votteler & Honer, 2017; 2014; Musch & Hay, 1999).

Furthermore, Helson *et al.* (2005) investigated birth date distributions across ten European countries, using 2,175 age citations across under-15, under-16, under-17, and under-18 age groups. Selection criteria included players representing national youth teams in international competitions or professional youth teams in international competitions. The results revealed an over-representation of players born in the first quarter for both the national and professional youth selections across all age groups, which again was independent of dissimilar cut-off dates. Helsen *et al.* (2012) also expressed their frustration illustrating ten years of research had made no impact on the structure of youth football involvement despite their initial concerns.

Contemporary research shows the occurrence of this phenomenon still exists at the highest levels of talent development in youth football. For example, Massa *et al.* (2014) investigated 341 youth football players (aged 10 to 20 years) at the high-level Brazilian football club Sao Paulo for their birthdate distributions. Results revealed a significantly higher percentage of athletes were born in the first quarter (47.5%) compared to the fourth quarter (8.8%). Furthermore, from a European perspective, Gonzalez-Villora *et al.* (2015) found the RAE was not apparent in the UEFA Champions League for senior professional teams; however it was present in the three youth categories (under-21, under-19, and under-17 age groups).

This subsequently reveals a problem around the selection and progression process and the coaches' or practitioners' view of a gifted or talented player (Meylan *et al.,* 2010). However, there is no current research that identifies whether the RAE is a discriminating factor between high- and low-performers that have already been selected within a football academy. Thus, there is no judgment supporting the differences in academy performance and birth quarter once players have been identified as talented.

7.3. Aims and hypothesis

A large amount of research has focussed on the physiological aspects of talent identification in elite youth football, although previous exploration has regularly focused solely on differentiating elite and non-elite athletes (Carling *et al.,* 2012; Le Gall *et al.,* 2010; Figueiredo *et al.,* 2009a; Vaeyens *et al.,* 2008; Gil *et al.,* 2007a; 2007b; Malina *et al.,* 2004). As a result, elite players often have superior physical performance, further developed through advanced growth and maturational processes, and are born earlier in the chronological year compared to their non-elite counterparts (Skorski *et al.,* 2016; Gil *et al.,* 2014a; McCunn, 2014; Grossmann & Lames, 2013). However, to the researcher's knowledge, there is no current investigation surrounding academy players alone regarding the physiological factors that discriminate high- and low-performers. Therefore, the aim of this research is to examine the combined physical performance, anthropometric and maturation status, and the RAE, and whether these physical characteristics distinguish high- and low-performers within the FDP and YDP.

For physical performance, participants were tested for their 0–10 m, 0–30 m, and 10–30 m sprint ability, L-agility speed, and CMJ. Although there is no direct comparison between high- and low-performers within an academy environment, the hypothesis for the physical characteristics is generated from Gouvea *et al.* (2017), Emmonds *et al.* (2016), Deprez *et al.* (2015b), Gil *et al.* (2014; 2007b), Gonaus & Muller (2012), Le Gall *et al.* (2010), and Mirkov *et al.* (2010), who all reveal discriminating differences between elite and sub-elite populations across a variety of age groups resembling both development phases within this study.

For anthropometric measures and maturation status, participants were tested for their height, body mass, body mass index (BMI), body fat percentage, predicted adult height, percentage of estimated adult height attained, and PHV status. Although there is no direct comparison between high- and low-performers within an academy environment, the hypothesis for the anthropometric measures and maturation status is generated from Malina *et al.* (2010; 2004; 2000), Figueiredo *et al.* (2010; 2009b), Le Gall *et al.* (2010), Nevill *et al.* (2009), and Vaeyens *et al.* (2008), who collectively reveal an association between enhanced anthropometric measures and maturation status, including body height, body mass, BMI, body fat percentage, predicted adult height, percentage of estimated adult height attained, and PHV status, and a greater likelihood of being identified and developed as an elite youth football player across both development phases within this study.

Finally, for the RAE, participants were tested for their birth quarter through observing their date of birth. Although there is no direct comparison between high- and low-performers within an academy environment, the hypothesis for the RAE is generated from Gonzalez-Villora *et al.* (2015), Massa *et al.* (2014), and Helson *et al.* (2005), who together reveal birth quarter 1 and 2's are significantly overrepresented compared to birth quarter 3 and 4's in elite youth football.

The specific aims of this chapter are:

1. To assess physical capabilities to identify whether high performance is associated with greater physical attributes, in both the FDP and YDP.
    a) It is hypothesised that high-performers will have a significantly quicker sprint ability (0–10 m, 0–30 m, and 10–30 m distances) and agility (L-agility test), alongside a greater jump height (CMJ), compared to low-performers, in both the FDP and YDP.
2. To assess anthropometric measures and maturation status to identify whether high performance is associated with advanced growth and maturation, in both the FDP and YDP.
    b) It is hypothesised that high-performers will have significantly greater height, body mass, BMI, percentage of estimated adult height attained, and PHV status compared to low-performers, in both the FDP and YDP.
    c) It is hypothesised that there will be no significant difference between high- and low-performers concerning body fat percentage and predicted adult height, in both the FDP and YDP.
3. To assess the RAE to identify whether high performance is associated with an earlier birth quarter born, in both the FDP and YDP.
    d) It is hypothesised that high-performers will have a significantly earlier birth quarter born compared to low-performers, in both the FDP and YDP.

7.4. Results

7.4.1. FDP physical performance tests

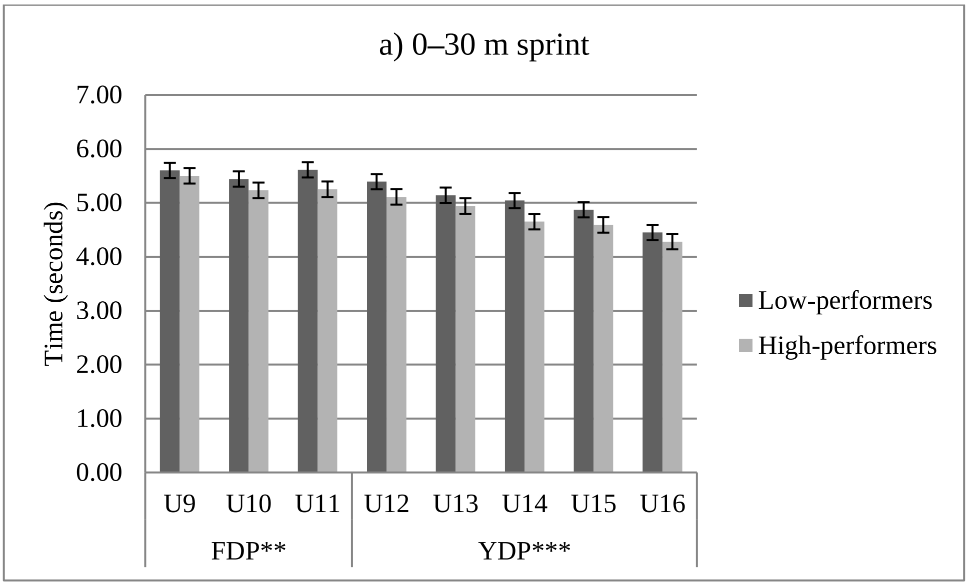
In the FDP, there was a significant difference between high-performers (M=-0.41, SD=0.88) and low-performers (M=0.68, SD=0.87) for the 0–30 m sprint (Figure 7.1. a)), with high-performers having quicker mean results compared to low-performers (t(24.00)=-3.16, p=0.004). Furthermore, there was a significant difference between high-performers (M=-0.40, SD=0.76) and low-performers (M=0.63, SD=0.89) in the FDP for the 10–30 m sprint (Figure 7.1. b)), with high-performers having quicker mean results compared to low-performers (t(24.00)=-3.17, p=0.004).

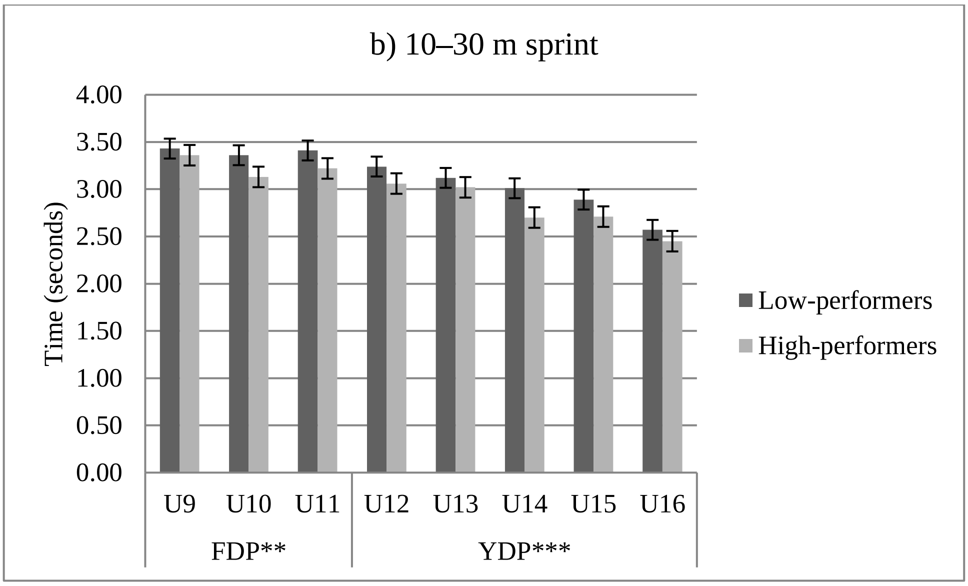
No significant difference was established between high-performers (M=-0.19, SD=1.13) and low-performers (M=0.41, SD=0.83) in the FDP for the 0–10 m sprint (t(24.00)=-1.56, p=0.133; (Figure 7.1. c)). Furthermore, there was no significant difference between high-performers (M=0.11, SD=0.95) and low-performers (M=-0.20, SD=1.04) in the FDP for CMJ (t(24.00)=0.79, p=0.437; (Figure 7.1. e)). Additionally, there was no significant difference between high-performers (M=-0.37, SD=1.09) and low-performers (M=0.20, SD=0.92) in the FDP for the L-agility test (t(24.00)=-1.44, p=0.163; (Figure 7.1. d)).

7.4.2. YDP physical performance tests

Within the YDP, there was a significant difference between high-performers (M=-0.64, SD=0.81) and low-performers (M=0.74, SD=0.64) for the 0–30 m sprint (Figure 7.1. a)), with high-performers having quicker mean results compared to low-performers (t(36.00)=-5.79, p=0.000). Moreover, there was a significant difference between high-performers (M=-0.58, SD=0.83) and low-performers (M=0.70, SD=0.70) in the YDP for the 10–30 m sprint (Figure 7.1. b)), with high-performers having quicker mean results compared to low-performers (t(36.00)=5.13, p=0.000). Also, there was a significant difference between high-performers (M=-0.53, SD=0.80) and low-performers (M=0.56, SD=1.01) in the YDP for the 0–10 m sprint (Figure 7.1. c)), with high-performers having quicker mean results compared to low-performers (t(36.00)=-3.70, p=0.001).

Additionally, there was a significant difference between high-performers (M=0.54, SD=1.05) and low-performers (M=-0.37, SD=0.80) in the YDP for CMJ (Figure 7.1. e)), with high-performers demonstrating greater mean results compared to low-performers (t(36.00)=2.99, p=0.005). However, no significant difference was established between high-performers (M=-0.16, SD=0.98) and low-performers (M=0.33, SD=1.01) in the YDP for the L-agility test (t(36.00)=-1.53, p=0.136; Figure 7.1. d)).





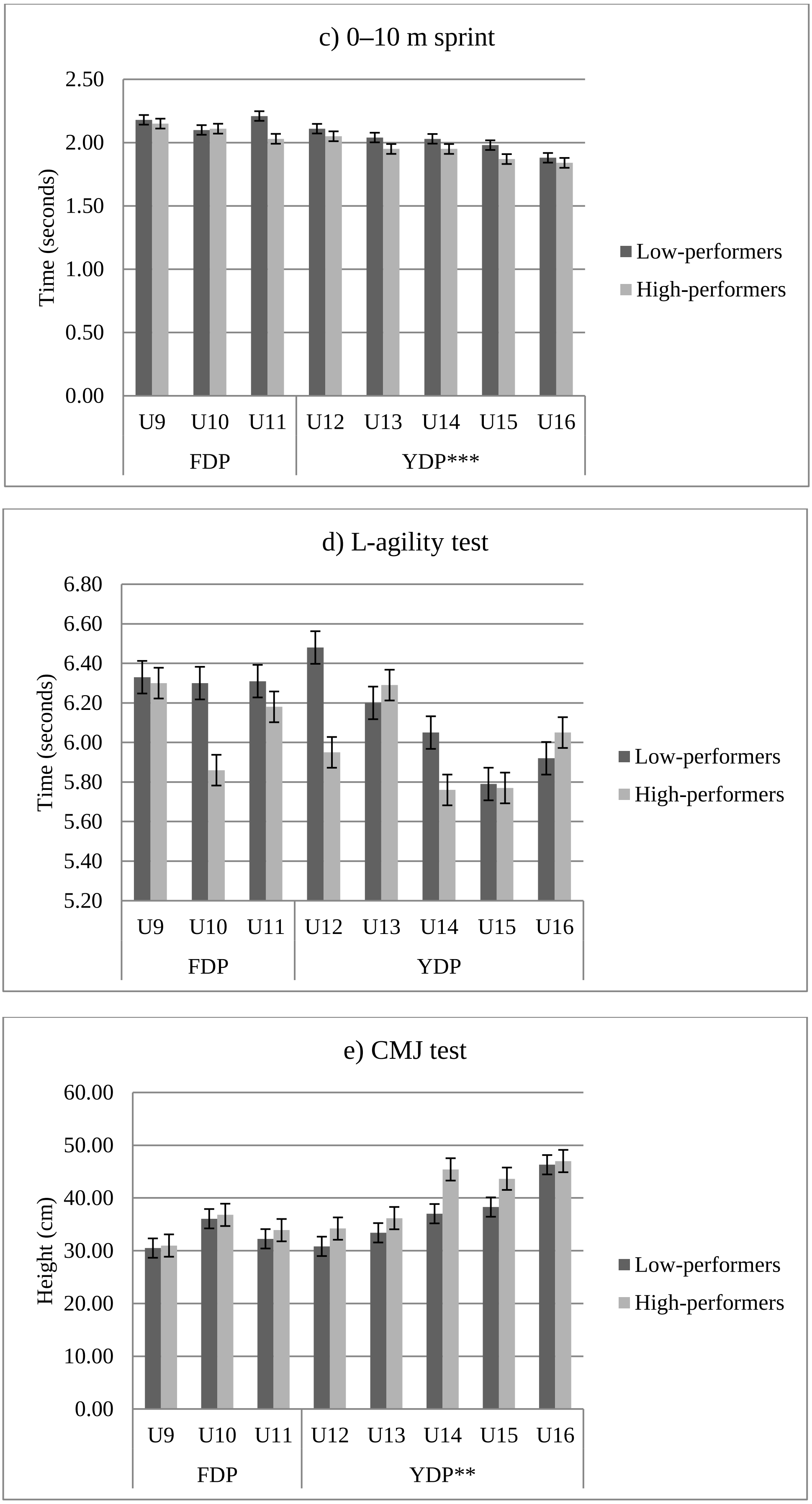


Figure 7.1. Physical performance results (**p*<0.050 ***p*<0.005 ****p*<0.001)

7.4.3. FDP anthropometric measures and maturation status

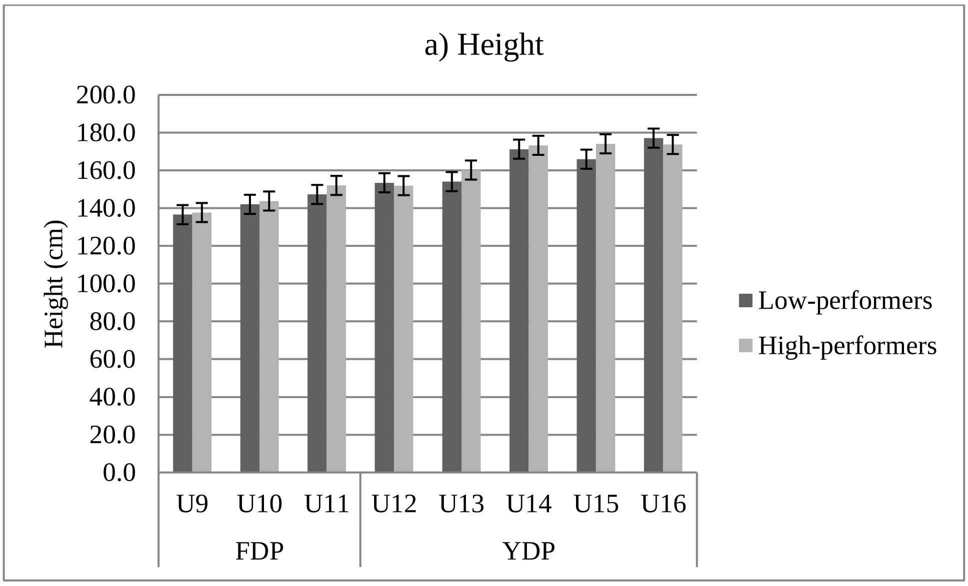
Regarding anthropometric measures, no significant difference was established between high-performers (M=0.18, SD=0.91) and low-performers (M=-0.27, SD=1.06) in the FDP for their current height (*t*(24.00)=1.15, *p*=0.263; Figure 7.2. a)). Similarly, there was no significant difference between high-performers (M=0.17, SD=0.88) and low-performers (M=-0.18, SD=1.03) in the FDP for their current body mass (*t*(24.00)=0.93, *p*=0.362; Figure 7.2. b)). Furthermore, there was no significant difference between high-performers (M=0.10, SD=0.77) and low-performers (M=-0.03, SD=0.10) in the FDP for their current BMI (*t*(24.00)=0.35, *p*=0.731; Figure 7.2. c)). In addition, there was no significant difference between high-performers (M=0.12, SD=0.52) and low-performers (M=-0.22, SD=0.92) in the FDP for their current body fat percentage (*t*(18.97)=1.34, *p*=0.194; Figure 7.2. d)).

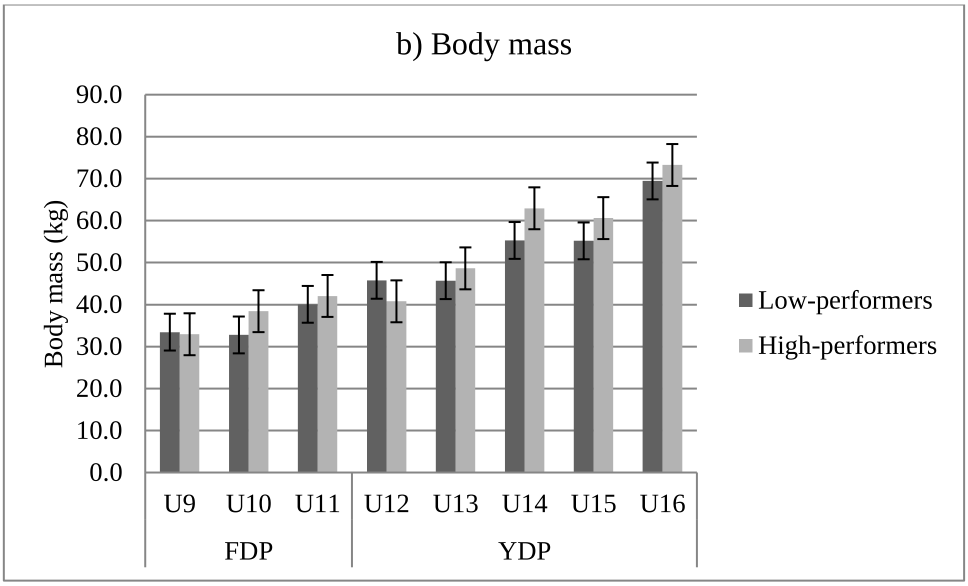
After observing the maturation status', there was no significant difference between high-performers (M=0.10, SD=0.84) and low-performers (M=-0.10, SD=1.01) in the FDP for their estimated adult height (*t*(24.00)=0.53, *p*=0.598; Figure 7.2. e)). Furthermore, there was no significant difference between high-performers (M=0.18, SD=1.11) and low-performers (M=-0.15, SD=0.90) in the FDP for their percentage of estimated adult height attained (*t*(24.00)=0.81, *p*=0.426; Figure 7.2. f)). In addition, there was no significant difference between high-performers (M=0.12, SD=1.26) and low-performers (M=-0.23, SD=0.00) in the FDP for their estimated PHV status (*t*(12.00)=1.00, *p*=0.337; Figure 7.2. g)).

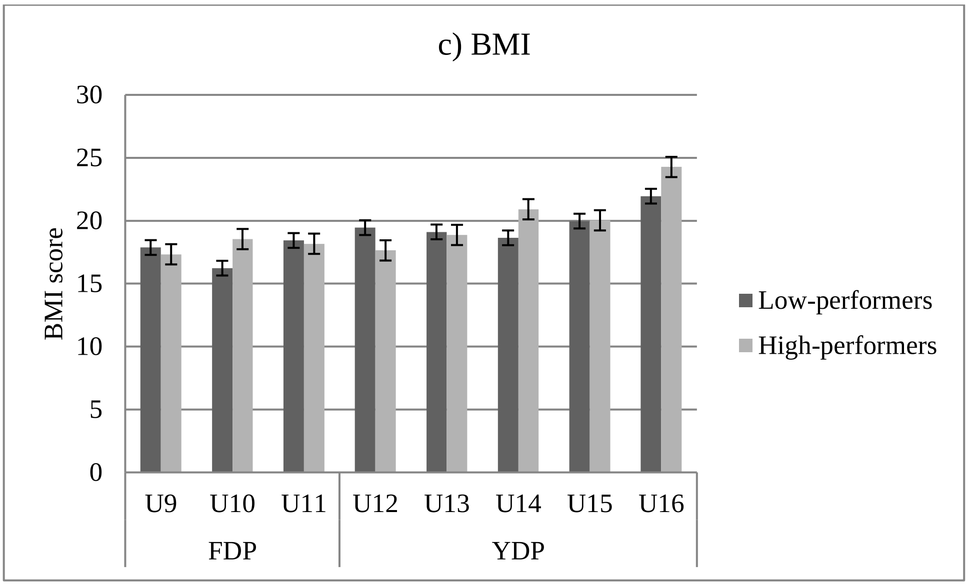
7.4.4. YDP anthropometric measures and maturation status

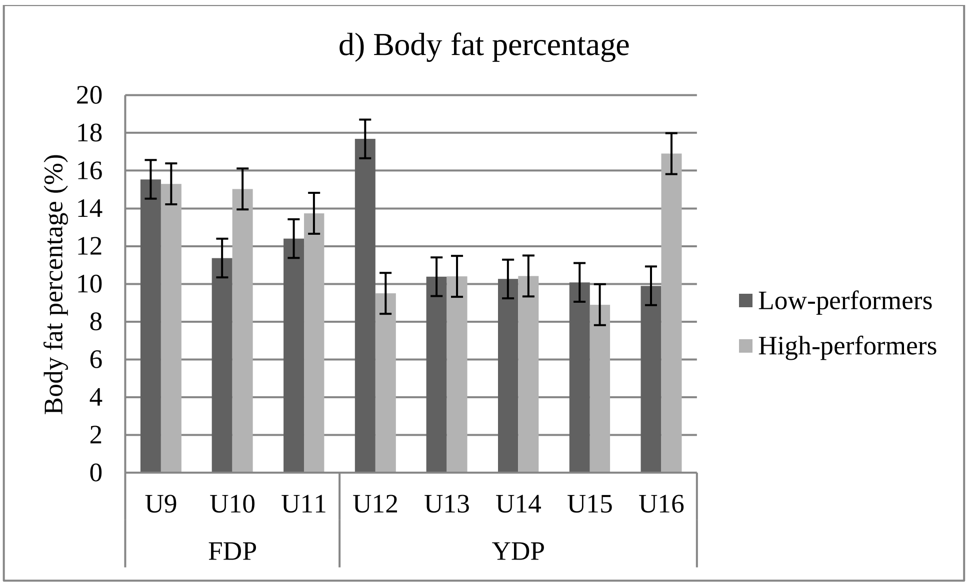
Regarding anthropometric measures in the YDP, no significant difference was established between high-performers (M=0.15, SD=0.65) and low-performers (M=-0.17, SD=1.13) for their current height (*t*(28.82)=1.06, *p*=0.297; Figure 7.2. a)). Similarly, there was no significant difference between high-performers (M=0.09, SD=0.69) and low-performers (M=-0.25, SD=1.11) in the YDP for their current body mass (t(30.26)=1.06, p=0.256; Figure 7.2. b)). Furthermore, there was no significant difference between high-performers (M=-0.02, SD=0.95) and low-performers (M=-0.16, SD=0.88) in the YDP for their current BMI (t(36.00)=0.46, p=0.651; Figure 7.2. c)). In addition, there was no significant difference between high-performers (M=-0.22, SD=0.79) and low-performers (M=0.01, SD=0.91) in the YDP for their current body fat percentage (t(36.00)=-0.82, p=0.420; Figure 7.2. d)).

After observing the maturation status' in the YDP, no significant difference was established between high-performers (M=-0.02, SD=0.77) and low-performers (M=0.00, SD=1.25) for their percentage of estimated adult height attained (t(36.00)=1.65, p=0.109; Figure 7.2. f)). Moreover, there was no significant difference between high-performers (M=-0.02, SD=1.09) and low-performers (M=0.02, SD=0.91) in the YDP for their estimated adult height (t(29.96)=-0.05, p=0.958; Figure 7.2. e)). Lastly, there was no significant difference between high-performers (M=0.25, SD=0.89) and low-performers (M=-0.22, SD=1.07) in the YDP for their estimated PHV status (t(36.00)=1.48, p=0.148; Figure 7.2. g)).




b) Body mass
Body mass (kg)
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers


c) BMI
BMI score
30
25
20
15
10
5
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers


d) Body fat percentage
Body fat percentage (%)
20
18
16
14
12
10
8
6
4
2
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers

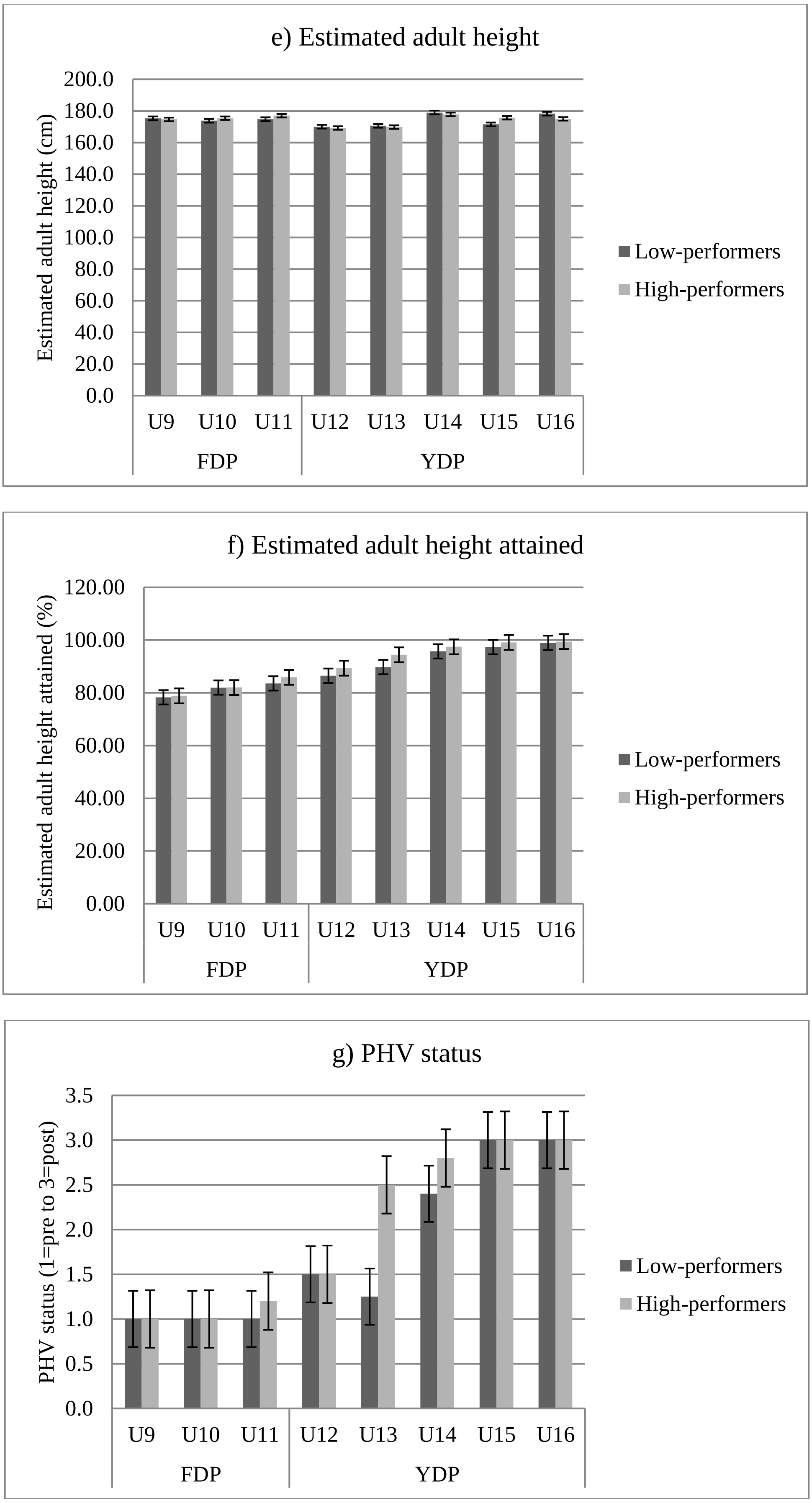


Figure 7.2. Anthropometric measures and maturation status results (**p*<0.050 ***p*<0.005 ****p*<0.001)

7.4.5. FDP and YDP RAE

In the FDP, there was no significant difference between high-performers (M=-0.32, SD=0.82) and low-performers (M=0.11, SD=0.97) for their relative age (t(24.00)=-1.22, p=0.235; Figure 7.3.). Furthermore, in the YDP, there was no significant difference between high-performers (M=-0.29, SD=1.09) and low-performers (M=-0.24, SD=0.91) for their relative age (t(36.00)=-0.02, p=0.988; Figure 7.3.).

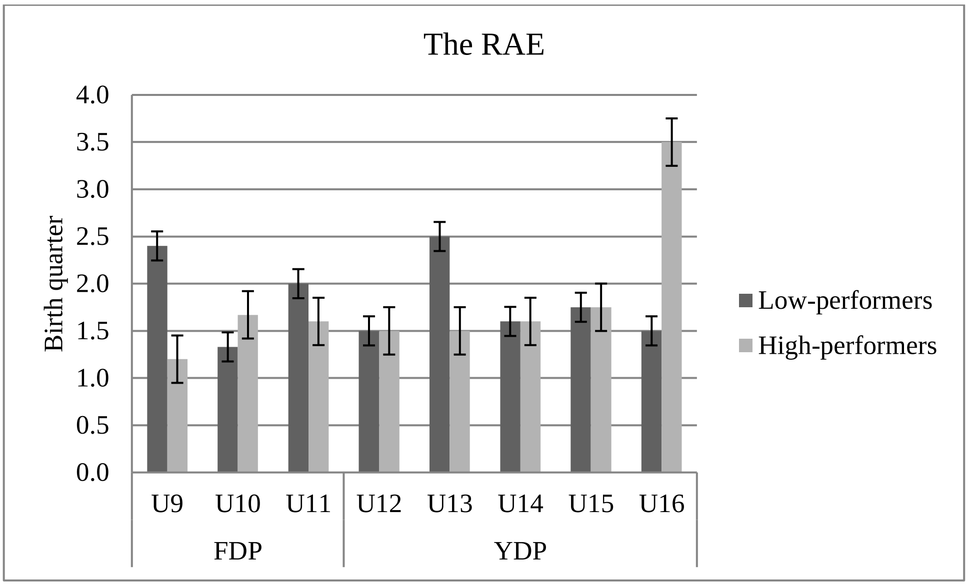


Figure 7.3. The RAE results (*p<0.050 **p<0.005 ***p<0.001)

7.5. Discussion

The main findings concerning the physical performance data indicate how 0–30 m total sprint speed and 10–30 m maximal sprint speed discriminates ability, with high-performers being significantly quicker compared to low-performers in the FDP. Moreover, additional physical differences continue to differentiate the participants within the YDP, with high-performers recording superior 0–10 m acceleration speed, 0–30 m total sprint speed, 10–30 m maximal sprint speed, and CMJ compared to low-performers. However, the two latter variables were insignificant in discriminating high- and low-performers within the FDP, while the L-agility test failed to distinguish any differences within both the FDP and YDP.

The main findings from this study regarding anthropometric and maturation status data reveal no significant differences between high- and low-performers, within both the FDP and YDP, for all variables analysed. This includes height, body mass, BMI, body fat percentage, estimated adult height, percentage of adult height attained, and estimated PHV status. Additionally, the findings from the RAE highlight its insignificance on coach ratings concerning ability in academy players aged 8 to 16 years.

7.5.1. Physical performance tests

These outcomes highlight the increasing importance of physical characteristics throughout the development process, with greater physical features discriminating high- and low-performers within the YDP compared to the FDP. According to Little & Williams (2005), together with acceleration, maximum sprint, total sprint, and power, directional change is a significant characteristic possessed by elite performers at professional level. Consequently, this highlights the increasing relevance of physical function throughout the development process and subsequently within football performance.

The ability to make forward runs in possession, to support teammates on the ball, is a key moment during competitive fixtures. For example, Faude *et al.* (2012) revealed straight sprinting is the most frequently used action in goal situations in professional football. Consequently, it may be suggested sprint ability is an essential factor to facilitate holistic youth development to achieve professional status. Therefore, this supports the suggestion of associating greater performance and 0–30 m and 10–30 m sprint ability in both the FDP and YDP.

The results from the current study regarding sprint ability within the FDP and YDP correspond with previous findings from Gil *et al.* (2014; 2007b) and Le Gall *et al.* (2010), who also illustrated the importance of speed within academy football. Additionally, this evidence from Spanish youth football players provides further evidence regarding the importance of sprint ability from a European context. However, the current results conflict with those of Carling *et al.* (2012; 2009) and Martinez-Santos *et al.* (2016), who did not report speed as an influential factor surrounding the progression to professional status. Consequently, this highlights further research is required to observe sprint ability from a longitudinal viewpoint to understand if it facilitates the development and elite progression.

From a theoretical perspective, the YPDM appears to apply a greater emphasis on speed during the year's post-PHV in adolescence (Lloyd & Oliver, 2012). As a result, this research highlights the importance of recognising 0–30 m and 10–30 m sprint speed ability during childhood, as well as adolescence, from a talent identification viewpoint. Thus, the development of sprint speed may be incorporated to strength and conditioning training programmes for players pre-PHV years, as well as post-PHV years, to support greater physical development, and consequently superior performance outcomes in elite youth football players throughout an academy setting.

Converse to the 0–30 m and 10–30 m sprint tests, this current study reveals no association between higher ability in an English football academy for players aged 8 to 11 years and 0–10 m acceleration speed. However, when observing older participants from the same environment, it demonstrates a significant relationship for players aged 11 to 16 years. Interestingly, Emmonds *et al.* (2016) also found no differences in the 0–10 m sprint test within their under-9 to 11's age groups of player who eventually progressed to professional status and those who did not. However, they did reveal significant differences in the 0–10 m sprint test at under-16 and under-18 after following English academy football players from 2005 to 2012.

Similarly, Deprez *et al.*'s (2015b) retrospective study on 388 Belgian youth football players found contracted participants had faster 5 m sprint times compared to non-contract players at under-15 to 17's. In addition, Gonaus & Muller's (2012) longitudinal study on players aged under-14 to 17 to predict future career progression in Austrian academy soccer players revealed football-specific speed, such as acceleration, was one of the greatest predictors for discriminating 'drafted' national youth team players against their 'non-drafted' peers. As a result, this further supports the importance of acceleration sprint time in relation to performance outcomes in elite youth football from a European perspective. Thus, corresponding with Deprez *et al.*'s (2015b) summary following their research, it is proposed the measurement of acceleration is included in the evaluation of physical performance characteristics to distinguish high-level youth football players.

Whilst observing the YPDM, conversely to 0–30 m and 10–30 m sprint speed, 0–10 m acceleration speed appears to be an age-specific physical characteristic that discriminates performance. Thus, it may be suggested 0–10 m acceleration speed is a combination of sprint ability, power, and strength, which is potentially why the FDP results differ to 0–30 m and 10–30 m sprint speed. Furthermore, the increased emphasis of hypertrophy training during year's post-PHV to improve physical performance, for attributes such as strength and power, may support the current age-specific findings.

Similarly to acceleration speed outcomes through the 0–10 m sprint test, the CMJ findings of this current study demonstrate no association with higher ability in an English football academy for players aged 8 to 11 years. However, when observing older participants aged 11 to 16 years from the same environment, it reveals a significant relationship. Corresponding with 0–10 m sprint ability, these current outcomes display the age-specific relationship between performance and power, through its insignificance within the FDP, whilst significantly differentiating high- and low-performers within the YDP. Arguably, 0–10 m sprint speed requires a relative amount of power, which may have influenced the result of the acceleration speed and underline why they elicit the same results within both age phases (Mendez-Villanueva *et al.,* 2011).

These results are converse to those of Gil *et al.* (2014), who found that pre-selected under-10 outfield players from a professional football academy performed better in the CMJ test compared to non-selected players. However, their study presents physical differences between selected and non-selected players, whereas the current chapter discriminates academy players alone. Consequently, both Gil *et al.* (2014) and the current study combined offer the suggestion that CMJ ability differentiates academy and non-academy FDP players, while failing to do the same once players are recruited within an academy setting alone. Moreover, the current results of the YDP players correspond with a number of observational and longitudinal studies, which have highlighted a positive association between superior CMJ ability and performance outcomes within football (Gouvea *et al.,* 2017; Le Gall *et al.,* 2010). Furthermore, other evidence has shown similar power related physical performance tests are associated with greater performance outcomes within the YDP (Deprez *et al.*, 2015b; Mirkov *et al.*, 2010). For instance, Deprez *et al.*'s (2015b) found contracted participants jumped further compared to non-contracted players.

Whilst observing the YPDM, players within middle childhood (aged 5 to 11 years), who are generally going through steady growth in years pre-PHV, require a predominantly age-related neural physical training adaptation (Lloyd & Oliver, 2012). Consequently, this proposes players within the FDP participate in less power-specific development compared to players within the YDP, through engaging in low-structured practice to support their power-related physical development (Lloyd & Oliver, 2012). Furthermore, the YPDM recommends players within adolescence (aged 12 to 16 years), who are generally going through their growth spurt, which later leads to a decline in growth rate post-PHV years, require a maturity related training programme (Lloyd & Oliver, 2012). During this training adaptation, power is highlighted as a major physical development factor (Lloyd & Oliver, 2012). For instance, Mirkov *et al.* (2010) reveal explosive muscle power is characterised by chronological age in elite youth football players aged 11 to 14 years. This may be completed through a combination of individualised physical training programmes and conditioned small-sided games (Tessitore *et al.*, 2012; Mendez-Villanueva *et al.*, 2011).

Therefore, it may be recognised that superior power supports the proposal of increased coach-perceived ability within the YDP, through its increased function and relevance. Furthermore, the incorporation of individualised strength and conditioning programmes within an academy setting should apply a biological age approach rather than a chronological age-grouping method (Cumming *et al.*, 2018; 2017). Consequently, the development of power can be greater developed at specific moments during each players post-PHV years (Lloyd & Oliver, 2012).

This current study reveals no significant relationship between higher ability in an English football academy for players within the FDP and YDP for L-agility speed. Interestingly, although the present findings from both the sprint abilities and CMJ are reinforced through existing research, results for the L-agility speed appear to differ from previous studies, through the current chapter illustrating its statistical insignificance compared to the significance demonstrated in other related literature (Mirkov *et al.*, 2010; Gil *et al.*, 2007b). For example, Mirkov *et al.* (2010) show that agility could be among the essential characteristics surrounding the success in 11-year-old players. These participants are within the transition between the FDP and YDP through both the under-11 and under-12 age groups consisting of 11-year-old players, thus offering a relevant comparison for both age phases. Furthermore, Gil *et al.* (2007b) indicated agility was an important factor when selecting young talented Spanish football players to progress throughout YDP age groups.

Additionally, while there is also support, albeit through limited evidence, against sprint speed and CMJ abilities influencing performance outcomes (Martinez-Santos *et al.,* 2016; Carling *et al.,* 2012; 2009), to the researcher's knowledge, there appears to be no current study that does not discriminate agility and football performance. Consequently, this research seems to present the first findings that illustrate agility does not differentiate ability within an academy environment. As a result, these findings should be applied with caution, with further investigation required.

Similarly to the findings concerning power, Gil *et al.* (2007b) state that agility may be apparent after the on-set of puberty, thus highlighting the age-specific nature of measuring agility for talent identification purposes. Similarly, the YPDM also highlights a greater emphasis on the development of agility post-PHV during the adolescent years (Lloyd & Oliver, 2012), thus supporting this current research through illustrating the greater age-specific significance of physical capacities within the YDP compared to the FDP. This research supports the proposal that physical assessments should be used for monitoring physical development and talent identification purposes (Emmonds *et al.,* 2016; Hirose & Seki, 2016; Hammani *et al.,* 2013), whilst also considering the age-specific findings (Lloyd & Oliver, 2012; Gil *et al.,* 2007b).

7.5.2. Anthropometric measures and maturation status

The current findings reveal anthropometric measures do not influence ability, irrelevant of age. As a result, this supports Franks *et al.*'s (1999) and Malina *et al.*'s (2007b) suggestion from an elite youth football perspective that, with the possible exception of goalkeepers, there is no typical size and physique required to be a successful professional football player when compared to other sports such as basketball or gymnastics. While some research (e.g., Figueiredo *et al.* 2009a; 2009b; Malina *et al.*, 2004) has suggested that greater size and maturity may help in getting selected into an academy in the early talent identification phase, the current research demonstrates once you have are selected within an academy environment, current growth and maturation data has no influence on coach ratings surrounding ability (also see Meylan *et al.,* 2010; Malina *et al.,* 2007b; 2004; 2000).

However, not all research supports this contention that maturity is not important when you get into an academy. For example, Le Gall *et al.* (2010) highlight graduates from an academy who achieved professional status had advanced maturity status, body height, and body mass compared to those who did not. Conversely, during their longitudinal study, Ostojic *et al.* (2014) demonstrated a significantly larger amount of their academy players who achieved professional status were late maturers (60.1%) compared to early maturers (11.8%). As a result, further research is required to discover why these players are predominated before overtaking their peers to gain a greater opportunity to achieve the overall purpose of professional status.

Furthermore, there appears to be a large amount of research that discriminates elite and non-elite youth football players concerning their anthropometric measures and growth and maturation data, thus further research is required to incorporate strategies, such as bio-banding and 'future' teams, to support potential recruitment within professional academies (Cumming *et al.,* 2017; Vandendriessche *et al.,* 2012a). As a result, once each player's maturation starts to plateau towards adulthood, the preconceived physical advantage may be eliminated and less-mature players gain a greater opportunity to partake within talent development systems (Malina *et al.,* 2000).

7.5.3. The RAE

While a large amount of research highlights a greater selection of birth quarter 1 and 2 players compared to 3 and 4 within elite settings (Gonzalez-Villora *et al.,* 2015; Massa *et al.,* 2014; Helson *et al.,* 2012; 2005; Glamser & Vincent, 2004), this chapter indicates how birth quarters are evenly distributed between high- and low-performers within that particular environment.

Consequently, although there is clearly a greater number of birth quarter 1 and 2's compared to 3 and 4's among the participants (Figure 7.4.), once academy status is gained, birth quarter apparently becomes irrelevant surrounding coach ratings concerning current ability from a holistic perspective. Consequently, birth quarters 1 to 4's are evenly distributed throughout high- and low-performers, thus these findings reveal the RAE is insignificant in discriminating high- and low-performers within both the FDP and YDP.

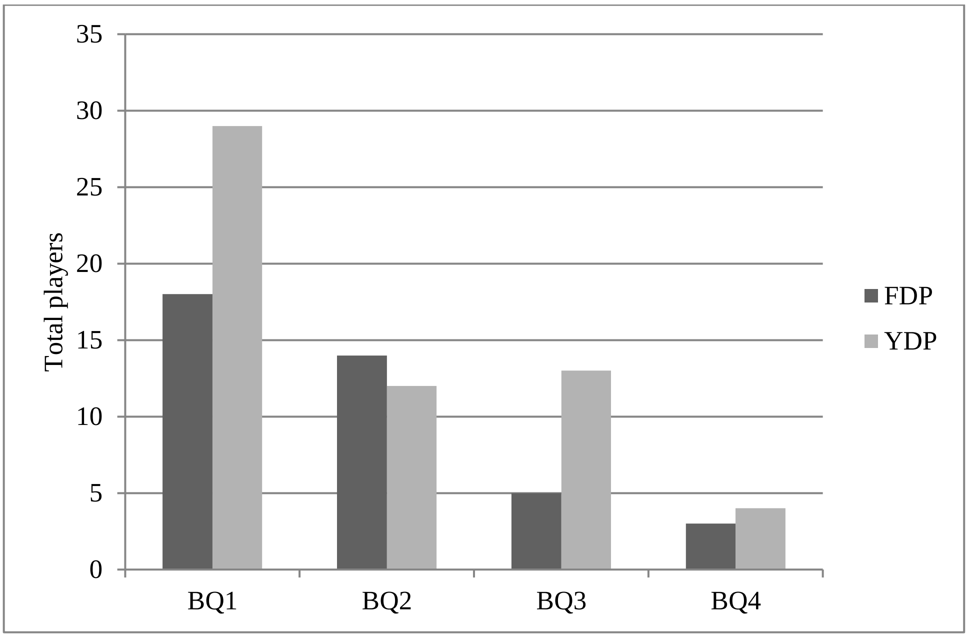


Figure 7.4. Birth quarter distributions within the FDP and YDP

Since Barnsley *et al.*'s (1985) initial investigation exposing the RAE in youth sport, there continues to be a stigma surrounding the recruitment of younger athletes into professional talent development environments throughout various sports (Ulbricht *et al.*, 2015; Hollings *et al.*, 2014; Nakata & Sakamoto, 2013; Van Der Honert, 2012; Musch & Grondin, 2001; Grondin & Koren, 2000; Baxter-Jones, 1995; Dudink, 1994; Edwards, 1994). Similarly, the current sample population has drafted 18 birth quarter 1's compared to three birth quarter 4's within the FDP, while there are 29 birth quarter 1's compared to four birth quarter 4's within the YDP (Figure 6.5.).

Therefore, although Barnsley *et al*.'s (1985) original study was over thirty years ago, Mann & Van Ginneken (2017) have only just recently produced the first piece of evidence to reduce the RAE through applying an age-ordered shirt numbering system. Further strategies formerly highlighted, such as bio-banding and 'future' teams, may potentially also support younger recruitment within professional academies, although this has currently only been established from a growth and maturation perspective (Cumming *et al.,* 2017; Vandendriessche *et al.,* 2012a).

Furthermore, while differences in chronological age of less than 12 months have little relevance on adult physiques, peers within the same chronological age group during adolescence can have a biological age difference of up to five years (Gonzalez Bertomeu, 2018). Therefore, it may be suggested that age grouping could possibly divide itself into 6 monthly age groups rather than 12, to support a fair recruitment process within youth development. Football is the leading team sport within the UK with thousands of players available for selection within a multi-million pound industry (Mann & Van Ginneken, 2017; Roe & Parker, 2016). However, it is clear further investigation is required to support this notion, whilst doubling youth development practitioners and resources may be challenging. Nevertheless, research is required to continue to explore what factors can facilitate birth quarter 3 and 4's talent identification and development compared to a birth quarter 1 and 2's.

Conversely, it may be argued these potential concepts would diminish the reverse effect, where it is suggested late-birth players are more likely to achieve senior professional status compared to their older peers (McCarthy & Collins, 2014). For example, Jones *et al.* (2018) describes the reverse effect at 'super-elite' level as the resilient and mind-set that birth quarter 4's obtain throughout their development route as a result of being younger and less mature compared to birth quarter 1's, and presented a disadvantage and are consequently required to develop certain psychological and technical strategies to keep up. As a result of reducing the RAE, it may be suggested this natural rocky road would also decrease, therefore eliminating certain developmental factors that are provided within the current yearly chronological age grouping system.

However, the current reverse effect research only applies to a rugby academy and youth cricket perspective. Thus, similar research should be applied to football, and other sports, before it is presumed in the same circumstance. Consequently, further research needs to identify if there is a reverse RAE in the transition from elite youth football to professional status, which will support the suggestion that being a younger player in a group develops valuable psychological characteristics (McCarthy *et al.,* 2016; McCarthy & Collins, 2014; Abbott *et al.,* 2005). Therefore, this observation requires a more detailed examination from a theoretical perspective, before being formally applied in a practical talent development process.

7.6. Limitations

When focussed on a physical performance perspective, it is important to indicate that acceleration, speed, and power alone cannot solely predict the outcome of overall success (Gonaus & Muller, 2012). Although physical factors are identified as key characteristics in high-performers within elite youth football at specific age phases, they could be further analysed from a holistic perspective alongside other variables that contribute to ultimate realisation of identification and development. Therefore, further research must use various talent identification factors to measure a multidisciplinary development model. However, this study does provide an original insight into the physical performance of elite youth football players within the FDP and YDP from a talent identification viewpoint.

It is also important to comment on the methods applied to this study that have noteworthy limitations, including the measurement of body fat percentage and the maturation measurements of predicted adult height, percentage of predicted adult height, and estimated

PHV status applying the Khamis-Roche formula. This includes the limited accuracy of the bioelectrical impedance method of the Tanita BF-350 Body Composition Monitor, which has a greater margin for error compared to other body fat percentage measures such as callipers and DXA scanners (Shah & Braverman, 2012; Collins *et al.,* 1999; Deurenberg, 1996). However, as a result of the participant size, the particular measure applied to this study is proved useful for gathering data in large populations (Deurenberg, 1996). Furthermore, the Khamis-Roche algorithm (Khamis & Roche, 1994) has also been criticised regarding its performance and accuracy for predicting adult height and maturity offset (Malina & Koziel, 2014). However, it is evident this measure has been applied to scientific monitoring and inquiry throughout large paediatric studies (Cumming *et al.,* 2009; Sherar *et al.,* 2005) and elite youth football literature (Malina *et al.,* 2007a), thus offering a suitable procedure for acquiring relevant data concerning growth and maturation status in this current study.

7.7. Conclusion

Physical performance in football is an increasingly central factor surrounding elite performance at senior professional level (Barnes *et al.,* 2014; Malina *et al.,* 2004). The ability to jump, accelerate, sprint, and change direction quickly during competitive match-play is constantly evolving, with outstanding physical characteristics essential to flourish in the top professional football leagues across the world (Barnes *et al.,* 2014). This current study highlights the importance of 0–30 m total sprint speed and 10–30 m maximal sprint speed at both the FDP and YDP, through differentiating high- and low-performers. Furthermore, it also illustrates the evolving importance of physical characteristics in relation to age, with 0–10 m acceleration speed and CMJ ability also significantly discriminating high- and low-performers within the YDP. However, agility did not distinguish high- and low-performers within either the FDP or YDP, thus revealing it may not be a useful predictor compared to other physical performance measures in elite youth football. Consequently, this collection of research highlights the importance of applying sprint and power characteristics to a battery of physical performance tests in both the FDP and YDP to support recruitment and development.

Anthropometric measures and growth and maturation data have been previously highlighted as discriminating factors between elite and non-elite you football players (Waldron & Murphy, 2013). However, this current research illustrates how, once players within the academy, these factors become insignificant. Nevertheless, although these physical characteristics within this current research do not discriminate high- and low-performers, it is necessary to explain these methods do offer an additional instrument to facilitate developmental procedures, particularly surrounding physical loading and strength and conditioning training, due to the diverse period youths go through their growth spurt and achieve their PHV.

Additionally, while a large amount of research highlights greater selection of birth quarter 1 and 2 players compared to 3 and 4 within elite settings (Gonzalez-Villora *et al.*, 2015; Massa *et al.*, 2014; Helson *et al.*, 2012; 2005; Glamser & Vincent, 2004), similarly to the anthropometric measures and growth and maturation data in this study, this current research reveals how once players are drafted into the academy, birth quarters are evenly distributed between high- and low performers. Consequently, although there is clearly a greater number of birth quarter 1 and 2's compared to 3 and 4's amongst the participants, once academy status is gained, birth quarter apparently becomes irrelevant surrounding coach ratings regarding current ability from a holistic perspective.

8. TECHNICAL

8.1. Introduction

Football is a sport that requires the repetition of many complex technical actions, such as dribbling, passing, tackling, and shooting (Dardouri *et al.,* 2014; Figueiredo *et al.,* 2011; O'Reilly & Wong, 2012; Mirkov *et al.,* 2008). Historically, objective technical analysis was rarely monitored for talent identification and development (Abt *et al.*, 1998). For example, Ali (2011) states how there is a 'dearth' of studies on skill execution within academic literature, particularly when it is readily acknowledged that successful execution of skill is one of the most important aspects in football performance. More recently however, the growing interest from practitioners, alongside an increasing technology capability, has resulted in researchers focussing on technical tests and match analysis statistics as part of their methodologies (Archer *et al.,* 2016; Forsman *et al.,* 2016a; 2016c; Keller *et al.,* 2016; Pedretti *et al.,* 2016; Vaeyens *et al.,* 2006; Fenoglio, 2004a; 2004b).

The difference between technique and skill has caused some confusion among coaches and researchers (Keller *et al.,* 2016; Ali, 2011). Keller *et al.* (2016) describes technique as the ability to execute a solitary action in isolation from the game, which involves minimal mental decision making. Keller *et al.* (2016) continues by defining skill as the ability to be in the correct place at the right time, whilst being able to select and apply the correct technique on demand. Unlike technique, the environment for skilled execution is unpredictable and often requires optimum levels of decision making.

Current research has illustrated the technical demands of contemporary football have increased significantly in recent years (Barnes *et al.,* 2014), alongside a significant association between greater ball possession and successful results (Liu *et al.,* 2016), with players from successful teams shown to complete more technical actions (Rampinini *et al.,* 2009). Therefore, from a talent identification and development perspective, it may be important to assess and monitor both unopposed technique and skill behaviours, using technical tests and match analysis data respectively, to measure these fundamental technical attributes in elite youth football.

Although there are number of studies that demonstrate elite youth athletes elicit superior technical skills compared to their non-elite counterparts (Woods *et al.,* 2015; Vaeyens *et al.,* 2006), there is no research surrounding technical characteristics within an academy environment that predict performance outcomes. Therefore, the aim of this study is to recognise discriminating technical attributes and skill behaviours between high- and low-performers in a professional football academy in England, while also identifying age appropriate differences within the FDP and YDP.

8.2. Rationale

8.2.1. Technical testing

The acute motor skills of manipulating a ball effectively are fundamental factors in the professional game of football and can be tested in isolation (Vaeyens *et al.*, 2006). Ali (2011) states the advantages of measuring these technical attributes as facilitating initial talent identification, providing a strategy for skill acquisition, and offering an alternative predictor for measuring technical ability compared to a skilled execution during competitive match-play. The importance of technical ability in successful football performance has been supported in previous studies that have demonstrated the association between technical capabilities and performance outcomes at varying performance levels (Huijgen *et al.,* 2014; Rebelo *et al.,* 2013; Coelho-e-Silva *et al.,* 2010; Figueiredo *et al.,* 2009a; Vaeyens *et al.,* 2006).

For example, Vaeyens *et al.* (2006) used a sequence of technical tests as part of their research testing the relationship between physical and technical performance characteristics in youth football. They assessed anthropometric measures and physical characteristics alongside technical ability in elite, sub-elite, and non-elite youth football players (*n*=490) aged 12 to 16 years. Their battery of isolated technical tests included slalom dribbling, lob passing, shooting accuracy, and ball juggling. Subsequent results revealed that these technical tests distinguished elite and non-elite youth football players at under-13, 14, and 15 age groups (*p*=0.000), whilst being marginally significant predictors at under-16's (*p*=0.072). When observing the specific technical characteristics, Vaeyens *et al.* (2006) revealed elite under-13 players demonstrated significantly better lob passing, dribbling, and ball juggling abilities compared to non-elite players. Under-14 and under-15 elite and sub-elite players performed significantly better than their non-elite peers in lob passing, slalom dribble, and ball juggling. Under-16 elite players' achieved better scores compared to sub-elite players on the lob pass and slalom dribble tests, and non-elite players' on the ball juggling and slalom dribble. Consequently, whilst overall technical ability in lob pass, ball juggling, and slalom dribble tests predicted ability level, it appears shooting accuracy failed to discriminate between participants across all age groups.

Furthermore, Keller *et al.* (2016) used the Loughborough Short Passing Test, long passing test, shooting test, and speed dribbling test to discriminate under-18 national elite (*n*=18), state elite (*n*=22), and sub-elite (*n*=22) youth football players. They reported that the elite group had higher scores on the Loughborough Short Passing Test, were quicker on the speed dribbling test, and had superior shooting accuracy compared to the state elite and sub-elite groups, whilst the sub-elite group scored fewer points compared to both the elite national and elite state groups for the long passing test. In addition, Huijgen *et al.*'s (2010) longitudinal study also found that dribbling performance during adolescence could discriminate between players who achieved senior professional football status and those who reached amateur level. As a result, technical attributes, such as controlling, passing, shooting, and dribbling, are valuable measures for assessing young football players' future potential (Huijgen *et al.*, 2010).

Technical ability has also been illustrated to improve with age among youth football players, with the greatest developments shown to occur in pre-pubertal years, after which technical skills are gradually developed until adulthood (Wilson *et al.,* 2016; Valente-dos-Santos *et al.,* 2014; 2012; Huijgen *et al.,* 2010). Additionally, some studies have also revealed growth and maturation status may also be associated with technical skill development, with biological maturity impacting the technical progression in young football players (Valente-dos-Santos *et al.,* 2014; Malina *et al.,* 2007b; 2005). Moreover, time spent within practice activities, such as deliberate play, coach-led practice, and early diversification, have also been allied with developing technical ability within a football context (Valente-dos-Santos *et al.,* 2014; Huijgen *et al.,* 2013; 2010). Consequently, this highlights the importance of investigating technical ability from an age-specific concept to support the development process.

8.2.2. Skill behaviour

Football is characterised as a free-flowing team sport that requires the execution of many aspects of skill in a dynamic context (Kempe *et al.,* 2014). Therefore, although there are some 'closed skills' (i.e., penalty, corner, and free-kick), football is an 'open skill' game (Carling *et al.,* 2007). Thus, a player is required to perform the correct action at the right time to be effective. In addition, consistent technique is required for a long period of time during a game, which has been shown to be variable during the later stages of a game when fatigue sets in (Mohr *et al.,* 2003). Therefore, match analysis, via recording competitive games and objectively analysing them, provides both researchers and practitioners useful data on individual skill execution and technical performance in football.

Match analysis refers to the objective recording and examination of behavioural events occurring during competition (Carling *et al.*, 2007). The notational style of analysis applied to this chapter is an objective method of providing data for player development (Appleby &

Dawson, 2002). The scientific analysis of sports performance aims to advance understanding of game behaviour with a view to improving future outcomes (McGarry, 2009). Within the academic literature, match analysis research has largely focussed on the concept of notational analysis (Wright *et al.,* 2014), with football being the first sport in Britain to adopt computerised notational analysis systems to examine the movement, actions, and skills of individuals and teams (Hughes *et al.,* 2007; Hughes, 1988).

Maintaining ball possession, through passing and keeping it within a team's control during competitive matches, has been shown to be associated with success at the highest levels of professional football (Liu *et al.,* 2016). Moreover, players from more successful teams generally possess a greater pass completion percentage, alongside other technical variables such as tackles, dribbles, and shots during competitive match-play (Rampinini *et al.,* 2009). Although these characteristics have been shown to be fundamental skills in professional football, current academic research appears to overlook the possible significance match analysis can provide as a method for monitoring talent identification and development (Atan *et al.,* 2014; James, 2006).

8.3. Aims and hypothesis

Technical investigations, through testing and match analysis observations, are surprisingly scarce amongst talent identification in elite youth football. Moreover, previous research surrounding these variables has repeatedly focused solely on differentiating elite and non-elite athletes (Waldron & Worsfold, 2010). Therefore, this chapter offers an original insight into explicit technical attributes in a football academy by applying football-specific technique tests, and observing skill behaviours through match analysis statistics from competitive match-play. Four measures were examined for the technical tests; ball juggling, slalom dribble, shooting accuracy, and lob pass (Vaeyens *et al.,* 2006). Consequently, the hypothesis is articulated through Vaeyens *et al.*'s (2006) findings, which have applied these particular measures to their study. Furthermore, eight skill behaviours were measured, that are considered important by ECFC Academy, including match averages for; reliability in possession percentage, pass completion percentage, number of tackles, blocks, loose balls retrieved, successful dribble percentage, total touches, and goals scored. These skill behaviours were calculated from match analysis data from subsequent match footage. Although there is no direct research within paediatrics regarding match analysis statistics and performance outcomes, the hypothesis is articulated through both Liu *et al.*'s (2016) and Rampinini *et al.*'s (2009) findings, which have already been highlighted.

The specific aims of this chapter are:

1. To assess technical ability to identify whether high performance is associated to greater technical proficiency, in both the FDP and YDP.
    a) It is hypothesised high-performers will have significantly superior results regarding their ball juggling, slalom dribble, and lob pass abilities compared to low-performers, in both the FDP and YDP.
    b) It is hypothesised that there will be no significant difference between high- and low-performers concerning shooting accuracy, in both the FDP and YDP.
2. To assess match analysis statistics to identify whether high performance is associated to greater skill behaviours, in both the FDP and YDP.
    c) It is hypothesised high-performers will have significantly superior results regarding their average reliability in possession percentage, pass completion percentage, number of tackles, blocks, loose balls retrieved, successful dribble percentage, and total touches compared to low-performers, in both the FDP and YDP.

d) It is hypothesised that there will be no significant difference between high- and low-performers concerning goals scored, in both the FDP and YDP.

8.4. Results

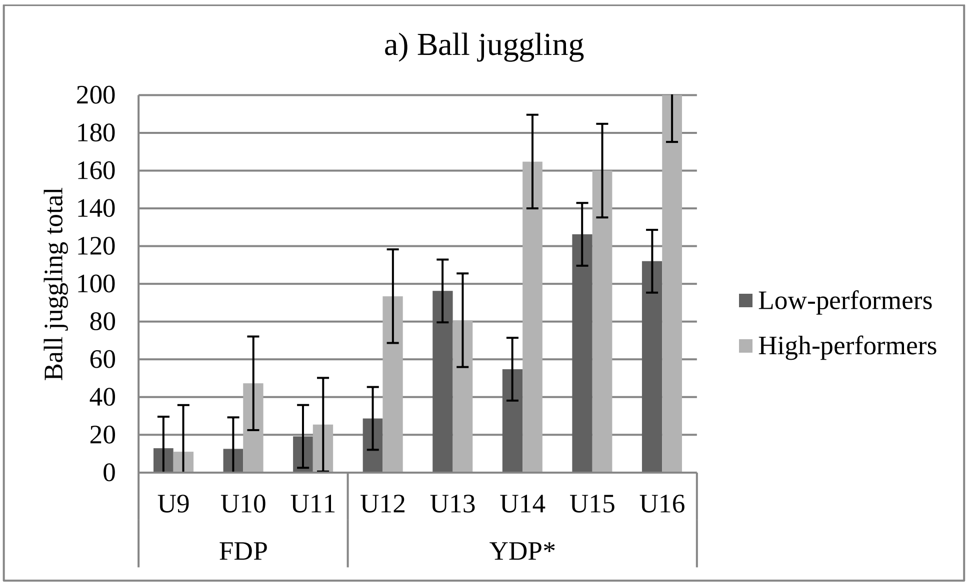
8.4.1. FDP technical tests

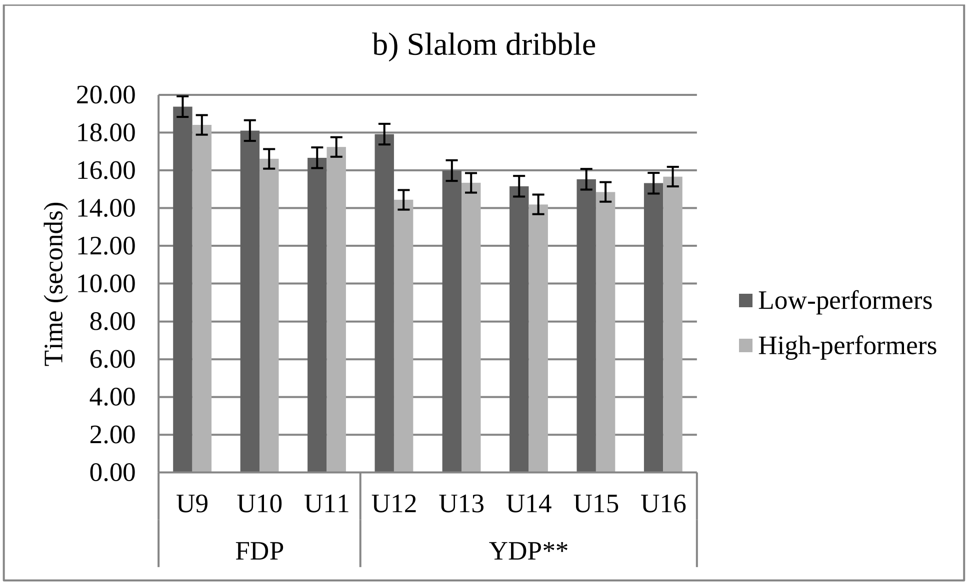
Within the FDP, there was a significant difference between high-performers (M=0.87, SD=0.77) and low-performers (M=-0.63, SD=0.54) for the lob pass test (Figure 8.1. d)), with high-performers demonstrating a greater total mean score compared to low-performers (t(24.00)=5.78, p=0.000).

However, there was no significant difference between high-performers (M=0.13, SD=1.08) and low-performers (M=-0.26, SD=0.79) in the FDP for the ball juggling test (t(24.00)=1.03, p=0.313; Figure 8.1. a)). Furthermore, there was no significant difference between high-performers (M=-0.18, SD=0.96) and low-performers (M=0.01, SD=0.94) in the FDP for the slalom dribble test (t(24.00)=-0.51, p=0.612; Figure 8.1. b)). In addition, there was no significant difference between high-performers (M=0.22, SD=0.69) and low-performers (M=-0.36, SD=0.54) in the FDP for the shooting accuracy test (t(20.15)=1.50, p=0.149; Figure 8.1. c)).

8.4.2. YDP technical tests

Within the YDP, there was a significant difference between high-performers (M=0.43, SD=1.12) and low-performers (M=-0.44, SD=0.89) for the ball juggling test (Figure 8.1. a)), with high-performers demonstrating a greater total mean score compared to low-performers (t(36.00)=2.66, p=0.012). Moreover, there was a significant difference between high-performers (M=-0.40, SD=0.73) and low-performers (M=0.49, SD=0.97) in the YDP for the slalom dribble test (Figure 8.1. b)), with high-performers demonstrating a quicker mean score compared to low-performers ($t(36.00)=-3.19$, $p=0.003$). Additionally, there was a significant difference between high-performers (M=0.47, SD=0.66) and low-performers (M=-0.36, SD=0.98) in the YDP for the shooting accuracy test (Figure 8.1. c)), with high-performers demonstrating a greater total mean score compared to low-performers ($t(31.60)=3.05$, $p=0.005$). Lastly, there was a significant difference between high-performers (M=0.49, SD=1.08) and low-performers (M=-0.54, SD=0.78) in the YDP for the lob pass test (Figure 8.1. d)), with high-performers demonstrating a greater total mean score compared to low-performers ($t(36.00)=3.38$, $p=0.002$).





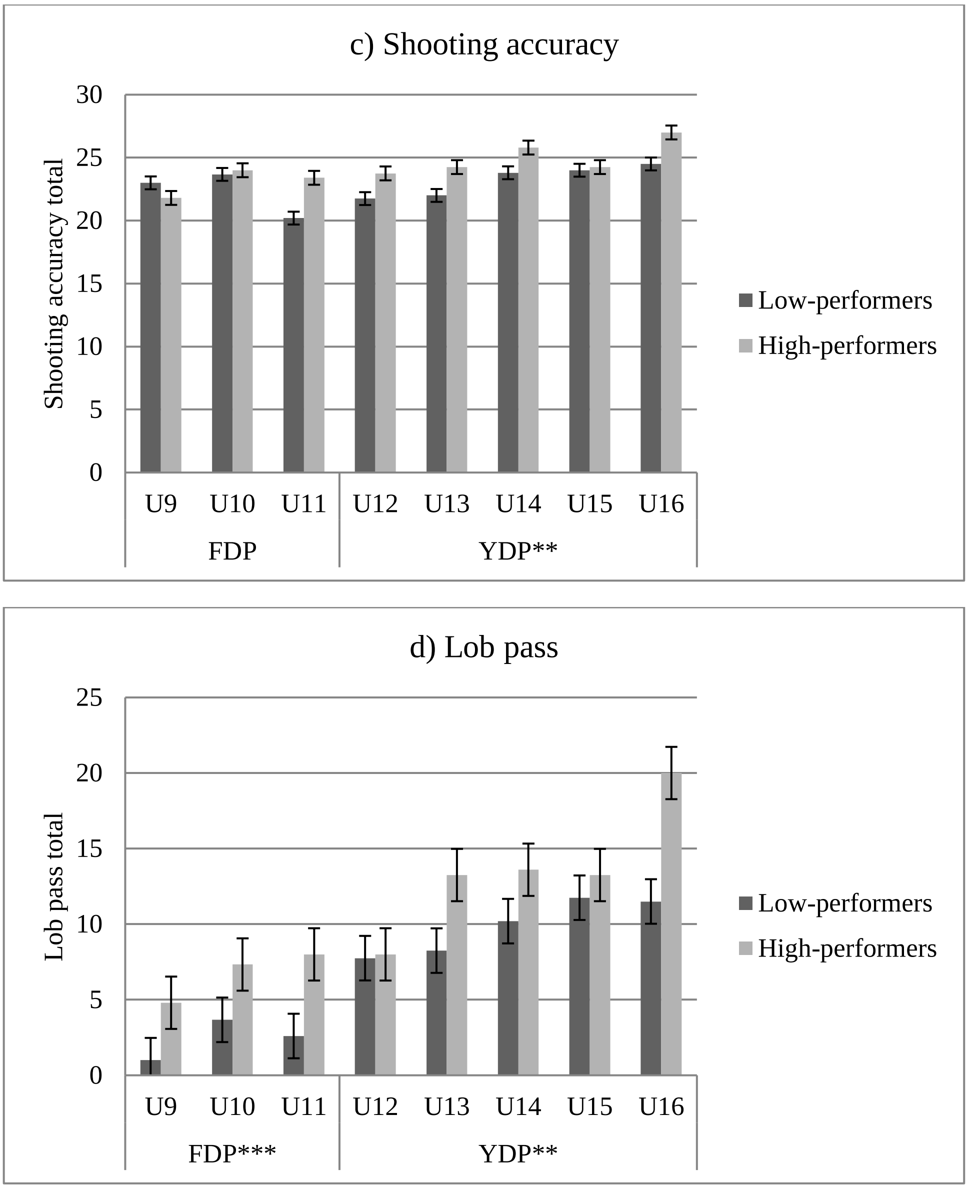


Figure 8.1. Technical test results (**p*<0.050 ***p*<0.005 ****p*<0.001)

8.4.3. FDP match analysis statistics

In the FDP, there was a significant difference between high-performers (M=0.62, SD=0.83) and low-performers (M=-0.33, SD=0.86) for reliability in possession (Figure 8.2. a)), with high-performers having a greater mean percentage compared to low-performers ($t(24.00)=2.87$, $p=0.009$). Furthermore, there was a significant difference between high-performers (M=0.77, SD=0.81) and low-performers (M=-0.61, SD=0.89) in the FDP for pass completion (Figure 8.2. b)), with high-performers having a greater mean percentage compared to low-performers ($t(24.00)=4.14$, $p=0.000$). In addition, there was a significant difference between high-performers (M=0.26, SD=1.26) and low-performers (M=-0.62, SD=0.42) in the FDP for average touches (Figure 8.2. g)), with high-performers having a greater mean total compared to low-performers ($t(14.65)=2.40$, $p=0.030$).

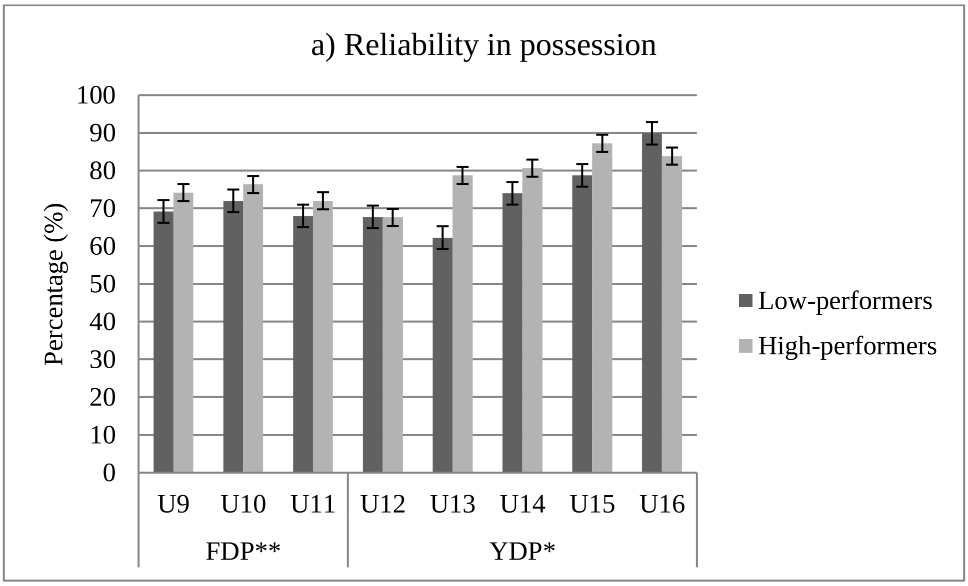
However, no significant difference was established between high-performers (M=0.21, SD=1.42) and low-performers (M=-0.01, SD=0.65) in the FDP for average tackles completed ($t(24.00)=0.51$, $p=0.616$; Figure 8.2. c)). Similarly, there was no significant difference between high-performers (M=-0.10, SD=0.95) and low-performers (M=-0.11, SD=1.2) in the FDP for average blocks ($t(24.00)=0.02$, $p=0.983$; Figure 8.2. d)). Furthermore, there was no significant difference between high-performers (M=-0.11, SD=1.21) and low-performers (M=-0.16, SD=0.78) in the FDP for average loose balls retrieved ($t(24.00)=0.13$, $p=0.897$; Figure 8.2. e)). In addition, there was no significant difference between high-performers (M=0.40, SD=0.79) and low-performers (M=-0.60, SD=1.32) in the FDP for average successful dribbles completed percentage ($t(19.62)=0.23$, $p=0.818$; Figure 8.2. f)). Finally, there was no significant difference between high-performers (M=0.28, SD=1.30) and low-performers (M=-0.36, SD=0.70) in the FDP for average goals scored ($t(24.00)=1.57$, $p=0.231$; Figure 8.2. h)).

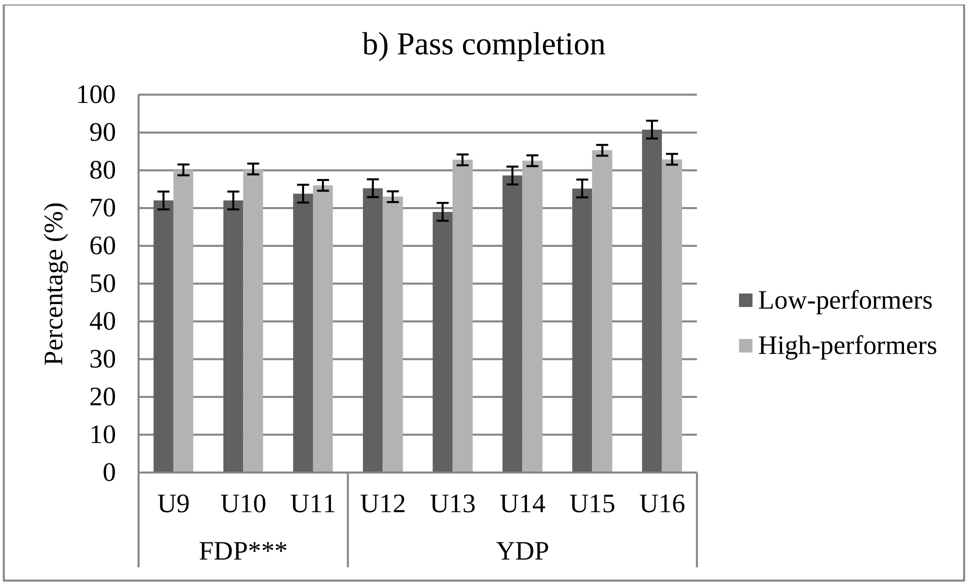
8.4.4. YDP match analysis statistics

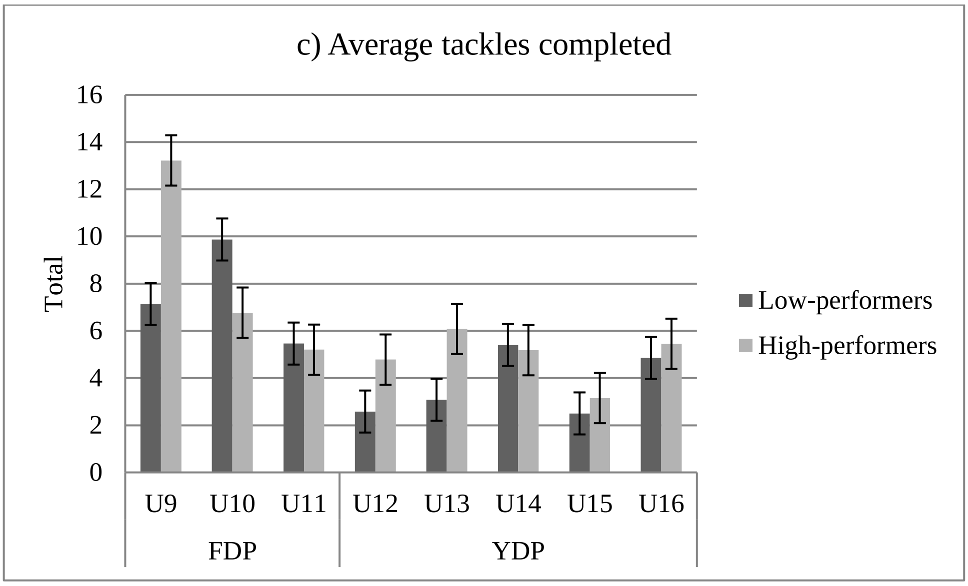
Within the YDP, there was a significant difference between high-performers (M=0.41, SD=0.98) and low-performers (M=-0.33, SD=0.99) for reliability in possession (Figure 8.2. a)), with high-performers having a greater mean percentage compared to low-performers ($t(36.00)=1.52$, $p=0.027$). Moreover, there was a significant difference between high-performers (M=0.62, SD=0.62) and low-performers (M=-0.42, SD=1.07) in the YDP for average successful dribbles completed percentage (Figure 8.2. f)), with high-performers having a greater mean percentage compared to low-performers ($t(28.84)=3.68$, $p=0.001$).

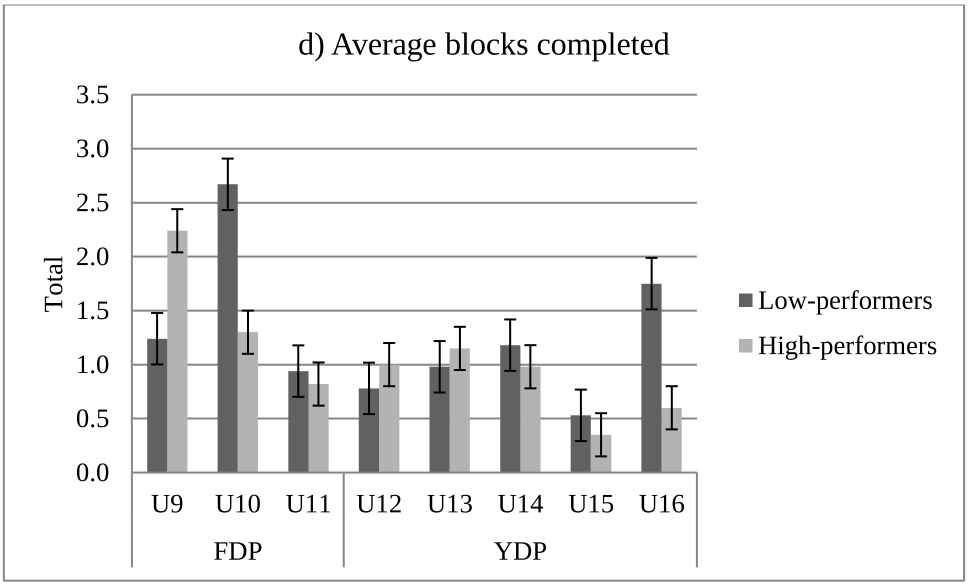
Additionally, there was a significant difference between high-performers (M=0.26, SD=1.26) and low-performers (M=-0.62, SD=0.42) in the YDP for average touches (Figure 8.2. g)), with high-performers having a greater mean total compared to low-performers (t(36.00)=5.03, p=0.000).

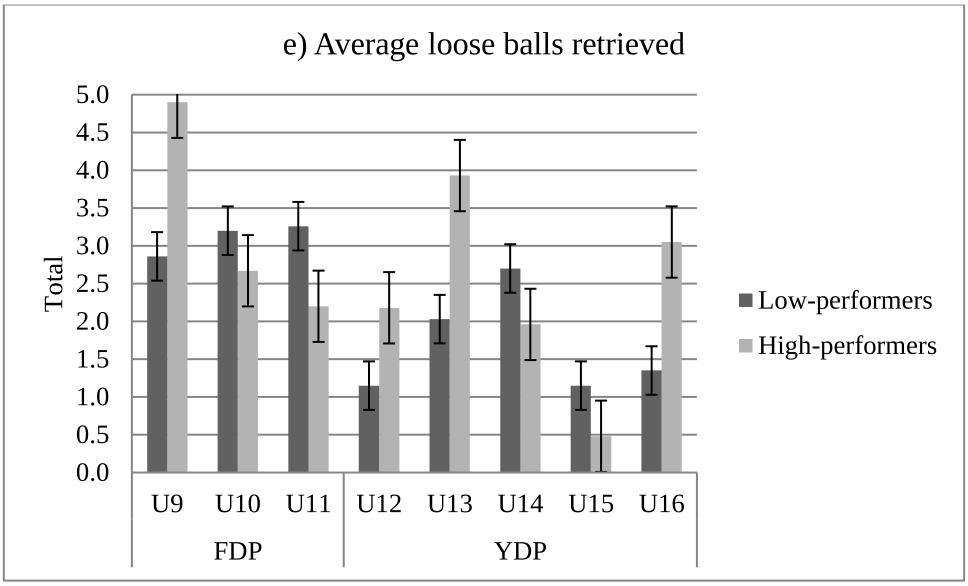
No significant difference was established between high-performers (M=0.17, SD=1.11) and low-performers (M=-0.36, SD=0.77) in the YDP for average tackles completed (t(36.00)=1.72, p=0.094; Figure 8.2. c)). Furthermore, no significant difference was established between high-performers (M=0.21, SD=1.08) and low-performers (M=-0.27, SD=0.54) in the YDP for average goals scored (t(26.40)=1.72, p=0.097; Figure 8.2. h)). Likewise, no significant difference was established between high-performers (M=0.26, SD=0.97) and low-performers (M=-0.23, SD=1.00) in the YDP for pass completion (t(36.00)=1.52, p=0.137; Figure 8.2. b)). Also, there was no significant difference between high-performers (M=-0.10, SD=0.70) and low-performers (M=0.01, SD=1.13) in the YDP for average blocks (t(29.95)=-0.62, p=0.720; Figure 8.2. d)). Lastly, there was no significant difference between high-performers (M=-0.03, SD=1.28) and low-performers (M=-0.22, SD=0.63) in the YDP for average loose balls retrieved (t(26.24)=0.58, p=0.566; Figure 8.2. e)).

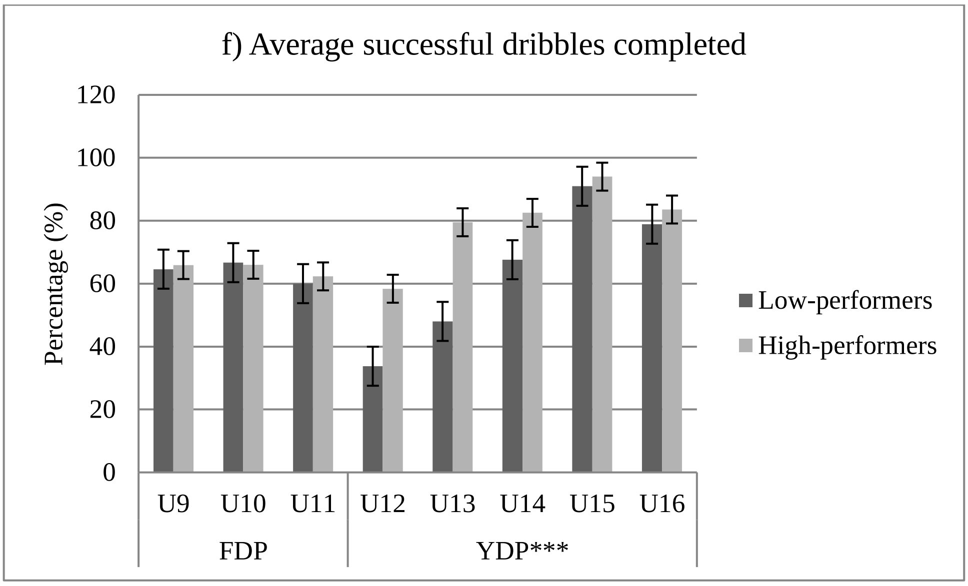


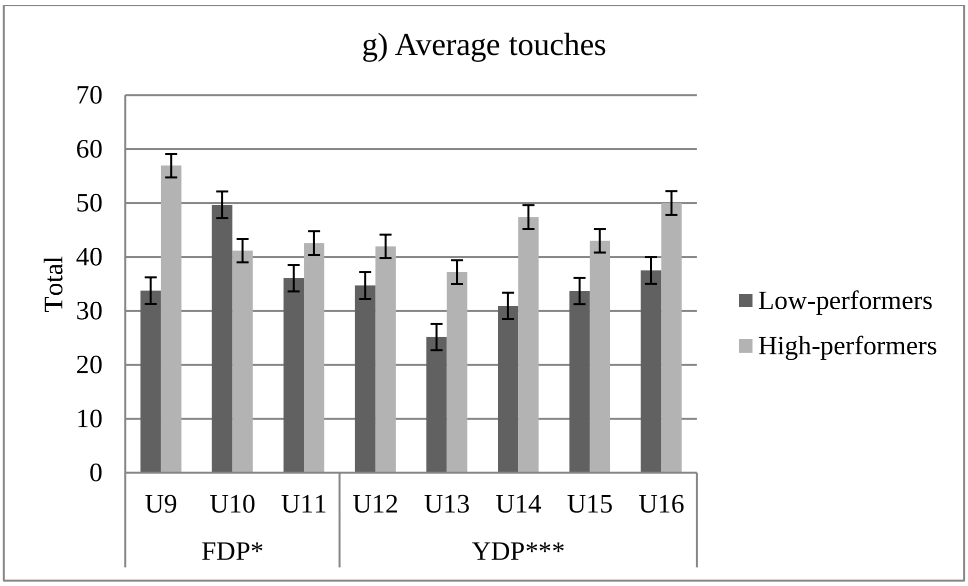

b) Pass completion
Percentage (%)
100
90
80
70
60
50
40
30
20
10
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP***
YDP
Low-performers
High-performers


c) Average tackles completed
Total
16
14
12
10
8
6
4
2
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers


d) Average blocks completed
Total
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers


e) Average loose balls retrieved
Total
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP
Low-performers
High-performers


f) Average successful dribbles completed
Percentage (%)
120
100
80
60
40
20
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP
YDP***
Low-performers
High-performers


g) Average touches
Total
70
60
50
40
30
20
10
0
U9
U10
U11
U12
U13
U14
U15
U16
FDP*
YDP***
Low-performers
High-performers

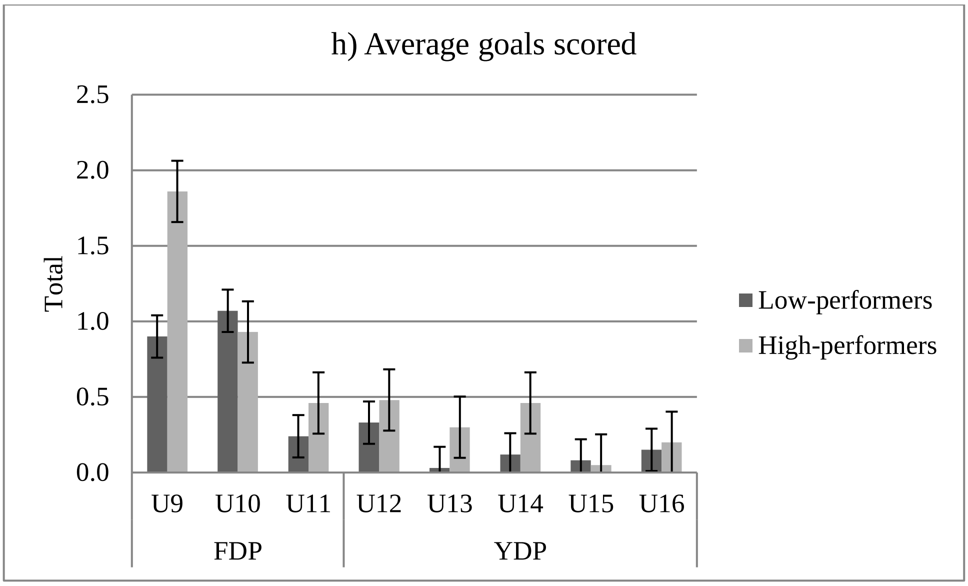


Figure 8.2. Skill behaviour results (**p*<0.050 ***p*<0.005 ****p*<0.001)

8.5. Discussion

To the best of the author's knowledge, this was the first study to investigate the combined effects of technical ability and skill behaviour, through analysing technical tests and match analysis statistics respectively, on ability level within a professional football academy. Therefore, this research introduces the opportunity to recognise technical differences between both high- and low-performers and age phases, while observing specific technical characteristics that may influence the pathways relevant to talent identification and development in academy football. Key findings reveal, in the FDP, high-performers had significantly greater lob pass ability, average reliability in possession percentage, average pass completion percentage, and average total number of touches compared to low-performers. Within the YDP, high-performers had significantly greater lob pass, slalom dribble, shooting accuracy, and ball juggling abilities, alongside a greater average reliability in possession percentage, average successful dibbles completed percentage, and average total number of touches compared to low-performers.

8.5.1. Technical tests

Within the FDP, the current findings reveal ball juggling, slalom dribble, and shooting accuracy did not significantly discriminate the high- and low-performers. However, as previously highlighted, findings from the lob pass reveal high-performers have significantly greater performance compared to low-performers. Arguably, perhaps due to the physical capabilities required for striking the ball a relatively long distance within the FDP, physical factors may partially explain why high-performers achieved greater scores on the lob pass compared to low-performers (Nicolai *et al.,* 2016). Interestingly, this may be associated with Chapter 6 findings (Figure 6.6. Physical performance results a) 0–30 m sprint and b) 10–30 m sprint), that highlight how high-performers had significantly quicker 0–30 m and 10–30 m sprint ability compared to low-performers. Thus, it may be suggested the ability to sprint a longer distance faster is related to possessing the ability to kick the ball further, as a result of superior physical capabilities. Further investigations concerning both physical and technical characteristics within the talent identification process are required to fully understand the progression within the FDP.

When compared to the FDP, the technical tests were a better discriminator of ability in the YDP, with high-performers eliciting greater ball juggling, slalom dribble, shooting accuracy, and lob pass results. Consequently, this highlights technical competency as an influential factor when discriminating talented football players within this elite context. These results are similar to those of Vaeyens *et al.* (2006) who, with the exception of under-12's, studied the same age groups that are analysed in the YDP in this current study. However, in contrast to Vaeyens *et al.*'s (2006) findings regarding shooting accuracy, this current study reveals it as a statistically significant factor that discriminates high- and low-performers.

Similarly, the current findings also support those of Keller *et al.* (2016), who used passing, shooting accuracy, and dribbling tests to discriminate national, state, and sub-elite under-18 youth football players. Likewise, Keller *et al.* (2016) found that both their passing tests, shooting accuracy, and dribble speed distinguished greater results in the national PDP elite group compared to the state and sub-elite groups. With technical ability important for the future career progression of elite youth football players, as a result of the increasing technical demands in professional football over the recent years (Barnes *et al.,* 2014), these tests offer both the option for academies to highlight specific technical abilities as key performance indicators as part of their recruitment and talent identification process (Vanderfold *et al.,* 2004; Hoare & Warr, 2000; Rosch *et al.,* 2000).

The current findings further support, with the exception of lob pass ability, the suggestion that technical ability improves with age amongst youth football players, with the greatest developments shown to occur in pre-pubertal years, after which technical skills are gradually developed until adulthood (Wilson *et al.,* 2016; Valente-dos-Santos *et al.,* 2014; 2012; Huijgen *et al.,* 2010). Furthermore, with greater discriminatory ability evident within the YDP, the results also support previous studies that have revealed growth and maturation status to be associated with technical skill development (Valente-dos-Santos *et al.,* 2014; Malina *et al.,* 2007b; 2005). Therefore, it may be important to highlight the discriminating technical factors among youth football players that may vary with the timing and tempo of growth, consequently adding to the dynamic talent development process.

It may also support the notion that time spent within practice activities, such as deliberate play, coach-led practice, and early diversification, is also associated with developing technical ability within a football context (Valente-dos-Santos *et al.,* 2014; Huijgen *et al.,* 2013; 2010). On one hand, it may be suggested that through the greater difference in technical ability between high- and low-performers within the YDP compared to the FDP, later specialisation may support greater performance outcomes. However, it may also be proposed high-performers within the YDP have completed a greater amount of deliberate practice within the FDP, which has subsequently led to superior performance in the YDP; thus further research is required to investigate the practice history profiles of elite youth football players to assess these potential propositions (see Chapter 4).

From a talent identification perspective, it may be suggested technical testing only investigates current performance, and does not reveal an accurate consideration on the characteristics needed to develop into professional status. Therefore, a longitudinal approach would be recommended to expose a true reflection of the characteristics required to achieve adult expertise in elite youth football. Additionally, future directions surrounding technical competency should apply a multidisciplinary approach to gain a holistic perspective for talent identification. As a consequence of the FDP failing to discriminate high- and low-performers for shooting accuracy, ball juggling, and slalom dribble, it is important to further examine other contributing factors to fully understand the talent identification process within the FDP.

8.5.2. Match analysis statistics

The ability to maintain possession, particularly under pressure, is an important skill in football (Liu *et al.,* 2016). Arguably, the outcome of a player's reliability in possession is the combined execution of a technical action (i.e., pass or dribble) and a tactical decision (i.e., anticipation and awareness). Similarly to the findings from this current chapter, Liu *et al.* (2016) also found reliability in possession to be associated with greater success in professional competitive football. Consequently, the current findings suggest that being able to use the ball effectively (reliability in possession) is also important from a talent identification and development perspective.

Likewise, it may be suggested that pass completion is a technical and tactical recipe. For instance, a player requires the ability to execute a pass technically well (i.e., with the correct weight and angle), but also through selecting the correct option (i.e., decision making and positioning). Rampinini *et al.* (2009) also demonstrate players from more successful senior professional football teams generally possess a greater pass completion percentage compared to their less successful counterparts during competitive match-play. As a result, the feature of retaining superior pass completion seems to be a significant characteristic for early talent identification.

Interestingly, high-performers also have a significantly greater number of touches on the ball compared to their low-performing counterparts, in both the FDP and YDP. Therefore, it could be suggested that high-performers are getting on the ball more, and thus gaining more technical development opportunities during competitive match-play compared to low-performers. This concept may also support the early specialisation concept, where youth football players engage in a large amount of coach-led practice at a young age (see Chapter 4), thus increasing contact time with the football and arguably development (Cote *et al.*, 2007; Ericsson *et al.*, 1993). This also supports the application of Thomas *et al.* (2015) and Fenoglio's (2004a; 2004b) research, which reveals reducing player numbers during competitive match-play in sport during childhood increases technical outcomes. If players get more touches on the ball in which to try new things, this provides more opportunities to develop technical abilities (Katis & Kellis, 2009). Therefore, it is recommended to apply low player numbers, such as 4 vs. 4 to 6 vs. 6 SSGs, during competitive fixtures in the FDP, to increase individual touches on the ball and subsequently technical development opportunities.

Average tackles completed, average blocks made, and average loose balls retrieved revealed no significant difference when comparing high- and low-performers in both the FDP and YDP. When observing these characteristics, they appear to be skill behaviours that are executed out of possession. As a result, these defensive responsibilities cause a case for discussion, as it may be suggested these factors are required without initial control of the ball, therefore they may be easier to execute or more tactical in nature. Consequently, from a talent identification outlook, observing skill behaviours in possession may provide greater reliability from a talent identification perspective in elite youth football.

It was hypothesised that the average number of goals scored by participants throughout the development process would be an insignificant predictor for performance. Accordingly, the current results correspond with this suggestion through illustrating no significant difference between high- and low-performers within both the FDP and YDP. While goal-scoring ability may be perceived as an important attribute for an attacking player, defensive features may be better performance indicators for a defensive player. Consequently, this may suggest why the average number of goals scored by participants was an insignificant factor concerning performance. Thus, it is recommended future research applies a position-specific focus, particularly toward the latter stages of the talent identification and development phases, to potentially support greater individual analysis.

Although the FDP and YDP groups possessed the same number of significant results, the YDP had stronger relationships between high-performers and greater totals than the FDP. Therefore, although reliability in possession and average number of touches were key discriminators between high- and low-performers in both the FDP and YDP, the YDP had additional associations between high-performers and superior technical behaviours during competitive match-play. Thus, similarly to the technical tests, this displays the possible increased importance of technical competency within the YDP as an indication for talent identification.

8.6. Limitations

Football is a team sport that is characterised by technical attributes throughout high-intensity intermittent exercise (Russell *et al.,* 2010). As a result of significantly more goals being scored towards the end of a competitive match, both physical and mental fatigue may effect an individual's technical execution through reduced physical performance and decreased decision making ability (Reilly 2007; 1997). Consequently, it may be argued technical tests disregard the technical ability from a complete perspective through ignoring the physical and mental implications during the latter stages of a competitive game, whilst also applying an environment that differs to the one that is applied to actual match-play. Nevertheless, these technical tests do provide reliability and validity through replicating a technical football performance setting (Russell *et al.,* 2010). Furthermore, the incorporation of a battery of tests provides a dynamic context, thus supporting a greater determination of technical ability (Ali, 2011). Consequently, although technical testing can never fully provide an exact replication of technical ability as a result of the subsequent psychological and physical characteristics associated with competitive match-play, they do provide an example of a player's technique and how well they can execute certain technical attributes from an unopposed perspective.

While this current research provides some original findings regarding talent identification in elite youth football through applying match analysis, it may be suggested that the differing number of games performed by individuals throughout the research offers an unequal balance. For example, Taylor *et al.* (2008) illustrate match location, quality of opposition, and match status can influence technical performance in professional football. However, the ability to film and subsequently analyse both away matches and an equal number of matches amongst participants, is problematic from both a performance and data collection viewpoint.

Nevertheless, it should be illustrated that each participant had an adequate number of games filmed and analysed to participate in this study, through each player playing in at least 320 minutes and a maximum of 960 minutes, equating to a mean number of 640 minutes throughout the season, equalling a total average of eight 80 minute games. Additionally, the idealistic logistics of performing the same amount of games for each player throughout a whole season for the under-9 to 16’s in a single academy is impractical. Therefore, it should be acknowledged that this research presents a unique opportunity for academics and professionals alike to observe match-play behaviours within a professional academy, which provides data for future comparisons and benchmarking respectively. Furthermore, another potential limitation that may be highlighted is the variation in match formats between age groups (i.e., 5 vs. 5 in the under-9’s compared to 11 vs. 11 in the under-16’s). However, results were standardised within age groups using Z-scores to eliminate the potential difference between groups. Consequently, it should be recognised that both technical tests and match analysis statistics offer viable methods for acquiring relevant data concerning technical measures in elite youth football player populations.

8.7. Conclusion

The aim of this current study was to highlight what technical characteristics discriminate high- and low-performers within a professional football academy, through applying technical testing and match analysis statistics, within both the FDP and YDP to offer age-specific considerations. Results reveal unopposed lob pass ability, reliability in possession, and average number of touches distinguished high- and low-performers from ages 8 to 16 years. Consequently, these attributes must be considered from both a recruitment and progression viewpoint to support greater technical development.

While lob pass ability was the only technical test that influenced holistic performance outcomes in the FDP, ball juggling, slalom dribble, and shooting accuracy qualities were also discriminators within the YDP. As a result, this highlights the greater importance of technical ability concerning performance outcomes in the YDP compared to the FDP. Thus, performing a battery of technical tests to illustrate technical ability as part of the recruitment process, particularly within the YDP, is recommended for professional football academies. Furthermore, coaching sessions and learning outcomes could focus on the technical development of these unopposed techniques to facilitate their progression towards adult expertise (Barnes *et al.,* 2014).

Additionally, age-specific differences were also observed for other skill behaviours, through pass completion and the average number of successful dribbles, discriminating high- and low-performers within the FDP and YDP respectively. Other match analysis statistics also appeared to be insignificant predictors concerning performance outcomes in both the FDP and YDP including average tackles completed, average blocks completed, average loose balls retrieved, and average goals scored. With the exception of the latter, these variables appear to be defensive attributes, thus highlighting that ability in possession may support greater performance throughout the development process.

Additional research may offer further investigation into the technical ability and skill behaviour of elite youth football players, while applying characteristics from other significant talent development variables. Consequently, this will offer a multidisciplinary approach, while gaining a complete impression of the talent development process. Furthermore, collecting these variables from a longitudinal perspective will also offer suggestions regarding what technical abilities and skill behaviours differentiate performers who achieve professional status and those who do not, thus ultimately supporting a greater talent identification and recruitment process for professional football academies. Additionally, the coaching process surrounding how these technical qualities are developed, from an age-specific context, also requires investigation. Nevertheless, this research highlights the technical qualities that facilitate performance outcomes within an academy environment whilst also observing age-specific considerations.

Therefore, future studies need to concentrate on applying match analysis statistics as part of a system for talent identification and observing elite youth development, rather than solely applied as a control method in research or as a tool to support the coaching process (Atan *et al.,* 2014; James, 2006). Consequently, specific age groups within elite youth football need to be assessed during competitive fixtures to constantly assess technical performance variables and consequently apply customised training plans regarding individual technical statistics.

9. TACTICAL

9.1. Introduction

Experts in ball games are characterised by extraordinary creative behaviour (Memmert & Perl, 2009). The world's greatest professional athletes in team sports are able to make effective tactical decisions in unpredictable situations (Memmert, 2013). Creative solutions are crucially important in all team sports; through producing greater innovation during unexpected moments, individuals are likely to have superior decision making ability, creativity, and game intelligence during a competitive match (Memmert, 2013; Perl *et al.,* 2013; McPherson, 1994). These skills are generally acknowledged as tactical characteristics within football, and are important features of contemporary talent identification and development strategies in elite youth football (Huijgen *et al.,* 2015; Broadbent *et al.,* 2014; Gonzalez-Villora *et al.,* 2013; Savelsbergh *et al.,* 2010).

PCE research, which generically uses video-based simulation testing to examine decision making ability, offers a considerable amount of previous investigations concerning youth football (Larkin *et al.,* 2016a; Williams *et al.,* 2012; Mann *et al.,* 2007; Ward & Williams, 2003). However, although this previous research investigates both senior and paediatric populations, it appears to be largely constructed on comparing elite and non-elite athletes, with the focus solely on elite players' uncommon (Williams *et al.,* 2012).

Unlike the large availability of PCE studies within sport science research, testing tactical abilities through practical execution and subjective analysis appears to be limited (Memmert, 2013; Perl *et al.,* 2013; Memmert & Perl, 2009). However, there is a small but steadily growing body of research, predominantly (but not exclusively) from Germany and funded by the German Football Association, which looks specifically at creativity and game intelligence in team sports (Pain, 2013). Consequently, this increasing volume of research surrounding tactical skills suggests the importance of judgemental, creative, and intelligent behaviours in professional football, and thus supports this form of research surrounding talent identification and development.

The aim of this chapter is to evaluate tactical behaviours from both PCE tests and game test situations, through video simulations and skill behaviour analysis respectively, that discriminate high- and low-performers in a professional football academy in England, while identifying age appropriate differences within the FDP and YDP.

9.2. Rationale

9.2.1. PCE and decision making ability

The ability to process and recognise sport-specific situations is a result of the multifaceted and selective long-term memory structures, which is crucial for anticipation and decision making in football (Williams, 2000). Equally, expert performers use their knowledge of situational probabilities to anticipate future events and apply skilful decisions (Belling *et al.,* 2014). Players must process information from the ball, team-mates, and opponents before deciding on an appropriate response based upon the current objectives (e.g., tactics and opposition) and actions (e.g., technical skill and physical capacity). These decisions are repeatedly made under pressure, with opponents trying to limit ‘time’ and ‘space’ accessible to execute the desired action (Williams, 2000).

As a result of the increasing literature surrounding PCE in sport, Mann *et al.* (2007) published a meta-analysis. The results of their 180 retrieved articles revealed that expert or elite performers possessed a greater ability compared to non-experts or non-elite counterparts, concerning picking up perceptual cues, through measuring both response accuracy and response time. Additionally, systematic differences in visual search behaviours were also found, with greater expert performers using fewer fixations of longer duration, including prolonged quiet eye periods, compared to non-experts (Mann *et al.*, 2007). While Mann *et al.* (2007) display the difference between elite and non-elite performers regarding PCE, it is evident their meta-analysis fails to identify literature concerning any discriminating factors solely within elite populations. Thus, contemporary literature is required to highlight any differences between high- and low-performers independently to reveal any variance within an elite environment alone.

Within football, Ward & Williams (2003) found advanced PCE was demonstrated in elite youth players between the ages of 9 and 17 years in comparison to sub-elite players. They analysed visual, perceptual, and cognitive skills using a multidimensional approach of video simulation, revealing elite youth football players as young as aged 9 years demonstrate superior perceptual-cognitive skills. The strengths of this study include large participant numbers (*n*=137), while the elite players were all from English Premier League academies compared to the sub-elite players from local elementary and secondary schools.

More recently, Williams *et al.* (2012) examined PCE and practice history profiles in 'high-performing elite' and 'low-performing elite' alongside non-elite youth football players (under-18's). They categorised the 48 participants through applying a quartile split to stratify elite players into either 'high-performing elite' (*n*=12) or 'low-performing elite' (*n*=12) groups based on their PCE test scores, with the two middle groups discarded from the study (*n*=24), while an additional group of non-elite players (*n*=12) also acted as controls. Participants from all three groups (high-performing elite, low-performing elite, and non-elite) then completed a questionnaire about their participation history. Results revealed the high-performing group had accumulated significantly more hours in football-specific play activities (i.e., football in the playground, park, and streets) over the last six years of engagement in the sport compared to the low-performing and non-elite groups. No differences were reported for hours accumulated in football-specific practice (i.e., coach-led and individual practice) or competition (i.e., competitive match-play) amongst the groups. These results concur with Ford *et al.*'s (2009) early engagement hypothesis, who also found the accumulation of football-specific play activities differentiate elite youth football players who progressed to professional status and those who did not, revealing a significantly higher total hours in the players that achieved professional status.

Additionally, Roca *et al.* (2012) also found the average number of hours accumulated per year during childhood in football-specific play activity was the strongest predictor for greater PCE during their investigation. Thus, these initial studies reveal both the importance of PCE and practice through play-like activities throughout the talent development process in youth football. Additionally, this current perspective offers a combination of developmental factors, which is vital in contemporary research to apply a holistic view, which is a typical approach in the modern environment within football academies. Williams *et al.* (2012) also used their high- and low-performing groups to examine memory recall. Their novel test successfully differentiated elite and non-elite performers, however failed to distinguish differences between high- and low-performers. As a result, Williams *et al.* (2012) illustrate the necessity of analysing high- and low-performers within an elite youth football context to confirm critical components of performance.

Whilst studies examining PCE from a football perspective have generally tested single occlusion phases to discriminate performance outcomes, Belling *et al.* (2014) applied three occlusion points to test decision making ability. During their Online Assessment of Strategic Skill in Soccer (OASSIS), Belling *et al.* (2014) used 'pre', 'during', and 'post' execution clips to observe PCE through decreasing difficulty as a result of occluding before, during, or after the player on the ball has executed their necessary action. Their results revealed that domain-specific skill, namely anticipation ability, is more predictive of skill-group membership compared to domain-general measures. Belling *et al.* (2014) also highlight how they experienced difficulty in securing highly-skilled participants, thus suggesting future research should replicate the discriminative power of the OASSIS among new and independent skill groups. Consequently, this current chapter applies varying occlusion phases to independently discriminate high- and low-performers within an academy environment, to illustrate whether PCE, through observing situational probabilities and strategic decision making, is associated with greater performance.

More recently, Van Maarseveen *et al.* (2018) tested and analysed PCE through an in situ design. Van Maarseveen *et al.* (2018) found that it was unclear whether an association existed between performance during video-based simulation tests of PCE and actual on-field outcomes. Their initial results revealed on-field performance could not be predicted on the basis of performance during the PCE tests. Thus, Van Maarseveen *et al.* (2018) argue PCE tests may not be as strong determinants of actual performance as may have previously been assumed. However, it is important to highlight this experimental design incorporated female participants, whereas a large amount of the previous research completed and discussed above was applied to male populations. Additionally, their investigation only included 22 players, therefore weakening its reliability and validity. Consequently, Van Maarseveen *et al.*'s (2018) assumptions should be further investigated through applying larger sample populations throughout various clubs and age ranges within male football, before it is presumed testing PCE through video-based simulations is not a strong predictor for performance.

The factors presented above focus broadly on PCE ability, including advance cue utilisation, pattern recognition, visual search behaviours, situational probabilities, and strategic decision making (Roca *et al.*, 2013). Through applying video based simulations, researchers possess the capability to analyse participants' ability to select correct situational probabilities and strategic decision making skill (Roca *et al.*, 2013). It is evident expert performers possess greater accurate expectations as to what their opponents are likely to do in advance of an actual event compared to their non-expert equivalents (Williams & Ford, 2008). Furthermore, expert performers have a greater ability compared to non-experts regarding decision making ability during certain situations (Vaeyens *et al.* 2007). For example, according to McPherson & Kernodle (2003), experts develop memory structures called 'action plan profiles' and 'current event profiles' that facilitate superior strategic decisions during competitive situations. However, current research has failed to discriminate these PCE performance variables independent of experts. As a result, this current research will examine the PCE ability of both high- and low-performers within an academy environment whilst offering age phase differences. Furthermore, two different occlusion phases will be applied to support greater options for analysing specific differences between both performers and age phases (Belling *et al.,* 2014).

9.2.2. Creativity and game intelligence

Following the broad creativity research surrounding generic sports, Memmert (2010a) further developed two football-specific game test situations to examine creativity and game intelligence in young players. Presented in a twofold study, test one analysed a player's ability to take advantage of openings for the chance to pass in confrontation with opponents. Test two analysed a player's capability of offering and orienting through taking the optimal position on the playing field at the right time. Memmert (2010a) tested 195 elite youth football players aged 12 to 13 years, and as a consequence, through using the results of five evaluation criteria, both diagnostics game test situations were considered beneficial for recording football-specific creativity and game intelligence in talented young players. Accordingly, these tactical analysis methods can be described as objective and valid, and could have a significant purpose when examining creativity and game intelligence in a talent development environment. Although

Memmert (2010a) had a large sample size, it is important to highlight this research needs to encompass other ages to test football-specific tactical skills. In addition, comparisons with other characteristics within the talent development process should be investigated, to understand why certain players demonstrate superior creativity in youth football.

As a result of its increasing focus in sport science, Kannekens and colleagues have supported the creativity research initiated by Memmert and colleagues, through assessing the tactical skills that support talent identification and development in elite youth football. For instance, Kannekens *et al.* (2009a) examined the relationship between tactical skills and competitive standard of national youth team players (aged 18 to 23 years) from Holland (*n*=18) and Indonesia (*n*=19). Through using the Tactical Skills Inventory for Sport (TACSIS), Dutch players outscored their Indonesian equivalents on the subscales 'knowing about the ball actions', 'knowing about others', and 'positioning and deciding'. Consequently, this illustrates that tactical skills are important factors for achieving high-level football performance.

Furthermore, Kannekens *et al.* (2011) also found 'positioning and deciding' as a key factor for talent development in elite youth football. Through analysing 105 elite youth football players using the TACSIS, outcome measures were related to their eventual adult performance level, specifically whether they became professionals (*n*=52) or amateurs (*n*=53). Kannekens *et al.* (2011) performed a logistic regression to identify which tactical skills contributed to overall performance outcomes, revealing 'positioning and deciding' as the greatest predictor for adult performance level, with an odds ratio indicating a 6.60 times greater chance that an individual became a professional player compared to lower scoring players. This reinforces Kannekens *et al.*'s (2009a) findings, through highlighting the tactical differences between performance outcomes.

In addition, from a longitudinal perspective, Kannekens *et al.* (2009b) assessed 191 youth football players from aged 14 through to 18 years playing in different positions. On a yearly basis, all players completed the TACSIS with a scale for attacking and defensive situations. The multilevel analysis indicated that defenders and midfielders did not improve their tactical scores, whereas attackers increased their overall score throughout the assessment years. The representative tactical attribute for defenders was 'acting in changing situations', for midfielders was 'positioning and deciding', and for attackers was 'knowing about ball actions'. Consequently, this highlights the possible position-specific requirements for effective tactical ability.

As a result of highlighting age-specific needs and the longitudinal requirements concerning the development of creativity, Santos *et al.* (2016) generated the Creativity Developmental Framework (CDF). This context describes five incremental creative stages throughout childhood and adolescence, including beginner, explorer, illuminati, creator, and rise, which combines them into multidisciplinary approaches embodied within creative assumptions (Santos *et al.*, 2016). The model appears to highlight the importance of early diversification, deliberate play, and deliberate preparation theories during childhood, with a greater emphasis on deliberate practice as age increases. Consequently, this highlights the importance of analysing tactical behaviours from an age-specific perspective to support the overall talent identification and development process in elite youth football in-line with the CDF.

As a result of the diverse nature of this research, it is important to provide a concise overview surrounding the comparisons between video simulation tests and game test situations. According to Memmert (2013), video simulation tests are less complex with a distinct advantage of providing a clear test situation and response, and therefore require no confounding variables. In contrast, the performances of game test situations are investigated through the participants' ability, thus the technical skills of each player has an influence on the tactical solutions. Furthermore, the subjectivity of expert coaches, who conduct the ratings for each player, may be of concern. However, it should be highlighted coach rating of skill has been previously illustrated as the strongest association for performance outcome (Tangalos *et al.*, 2015). Thus, a combination of both observational and practical tests within tactical research may facilitate the application of a holistic approach for talent identification in elite youth football.

9.3. Aims and hypothesis

The purpose of this research is to compare the high- and low-performers within both the FDP and YDP for their tactical ability using PCE video simulations (Belling *et al.*, 2014) and football-specific game test situations (Memmert, 2010a). Two measures of occlusion were examined for the PCE tests including ‘at’ and ‘post’ execution. Furthermore, two game test situations, including taking advantage of openings and offering and orienting, were observed to elicit originality and quality variables. Although there is other research available surrounding the PCE discriminants between elite and non-elite youth football populations, the hypothesis of this chapter is based upon the findings of Ward & Williams’s (2003), who found advanced PCE in elite youth players between the ages of 9 and 17 years in comparison to sub-elite players during their video based simulations.

This chapter also offers an original insight into the tactical ability of academy players using football-specific game test situations, concerning whether these tactical characteristics distinguish high- and low-performers, whilst offering observations between age phases. As a result, through applying Memmert’s (2010a) findings to form the hypothesis, this chapter will highlight the necessary originality and quality, of both taking advantage of openings and offering and orienting game situation test situations, which differentiates high- and low-performers in both the FDP and YDP.

The specific aims of this chapter are:

1. To assess PCE to identify whether high performance is associated to greater decision making skill at two occlusion stages, in both the FDP and YDP.
    a) It is hypothesised that high-performers will have significantly greater PCE scores for both ‘at’ and ‘post’ occlusion phases compared to low-performers, in both the FDP and YDP.
2. To assess both the taking advantage of openings and offering and orienting game test situations to identify whether high performance is associated to greater originality and quality, in both the FDP and YDP.
    b) It is hypothesised that high-performers will have significantly greater originality and quality scores for both taking advantage of openings and offering and orienting game test situations compared to low-performers, in both the FDP and YDP.

9.4. Results

9.4.1. FDP PCE tests

Within the FDP, there was a significant difference between high-performers (M=0.15, SD=0.84) and low-performers (M=-0.58, SD=0.89) for the PCE ‘post’ test (Figure 9.1. b)), with high-performers demonstrating greater mean results compared to low-performers (t(24.00)=2.15, p=0.042). However, there was no significant difference between high-performers (M=-0.05, SD=1.03) and low-performers (M=-0.20, SD=0.91) in the FDP for the PCE ‘at’ test (t(24.00)=0.42, p=0.679; Figure 9.1. a)).

9.4.2. YDP PCE tests

Within the YDP, there was a significant difference between high-performers (M=0.43, SD=0.93) and low-performers (M=-0.29, SD=1.05) for the PCE ‘at’ test (Figure 9.1. a)), with high-performers demonstrating greater mean results compared to low-performers (t(36.00)=2.27, p=0.030). However, there was no significant difference between high-performers (M=0.19, SD=0.82) and low-performers (M=-0.46, SD=1.14) in the YDP for the PCE ‘post’ test (t(36.00)=2.01, p=0.052; Figure 9.1. b)).

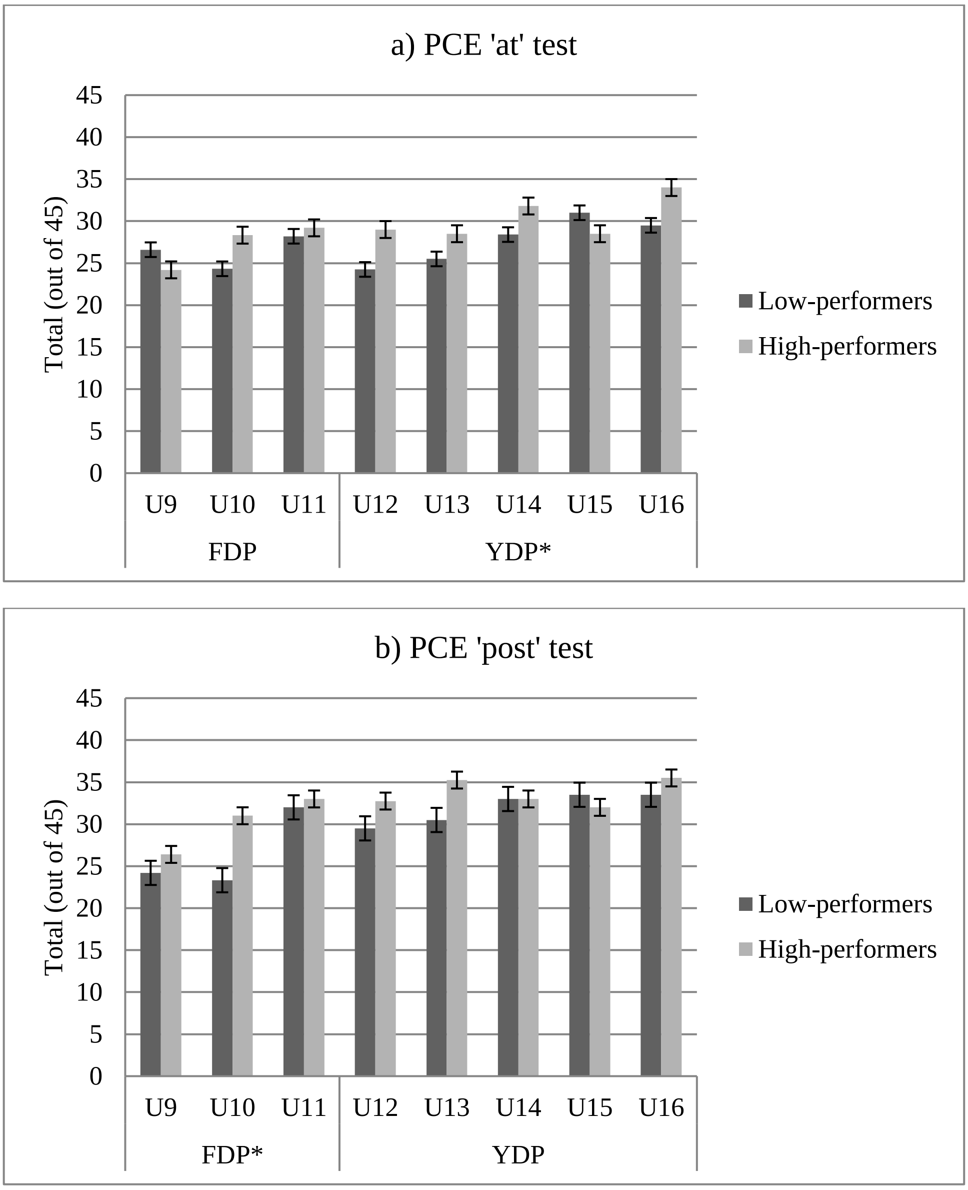


Figure 9.1. PCE video simulation test results (*p<0.050 **p<0.005 ***p<0.001)

9.4.3. FDP game test situations

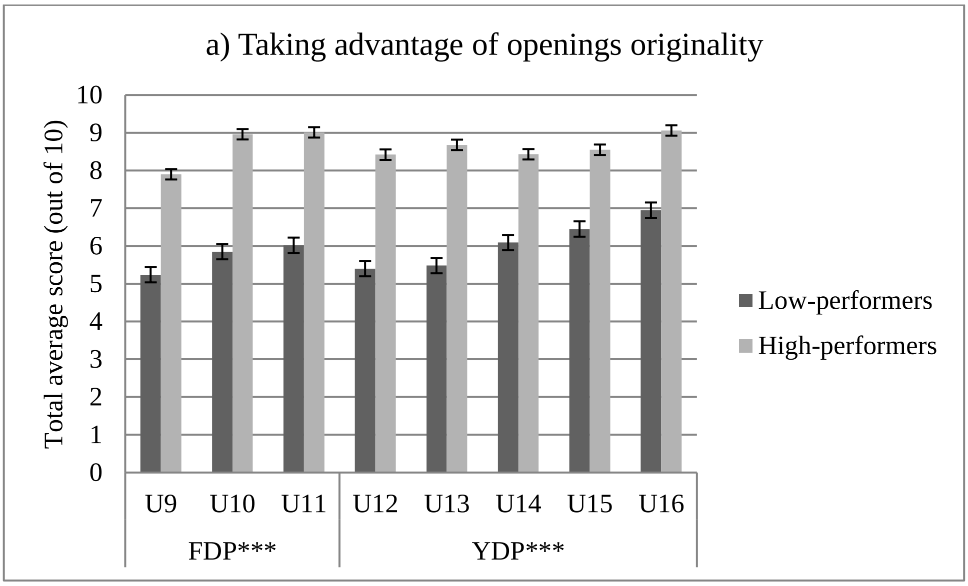
In the FDP, there was a significant difference between high-performers (M=1.04, SD=0.26) and low-performers (M=-1.01, SD=0.62) for taking advantage of openings originality (Figure 9.2. a)), with high-performers demonstrating a greater total mean compared to low-performers ($t(16.05)=11.06$, $p=0.000$). Furthermore, there was a significant difference between high-performers (M=1.00, SD=0.28) and low-performers (M=-0.98, SD=0.47) in the FDP for taking advantage of openings quality (Figure 9.2. b)), with high-performers having a greater total mean compared to low-performers ($t(15.62)=9.37$, $p=0.000$).

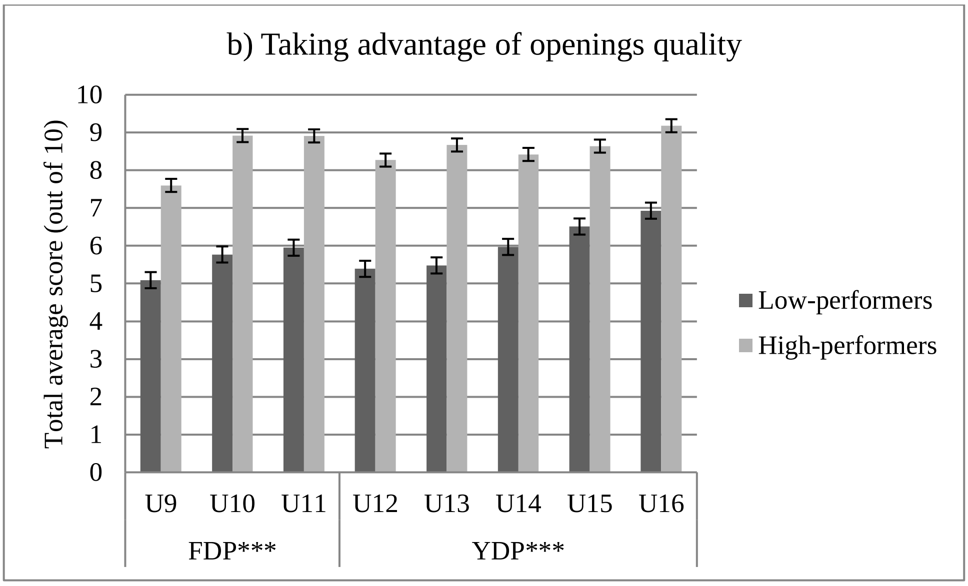
Also, there was a significant difference between high-performers (M=1.00, SD=0.21) and low-performers (M=-1.06, SD=0.69) in the FDP for offering and orienting originality (Figure 9.2. c)), with high-performers having a greater total mean compared to low-performers ($t(14.18)=10.28$, $p=0.000$). In addition, there was a significant difference between high-performers (M=1.03, SD=0.19) and low-performers (M=-1.01, SD=0.65) in the FDP for offering and orienting quality (Figure 9.2. d)), with high-performers having a greater total mean compared to low-performers ($t(13.98)=10.81$, $p=0.000$).

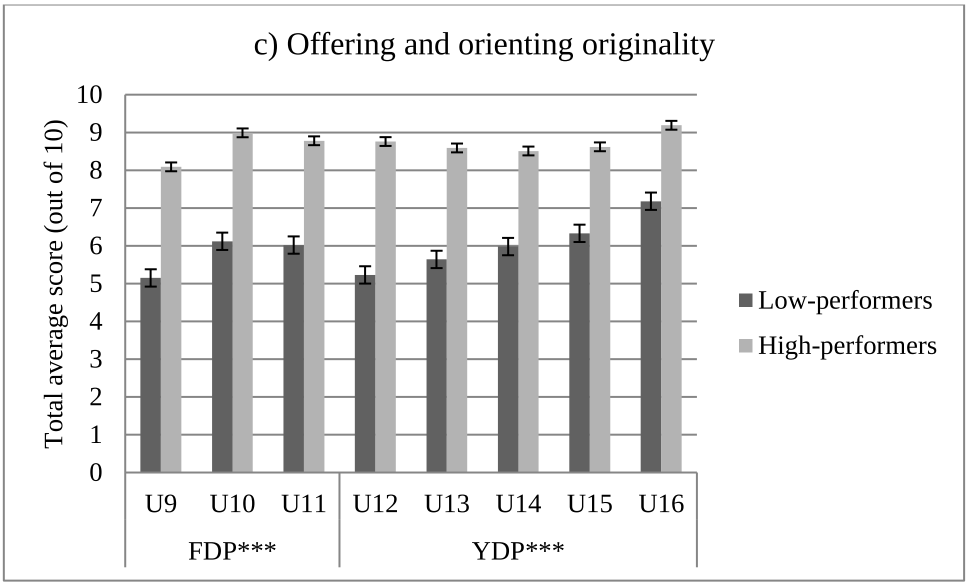
9.4.4. YDP game test situations

In the YDP, there was a significant difference between high-performers (M=1.02, SD=0.47) and low-performers (M=-1.00, SD=0.52) for taking advantage of openings originality (Figure 9.2. a)), with high-performers demonstrating a greater total mean compared to low-performers ($t(36.00)=12.63$, $p=0.000$). Moreover, there was a significant difference between high-performers (M=1.03, SD=0.52) and low-performers (M=-0.98, SD=0.47) in the YDP for taking advantage of openings quality (Figure 9.2. b)), with high-performers demonstrating a greater total mean compared to low-performers ($t(36.00)=12.46$, $p=0.000$).

Additionally, there was a significant difference between high-performers (M=1.02, SD=0.44) and low-performers (M=-1.00, SD=0.50) in the YDP for the offering and orienting originality (Figure 9.2. c)), with high-performers demonstrating a greater total mean compared to low-performers (t(36.00)=13.26, p=0.000). Lastly, there was a significant difference between high-performers (M=1.06, SD=0.45) and low-performers (M=-0.97, SD=0.46) in the YDP for offering and orienting quality (Figure 9.2. d)), with high-performers demonstrating a greater total mean compared to low-performers (t(36.00)=13.70, p=0.000).







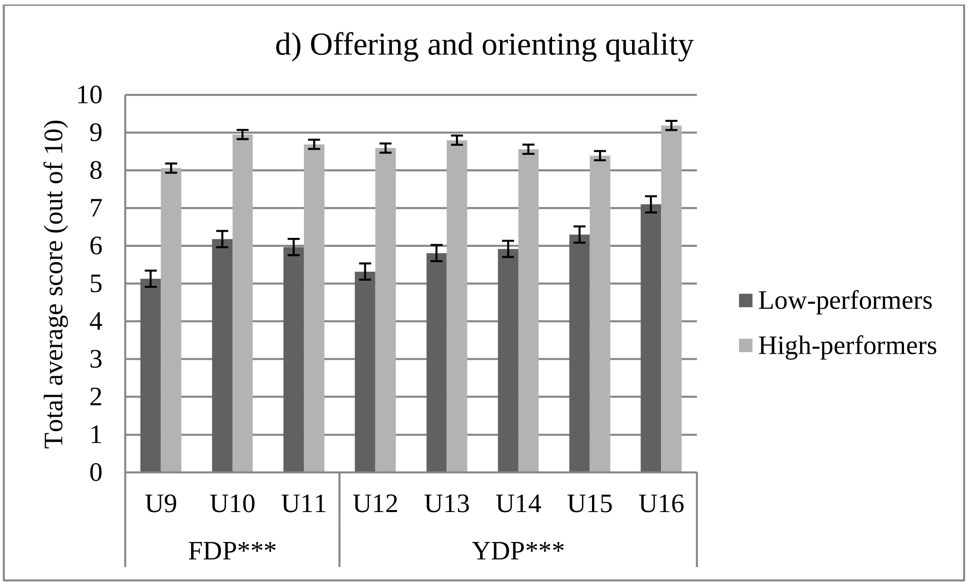


Figure 9.2. Game test situation results (**p*<0.050 ***p*<0.005 ****p*<0.001)

9.5. Discussion

The key findings within the FDP showed high-performers had a significantly greater PCE ‘post’ score compared to low-performers. Furthermore, taking advantage of openings demonstrated high-performers had significantly greater originality and quality compared to low-performers within the FDP. Similarly, offering and orienting revealed the same results for both originality and quality when comparing high- and low-performers within the FDP. Within the YDP, key findings revealed high-performers had significantly greater PCE ‘at’ scores compared to low-performers. Additionally, taking advantage of openings illustrated high-performers had significantly greater originality and quality compared to low-performers within the YDP. Likewise, offering and orienting highlighted the same results for both originality and quality when comparing high- and low-performers within the YDP.

9.5.1. PCE tests

Similarly to previous research comparing PCE skills in elite and non-elite youth football players, this present study supports the hypothesis that high-performers have significantly enhanced PCE skills compared to low-performers in at least one of the decision making phases within the FDP and YDP. This demonstrates that a differentiation in PCE skill does not exclusively exist for elite and non-elite youth football players (Williams *et al.,* 2012; Mann *et al.,* 2007; Ward & Williams, 2003), but also between high- and low-performers within an elite youth football context.

Additionally, it is important to highlight this discrimination is in both the FDP and YDP, which indicates superior PCE is possessed by high-performing players throughout the developmental process from aged 8 to 16 years. Although previous research reveals an extensive amount of play and practice is required for expert tactical performance (Roca *et al.,* 2012; Williams *et al.,* 2012), this research demonstrates that high-performing elite youth football players as young as aged 8 years already have greater PCE skills compared to their low-performing peers. This emphasises the importance of situational awareness and understanding the certainty of an event's occurrence, through identifying task-related cues, body positioning, and possibilities for the player in possession of the football (Williams & Ford, 2008).

Another contribution to the originality of this current study is the two decision making phases including 'at' and 'post' execution. In the FDP, there was no significant difference between high- and low-performers during the 'at' phase. However, high-performers had significantly greater scores compared to low-performers during the 'post' phase. In the YDP, high-performers had significantly higher scores compared to low-performers during the 'at' phase, whilst although it was not statistically significant, high-performers also had higher mean scores in the 'post' phase compared to low-performers. When examining the differences between the FDP and YDP, it is apparent that there is a reverse effect the older the players get. This is arguably due to the increased difficulty of the 'at' phase clips, compared to the 'post' phase clips, which do not separate the FDP players (Belling *et al.,* 2014; Williams *et al.,* 2012). However, the significant discrimination between high- and low-performing players for the 'at' phase clips that is apparent in the YDP players, is possibly a result of older high-performers engaging longer within the talent development system, which has allowed them to build up and develop superior anticipation and decision making skills compared to their younger high-performing counterparts.

Furthermore, the 'post' phase clips did not significantly separate the high- and low-performers in the YDP, thus it may be speculated that this is because the 'post' phase clips are easier than the 'at' phase clips, allowing the low-performing elite youth football players to level out their total scores with the high-performers. In contrast, although the 'at' phase clips could not distinguish high- and low-performers in the FDP, they did establish a significant difference with the 'post' phase clips, with the high-performers achieving a significantly greater score compared to low-performers. It can be suggested this is a result of the increasing ease of the 'post' phase clips compared to the 'at' phase clips, which allows the high-performers to apply their superior PCE skills compared to the low-performers in the FDP.

When compared with previous PCE research in youth football, there appears to be a trend in the findings between the traditional method of comparing elite and non-elite players, and the current method of comparing high- and low-performing elite players (Williams *et al.,* 2012); Ward & Williams, 2003). The results between these two approaches highlights the superior

PCE performance in the players who are considered superior from a holistic viewpoint. Therefore, the relationship between performance and PCE does not only discriminate elite and non-elite youth football players, but also the high- and low-performing players within an elite youth football context. This also supports the earlier criticism surrounding Helston & Starkes (1999) research that had low participant numbers and failed to fully study ‘elite’ participants, and as a consequence, failed to recognise the PCE differences between elite and sub-elite.

Williams *et al.* (2012) also applied the term ‘high- and low-performers’ to their elite population whilst analysing English academy players, through quartering performance on PCE ability, whilst also observing a non-elite control group. As a result, although elite athletes may possess greater memory recall ability compared to non-elite athletes, memory recall may not be a crucial attribute regarding PCE in football as it failed to differentiate elite performance alone. Conversely, this current study has revealed decision making ability during situational probabilities is a significant factor surrounding performance outcome. Thus, together these findings may show memory recall is not as important as decision making ability when focussing on performance outcomes in elite youth football.

As a consequence of greater PCE supporting superior performance, practical implications from this research support the possible prerequisite for recognising PCE skills when identifying youth football players for elite programmes, and are therefore recommended to be incorporated into the recruitment process in professional football academies. Additionally, it may also be considered necessary to develop and implement applied PCE training programmes within football academies to support the development of this particular tactical attribute. Through reflecting on previous research, PCE is potentially developed through participation of deliberate play and practice in football during childhood (Roca *et al.*, 2012; Williams *et al.*, 2012).

Therefore, academies could incorporate a deliberate play structure within an applied environment in the FDP, which can be accomplished through facilitating practice, player-led sessions, eliminating coaches and session structure, and incorporating game related activities as opposed to closed drills (Roca *et al.,* 2012; Williams *et al.,* 2012). Additionally, coaches should aim to foster sessions around challenging anticipation alongside decision making skills and techniques within the YDP, achieved through intentionally creating an environment to attain specific perceptual-cognitive outcomes (Ward & Williams, 2003). Moreover, these findings also support Belling *et al.*'s (2014) notion that future research should replicate the discriminative power of the OASSIS among new and independent skill groups, after they failed to recruit highly-skilled participants.

Finally, contemporary PCE research appears to be completing in-situ designs to support a greater practical association between PCE and performance outcomes (Van Maarseveen *et al.,* 2018). For example, as previously illustrated, Van Maarseveen *et al.*'s (2018) initial research has failed to highlight the association between in-situ PCE performance, thus showing video-based PCE tests may not be as strong determinants of actual performance as may have previously been assumed. However, these presumptions have been highlighted as inadequate as a result of a poor sample size alongside the fact participants were female, thus when compared to the mostly male participants in studies, including this current chapter, in-situ PCE designed research requires further investigation.

9.5.2. Game test situations

The current results of the taking advantage of openings and offering and orienting game test situations demonstrate a strong relationship, for originality and quality, with both age phases when comparing high- and low-performing elite youth football players. Whilst Memmert (2010a) applied these game test situations within a talent development perspective, through comparing performance over a 6 month period, the present study employed it as part of talent identification research, which initially incorporates one testing time point. Furthermore, Memmert (2010a) only focused on players born in 1991 and 1992 from four separate talent bases in Germany, whereas in contrast, the current study focused its research on 98 players from an individual academy throughout the FDP and YDP (under-9 to 16's). Therefore, together this research supports the use of game test situations as a form of tactical analysis within an applied environment, for both talent identification and development. Additionally, results from both studies demonstrate the ability to apply the game test situations across diverse cultures.

Further tactical research from Kannekens *et al.* (2011; 2009a; 2009b) has applied the TACSIS to observe significant tactical factors that influence international youth playing standards, position-specific attributes, and the importance of positioning and deciding respectively. Firstly, similarly to the difference observed between the Dutch and Indonesian nation youth team players, this current study also discriminated tactical performance from an elite youth football viewpoint. Consequently, as a result of this current chapter highlighting the importance of tactical ability from aged 8 to 16 years, whilst Kannekens *et al.*'s (2009a) study observes players aged 18 to 23 years, combined these studies illustrate the significance of tactical ability from the FDP through to the PDP.

Furthermore, Kannekens *et al.* (2011) discovered 'positioning and deciding' as a key factor for talent development in elite youth football. When compared to Memmert's (2010a) study design, 'positioning and deciding' could be associated with both offering and orienting (positioning) and taking advantage of openings (deciding) through their similar outcome measures. Therefore, it may be suggested this current study supports Kannekens *et al.*'s (2011) outcomes, which highlights 'positioning and deciding' as one of the greatest tactical predictors for eventual adult performance level. While the TACSIS appears to support operational tactical research, for the purpose of this current study, Memmert's (2010a) game test situations provide a practical option alongside the laboratory based PCE tests to provide an equal distribution of applied and experimental procedures.

Due to the subjective nature of both the dependent and independent variables, it is proposed that these findings support the use of expert knowledge within talent identification. Historically, the subjective opinion through a coach's perspective of an elite youth football player would be the only feature for talent identification (Saether, 2014; Stebbings *et al.*, 2011; Williams & Hodges, 2005; Reilly *et al.*, 2000b). Therefore, it is recommended that these game test situations are applied alongside objective data to support a holistic approach. Similarly to the practical suggestions from the PCE results, applied implications from the game test situation findings also support a well-rounded early engagement to support the talent development process within elite youth football. For example, during the FDP years, coaches could apply game test scenarios, designed to assess creativity during off the ball movement to facilitate the identification of space (Memmert, 2006). Furthermore, coaches are also encouraged to develop creativity through an attention-broadening training concept, through focusing on the type of instruction given by the coach (Memmert, 2015; 2006; Ford *et al.*, 2010b; 2010c; Memmert & Furley, 2007; Williams & Hodges, 2005). As a result, no explicit tactical advice or information relating to focus of attention is given. This is a result of the narrowing condition that can negatively affect performance, through explicit tactical advice and correctional feedback given, which inhibits children from directing their attention to different kinds of stimuli that could inspire unique and original solutions to game related problems (Memmert, 2006).

Similarly, Santos *et al.*'s (2016) CDF also recommends a large amount of fundamental movement and game-related skills alongside early diversification and deliberate play to support greater development during the FDP, whilst leading to greater constraints-led learning and specialisation during the YDP. It is important to highlight that creative development is a holistic process that underpins complex interactions among several domains, including practice pathway, physical literacy, nonlinear pedagogy, and creative thinking (Santos *et al.,* 2016; Memmert, 2015). Additionally, future research should also investigate coaching styles and practice designs within an academy environment to facilitate this particular concept.

9.6. Limitations

Accurate measures of PCE can be used for the purposes of talent identification and development in elite youth football (Mann *et al.,* 2007). However, it remains unclear what might be the most effective procedure to measure PCE to accurately reflect the demands of an on-field competitive performance (Mann & Savelsbergh, 2015; Pinder *et al.,* 2015; Williams & Ericsson, 2005). Furthermore, although video-based simulation tests offer a significant advantage surrounding their methodological rigour and control, it remains unclear how well these tests may accurately represent on-field performance (Mann & Savelsbergh, 2015; Pinder *et al.,* 2015; Williams & Ericsson, 2005; Williams & Davids, 1998).

The decoupling of perception and action provides a clear distinction between task designs in which participants are required to make an actual movement and those in which participants respond by selecting an answer (Van Maarseveen *et al.,* 2018). As a result, there is initial research applying an in-situ design to support this perception and action divide, though it needs further research before assumptions are made (Van Maarseveen *et al.,* 2018). It is also important to acknowledge that this research has also incorporated a tactical task design to compliment the video-based simulation tests. Additionally, there appears to be a large amount of evidence to support the application of PCE video simulation tests to gauge decision making skill, thus it supplies a reliable and valid method (Williams *et al.,* 2012; Mann *et al.,* 2007; Ward & Williams, 2003).

Game test situations offer the opportunity to examine practical in-situ behaviours, which provide realistic match-play scenarios to analyse. They act as a type of conciliation between standardised tactical tests and match-play observation methods (Memmert, 2010a). However, their subjective nature allows for criticism from reviewers for possible inconsistencies from expert observers. Moreover, as only six minutes per game test situation were judged towards the findings, it can be argued this is not long enough for players to demonstrate their full capacity or the possibility of an irregular performance. Furthermore, the examiners grading the originality and quality, for both the taking advantage of openings and offering and orienting game test situations, were coaches already working with the participants. Therefore, it may be argued these coaches already had a preconceived opinion of certain individuals, thus it may be suggested this may have influenced their marking. To minimise this effect, coaches were qualified to a professional standard. Additionally, coach ratings on player ability has been previously demonstrated as the strongest predictor for performance outcome (Tangalos *et al.,* 2015). Therefore, a combination of video-based simulations and game test situations within tactical research may support the application of a multidisciplinary approach for talent identification in elite youth football.

9.7. Conclusion

To the best of the researcher's knowledge, this is the first study to examine the combined effects of PCE video-based simulations and game test situations on ability level within a professional football academy. Thus, this highlights tactical differences, between both high- and low-performers and age phases, within an academy football environment. Investigating tactical ability, through examining PCE video-based simulations and game test situations, has found significant characteristics that support greater holistic performance within an academy environment. Moreover, applying both these tactical testing procedures has combined observations on tactical ability from both the laboratory and practical based settings, thus supporting an inclusive tactical investigation with strong ecological validity.

The originality of the current PCE study focussed on comparing elite youth football players independently, whilst examining academy participants between two decision making phases. When inspecting the variances between the FDP and YDP, it was found that there is a reverse effect with age. It may be suggested this is a result of the increased difficulty of the ‘at’ phase clips compared to the ‘post’ phase clips. Whilst observing the results of the game test situations, it is evident that there is strong association between tactical ability and performance outcomes within both the FDP and YDP.

Together, these results highlight the importance of superior tactical ability within an academy setting throughout the development process, therefore it is recommended suitable strategies should be incorporated as part of a multidisciplinary training programme. Furthermore, previous research has revealed the importance of deliberate play and early diversification to support greater PCE and creativity development. Thus, the CDF appears to deliver a suitable coaching methodology for an applied environment to support this projected notion (Santos *et al.,* 2016). However, future research should consider investigating key structures of the CDF, including practice pathway, physical literacy, nonlinear pedagogy, and creative thinking, to confirm its valid application. Furthermore, PCE investigations should focus towards in-situ designs to support on-field performance. Also, further research should incorporate a multidisciplinary approach to support tactical research and development from a holistic perspective.

10. A FULLY-INTEGRATED MULTIDISCIPLINARY INVESTIGATION

10.1. Introduction

A multi-dimensional approach, which illustrates the effectiveness of a combination of common factors, supports the overall development of expertise within elite youth football (Forsman, 2016; Forsman *et al.,* 2016c; Gullich, 2014). Accordingly, this chapter builds on the talent identification outcomes that have been previously identified, by shifting the focus towards the features of development through considering these factors together (Forsman *et al.,* 2016b; Zuber *et al.,* 2016; Huijgen *et al.,* 2014). These influential developmental features include participation history (Ford *et al*., 2009; Cote *et al*., 2007; Ericsson *et al.*, 1993), psychological attributes (MacNamara & Collins, 2013), social circumstances (Bourke, 2003), physical performance (Gouvea *et al.,* 2017; Emmonds *et al.,* 2016; Deprez *et al.,* 2015b; Gil *et al.,* 2014b; 2007b; Gonaus & Muller, 2012; Le Gal *et al.,* 2010; Mirkov *et al.,* 2010), growth and maturation status (Malina *et al.,* 2007b; 2005; 2004; 2000; Malina, 2010; Figueiredo *et al.,* 2010a; 2010b; Le Gall *et al.*, 2010; 2008; Nevill *et al.,* 2009; Vaeyens *et al.*, 2008), the RAE (Gonzalez-Villora *et al.,* 2015; Massa *et al.,* 2014; Helson *et al.*, 2005), technical capacity (Vaeyens *et al.,* 2006), skill behaviour outcomes (Liu *et al.*, 2016; Rampinini *et al.*, 2009), PCE (Williams *et al.,* 2012; Ward & Williams, 2003), and tactical ability (Memmert, 2010a).

Although these characteristics have been previously recognised as important factors to facilitate the acquisition of expert performance, to ultimately achieve senior professional status, the majority of the studies available have only focussed on these aspects independently (Carvalho *et al.,* 2018), thus resulting in limited multidisciplinary and interdisciplinary research. However, it appears both practitioners and researchers have directed their recent attention towards a holistic viewpoint to support greater understanding of individual player development (Williams & Drust, 2012).

Within a modern academy setting, these essential characteristics are often termed environmental, psychological, sociological, physiological, technical, and tactical attributes (Sarmento *et al.,* 2018; Forsman *et al.,* 2016c; Reilly *et al.,* 2000b). However, research regularly overlooks the importance of combining such factors to integrate a more rounded approach, whilst examination regarding this particular topic in England appears to be scarce. Consequently, this chapter combined these features, by measuring and assessing players over two football seasons, to determine what outcomes support greater progression within an English professional football academy, through identifying what characteristics explained the percentage of the variance regarding development. Furthermore, in order to consider age-specific developmental requirements (Vaeyens *et al.,* 2006), these findings will be explained in terms of both the FDP and YDP.

10.2. Rationale

10.2.1. Multidisciplinary talent development research in elite youth football

The ultimate purpose of a player development pathway is to realise the most effective methods to support young players to maximise their potential (Coutinho *et al.,* 2016; Robinson, 2016; Bergeron *et al.,* 2015; Davids *et al.,* 2013; Elissa *et al.,* 2010; Vaeyens *et al.,* 2009; Houlihan & Green, 2008; Martindale *et al.,* 2005; Abbott *et al.,* 2002). MacNamara & Collins (2011) suggest many approaches to talent development have become flawed by an ‘ill-conceived conception’, such as a generalisation concerning the ability to perform as an ‘elite’ player within a chronological age group. Consequently, little consideration may be given towards the factors that contribute to the eventual achievement of elite status as a senior professional (MacNamara & Collins, 2011). Since the objective of talent development should be to identify and then develop young players towards the future performance capacity of professional athletes, attention should logically turn to those attributes required to manage the route of development (Abbott & Collins, 2004). Therefore, this rationalised thinking differentiates the focus on an individual's capacity to learn and develop, from that of concentrating on what the coach already knows and how the player is performing at a particular time during their development (MacNamara & Collins, 2011). Consequently, whilst identifying factors that discriminate performance outcomes within the FDP and YDP is important to support the recruitment process and talent detection methods, it is also essential to highlight what characteristics facilitate greater development.

Over the recent years, there has been an increase in contemporary research in sport science that has investigated the application and effectiveness of holistic talent development environments, within sports such as Australian Rules football (Woods *et al.,* 2016b), basketball (Carvalho *et al.,* 2018), cricket (Phillips *et al.,* 2014), golf (Henriksen *et al.,* 2014), field hockey (Elferink-Gemser *et al.,* 2007; 2004), rugby league (Till *et al.,* 2016), sailing (Henriksen *et al.,* 2010a), and track and field (Henriksen *et al.,* 2010b). For example, Woods *et al.* (2016b) applied a multi-dimensional assessment approach to developing young talented athletes in Australian Rules football, where talent identified players significantly outperformed their non-talent identified peers through physical, technical, and PCE performance outcomes. Consequently, Woods and colleagues state how a multi-dimensional test battery supports both future research methods and practitioners whilst observing development within elite youth sport.

From a footballing viewpoint, a large proportion of studies have examined indicators of talent at an early stage by using different test batteries in isolation (Matin & Saether, 2017). Furthermore, initial 'multi-dimensional' talent development research in football has often disregarded eventual significant factors (Bailey & Collins, 2015; Meylan *et al.,* 2010; Figueiredo *et al.,* 2009a; Vaeyens *et al.,* 2006; Reilly *et al.,* 2000b). For instance, Reilly *et al.*'s (2000b) multidisciplinary approach to talent development in elite youth football illustrated the influence of physiological, psychological, technical, and tactical abilities. Whilst this original research created a holistic method to talent development, it fails to address contemporary questions. For example, it overlooked environmental factors that identify the engagement in specific activities, the importance of their personal socio-economic status, and the benefit of observing competitive situations, which arguably illustrate a greater representation of performance outcomes.

Alongside dismissing the factors rationalised above, Vaeyens *et al.*'s (2006) multidisciplinary selection model for youth football, which only gathered physiological and technical data, also ignored the value of testing psychological characteristics, which have been highlighted as crucial factors in achieving professional status (Cook *et al.*, 2014; Morley *et al.*, 2014; Mills *et al.*, 2012; Holt & Dunn, 2004). In addition, Meylan *et al.* (2010) argue a continuing focus on physical performance characteristics (i.e., speed, agility, and power) and anthropometrical measures (i.e., height, mass, and PHV status) alone can be misleading. Thus, these influential characteristics should be applied to a 'fully-integrated' research methodology to support a multidisciplinary developmental viewpoint. Similarly, although Figueiredo *et al.* (2009a) incorporated psychological qualities into their study alongside physical and technical capacities focussing characteristics of football players who drop out, persist, or move up, they too overlooked the potential barriers or support other influential developmental features may provide. Thus, while they illustrated functional capacity and skill behaviours that differentiated their specific groups, if other significant factors were added to their statistical model, their findings may have differed.

Corresponding with this holistic research method, during their short review of contemporary perspectives on talent identification and development, Williams & Drust (2012) highlight how future research needs to embrace a multidisciplinary approach to interpret any performance measures that may be employed for player evaluation, selection, and progression. Thus, research has established the usefulness of investigating a 'fully-integrated multidisciplinary' approach concerning talent identification and development in elite youth football (Sarmento *et al.,* 2018; Forsman, 2016; O'Connor *et al.,* 2016; Zuber *et al.,* 2016; Huijgen *et al.,* 2014; Ljac *et al.,* 2012). For example, Huijgen *et al.* (2014) used a multi-dimensional method to assess the performance characteristics in selected and deselected talented football players. They applied a battery of objective field tests and questionnaires within the four domains of physiological, technical, tactical, and psychological characteristics to players aged 16 to 18 years. Their multivariate analyses of covariance revealed selected players outperformed their deselected counterparts on repeated shuttle sprint, repeated shuttle dribble, and tactical 'positioning and deciding'. Furthermore, their discriminant function analysis demonstrated that the combination of the technical skill of dribbling, tactical characteristic of positioning and deciding, and the physiological characteristic of sprinting, classified 69% of talented players correctly.

Furthermore, Forsman *et al.* (2016c) observed the development of technical, tactical, physiological, and psychological capacities in 288 young football players aged 12 to 14 years across 16 clubs in Finland. Consequently, Forsman *et al.* (2016c) highlight the multi-dimensional nature of the talent development process in elite you football, through illustrating perceived competence, tactical skills, motivation, technical skills, and speed and agility performance remained relatively high and stable across the one year period. Forsman *et al.* (2016b) furthered their talent development literature amongst Finnish youth football players through examining technical, tactical, physiological, and psychological factors at aged 15 years that eventually contributed to successful football performance at aged 19 years. Accordingly, Forsman *et al.*'s (2016b) binary logistic regression analysis revealed that performance at aged 19 years was clearly associated with technical and tactical skills of passing and centering respectively, alongside agility performance and motivation levels, recorded at aged 15 years. Consequently, these findings extend current knowledge concerning the multi-dimensional nature of the talent development process and career progression in youth football, whilst also supporting the notion of an 'interdisciplinary approach', through combining discipline-specific factors to support the overall outcome of talent development (Buekers *et al.*, 2017; Jones, 2009; Szostak, 2007; Youngblood, 2007).

Zuber *et al.* (2016) observed holistic patterns as an instrument for predicting the performance of promising young football players over a three year period. They analysed psychological, physiological, and technical abilities in 119 players from aged 12 years at the starting point to aged 15 years when the level of performance reached by the players was determined. Their results revealed the highly skilled players scored above average on all factors and were significantly more likely to advance to the highest level of performance. Thus, indicating the importance of a holistic approach for predicting performance in promising young football players, alongside offering suggestions surrounding the characteristics coaches should devote time towards developing.

Interestingly, although the reviewed research so far has applied a multidisciplinary approach, it continues to fail to apply a fully-integrated model as a result of ignoring certain influential characteristics, such as socio-economic status, skill behaviours during competitive match-play, and practice history profiles. For example, Carvalho *et al.* (2018) state how researchers rarely adopt their intended multidisciplinary approach and instead consider a 'uni-disciplinary' method which can be flawed. Consequently, this chapter aims to provide an insight into the contributing factors to talent development in elite youth football from a holistic perspective.

In their review of talent identification and development in youth football, Fernandez-Rio & Mendez-Gimenez (2014) analysed all published data between 1985 and 2012, in order to gain a greater understanding of the multidisciplinary process. They revealed that influential factors in talent identification and development research in youth football are commonly recognised as physiological, psychological, technical, tactical, sociological, and environmental disciplines, which are often interconnected. Furthermore, Fernandez-Rio & Mendez-Gimenez (2014) also highlight the importance of PCE, tactical skills, and practice history as part of this developmental process. However, they also illustrate no current research to date has incorporated such methods within one particular study.

Raya-Castellano & Uriondo (2015) also conducted a review of the multidisciplinary approach regarding the development of elite youth players at professional football academies. Concurring with Fernandez-Rio & Mendez-Gimenez's (2014) analysis, Raya- Raya-Castellano & Uriondo (2015) illustrate the lack of notational analysis used to observe match analysis statistics as part of a multidisciplinary talent development research methodology. More recently, Sarmento *et al.*'s (2018) systematic review highlighted that, while technical and tactical skills combined with physiological characteristics are increasingly established, research regarding psychological, sociological, and environmental aspects in talent identification and development in football is lacking. As a result, Sarmento *et al.* (2018) concluded by stating that these limitations support future research, including appropriate elite performers from a longitudinal and multidimensional perspective.

10.2.2. Player profiling

Coaches within elite environments have the responsibility of developing talented children, thus play an important role in their lives and personal development (Strachan *et al.,* 2011). Consequently, coaches are responsible for significant aspects of programme planning and delivery in their holistic development (Strachan *et al.,* 2011). As a result, the use of player profiling is widely used within elite youth football to monitor the progress and development of individual strengths and weaknesses (Morley *et al.,* 2014). Traditional talent development programmes for children in elite environments have frequently applied independent subjective or isolated assessment regarding player development (Burgess & Naughton, 2010).

Accordingly, it is now accepted that a holistic approach concerning coaches decision making and judgement on player development is encouraged (Meylan *et al.,* 2010). Thus, from a modern viewpoint, talent development programmes now apply a profiling method as part of a multidisciplinary approach through combining subjective and objective measures (MacNamara & Collins, 2015; Philips *et al.*, 2010).

Player profiling is an effective coaching technique to allow players to understand current performance variables from a holistic perspective, which consequently allows the coach and player to set individual learning objectives to support their goal orientation (Philips *et al.,* 2010). Goal-setting is a powerful process for thinking about future development, which in turn motivates the athlete to improve and commit to developmental topics (Abbott *et al.,* 2005). These task-oriented targets, which are provided by expert coaches through player profiling reports, allow players to understand their individual needs within a team environment. For example, Van Yperen & Duda (1999) found the assessment of the coaches' appraisal had a positive effect on young elite football player's goal orientation, beliefs about success, and performance improvement. Additionally, an increase in skill performance over the season (as appraised by the coach) corresponded to greater task orientation and the beliefs that success in football is generated from hard work (Van Yperen & Duda, 1999). As a result, player profiling, through a coach's professional subjective assessment supported by objective measures, facilitates a useful and effective tool to support and monitor individual player development.

10.3. Aims and hypothesis

The purpose of this chapter is to examine what multidisciplinary factors support superior development across two seasons within a professional football academy, at both the FDP and YDP. The characteristics that have been applied to this hypothesis have been generated from the multidisciplinary findings from the previous chapters that have been presented;

environmental (Chapter 4), psychological (Chapter 5), sociological (Chapter 6), physiological (Chapter 7), technical (Chapter 8), and tactical (Chapter 9). Additionally, it was difficult to ascertain the differences between the findings in the previously summarised studies because these were not synthesised effectively. However, as a result of their similarities to this chapter's methodology, alongside its recent publication when matched with comparable studies, the hypothesis is formulated through Forsman *et al.*'s (2016b) findings, who reveal how certain superior psychological, physiological, technical, and tactical characteristics influence greater development in elite youth football. Furthermore, as a result of current multidisciplinary research in elite youth football overlooking the impact of environmental and sociological factors surrounding talent development within a professional football academy, this hypothesis is also formulated through Ford *et al.*'s (2009) early engagement theory (environmental), and Bourke's (2003) findings where young football players in Ireland are targeted from the working class families (sociological), respectively.

The specific aims of this chapter are:

1. To assess whether superior development is associated with an earlier started academy age, alongside greater current and change of total match-play hours, total coach-led hours, total sports played, and total multi-sports hours, in both the FDP and YDP.
    a) It is hypothesised superior development is associated with a younger started academy age, a greater current and change of total match-play hours, total coach-led hours, total sports played, and total multi-sports hours, in both the FDP and YDP.
2. To assess whether greater development is associated with superior current and change scores of psychological skills from the PCDEQ, including support for long-term success (Factor 1), imagery use during practice and competition (Factor 2), coping with

performance and developmental pressures (Factor 3), and evaluating performances and working on weaknesses (Factor 4), in both the FDP and YDP.

b) It is hypothesised superior development is associated with greater current and change support for long-term success (Factor 1) and coping with performance and developmental pressures (Factor 3), in both the FDP and YDP.

c) It is hypothesised greater development is not associated with current or change imagery use during practice and competition (Factor 2) and ability to organise and engage in quality practice (Factor 4), in both the FDP and YDP.

3. To assess whether greater development is associated with a lower home credit rating and social classification, in both the FDP and YDP.

d) It is hypothesised superior development is associated with a lower home credit rating and social classification, in both the FDP and YDP.

4. To assess whether greater development is associated with higher current and change percentage of predicted adult height attained and advanced PHV status, in both the FDP and YDP. Furthermore, to assess whether greater development is associated with quicker current and change 0–30 m, 10–30 m, 0–10 m, and L-agility test timings, alongside superior current and change CMJ, in both the FDP and YDP.

e) It is hypothesised superior development is associated with both a higher current and change percentage of predicted adult height attained and advanced PHV status, in both the FDP and YDP. Furthermore, it is hypothesised superior development is associated with both a quicker current and change 0–30 m, 10–30 m, 0–10 m, and L-agility test timings, alongside a greater current and change CMJ, in both the FDP and YDP.

5. To assess whether greater development is associated with superior current and change ball juggling, slalom dribble, shooting accuracy, and lob pass abilities, in both the FDP and YDP. Furthermore, to assess whether greater development is associated with superior current and change reliability in possession, pass completion, average tackles completed, average dribble completion, average total touches, and average goals scored, in both the FDP and YDP.
    f) It is hypothesised greater development is associated with both superior current and change ball juggling, slalom dribble, shooting accuracy, and lob pass abilities, in both the FDP and YDP. Furthermore, it is hypothesised greater development is associated with both superior current and change reliability in possession, pass completion, average dribble completion, and average total touches, in both the FDP and YDP.
    g) It is hypothesised greater development is not associated with current or change average tackles completed and average goals scored, in both the FDP and YDP.
6. To assess whether greater development is associated with superior current and change PCE 'at' and 'post' ability, in both the FDP and YDP. Furthermore, to assess whether superior development is associated with greater current and change taking advantage of openings originality and quality, alongside offering and orienting originality and quality, in both the FDP and YDP.
    h) It is hypothesised greater development is associated with superior current and change PCE 'at' and 'post' ability, in both the FDP and YDP. Furthermore, it is hypothesised greater development is associated with superior current and change taking advantage of openings originality and

quality, alongside better offering and orienting originality and quality, in both the FDP and YDP.

7. To assess what current and change interdisciplinary factors are associated with greater development, in both the FDP and YDP.
    i) It is hypothesised greater development is associated with superior current and change characteristics within environmental, psychological, physiological, technical, and tactical disciplines, in both the FDP and YDP. In addition, as a result of its methodology, only current sociological factors are hypothesised to be associated with superior development, in both the FDP and YDP.

10.4. Methods

10.4.1. Participants

This longitudinal chapter assessed ECFC Academy under-9 to under-16 age groups over two footballing seasons. A total of 98 participants provided the multidisciplinary data during the baseline season that has been analysed in the previous chapters. However, as a result of players leaving or being released from ECFC Academy, alongside new members of each age group unable to provide baseline data, participant numbers decreased to 87. Players were analysed within their respective age phase; FDP (n=36) and YDP (n=51). The FDP participants in this chapter are the players who were measured at under-9, 10, and 11 at baseline, thus subsequently measured at under-10, 11, and 12 the following season. Similarly, the YDP participants in this chapter were analysed at under-12, 13, 14, 15, and 16 during the initial season, thus analysed the following season at under-13, 14, 15, 16, and 17 accordingly. As with Chapter 3 (section 3.2), written consent and assent was obtained as previously described, and only outfield players were used.

10.4.2. Talent development measures

The 34 measures applied to this multidisciplinary investigation are both the significant (*p*<0.050) and near-significant (*p*<0.150) factors that discriminated high- and low-performers, in both the FDP and YDP, in the initial findings during Chapter 4 to 9 (Table 10.1.). Furthermore, with the exception of started academy age, home financial risk, and home social classification as a result of their methodology, these factors are examined at both current ability (from the second season) and delta change score over two football seasons, to identify whether current performance indicators or increased results support overall development respectively.

Table 10.1. Talent development measures that are applied to the statistical analyses

Environmental	**Psychological**
Started academy age Total match-play hours Total coach-led hours Total sports played Total multi-sports hours	PCDEQ Factor 1 PCDEQ Factor 2 PCDEQ Factor 3 PCDEQ Factor 4
Sociological	**Physiological**
Home financial risk Home social classification	Percentage of predicted adult height attained PHV status 0–30 m sprint 10–30 m sprint 0–10 m sprint CMJ L-agility test
Technical	**Tactical**
Ball juggling Slalom dribble Shooting accuracy Lob pass Reliability in possession Pass completion Average tackles Average dribble completion Average touches Average goals scored	PCE ‘at’ PCE ‘post’ Taking advantage of openings originality Taking advantage of openings quality Offering and orienting originality Offering and orienting quality

10.4.3. Player development profiling tool – 43 Progression Steps

Player profiling is a widely acknowledged process that is utilised within a professional academy environment (Morley *et al.,* 2014). ECFC Academy applies a unique progress assessment to highlight each individual's development. This tool, named the 43 Progression Steps (Figure 10.1.), applies a holistic approach when delivering observation and feedback through player profiling during their player review process. This includes ECFC Academy's pre-existing philosophy of developing core skills within mental, physical, technical, and tactical variables. These four components grade specific characteristics that are considered necessary for development and progress towards senior professional status within ECFC Academy.

The scoring system for the player profiling reports has a continual and progressive pattern rather than identical Likert scales. For example, the under-9's rating scale ranges from 1 (below average) to 4 (excellent) while the under-16's ranges from 26 (significantly below the required standard) to 33 (pushing towards the under-18's). Throughout the development process, these specific grades are not prescribed within specific age groups, with players able to move through the tool seamlessly if they are developing or playing in certain areas above or below their chronological age.

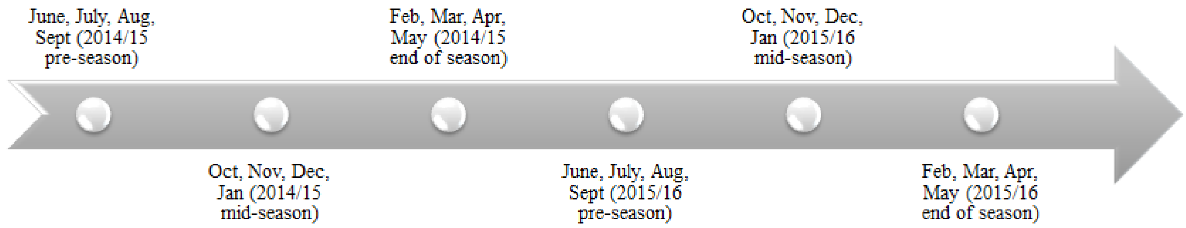
The player profiling reports are initially completed by the players who give their perception of themselves, and then the coach subsequently provides their ratings alongside specific individual learning objectives. These reports were completed three times (pre-season, mid-season, and end of season), with each coach having completed every participants profiling reports throughout the 2014/15 and 2015/16 seasons with the under-9 to under-16's (Appendix 8) for this chapter. The scores for all the components measured within each individual's 43 Progression Step rating, to provide an understanding of a player's current ability from a multidisciplinary perspective, were recorded. Furthermore, they are also measured to illustrate progress over certain time points. Consequently, for the purpose of this study, only the 2014/15 pre-season and 2015/16 end of season reports were used to identify progress of two football seasons. Thus, through comparing the differences between the overall scores from the two reports will illustrate each player's total development over two years.

Under-9's		
Below average	1	
Average	2	**Under-10's**
Good	3	Poor
Excellent	4	Below average
Under-11's	5	Average
Very poor	6	Good
Poor	7	Very Good
Average	8	Excellent
Above average	9	**Under-12's**
Good	10	Very poor
Very good	11	Poor
Excellent	12	Average
Under-13's	13	Above average
Very poor	14	Good
Poor	15	Very good
Average	16	Excellent
Above average	17	**Under-14's**
Good	18	Significantly below the required standard
Very good	19	Below the required standard
Excellent	20	Borderline
Under-15's	21	Just at the required standard
Significantly below the required standard	22	Above the required standard
Below the required standard	23	Pushing towards the Under-16's
Borderline	24	On track for a Scholarship
Just at the required standard	25	**Under-16's**
Above the required standard	26	Significantly below the required standard
Well above the required standard	27	Below the required standard
On track for a Scholarship	28	Borderline
Pushing towards the Under-16's	29	Just at the required standard
Under-17's		
Significantly below the required standard	30	Above the required standard
Below the required standard	31	Well above the required standard
Borderline	32	On track for a Scholarship
Just at the required standard	33	Pushing towards the Under-18's
		Under-18's
Above the required standard	34	Below the required standard
Well above the required standard	35	Borderline
On track for a Professional Contract	36	Just at the required standard
Pushing towards the Under-21's	37	Above the required standard
Under-21's		
Developing young professional	38	Ready for the Under121's
Under-21's squad regular	39	Under-21's squad regular
Ready to go on loan	40	To be offered a professional Contract
Pushing towards ECFC First Team	41	Pushing towards ECFC First Team
ECFC First Team squad regular	42	
ECFC First Team regular starter	43	

Figure 10.1. ECFC Academy's player development profiling tool – 43 Progression Steps

10.4.4. Procedures

Each under-9 to under-16 participant completed the talent development measures throughout two football seasons. As a result of data collection taking part during various times across the two seasons, a timeline has been created to highlight when each testing procedure was complete (Figure 10.2.).



• Pre-season player reviews • Anthropometric measures • Physical tests • PCDEQ • PHQ	• Mid-season player reviews • Anthropometric measures • Physical tests • Postcode data collection • PCE tests	• End of season player reviews (2014/15 season) • Match analysis stats from 2014/15 season • Anthropometric measures • Physical tests • Skill tests • Tactical tests	• Pre-season player reviews • Anthropometric measures • Physical tests • PCDEQ • PHQ	• Mid-season player reviews • Anthropometric measures • Physical tests • Postcode data collection • PCE tests	• End of season player reviews (2015/16 season) • Match analysis stats from 2015/16 season • Anthropometric measures • Physical tests • Skill tests • Tactical tests

Figure 10.2. Timeline of the data collection across two seasons

Since physical testing and anthropometric measures were completed three and seven times a season respectively, only the mid-season data collection for these factors was considered for further analysis. Furthermore, as already stated, to gather a complete impression of development over two football seasons, the pre-season 2014/15 and end of season 2015/16 player reviews were applied to demonstrate player development. These reviews apply the 43 Progression Step score that each player received from their coaches during that respective review, thus development is illustrated in this study as the delta change score from review 1 (pre-season 2014/15) to review 2 (end of season 2015/16). Consequently, a greater total change score between the two seasons explained superior development. Two coaches, who were deemed suitable assessors (UEFA Pro, 'A', or 'B' Licenced alongside either the FA Advanced Youth Award or the FA Youth Award) provided the 43 Progression Step score for each player within each age group. Furthermore, where appropriate, both current and change scores of each talent development measure was analysed to understand whether existing ability or progress supported a greater 43 Progression Step score. For the purpose of this research, players were analysed within their respective age phase (FDP (n=36) and YDP (n=51)) to facilitate the understanding of age-specific development.

10.4.5. Statistical analyses

To determine whether there were any significant relationships between 42 Progression Step progress scores and talent development measures at each age phase (FDP and YDP), Pearson's product correlation analyses were conducted. When a significant or near significant relationship was found (p<0.150), they were recorded for further analyses. Subsequently, stepwise regression analyses were conducted to assess the predictive capability of these recorded variables on 42 Progression Step progress scores. Data were checked for normality and collinearity using standard plots and variance inflation factor values. A dummy variable was created within each regression analyses at both age phases, through being referenced as absolute age, to negate the effect of age-specific development. All statistical tests were performed on both absolute and change scores. Data are presented as mean ± SD unless otherwise indicated, with an alpha level set at p<0.050. All analyses were conducted using IBM SPSS Version 24 (IBM Corp, 2016).

10.5. Results

Following the statistical analyses, characteristics that were significantly associated with the 43 Progression Step rating change scores over two seasons are illustrated in the regression models below (Table 10.2. to 10.9.). These factors were initially analysed from a fully-integrated multidisciplinary perspective, through being observed within each discipline-specific performance indicator (environmental, psychological, sociological, physiological, technical, and tactical) in both the FDP and YDP (Table 10.2. to 10.7.). As a result, this provided significant features that were consequently analysed in an interdisciplinary regression model within both age phases (Table 10.8. and 10.9.). Following non-significant relationships with the 43 Progression Step Rating change scores, there are no environmental, psychological, sociological, or physiological regression models for the FDP, and no psychological or sociological regression models for the YDP presented. As a result of their non-significance from a multidisciplinary perspective, these factors were subsequently also excluded from their respective phase-specific interdisciplinary regression model.

Whilst observing the environmental factors within the YDP (Table 10.2.), total match-play hours was positively associated with the 43 Progression Step rating change, explaining 13.6% of the variance (r^2=0.136, p=0.002). Furthermore, total sports played change over the two seasons was also positively associated with the 43 Progression Step rating change, thus when added to the model it explained a further 12.5% of the variance (r^2=0.261, p=0.007).

Table 10.2. YDP environmental regression model

Variable	***Standardised β***	***r^2 value***	***p value***
Total match-play hours	0.411	0.136	0.002
Total sports played change	0.355	0.261	0.007

Whilst observing the physiological factors within the YDP (Table 10.3.), only 0–10 m sprint change over the two seasons was negatively associated with the 43 Progression Step rating change, explaining 9.2% of the variance (r^2=0.092, p=0.031).

Table 10.3. YDP physiological regression model

Variable	***Standardised β***	***r^2 value***	***p value***
0–10 m sprint change	-0.303	0.092	0.031

Whilst observing the technical factors within the FDP (Table 10.4.), average total touches per game change over the two seasons was positively associated with the 43 Progression Step rating change, explaining 7.4% of the variance (r^2=0.074, p=0.003). Furthermore, lob pass ability was also positively associated with the 43 Progression Step rating change, thus when added to the model it explained a further 2% of the variance (r^2=0.094, p=0.011).

Table 10.4. FDP technical regression model

Variable	***Standardised β***	***r^2 value***	***p value***
Total touches change	0.274	0.074	0.003
Lob pass	0.210	0.094	0.011

Whilst observing the technical factors within the YDP (Table 10.5.), lob pass ability was positively associated with the 43 Progression Step rating change, explaining 11.7% of the variance (r^2=0.117, p=0.020). Furthermore, average pass completion percentage change over the two seasons was also positively associated with the 43 Progression Step rating change, thus when added to the model it explained a further 8.3% of the variance (r^2=0.200, p=0.031). In addition, reliability in possession percentage change over the two seasons was positively associated with the 43 Progression Step rating change, thus when added to the model it explained a further 8.2% of the variance (r^2=0.282, p=0.024).

Table 10.5. YDP technical regression model

Variable	***Standardised β***	***r^2 value***	***p value***
Lob pass	0.312	0.117	0.020
Pass completion change	0.289	0.200	0.031
Reliability in possession change	0.388	0.282	0.024

Whilst observing the tactical factors within the FDP (Table 10.6.), taking advantage of openings quality was positively associated with the 43 Progression Step rating change, explaining 4.5% of the variance (r^2=0.045, p=0.002). Furthermore, PCE 'post' change over the two seasons was positively associated with the 43 Progression Step rating change, thus when added to the model it explained a further 1.9% of the variance (r^2=0.064, p=0.030).

Table 10.6. FDP tactical regression model

Variable	***Standardised β***	***r^2 value***	***p value***
Taking advantage of openings quality	0.220	0.045	0.002
PCE 'post' change	0.142	0.064	0.030

Whilst observing the tactical factors within the YDP (Table 10.7.), only PCE 'at' was positively associated with the 43 Progression Step rating change, explaining 15.4% of the variance (r^2=0.154, p=0.004).

Table 10.7. YDP tactical regression model

Variable	***Standardised β***	***r^2 value***	***p value***
PCE 'at'	0.393	0.154	0.004

Following the identification of these significant performance indicators from the environmental, physiological, technical, and tactical findings that were associated with the 43 Progression Step rating change, these factors were subsequently examined within an interdisciplinary regression model for both age phases to apply a holistic perspective.

Whilst observing the interdisciplinary factors within the FDP (Table 10.8.), average total touches per game change over the two seasons was positively associated with the 43 Progression Step rating change, explaining 7.4% of the variance (r^2=0.074, p=0.023). Furthermore, taking advantage of openings quality was also positively associated with the 43

Progression Step rating change, thus when added to the model it explained a further 2.3% of the variance (r^2=0.097, p=0.003). In addition, PCE 'post' change over the two seasons was positively associated with the 43 Progression Step rating change, thus when added to the model it explained a further 1.8% of the variance (r^2=0.115, p=0.029).

Table 10.8. FDP interdisciplinary regression model

Variable	***Standardised β***	***r^2 value***	***p value***
Total touches change	0.191	0.074	0.023
Taking advantage of openings quality	0.204	0.097	0.003
PCE 'post' change	0.134	0.115	0.029

For the interdisciplinary factors within the YDP (Table 10.9.), PCE 'at' was positively associated with the 43 Progression Step rating change, explaining 15.4% of the variance (r^2=0.154, p=0.021). Furthermore, total sports played change over the two seasons was also positively associated with the 43 Progression Step rating change, thus when added to the model it explained a further 8.3% of the variance (r^2=0.237, p=0.008). In addition, total match-play hours was positively associated with the 43 Progression Step rating change, thus when added to the model it explained a further 10.4% of the variance (r^2=0.341, p=0.009).

Table 10.9. YDP interdisciplinary regression model

Variable	***Standardised β***	***r^2 value***	***p value***
PCE 'at'	0.293	0.154	0.021
Total sports played change	0.332	0.237	0.008
Total match-play hours	0.336	0.341	0.009

10.6. Discussion

10.6.1. Fully-integrated multidisciplinary approach

The main findings of this fully-integrated multidisciplinary research firstly illustrate what characteristics facilitate greater development within their specific discipline. From an environmental perspective, while there were no significant associations between participation histories and development within the FDP, total match-play hours and total sports played change were significantly associated with superior development when compared with the 43 Progression Step rating change, from the start of the 2014/15 season to the end of the 2015/16 season within the YDP. Similarly, whilst there were no significant associations between physiological features and development within the FDP, 0–10 m sprint change was significantly associated with superior development within the YDP.

Interestingly, psychological qualities, measured through the PCDEQ, did not distinguish any association with development within both the FDP and YDP. Likewise, sociological factors concerning individual sociodemographic status did not significantly discriminate any association with development across both age phases. From a technical viewpoint, total touches change and lob pass ability were significantly associated with development within the FDP. Within the YDP, lob pass ability was again significantly associated with development, alongside pass completion change and reliability in possession change. Both the FDP and YDP also had tactical factors that were significantly associated with superior development, including taking advantage of openings quality and PCE 'post' change within the FDP, and PCE 'at' within the YDP.

10.6.2. Fully-integrated interdisciplinary investigation

Following the fully-integrated multidisciplinary investigation, these significant characteristics were then analysed from an interdisciplinary stance. Within the FDP, total touches change, taking advantage of openings quality, and PCE 'post' change were all significant contributors to holistic development when compared to the 43 Progression Step ratings, explaining a total of 11.5% of the variance. Within the YDP, PCE 'at', total sports played change, and total match-play hours were all significantly associated with the same development profiling tool, explaining a total of 34.1% of the variance.

The term ‘interdisciplinary approach’ has been applied to this section of analyses, as a consequence of the research from each discipline combining and working in conjunction to develop and apply a shared conceptual framework, that integrates discipline-specific concepts and methodologies to address a common research focus (Buekers *et al.,* 2017; Jones, 2009; Szostak, 2007; Youngblood, 2007). Conversely, the former fully-integrated ‘multidisciplinary approach’ is regarded as a process whereby research from different disciplines focus on their field independently from a discipline-specific perspective, to address a common topic (Buekers *et al.,* 2017; Jones, 2009; Szostak, 2007; Youngblood, 2007). Consequently, the initial statistical analyses in this chapter focused on a discipline-specific fully-integrated multidisciplinary approach, through combining factors from various disciplines to support the overall understanding of the influences on talent development in a professional football academy. Following this investigation, these significant factors were combined and collaborated from an interdisciplinary viewpoint, to focus attention on what characteristics assisted greater development in both the FDP and YDP, to support a developmental framework shared by all within an academy environment.

10.7. Limitations

Firstly, one important limitation to highlight is how initially low-performers from a talent identification perspective within each age group may have been able to demonstrate just as much development as high-performers, as a result of having two seasons worth equalling the same total from the start of the 2014/15 season to the end of the 2015/16 season. However, although these low-performers have made significant development during this period of time, they may still be struggling or behind their high-performing peers. Nonetheless, it is important to emphasise that the 43 Progression Steps profiling tool is used as a current performance indicator, with the difference in scores from season to season representing a true reflection of individual progress and development from a professional coaches subjective viewpoint.

It is also worthy to highlight the length of this ‘longitudinal’ research, that has been limited to only two seasons. As a result of the overall development taking place throughout the whole of childhood, adolescence, and into adulthood, a true representation of significant factors concerning specific multidisciplinary and interdisciplinary methods would take over 10 years to collect. Therefore, although these results provide a ‘snapshot’ of developmental factors within a particular English football academy over a two year period, continuing to collect this data over the forthcoming years to facilitate the development of participants who ultimately achieve professional status is recommended. Consequently, this will illustrate particular ‘journeys’ that young players take from an environmental, psychological, sociological, physiological, technical, and tactical developmental viewpoint. However, the benefit of this research is that it has initiated this particular methodology, whilst also representing significant findings surrounding talent development within the FDP and YDP.

This current research only represents the development of individuals within this particular professional football academy. As a result of potential differences in recruitment and developmental processes that may exist between academies (Unnithan *et al.,* 2012; Williams & Reilly, 2000), influential developmental factors may also occur. Furthermore, the cultural dissimilarities between countries limit the external validity to facilitate potential knowledge transfer regarding developmental characteristics. It is also important to highlight that the reluctance of professional football clubs to share anonymised data remains a barrier in the English culture, thus delaying the potential of superior research and consequently greater contemporary applied talent identification and development strategies.

10.8. Conclusion

The term 'fully-integrated multidisciplinary approach' has been applied to the findings of this chapter, to signify the approach in the methodology to analyse a complete range of specific developmental characteristics within their respective disciplines, thus representing what factors facilitate superior development over two seasons within both the FDP and YDP. Through illustrating these significant findings, it has enabled the presentation of a unique perspective within an English football academy. Within the FDP, there was a significantly greater emphasis on the impact of technical and tactical attributes regarding superior 43 Progression Step change score across two seasons. The specific impact of total touches change and lob pass ability in the technical analysis, alongside total touches change, taking advantage of openings quality, and PCE 'post' change score in the tactical examination, were highlighted as the significant factors. Consequently, the development of technical and tactical ability is illustrated as an essential part of individual progress within an academy setting, thus the incorporation of these strategies must be integrated into a training and match-day programme to enhance overall development opportunities within the FDP.

From a YDP context, there appears to be a greater holistic viewpoint compared to the FDP, with environmental, physiological, technical, and tactical attributes all revealing significant associations with superior 43 Progression Step change score across two seasons. Total match-play hours and total sports played change were significant environmental factors, 0–10 m sprint change was a significant physiological attribute, lob pass ability, pass completion change, and reliability in possession change were significant technical abilities, while PCE 'at' score was a significant tactical characteristic. As a result of total match-play hours being an accumulation of time spent within that particular activity throughout their entire development, a generous games programme across both age phases is recommended to enhance overall development through a reproduction of senior match-play situations within a competitive learning environment.

Following this fully-integrated multidisciplinary investigation, this thesis also examined an original ‘interdisciplinary approach’ through illustrating the comparable differences from the former findings. As a result, this chapter has revealed that, through combining and analysing the holistic factors previously highlighted, there appears to be three significant factors that influence overall development within each age phase. From a FDP perspective, total touches change, taking advantage of openings quality, and PCE ‘post’ change were significantly associated with superior development. Consequently, this further supports the importance of technical and tactical development within the FDP. From a YDP standpoint, PCE ‘at’ score, total sports played change, and total match-play hours were significantly associated with greater development. As a result, this highlights the importance of understanding the environment players are exposed to, whilst also illustrating the importance of PCE as a key ingredient to support superior overall development. Therefore, professional football academies are encouraged to provide technical and tactical specific developmental activities within the FDP, alongside offering a substantial games programme and the opportunity to participate in multi-sports activities across both age phases, to support superior inclusive development.

Differences regarding age-specific development have been established from both a multidisciplinary and interdisciplinary standpoint, thus highlighting particular requirements that are necessary to be incorporated into the development pathway. Consequently, these findings benefit academies through exemplifying certain needs to facilitate the incorporation of relevant strategies to produce greater use of combined time, monetary, and human resources when working with players. Thus, although academies appear to be specialising earlier and gaining more contact time with players now than ever before (Premier League, 2013), these influential developmental factors can be integrated into coaching strategies to support greater age-specific development. Future research surrounding the fully-integrated multidisciplinary and interdisciplinary approaches that are applied to this chapter, should continue data collection over the forthcoming years to confirm or refute current findings. It is also recommended that professional football academies support each other through collaborating with data to increase participant sizes concerning these holistic approaches. As a result, an innovative and contemporary portfolio to facilitate the talent identification and development process for all academies will be illustrated, which will benefit both professional clubs and the national team alike.

11. THEORETICAL & PRACTICAL IMPLICATIONS

11.1. Introduction

Talent identification can be defined as the process of recognising current participants with the potential to become elite players (Unnithan *et al.,* 2012; Williams & Reilly, 2000). Meylan *et al.* (2010) state how a one-dimensional approach to examine talent identification in elite youth football can be misleading as a result of its narrow focus. Thus, a multidisciplinary approach addressing the environmental, psychological, sociological, physiological, technical, and tactical predictors can be studied to enhance holistic observations as expertise in football is not solely dependent on one standard set of skills (Meylan *et al.,* 2010; Bartmus *et al.,* 1987). Consequently, the aim of this thesis was to initially identify key age-specific characteristics that were associated with greater current ability at an English football academy within both the FDP and YDP. Thus, this is an important first step in initiating a complex, holistic approach.

When compared to the practice of talent identification, talent development methods are modified to provide the most appropriate learning environment to realise potential that has been previously identified (Unnithan *et al.,* 2012; Reilly *et al,* 2000b). Similarly to the talent identification process in elite youth football, contemporary talent development methods should apply a rounded approach to support the multi-dimensional nature of the pathway towards expertise (Csaki *et al.,* 2017; 2014; Forsman, 2016; Williams & Reilly, 2000). Consequently, the latter aim of this thesis was to illustrate significant age-specific factors that were associated with greater development at an English football academy, within both the FDP and YDP. Thus, this chapter will initially discuss the theoretical implications of these findings, and their implications for future research.

Frustrations from academic researchers often arise because of the perceived delayed response in the application of contemporary research into practice (Cushion *et al.,* 2012; Helsen *et al.,* 2012). One of the principal motives of this research was to support ECFC Academy in developing their current training programme and match-day strategies. As a result of this project, ECFC Academy has completed a number of modifications within their training syllabus and philosophy, which are supported by the results of this current thesis. Furthermore, because of the lack of initial talent identification models specifically developed for elite youth football, this thesis offers the Locking Wheel Nut Model (LWNM) to support football academies judgement regarding attributes that are associated to greater performance. Thus, this chapter will also provide an overview of the applied implications of this research, alongside the formation and guidelines of an applied model that was subsequently created. Moreover, recommendations for future research alongside a concise summary are also provided.

11.2. Theoretical implications

11.2.1. Environmental

The accumulation of football-specific match-play hours during each YDP participant's development, throughout both childhood and adolescence, revealed competitive matches has an impact on development. Consequently, this highlights that participating in a greater amount of competitive match-play hours supports superior development, thus professional academies should support this notion through creating and fulfilling a productive games programme in both the FDP and YDP. Whilst it may be suggested this would create more travelling commitments to locate challenging fixtures, local grassroots clubs could also participate to provide a greater match-play programme, through academy sides competing against older age groups, to keep the games challenging for both teams. However, in England, there has also been cause for concern regarding the lack of facilities, such as artificial playing surfaces, particularly to meet the demands of the detrimental British weather, which often results in games being cancelled (Premier League, 2013). Therefore, professional clubs, as part of the

EPPP auditing process, must possess certain facilities to achieve specific requirements to ensure competitive matches are playable in all types of weather (Premier League, 2013). On the contrary, the EPPP notion is non-existent outside professional academy football, thus further funding for facilities from organisations such as the FA and the Premier League is needed to meet these particular requirements, to support grassroots player development concerning competitive match-play (Cumming *et al.,* 2018; Premier League, 2013). As a result, this may also provide greater external recruitment for professional football academies, particularly for those specialising in their later development years.

Whilst engaging in a superior amount of multi-sport hours was a significant factor while analysing participation history from a talent identification perspective within the YDP, total sports played change was associated with superior development. Thus, it may be proposed that engaging in a greater amount of sports is beneficial for overall development within elite youth football (Gullich *et al.,* 2017). As a result, similarly to the recommendations constructed in Chapter 3 concerning environmental factors, it is suggested academy players engage in other sports, possibly by academies creating multi-sports programmes (Barreiro *et al.,* 2017). Furthermore, it also supports the prospect for players to remain in other sports outside the academy setting within the YDP age groups, thus not necessarily only encouraging sampling within the FDP as previously suggested in the DMSP (Cote *et al.,* 2007) and the early engagement theory (Ford *et al.,* 2009). Therefore, it is also recommended academies provide knowledge for parents regarding the usefulness of their children participating in other sports.

Interestingly, no participation activities revealed superior development within the FDP. However, the circumstance of these players only participating in academy football for two to four years means they may have not yet acquired the long-term developmental benefits of engaging in particular activities compared to YDP players. Nevertheless, the YDP participation history profiles illustrate a mixture of specialisation and diversification, through superior development associated with long-term participation in a greater amount of competitive match-play and increased engagement in total sports played change respectively.

Similarly to the summary in Chapter 4 concerning influential environmental factors surrounding talent identification, these findings do not support one particular model. Thus, it appears applied practitioners and coaches must move away from these isolated approaches, through combining methods such as diversification, specialisation, engagement, and preparation, to support greater overall development in academy football.

11.2.2. Psychological

Despite the considerable amount of research that is directed towards the benefits of PCDEs from a football development perspective (Forsman, 2016; Forsman *et al.,* 2016b; Honer & Feichtinger, 2016b; Zuber *et al.,* 2016; Mills *et al.,* 2014a; 2012; Coelho-e-Silva *et al.,* 2010; Reilly *et al.,* 2000b; Williams & Reilly, 2000), this chapter did not find any significant associations between PCDEQ Factor's 1, 2, 3, or 4 and superior development over the two seasons in both the FDP and YDP. For example, the PCDE results contrast to those of Forsman (2016), who revealed motivation was the most prevalent psychological characteristic measured that predicted the future performance level during their holistic investigation.

However, the current findings do correspond with Huijgen *et al.*'s (2014) study, who also illustrated no significant relationship between selected and deselected talented youth football players and psychological skills. However, the summary of technical, tactical, and physiological features were discriminative of the factors that distinguished their two population groups. Furthermore, Figueiredo *et al.* (2009a) also revealed how the psychological characteristics they analysed, including task and ego orientation, did not differ between drop-outs, club players, and elite players during their two year study in YDP aged players.

Whilst the cognitive function of tactical skills was highlighted as a discriminative factor chapter 10, PCDEs were not associated with superior development. It is possible that this is a result of of the limited potential for 'developing experttise' over the two season investigation in this thesis. A number of studies exploring psychological characteristics have observed the importance of these features surrounding the transition from academy football into the professional environment (Cook *et al.,* 2014; Morley *et al.,* 2014; Mills *et al.,* 2012; Holt & Dunn, 2004). For example, Cook *et al.* (2014) highlight how the four dimensions of mental toughness, including competitiveness, mind-set, resilience, and personal responsibility, were acknowledged to be crucial factors in securing a professional contract in the English Premier League.

However, this research does not show the importance of developing certain psychological skills within the younger age phases of the talent development environment. As a result, further investigation is required to highlight what PCDEs support greater long-term development and eventual senior professional status. This could be completed through following the participants within this current chapter into adulthood to illustrate what psychological factors support overall success. Furthermore, a larger sample size through collaborating with other professional academies, alongside the inclusion of other possible psychological measures, may also increase general reliability and validity.

11.2.3. Sociological

Whilst the sociological characteristics of home social classification and financial risk were significant discriminators from a talent identification perspective in Chapter 5, these current findings demonstrate how these particular factors are not associated with superior development in both the FDP and YDP. Unlike the consistent inclusion of technical, physiological, and psychological characteristics during holistic talent development research in youth football, the sociological influence of parental social classification and financial risk has often been ignored. As a result, and to the researcher's knowledge, the inclusion of these social influences within this chapter creates the first fully-integrated multidisciplinary investigation into the talent development process in a professional academy environment. Although this research provides a unique insight into the sociological impact, it is difficult to make relevant comparisons. This reasoning is reinforced by Morley *et al.*'s (2014) comments regarding both player and coach perspectives on the development context and features in an academy environment. They stated that ability demonstrated in training and match-play was perceived as most important, whereas personal, social, school, and lifestyle characteristics featured significantly less (Morley *et al.,* 2014). As a result, this highlights the ignorance and lack of knowledge of coaches regarding the impact of sociological effects on the talent development process within an academy setting. Consequently, further research is required to characterise the notion of sociological characteristics on talent development in elite youth football.

11.2.4. Physiological

From a physiological perspective, physical performance characteristics, such as sprint ability, agility, and jumping, have been found to influence development and subsequent progression towards professional status (Forsman, 2016; Forsman *et al.,* 2016a; 2016c; Huijgen *et al.,* 2014; Coelho-e-Silva *et al.,* 2010; Figueiredo *et al.,* 2009a; Gil *et al.,* 2007a; 2007b; Vaeyens *et al.,* 2006; Reilly *et al.,* 2000b). This current study adds to these findings through illustrating that a greater 0–10 m sprint change is associated with superior development in YDP players. When compared to specific physical performance indicators, these findings were dissimilar from previous studies surrounding talent development in elite youth football. For example, Forsman (2016) found 0–30 m sprint ability, agility, and endurance separated their performance groups. Furthermore, Gonaus & Muller (2012) highlighted agility as the greatest discriminating factor to predict future career progression. However, these current findings do coincide with Emmonds *et al.* (2016) talent development literature, who found a significant difference in both their under-16 and under-18 age groups when investigating what characteristics influence obtaining a professional contract in football. In addition, Deprez *et al.*'s (2015b) research regarding elite youth football players also found contracted participants had faster 0–5 m sprint ability compared to non-contract players at under-15 to 17's.

The importance of 0–10 m sprint ability in the modern game is also illustrated by Barnes *et al.* (2014), who reveal the number of sprints has increased by 35% in the English Premier League, whilst the proportion of explosive sprints has also increased, alongside sprint distance becoming shorter, over a seven season period between 2006/07 and 2012/13. As a result, 0–10 m sprint ability, that supports the capability of sprinting quickly during competitive match-play to get to the ball first, beat an opponent 1 vs. 1, and recover quickly after a turnover of possession, appears to be an important aspect of both development and performance (Barnes *et al.,* 2014; Di Salvo *et al.,* 2013; Bloomfield *et al.,* 2007; Mohr *et al.,* 2003). Furthermore, Faude *et al.* (2012) reveal straight line sprinting is the most frequent physical action used in goal situations in professional football, thus as scoring more goals than the opposition is the ultimate aim during competitive match-play, the development of this physical characteristic should not be ignored. Consequently, this further highlights the importance of 0–10 m sprint ability to increase the prospect of possessing the physical requirements for performing within a senior professional environment. Therefore, conforming with Deprez *et al.*'s (2015b) conclusion following their research surrounding a retrospective study on influential characteristics that support greater first team playing time, it is proposed the measurement of 0–10 m sprint ability is included in a batch of testing procedures of physical performance characteristics to monitor athletic development.

Growth and maturation data revealed no significant association with talent development across both age phases. Even though growth and maturation are related to physiological advantages during childhood and adolescence, it is suggested these characteristics are irrelevant at senior professional status (Philippaerts *et al.,* 2006; Malina *et al.,* 2004). As a result, professional coaches may need education on how to see past short-term maturational effects when making decisions on taklent development.

11.2.5. Technical

Technical development in elite youth football has historically been a central focus of applied coaches. For instance, Kirk & MacPhail (2002) previously stated how much of the literature regarding coach behaviour in youth football focussed on the technical development of players. However, as a result of contemporary research illustrating the holistic nature of the talent development process, professional football academies and sport science academics alike have applied technical development as part of a multidisciplinary approach (Roe & Parker, 2016; Premier League, 2013). Nevertheless, technical capabilities remain a reliable measure for supporting greater talent development within elite youth football (Vaeyens *et al.,* 2006). For example, these current findings are consistent with several previous multidisciplinary reports (Forsman, 2016; Forsman *et al.,* 2016a; 2016c; Huijgen *et al.,* 2014; Coelho-e-Silva *et al.,* 2010; Figueiredo *et al.,* 2009b; Vaeyens *et al.,* 2006; Reilly *et al.,* 2000b), that show technical ability differentiates young talented football players from their relevant controlled peers.

In this current study, superior development was significantly associated with the technical characteristics of lob pass, pass completion change, and reliability in possession change within the YDP. Opposed to the dribbling test suggested by Huijgen *et al.* (2014; 2013), these findings were consistent with Forman *et al.* (2016c), who also highlighted passing ability as a key indicator for progression. Furthermore, these findings also correspond with Liu *et al.* (2016), who found how maintaining ball possession, through passing it continuously during a game, is associated with greater success. Consequently, the ability to pass the ball precisely unopposed through the lob pass test, alongside continuously increasing one's ability to complete passes accurately and reliably throughout their development during competitive match-play, supports the overall development within a professional football academy.

The FDP findings also correspond with this notion, through illustrating how technical characteristics support superior development, as a result of its significant association with greater total touches change and lob pass ability. However, whilst observing comparable studies of players within the YDP, it is difficult to make direct comparisons with them surrounding the FDP. Nevertheless, converse to other factors, such as environmental and physiological characteristics, that only reveal significant findings within the YDP, these results highlight how technical capacity is associated with greater development in elite youth football players as young as aged 8 years within the FDP.

Similarly to the observation during Chapter 8 for the association between total touches and current performance, as a result of a greater total touches change score being significantly associated with superior development, it is suggested that coaches and talent development programme designers incorporate strategies to increase ball contact time. For example, competitive match-play could compete with reduced player numbers, which will consequently increase individual total touches (Thomas *et al.*, 2015; Fenoglio, 2004a; 2004b). Interestingly, this notion may also explain the differences in the particular significant match analysis statistics between age phases, with lower player numbers during competitive match-play in the FDP offering a superior opportunity for more touches. Moreover, the larger match formats within the YDP potentially offer a higher control of possession, thus a greater opportunity to increase an individual's reliability in possession.

It may also be suggested that superior passing ability is essentially important for the future career progression of young football players, as a result of the increasing technical demands in professional football in recent years (Barnes *et al.,* 2014). For example, Barnes *et al.* (2014) displays the growing quality required to perform in the English Premier League, evidenced through a 40% increase in successful passes from 2006-07 compared to 2012-13. Subsequently, this is replicated in this current study through the significance in change scores, rather than actual scores, for the match analysis statistics.

Clement & Martins (2017) also revealed teams who successfully progressed during the 2015-16 UEFA Champions League final stages generally achieved a greater percentage of ball possession compared to those who did not. This observation shows that teams with a superior capacity to perform longer passing sequences may involve more players with enhanced reliability in possession. Consequently, together this research supports the proposition that professional football academies should emphasise development on passing ability, both from an unopposed technique perspective and unpredictable pressurised viewpoint. Therefore, coaches and applied practitioners are encouraged to plan and deliver a range of practices within their training programmes, which engage players surrounding a passing focus to support technical development in both the FDP and YDP.

11.2.6. Tactical

Tactical skills can be referred to as the ability to recognise and execute the right action at the correct moment during competitive match-play situations (Grehaigne & Godbout, 1995). These current findings regarding tactical abilities are in agreement with other previous studies, which found these characteristics were significantly associated with superior development in both the FDP and YDP (Forsman 2016; Huijgen *et al.,* 2014; Kannekens *et al.,* 2011; 2009a; 2009b). Taking advantage of openings quality, which can be described as the ability to recognise an opportunity to play a forward pass whilst executing it effectively, was significantly associated with greater development in the FDP. Thus, these findings correspond with Kannekens *et al.* (2011), who found positioning and deciding as a key tactical skill for talent development in elite youth football. As a result of offering and orienting producing insignificant findings, these 'off-the-ball' characteristics may be considered less important than the 'on-the-ball' skill of taking advantage of openings that were noteworthy (Kannekens *et al.,* 2011). However, as opposed to positioning and deciding and taking advantage of openings, that demonstrate the importance of offensive skill, Forsman (2016) argues procedural defensive knowledge through 'acting and changing' is also a significant factor for talent development in elite youth football. Kannekens *et al.* (2009a) also suggest tactical skills are subsequent to position-specific knowledge, which was excluded from this current study's methodology, therefore future research in talent development may warrant a positional focus to observe particular tactical capabilities.

PCE ability, through anticipation and decision making skill, has been previously highlighted as an influential component of tactical proficiency (Roca *et al.,* 2013). In this current thesis, greater PCE 'post' change and PCE 'at' were significantly associated with superior development in the FDP and YDP respectively. As a result, these findings support studies that have illustrated PCE ability as an important aspect in the development process in elite youth football to achieve subsequent senior professional status (Williams *et al.,* 2012; Mann *et al.,* 2007; Ward *et al.,* 2007; Ward & Williams, 2003; Williams, 2000).

Together these findings demonstrate both tactical performance and development are associated with holistic talent development in players as young as aged 8 years. As a result, research driven and expert-led football-specific training and competitive match-play at a high standard (Serra-Olivares *et al.,* 2016; Memmert *et al.,* 2010; Kannekens *et al.,* 2009b; Memmert & Perl, 2009; Memmert & Roth, 2007; Ward *et al.,* 2007), starting at a young age (Santos *et al.,* 2016;

Memmert, 2011a; Ward & Williams, 2003), participating in football-specific play activities (Roca *et al.,* 2012; Williams *et al.,* 2012; Memmert, 2011a; Memmert *et al.,* 2010), and engaging in a high-quality talent development programme (Kannekens *et al.,* 2009b; Memmert, 2007), are proposed as key ingredients for the development of superior tactical skills. Therefore, professional coaches and practitioners must appreciate the incorporation of these tactical development features, from both a micro viewpoint, through individual session design, and a macro perspective, as a result of an academy philosophy and training programme (Davids *et al.,* 2017).

11.2.7. Interdisciplinary approach

Firstly, it is important to recognise the cultural and environmental implications of holistic talent development research in elite youth football, with countries like Australia (Larkin & O'Connor, 2017), Germany (Gullich, 2014), Finland (Forsman, 2016; Forsman *et al.,* 2016a; 2016c), Holland (Huijgen *et al.,* 2014), Hungary (Csaki *et al.,* 2014), Iran (Taher & Haddadi, 2011), Malaysia (Abdullah *et al.,* 2017), Portugal (Figueiredo *et al.,* 2009a), and Switzerland (Zuber *et al.,* 2016), all illustrating dissimilar findings within their respective nations. To the researcher's knowledge, this thesis offers the first fully-integrated multidisciplinary and interdisciplinary talent development investigation from an English football academy perspective, thus providing original domestic findings and further national comparisons. In addition, it has been previously identified that English football in particular suffers from a 'paucity' of research in this respect (Cushion, 2001).

From an interdisciplinary viewpoint, when compared to other holistic talent development investigations into elite youth football, Abdullah *et al.* (2017) found seven 'essential requirements' out of 26 components that significantly discriminated superior levels of expertise in Malaysian academy players, including body flexibility, body composition, explosive power, mastery of skills, core body strength, technical skills, and body height. Furthermore, Forsman *et al.* (2016b) revealed passing and centering skills, agility, and motivation recorded at aged 15 years predicted elite performance level at aged 19 years in Finnish participants. Moreover, Huijgen *et al.* (2014) illustrated how the combination of dribbling, positioning and deciding, and sprinting successfully, classified 69% of talented players correctly in Holland. In addition, Figueiredo *et al.*'s (2009a) two year follow-up study on Portuguese academy players found elite players were older chronologically and skeletally, larger in body size, performed better in functional capacity tests, and demonstrated greater technical ability in their skill tests.

As a result, whilst there are some similarities regarding particular findings, there appears to be inconsistencies surrounding others. Resembling outcomes seem to consistently support the importance of technical and tactical ability within a talent development environment. This supports the current findings, where all three interdisciplinary characteristics conclude with technical and tactical capabilities in the FDP, whilst one of the three features in the YDP. In contrast, discrepancies appear to significantly differ for physical components between age phases, whilst psychological characteristics fail to surface. Additionally, environmental and sociological features emerge as insignificant or are ignored in previous holistic studies. This conflicting data does not support the current findings, which highlight the importance of the development environment within a professional football academy. Consequently, this further illustrates the need for a fully-integrated approach when examining the talent development process in elite youth football, whilst also recognising the differences that may arise from a cultural viewpoint.

It is also worthy to mention how professional football academies often highlight an initial assessment criteria that is required to support recruitment and subsequent development towards transforming into professional status (Matin & Saether, 2017; Cook *et al.,* 2014; Morley *et al.,* 2014; Mills *et al.,* 2012; Holt & Dunn, 2004). Unnithan *et al.* (2012) reinforce this notion through stating how potential elite youth football players may require prerequisites that fit into the style of play at a particular club. For example, it may be that certain clubs identify size, strength, and speed as paramount for success, whereas other clubs may adopt a greater creative emphasise regarding their philosophy. Williams & Reilly (2000) state how these requirements are often illustrated through acronyms. For example, Ajax FC, who are famed for their production of young talent, encourage their coaches to use the acronym TIPS (Talent, Intelligence, Personality, and Speed) within their talent identification procedure (Brown, 2001). Similarly, Stratton *et al.* (2004) reveal other acronyms, such as TABS (Technique, Attitude, Balance, and Speed) and SUPS (Speed, Understanding, Personality, and Skill), have been installed by coaches in England to assist intuitive judgements with scientific rationale. Through applying a similar notion, ECFC Academy possess their own list of 'must haves' that are abbreviated as ABC + WR & R (Attitude, Bravery, Competitiveness plus Work Rate and Reactions). Consequently, this further highlights the potential differences that may arise within each respective club, thus further supporting the potential 'shopping list' of each respective academies recruitment and developmental philosophy.

Interestingly, although ECFC Academy represents a psychological based framework through emphasising their 'must haves' as ABC + WR & R, the PCDEQ had no association with overall development from both an individual and interdisciplinary viewpoint within the FDP and YDP. Perhaps it may be suggested, as a result of ECFC Academy engaging a greater emphasis towards these particular factors concerning players throughout both age phases, an equal amount of superior psychological development may be acquired compared to other characteristics. Thus, the significant characteristics that have been illustrated in the interdisciplinary approach within the FDP and YDP, may also provide a cause for discussion regarding future developmental acronyms or 'must haves'.

11.3. Practical implications

From a technical perspective, a ‘Technique Specific Programme’ has been incorporated into the ECFC Academy training syllabus, to facilitate the development of the particular technical actions observed in this research. This includes the inclusion of 30 minutes practice during each training session across the three sessions provided each week within the FDP, covering the three technique specific elements of ‘ball striking’, ‘1 vs. 1’s’, and ‘passing and receiving’. These relate to the technical abilities that support greater performance in the YDP, such as lob pass, slalom dribble, shooting accuracy, and ball juggling. Consequently, the aim of this programme is to enable players to move into the YDP with these three technical aspects reinforced. These particular sessions provide the opportunity to develop these techniques, through a coach designed or player-led structure, to ensure there is a high volume and repetition, or as described by Bernstein (1967) ‘repetition without repetition’, thus allowing players to increase the maximum number of attempts in the allocated time slot in an age-appropriate manner.

Furthermore, as a result of the technical and tactical discriminating factors within the FDP, a focus on developing greater individual technical and tactical ability has been incorporated into competitive match-play within the FDP, through reducing player numbers during scheduled fixtures. This is highlighted through the 5 vs. 5 formats that are now played during home games at under-9 and under-10 age groups, compared to the 7 vs. 7 formats that were previously applied. Additionally, a competitive 5 vs. 5 game is employed alongside a 9 vs. 9 fixture at under-11 and under-12 age groups, to increase match-play hours and total touches for ‘substitutes’, thus creating an elevated and innovative environment together with supporting greater technical and tactical development respectively. It is also worth mentioning that match-play hours was a key predictor for both ability and development, therefore it is important to increase everyone's match-play minutes in case the direction of causality (i.e., more minutes = better player; not just better player = more minutes).

Alongside this technical and tactical emphasis, incorporating age-specific strategies regarding the relevant findings of the PCDEQ are also considered when focussing on individual development. Thus, as now documented in ECFC Academy's 'Grecian Plan', which highlights their philosophy through incorporating particular training and match-day strategies, coaches are encouraged to support age-specific psychological development. For example, a facilitated approach within the FDP is fostered through players creating their own learning environment, with the coach acting as a facilitator; such as players leading sessions, team talks, and team selection. Consequently, this aims to support an individual's ability to engage in quality practice at a young age. Within the YDP, ECFC Academy has instilled a 'rocky road' process (Collins & MacNamara, 2017a; 2017b; 2012; Collins *et al.,* 2016; 2015), whereby players are deliberately challenged, in a controlled and professional manner, to facilitate the development of coping with performance and developmental pressures. Strategies may include playing players up or down chronological age groups, being left out of relevant match-day squads, being a substitute or being substituted at a particular moment during competitive match-play, or offering the opportunity to lead training sessions, match-day team-talks, or captain their team during competitive match-play.

Moreover, an 'Athletic Development Pathway' has been created, as a result of the supporting evidence concerning the physical ability and engagement in multi-sport activities that distinguish high- and low-performers across both age phases, whilst also supporting greater overall development within the YDP. Initially, FDP players participate in a 'fundamental phase' (Balyi, 2001), where they engage in a large amount of multi-sport activities during their 20 minute allocated strength and conditioning slot, such as handball, basketball, and racket sports, which are also regularly altered in order to provide varying motor learning stimuli

(Lloyd & Oliver, 2012; Balyi & Hamilton, 2004). 'Pre-PHV' players within the YDP will focus on the development of strength, power, and speed using an integrative neuromuscular training approach (Lloyd & Oliver, 2012; Balyi & Hamilton, 2004). 'During-PHV' players who cannot tolerate greater loads will have a reduced training protocol, through limiting repetitive loading as a result of vulnerable joints and increased injury risk (Lloyd & Oliver, 2012; Balyi & Hamilton, 2004). Finally, 'post-PHV' players gain the opportunity to rapidly increase muscle mass as a consequence of circulating hormones (Lloyd & Oliver, 2012; Balyi & Hamilton, 2004). Thus, strength and power will the focus of physical development with these players to increase their acceleration speed, total sprint speed, maximal sprint speed, and CMJ ability.

From a talent identification perspective, a player's socio-economic status is now observed as part of ECFC Academy's recruitment strategy, as a result of high-performers deriving from significantly lower home social classification and credit rating within the YDP. Indeed, while this characteristic is measured when contemplating a potential signing within ECFC Academy, it is by no means considered an essential factor, thus merely being part of a holistic talent identification strategy. Additionally, physical performance characteristics, such as speed and strength, are also taken into account regarding the recruitment process as a result of significant findings within this thesis. This may be completed through engaging in specific fitness tests or coach observation during conditioned SSGs. This is alongside the subjective and objective data surrounding the technical, tactical, and psychological prerequisites that pre-existed prior to this particular research.

Finally, previous to this thesis, ECFC Academy worked off a 'four corner' approach consisting of technical, tactical, physiological, and psychological characteristics. However, as a result of this fully-integrated multidisciplinary investigation, which is also documented in their 'Grecian Plan', the ECFC Academy training and match-day syllabus now offers a 'five pillar' approach, by incorporating sociological factors. Likewise, the environment that players are engaging in is also taken into consideration, through coaches being encouraged to deliver a broad range of activities such as coach-led practice, competitive match-play, and play-like engagement. This is through both facilitated designs and structured conditions, with internal continual professional development forming a centre for coach education.

11.4. The Locking Wheel Nut Model

Locking wheel nuts were originally invented to prevent alloy wheel theft as a result of an individualised key required to manipulate its release. These were created to replace a generic lug nut, which is easily deployed through their specific design. Working on a very simple principle, each locking wheel nut has a patterned indent alongside a key which matches this unique outline, thus only when the correct key is inserted will the locking wheel nut be able to be freed. This locking wheel nut concept is applied to this research to illustrate the talent identification process in elite youth football through the proposed LWNM. This is a result of applying the methodology and visual design of the locking wheel nut, through recognising the concept of an individualised approach while observing critical requirements to achieve expertise within a specific process. Similarly to the locking wheel nut, it is important to understand where the player fits within the LWNM, through identifying and categorising individual strengths and weaknesses through player profiling. Conversely, without all the relevant information, the coach may not have the precise ‘key’ to support optimum talent identification and subsequent development.

Following successful recruitment within an academy setting, a coach acts as a key to support each player’s holistic development through targeting individual strengths and weaknesses that are illustrated from a fully-integrated multidisciplinary perspective (Figure 10.1.). Whilst observing the LWNM, the environment surrounds the psychological, sociological, physiological, technical, and tactical disciplines, as a result of the interchangeable outcomes that are created from particular activities. Therefore, it may be considered each player's patterned indent on the LWNM regarding each of these factors may differ depending of what activity the player is engaging in, whilst also highlighting how one player can look very different from another within the same age group (Figure 11.1.). Consequently, the LWNM provides a flexible user-friendly concept for an applied talent identification and development process in elite youth football.

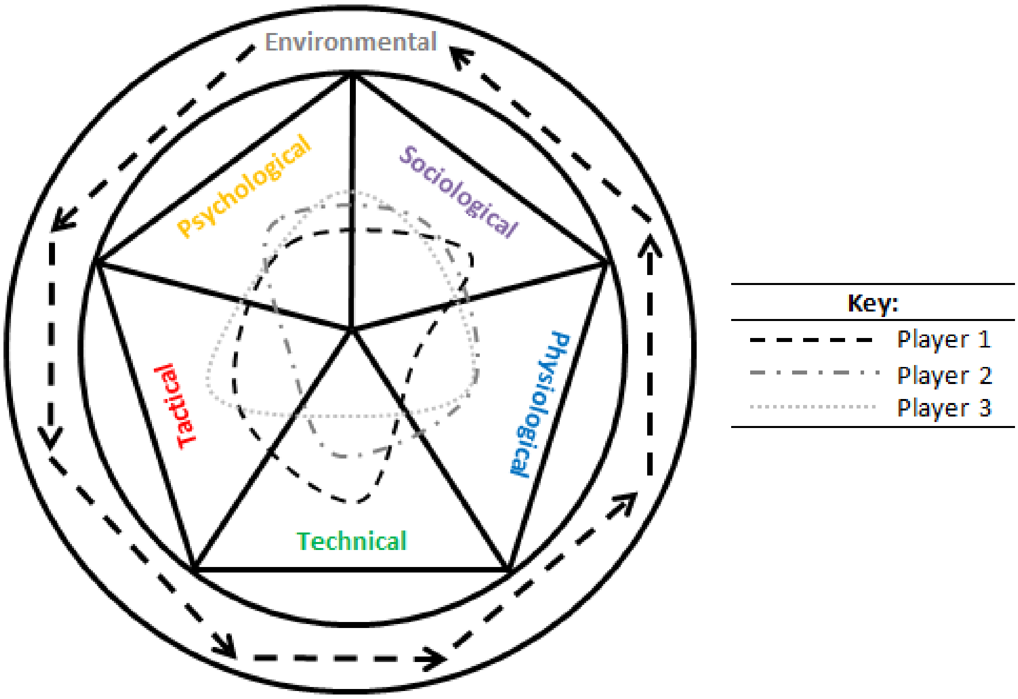


Figure 11.1. The Locking Wheel Nut Model – three player example

The LWNM has been developed through identifying the discipline-specific characteristics, which have been identified as influential factors surrounding the talent identification process in an English football academy within this thesis. Subsequently, within each of these disciplines, there are characteristics for coaches and practitioners to consider when identifying potential elite youth football players. As a result of the environmental factors creating the foundation to the opportunity for engagement, this surrounds the other five significant disciplines; psychological, sociological, physiological, technical, and tactical.

There have been a number of attempts to distinguish the talent identification and development process, such as the YPDM (Lloyd & Oliver, 2012), DMSP (Cote *et al.*, 2007), and the early engagement theory (Ford *et al.*, 2009), which have all been reviewed and discussed throughout this thesis. However, these models offer a one-dimensional approach, through focussing on isolated concepts such as physiological characteristics or participation activities respectively. Generic holistic endeavours towards a talent identification and sport development include Gagne's (2009; 2004; 2003) DMGT, Henriksen *et al.*'s (2010a) ATDE, Gulbin *et al.*'s (2014; 2013) FTEM, and Gulbin & Weissensteiner's (2013) 3D-AD 'beehive' conceptual model of expertise. When comparing the LWNM to these concepts, while the DMGT Gagne's (2009; 2004; 2003) provides a model for elite athletes, interpersonal and environmental characteristics would need to be researched and applied for specific sports, which are illustrated in the LWNM. Furthermore, during their observations whilst developing the ATDE, Henriksen *et al.* (2010a) argue research in the area of talent development tends to focus on the individual athletes rather than relating them to the current environment, thus supporting the individualised, adaptable, and flexible nature of the LWNM.

In addition, the FTEM has received criticism from researchers, who believe the framework is theoretically weak and empirically questionable (MacNamara & Collins, 2014). Furthermore, MacNamara & Collins (2014) also believe there is a possible need to move away from prescriptive models surrounding talent development, while focussing on considering alternative approaches such as features of best practices, process markers of development, and robust guidelines for implementing in applied settings. The LWNM supports MacNamara & Collins' (2014) proposal, through providing a user-friendly framework relevant to the applied environment. Furthermore, the LWNM supports Butler & Hardy's (1992) early theory and application of performance profilling in sport, through both its flexibility and supporting coaches and practitioners understanding of their footballers in several aspects.

Gulbin & Weissensteiner (2013) state how there is a gap that is constantly growing between theory and practice surrounding talent development. They argue this is due to limitations, inconsistencies, and contradictory contentions from literature, and therefore result in stakeholder's scepticism regarding the usefulness of current research. Certain published books, such as The Talent Code (Coyle, 2010), Bounce (Syed, 2010), and Outliers (Gladwell, 2009), possibly provide more digestible literature for the practitioner on talent development approaches, however, these hold limited reliability (Gulbin & Weissensteiner, 2013). Additionally, Cushion *et al.* (2012) suggest how it can take at least 10 years before research is applied to coaching practice. They argue coach education remains 'fixed' while research continues to evolve. Similarly, researchers often fail to generate clear guidelines for practitioners to simplify the practical enactment. Pankhurst & Collins (2013) also believe there is lack of coherence in the understanding of talent development systems and processes between key stakeholders and researchers, and a deficiency of research into the importance of this relationship.

Therefore, the aim of the LWNM aims to adopt a 'user friendly' approach while implementing contemporary data from reliable and valid methodologies. Furthermore, the common modern talent identification and development models that this thesis has analysed provide relevant practical implications, which can be applied to support the LWNM, through facilitating the structures from a multidisciplinary perspective. Moreover, from a football viewpoint, the LWNM further develops the current 'four corner model' that is commonly applied within football organisations and academies in England (Unnithan *et al.*, 2012), which was initially created by Williams & Reilly (2000) almost two decades ago. Additionally, this model also has the advantage of incorporating influential talent identification characteristics within each discipline (Figure 11.2.). Consequently, the LWNM supports coaches and practitioners alike regarding the significant factors that support superior overall performance within each discipline, therefore creating a greater understanding concerning the talent identification process within an academy environment. From a talent development perspective, this model can also support a coach or practitioner, and subsequently their players, through gauging current performance from an interdisciplinary viewpoint to facilitate the opportunity to develop individual strengths and weaknesses. Therefore, while other models such as the DMGT, ATDE, and FTEM offer generic principles for age-specific development, this model applies an individualised approach, similar to 3D-AD 'beehive' conceptual model of expertise, whilst also illustrating age-appropriate and football-specific developmental factors from this thesis' findings (Figure 11.2.).

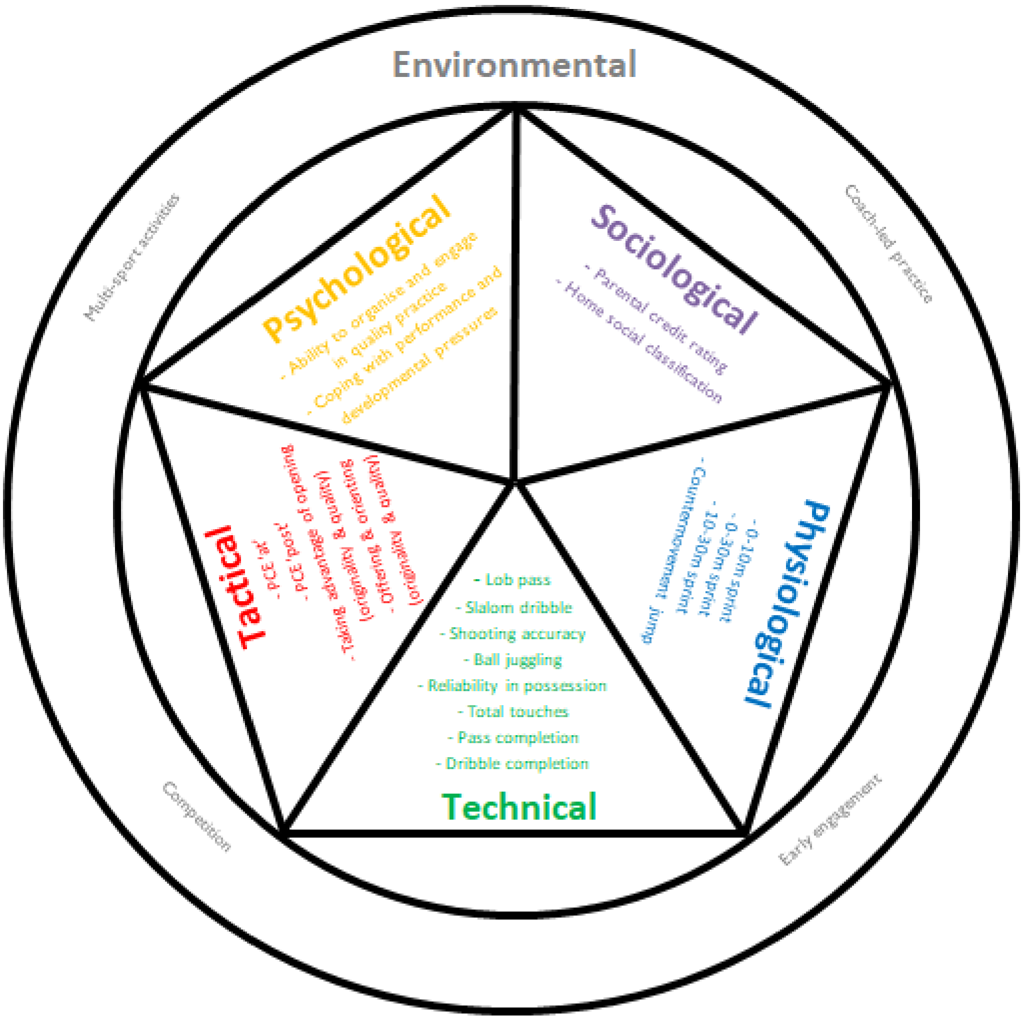


Figure 11.2. The Locking Wheel Nut Model – significant influencing characteristics for high-performance that are illustrated in this thesis

Through identifying an individual players locking wheel nut, a coach or practitioner is firstly able to identify whether the potential athlete possesses the relevant characteristics required to engage in an elite youth football setting. Secondly, professional staff within an academy environment are able to illustrate strengths and weaknesses within each discipline, thus facilitating the ability to create an individualised support programme, such as incorporating football-specific technical and tactical strategies, alongside performance analysis, physiotherapy/sports therapy, sport science, strength and conditioning, psychology, and education and welfare support, where required. As a result, not only does the LWNM offer a fully-integrated multidisciplinary approach to talent identification, it also highlights the interdisciplinary nature of the talent development process (Figure 11.3.). This is illustrated for each discipline within an academy setting through combining and working in unification to develop and apply a shared conceptual framework, that integrates discipline-specific concepts and methodologies to address a common research focus (Buekers *et al.*, 2017; Jones, 2009; Szostak, 2007; Youngblood, 2007).

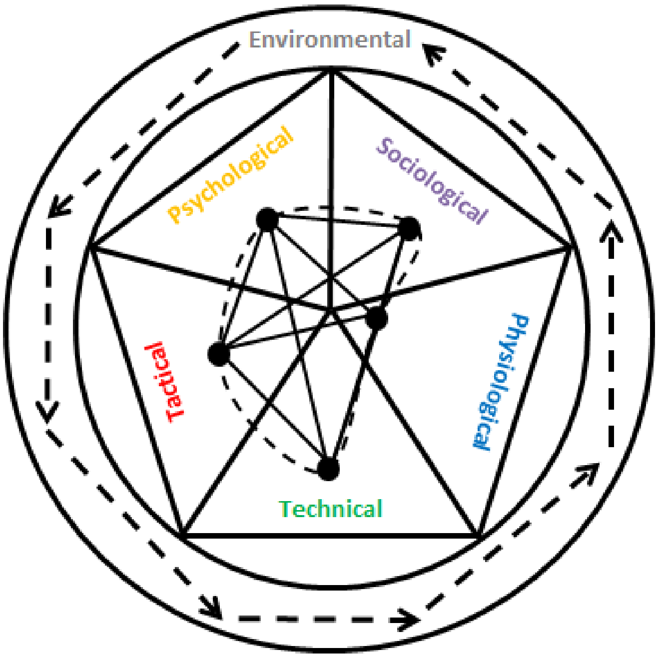


Figure 11.3. The Locking Wheel Nut Model – an example of the application of an interdisciplinary concept

Therefore, professional football coaches, performance analysts, physiotherapist/sports therapists, sport scientists, strength and conditioning coaches, psychologists, and education and welfare specialists combine their expertise within this shared conceptual framework. Consequently, this interdisciplinary approach facilitates overall player development, through recognising individual strengths and weaknesses, while supporting the collaboration between departments that is required for greater common outcomes.

11.5. Future research

As the main purpose of a talent development environment is to provide a player pathway towards senior professional status, the journeys individuals take towards achieving adult expertise must be monitored to illustrate successful passages. Consequently, this longitudinal approach will support future talent development strategies to facilitate superior development. As a result of this thesis only demonstrating two seasons worth of development, it is recommended that this multidisciplinary data is continued to be collected to eventually support this notion.

The importance of shifting towards a fully-integrated multidisciplinary approach to analyse the talent identification and development process has been highlighted by this thesis (Sarmento *et al.,* 2018; Phillips *et al.,* 2010). Consequently, future inquiry requires a holistic approach to advance understanding of talent identification and development, as a result of incorporating a comprehensive multidisciplinary theoretical rationale. For example, a longitudinal focus, through gathering holistic data, is required to identify specific journeys that have supported the transition to professional status, thus identifying and subsequently developing multi-dimensional pathways towards expertise in elite youth football. Furthermore, this thesis has explored a modern interdisciplinary approach, which is also beneficial for future research, through the modern concept of collaborating to develop and apply a shared theoretical context, which integrates discipline-specific notions and methodologies to support a common research focus (Buekers *et al.,* 2017; Jones, 2009; Szostak, 2007; Youngblood, 2007). For instance, further research should identify position-specific characteristics that are required to achieve expertise, whilst also observing differences between academy settings to illustrate variations between elite youth football environments.

It is also important that future investigations incorporate other emerging factors surrounding the talent identification and development process. For example, genetics and its influence on talent identification and development (Rees *et al.,* 2016) may subsequently increase the variance of understanding specific characteristics to achieve adult expertise. Furthermore, the expansion of current methodologies may also provide a noteworthy implication for future research. For example, this thesis applied regular match-play footage for game simulations to examine PCE, whereas Van Maarseveen *et al.* (2018) have recently applied an in-situ design to incorporate greater realism to their study.

Whilst this thesis has illustrated significant findings from a category three academy, future research should apply a perspective from both category one and two academies. Therefore, this may facilitate a greater understanding of any differences between the talent identification and development processes within particular categories (Premier League, 2013). However, as formerly mentioned, the unwillingness of academies to share anonymised data remains apparent within England, consequently delaying the understanding of superior modern applied talent identification and development strategies. Furthermore, talent identification and development process comparisons with other sporting environments, such as rugby, basketball, cricket, and tennis, may also reveal transferability between sports. Additionally, this notion may also identify generic characteristics that support the talent identification and development processes within sport, whilst also illustrating sport-specific factors.

11.6. Summary

These concluding comments reinforce the multidisciplinary application and individualised approach that is required to facilitate optimum talent identification and development within elite youth football. This current study has illustrated environmental, psychological, sociological, physiological, technical, and tactical attributes, which support greater talent identification and development within an English football academy setting. Furthermore, it has also been demonstrated that these elements are age-specific, with certain factors supporting greater performance and progress within both the FDP and YDP. From a multidisciplinary talent identification perspective within the FDP, total coach-led hours, the ability to organise and engage in quality practice, 0–30 m sprint, 10–30 m sprint, lob pass ability, reliability in possession, pass completion, average total touches, PCE ‘post’ ability, taking advantage of openings originality and quality, and offering and orienting originality and quality successfully discriminated high-performers from their low-performing counterparts. Within the YDP, total match-play hours, total multi-sports hours, the ability to cope with performance and developmental pressures, home social classification, home credit rating, 0–30 m sprint, 10–30 m sprint, 0–10 m sprint, CMJ, ball juggling, slalom dribble, shooting accuracy, lob pass ability, reliability in possession, average dribble completion, average total touches, PCE ‘at’ ability, taking advantage of openings originality and quality, and offering and orienting originality and quality positively distinguished high-performers from their low-performing peers. Consequently, this illustrates the multidisciplinary and age-specific nature of the talent identification process in an English football academy.

From a fully-integrated multidisciplinary talent development viewpoint within the FDP, total touches change, lob pass ability, taking advantage of openings quality, and PCE ‘post’ change were significantly associated with superior development. Additionally, as a result of further interdisciplinary analysis, total touches change, taking advantage of openings quality, and PCE ‘post’ change explained a combined 11.5% of the variance. Within the YDP, total match-play hours, total sports played change, 0–10 m sprint change, lob pass ability, pass completion change, reliability in possession change, and PCE ‘at’ were significantly associated with greater development. In addition, as a consequence of the following interdisciplinary analysis, PCE ‘at’, total sports played change, and total match-play hours explained a combined 34.1% of the variance.

As a result, this current study has supported the evidence and subsequent development of a number of contemporary strategies within ECFC Academy’s training and match-day syllabus. Furthermore, this thesis also offers an applied talent identification and development model to support a practical approach. The LWNM illustrates both the multidisciplinary and interdisciplinary age-specific nature of talent identification and development within elite youth football, through its ability to highlight individual strengths and weaknesses, thus supporting a holistic individualised coaching programme to provide optimum development. In addition, future recommendations regarding talent identification and development research in elite youth football include greater longitudinal data collection, measuring position-specific characteristics, other emerging factors regarding a fully-integrated multidisciplinary approach, and collaborating with other academies and sporting organisations to gain a greater insight into the differences between category statuses and sports respectively.

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X. APPENDICES

1. Appendix 1 – Parent/Guardian Consent Form

EXETER

VS – 16/03/2015

Sport and Health Sciences
St Luke's Campus
Heavitree Road
EXETER, EX1 2LU

PARENT/GUARDIAN CONSENT FORM

Title of the study: A multidisciplinary investigation into talent identification and the development process in elite youth football.

I have read the information sheet concerning this study (VS dated: 16th March 2015) and understand what it is about. All my questions have been answered to my satisfaction. I understand that my son will participate in psychological & participation history questionnaires, physical, technical & tactical testing and be filmed for video analysis. I understand that I am free to request further information at any stage or withdraw him at any time.

Please read the following and initial the box provided if you agree:

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions. ☐
2. I understand that my son/daughters' participation is voluntary and that they are free to withdraw at any time, without giving reason. ☐
3. I agree for my son/daughter to take part in the above study. ☐

*If you **DO** accept your son to take part in this study please sign below and return this form to the Researcher (Adam Kelly).*

Name of child taking part:...

Name of person taking consent (Parent/Guardian):...

Signature of person taking consent (Parent/Guardian):......................................

Date:..

Name of child taking part:...

Name of Researcher:..

Signature of Researcher:..

Date:..

The Ethics Committee of the Department of Sport and Health Sciences has reviewed and approved this study.

Dr. Mark Wilson (mark.wilson@ex.ac.uk); Adam Kelly (alk210@exeter.ac.uk)

2. Appendix 2 – Participant Assent Form

Participant Assent Form_V1_20th January 2015

Sport and Health Sciences
St Luke's Campus
Heavitree Road
EXETER, EX1 2LU

PARTICIPANT ASSENT FORM

Title of the study: A multidisciplinary investigation into talent identification and the development process in elite youth football.

I have read the information sheet concerning this study (V1 dated: 20th November 2014) and understand what it is about. All my questions have been answered to my satisfaction. As an ECFC Academy player, I understand that I will participate in psychological & participation history questionnaires, physical, technical & tactical testing and be filmed for video analysis. I understand that I am free to request further information at any stage.

Please read the following and initial the box provided if you agree:

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions. ☐
2. I understand my participation is voluntary and that they are free to withdraw at any time, without giving reason. ☐
3. I agree to take part in the above study. ☐

*If you **DO** accept to take part in this study please sign below and return this form to the Researcher (Adam Kelly).*

Name of participant taking part:...

Participant signature:...

Date:...

Name of Researcher:...

Signature of Researcher:...

Date:...

The Ethics Committee of the Department of Sport and Health Sciences has reviewed and approved this study.

Dr. Mark Wilson (mark.wilson@ex.ac.uk); Adam Kelly (alk210@exeter.ac.uk)

3. Appendix 3 – Information Sheet for Participants

Information Sheet for Participants_V1_20th January 2015

Sport and Health Sciences
St Luke's Campus
Heavitree Road
EXETER, EX1 2LU

INFORMATION SHEET FOR PARTICIPANTS

Title of the study: A multidisciplinary investigation into talent identification and the development process in elite youth football.

Dear ECFC Academy Player,

Thank you for showing an interest in taking part in this study. This sheet will tell you a bit more about the study and what we would like you to do. If you decide not to take part it will not change your relationship with the research team or ECFC Academy.

What is the project about?

This research will try to find the important factors that influence football player development within an Academy setting. This will be completed by identifying current performance levels. The research will then continue to assess these characteristics over a two year period to identify important factors for talent development and progress in an Academy setting.

What do we want to find out?

The procedures of this study will assess a number of characteristics identified to help the progression and development of elite youth football players. This will include psychological, physical, technical, tactical, social, environmental and subjective research methods. This will be completed by investigating ECFC Academy players over a 2 year period to show the important factors for progress and development.

What are the benefits of taking part?

Firstly, you will conduct various tests to identify both strengths and weaknesses surrounding their initial identification. This will allow coaches to implement strategies to maintain strengths while developing weaknesses. Following the 2 year investigation, it should allow ECFC Academy to allocate time and resources more effectively toward characteristics that are identified to further help yours and others progress and development.

What do you have to do?

If you wish to take part in this research, please sign and complete the Assent Form, and ask your parents/guardians to read and complete the Parents/Guardians Information Sheet and Consent Form, both of which are attached, and return it to Adam Kelly.

Can I change my mind?

Yes, you can stop the study at any time without having to give a reason.

What will we do with the information and how will we store data?

Only the researchers on this project and the ECFC Academy Coaches will have access to the data and your child's individual anonymity will be preserved at all times. All player data is kept on a password protected computer that provides confidential information through player codes using numbers and letters. These player numbers and codes are kept in a locked filing cabinet at ECFC Cat & Fiddle Training Ground.

Are there any risks in taking part?

General football injuries and extreme weather conditions have been highlighted as risks. There will be a qualified Physiotherapist present at all times alongside two members of staff present at all times. A health & safety check will also be administered before players take part in any activities.

What if I have any questions?

If you have any questions then please feel free to ask any of the researchers listed below.

What do I have to do next?

If you have read and understood everything that we want you to do and are happy to take part and for your child to take part, please sign the consent forms attached to this sheet, and give back to Adam Kelly.

Thank you,

Adam Kelly

Sport and Health Sciences
University of Exeter
St. Luke's Campus
Heavitree Road
Exeter, EX1 2LU
Tel: 07989 409383
Email: alk210@exeter.ac.uk

Additional contact:

Dr Mark Wilson

Tel: 01392 722891
Email: mark.wilson@exeter.ac.uk

The Ethics Committee of the Department of Sport and Health Sciences has reviewed and approved this study.

4. Appendix 4 – Information Sheet for Parents and/or Guardians

V.5 – 16/03/2015

Sport and Health Sciences
St Luke's Campus
Heavitree Road
EXETER, EX1 2LU

INFORMATION SHEET FOR PARENTS AND/OR GUARDIANS

Title of the study: A multidisciplinary investigation into talent identification and the development process in elite youth football.

Dear Parent/guardian,

Thank you for showing an interest in taking part in this study. This sheet will tell you a bit more about the study and what we would like you to do. If you decide not to take part it will not change your relationship with the research team or ECFC Academy.

What is the project about?

This research will seek to recognise the important factors that influence football player development within an Academy environment. Firstly, this will be completed by initial talent identification through current performance variables. The research will then continue to assess these variables over a two year period to recognise key characteristics of talent development in an Academy environment.

What do we want to find out?

The procedures of this study will assess a number of characteristics identified to facilitate the progression and development of elite youth football players. This will include psychological, physical, technical, tactical, social, environmental and subjective protocols. This will be completed by investigating ECFC Academy players over a 2 year period to simplify the significant factors for progress and development.

What are the benefits of taking part?

Firstly, the individual will have a multi-disciplinary examination to identify both strengths and weaknesses surrounding their initial identification. This will allow coaches to implement strategies to maintain strengths while developing weaknesses. Following the 2 year investigation, it should allow ECFC Academy to allocate time and resources more effectively toward characteristics that are identified to facilitate progress and development.

What do you have to do?

If you consent to your child to take part in this research, please sign and complete the Consent Form, and ask your child to read and complete the players' information sheet and assent form, both of which are attached, and return it to Adam Kelly.

Can I change my mind?

Yes, you and your child can stop the study at any time without having to give a reason.

What will we do with the information and how will we store data?

Only the researchers on this project and the ECFC Academy Coaches will have access to the data and your child's individual anonymity will be preserved at all times. All player data is kept on a password protected computer that provides confidential information through player codes using numbers and letters. These player numbers and codes are kept in a locked filing cabinet at ECFC Cat & Fiddle Training Ground.

Are there any risks in taking part?

General football injuries and extreme weather conditions have been highlighted as risks. There will be a qualified Physiotherapist present at all times alongside two members of staff present at all times. A health & safety check will also be administered before players take part in any activities.

What if I have any questions?

If you have any questions then please feel free to ask any of the researchers listed below.

What do I have to do next?

If you have read and understood everything that we want you to do and are happy to take part and for your child to take part, please sign the consent forms attached to this sheet, and give back to Adam Kelly.

Thank you,

Adam Kelly

Sport and Health Sciences
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Additional contact:

Dr Mark Wilson

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The Ethics Committee of the Department of Sport and Health Sciences has reviewed and approved this study.

5. Appendix 5 – Certificate of Ethical Approval

UNIVERSITY OF EXETER

College of Life and Environmental Sciences
SPORT AND HEALTH SCIENCES

St. Luke's Campus
University of Exeter
Heavitree Road
Exeter
EX1 2LU
United Kingdom

Certificate of Ethical Approval

Proposal Ref No: 141203/B/15

Title: A multidisciplinary investigation into talent identification and the development process in elite youth football

Applicants: Adam Kelly (PhD Student), Dr Mark Wilson, Prof Craig Williams, Lewis Welch (UG student), Alan Zhang (MSc student), Connor Powell (UG student)

The proposal was reviewed by the Sport and Health Sciences Ethics Committee.

Decision: This proposal has been approved until December 2016

Signature: Date: 1/6/2015

Name/Title of Ethics Committee Reviewer: Dr Melvyn Hillsdon

Your attention is drawn to the attached paper which reminds the researcher of information that needs to be observed when Ethics Committee approval is given.

6. Appendix 6 – PHQ

exeter city football club Youth Department

UNIVERSITY OF EXETER

Participation History Questionnaire (PHQ – U9-16's)

1. 'Milestones'

What is your name? ____

What is your date of birth? ____

What is your town/city of birth? ____________________________________

Which town/city did you go to: (i) primary school in? ______________________

(i) secondary school in? ______________________

Sports specific milestones

___ years old when you first started playing football (not in an organized league) ____ have never done it

___ years old for first took part in supervised training by an adult in football ____ have never done it

___ years old when first began football training regularly ____ have never done it

___ years old when first played in an organized football league ____ have never done it

___ years old when first began non-football training (e.g., running, strength, etc) regularly ____ have never done it

___ years old when first took part at School of Excellence level ____ have never done it

___ years old when first took part at Academy level ____ have never done it

___ years old when first took part at youth international level ____ have never done it

2. Engagement in football-related activities

The following section focuses on the football-related activities you have participated from when you began playing to the present day, the number of hours spent in these activities per week, and the number of months per year you spent in each of the activities. This will be done for each year you have participated.

Please group the activities you have participated in into the categories listed below:

1. Match-play: organized competition in a group engaged in with the intention of winning and supervised by adult(s), e.g. league games.

2. Coach-led group practice: organized group practice engaged in with the intention of performance improvement and supervised by coach(es) or adult(s), e.g. practice with team.

3. Individual practice – self: practice alone engaged in with the intention of performance improvement, e.g. practicing dribbling skills alone.

4. Peer-led play: play-type games with rules supervised by yourself/peers and engaged in with the intention of fun and enjoyment, e.g. game of football in park with friends.

Overleaf there is 'participation history' log, which lists these four categories and groups them into years. Please fill this in as accurately as possible, starting from this year (i.e., U15 or U14, 2006/2007) and working downwards until you have completed the first year you played football. Please do not fill in shaded areas.

For each year, please complete:

1a. The total number of hours spent taking part in activities related to each category.

1b. The number of months of the year that you spent taking part in activities related to each category.

2. The number of weeks from the relevant year that you were injured and unable to take part in the football activity. Leave blank if no injury.

NB. Please first write the name of the coach and team you played for in each season in the space provided

Age group	Team and coach	Activities	# of hrs/wk	Months /yr	Injury wks/yr
e.g.		1. Match-play	2	9	3
	John Smith	2. Coach-led practice	5	9	
	London Rovers FC	3. Individual practice	2	12	
		4. Peer-led play	5	12	
U16		1. Match-play			
		2. Coach-led practice			
		3. Individual practice			
		4. Peer-led play			
U15		1. Match-play			
		2. Coach-led practice			
		3. Individual practice			
		4. Peer-led play			
U14		1. Match-play			
		2. Coach-led practice			
		3. Individual practice			
		4. Peer-led play			
U13		1. Match-play			
		2. Coach-led practice			
		3. Individual practice			
		4. Peer-led play			
U12		1. Match-play			
		2. Coach-led practice			
		3. Individual practice			
		4. Peer-led play			

Categories:

1. Match-play: organized competition in a group engaged in with the intention of winning and supervised by adult(s), e.g. league games.

2. Coach-led group practice: organized group practice engaged in with the intention of performance improvement and supervised by coach(es) or adult(s), e.g. practice with team.

3. Individual practice: practice alone engaged in with the intention of performance improvement, e.g. practicing dribbling skills alone.

4. Peer-led play: play-type games with rules supervised by yourself/peers and engaged in with the intention of fun and enjoyment, e.g. game of football in park with friends.

Age group	Team and coach	Activities	# of hrs/wk	Months /yr	Injury wks/yr
U11		1. Match-play			
		2. Coach-led practice			
		3. Individual practice			
		4. Peer-led play			
U10		1. Match-play			
		2. Coach-led practice			
		3. Individual practice			
		4. Peer-led play			
U9		1. Match-play			
		2. Coach-led practice			
		3. Individual practice			
		4. Peer-led play			
U8		1. Match-play			
		2. Coach-led practice			
		3. Individual practice			
		4. Peer-led play			
U7		1. Match-play			
		2. Coach-led practice			
		3. Individual practice			
		4. Peer-led play			
U6		1. Match-play			
		2. Coach-led practice			
		3. Individual practice			
		4. Peer-led play			

Categories:

1. Match-play: organized competition in a group engaged in with the intention of winning and supervised by adult(s), e.g. league games.

2. Coach-led group practice: organized group practice engaged in with the intention of performance improvement and supervised by coach(es) or adult(s), e.g. practice with team.

3. Individual practice: practice alone engaged in with the intention of performance improvement, e.g. practicing dribbling skills alone.

4. Peer-led play: play-type games with rules supervised by yourself/peers and engaged in with the intention of fun and enjoyment, e.g. game of football in park with friends.

3. Engagement in other sport activities

The following section focuses on the other sporting activities you have engaged in, the period of your life in which you took part in this activity, the number of hours per week, and months per year spent in these activities, and the standard of this activity. For each activity, please complete:

1. Please place a tick next to the other sports that you have participated in during your life, outside of school physical education classes.

2a. The age you started taking part in each activity.

2b. The age you finished taking part in each activity (if you are still participating in an activity then leave this section blank).

3. The total number of hours per week spent taking part in each activity.

4. The number of months of the year in which you took part in each activity.

5. The standard of the activity that you took part in for that sport (e.g., school, club, national, international).

NB. Please only record other sport activity that has lasted a total of three months of activity.

Other sport activities.	Please tick if yes	Please cross if no	Start age	Finish age	Total # of hrs/wk	Months /yr	Standard participated at
e.g. Cross country	/	x	7	12	2	8	School, Club
Athletics							
Badminton							
Basketball							
Boxing/Kick boxing							
Canoeing							
Cricket							
Cycling							
Cross country							
Gymnastics							
Golf							
Handball							
Hockey							
Judo/Karate							
Rugby/Gaelic							
Running							
Snooker/Pool							
Swimming							
Skiing/Snowboarding							
Stretching/Yoga/Pilates							
Table tennis							
Tennis							
Volleyball							
Weights							
Other:							
Other:							
Other:							
Other:							
Other:							

7. Appendix 7 – PCDEQ

Psychological Characteristics of Developing Excellence Questionnaire

Male Exeter City FC Academy Football Player
Name:
Age group:
Date of Birth:
Date:

PSYCHOLOGICAL CHARACTERISTICS OF DEVELOPING EXCELLENCE QUESTIONNAIRE (PCDEQ)

Over the next couple of pages there are a series of statement which refer to your participation in your activity.

Please indicate how much each of the statements is like what you generally do in your activity RIGHT NOW.

For example:

How much is this statement like what you do in your activity	Very unlike me	Unlike me	A bit unlike me	A bit like me	Like me	Very like me
I never miss practice					✓	

This is like you, something that you would do fairly often.

How much is this statement like what you do in your activity	Very unlike me	Unlike me	A bit unlike me	A bit like me	Like me	Very like me
I think about my activity and ways that I can improve		✓				

This is unlike you, something that you would rarely do.

There are no right or wrong answers – I am just interested in how you go about your activity.

All answers will be kept confidential and nobody except for the researcher will see your personal responses. This is to ensure that you are comfortable about giving honest answers.

The questionnaire will take between around 30 minutes to complete. Please do not dwell on questions. Please try and answer every question – if you are not sure, go with your initial reaction. However, please try and answer the questions as honestly as possible.

After you have finished, please check through the questions to make sure that you have answered every question.

If you have any questions, just raise your hand and ask me.

How much is this statement like what you do in your activity		*Very unlike me*	*Unlike me*	*A bit unlike me*	*A bit like me*	*Like me*	*Very like me*
1.	I get on with what I have to do even if no one is watching						
2.	I find it difficult to relax when I get tense						
3.	My coach / teacher encourages me to seek advice from appropriate others						
4.	My coach / teacher and I plan on the basis of my future success, not just for today						
5.	I am willing to push myself really hard						
6.	My coach / teacher helps me to stay committed to my activity						
7.	My coach / teacher evaluates my performances against long-term goals for future success						
8.	My coach / teacher prepares me to cope with the pressures of performance						
9.	My coach / teacher always tells me what I should be aiming for and helps to direct my goals						
10.	I use imagery to correct my physical performance						
11.	During practice I block out distracting thoughts and focus my attention completely on what needs to be done						
12.	My pre-performance schedule is clear and carefully monitored						
13.	Before attempting a skill, I imagine myself performing it						

How much is this statement like what you do in your activity		*Very unlike me*	*Unlike me*	*A bit unlike me*	*A bit like me*	*Like me*	*Very like me*
14.	I find it difficult to concentrate on what I have to do and often find myself thinking about how other performers are doing						
15.	Before an important performance people around me keep me focused						
16.	We are encouraged to help each other in my practice environment						
17.	Mental rehearsal is incorporated in my practice						
18.	My coach / teacher and I keep an eye on my total workload to help me balance college / school and practice						
19.	In practice, I really think about and focus on what I have to do in that session						
20.	I work together with my coach / teacher to monitor my progress towards my goals						
21.	If something unexpected happens I find it really hard to adapt						
22.	My coach sets my targets and we work towards these						
23.	Mentally rehearsing my performance focuses me on what I have to do						
24.	My coach / teacher helps to keep me focused in practice						
25.	I am always looking for ways to improve						

How much is this statement like what you do in your activity		*Very unlike me*	*Unlike me*	*A bit unlike me*	*A bit like me*	*Like me*	*Very like me*
26.	I can rely on my coach / teacher to push me in activities that I don't really like						
27.	I regularly imagine what a good performance feels like						
28.	My coach / teacher helps me to keep a record of my progress						
29.	I always have at least one goal that I am working towards						
30.	My coach / teacher helps me to prepare for the unexpected						
31.	After a performance, I review my performance in my head to figure out what I did right and wrong						
32.	My coach / teacher provides me with clear routines						
33.	I find it hard to fit into new practice groups						
34.	My coach / teacher helps me focus on the objectives in practice						
35.	My coach / teacher structures practice to work mostly on my weaknesses						
36.	I can't stop my activity suffering when I am under pressure from school or college work						
37.	My coach / teacher encourages me to talk things through						
38.	People around me help me to accommodate the demands of my activity						

	How much is this statement like what you do in your activity	*Very unlike me*	*Unlike me*	*A bit unlike me*	*A bit like me*	*Like me*	*Very like me*
39.	If something doesn't go like I wanted it to, I adapt my plans and refocus my goals if necessary						
40.	My coach / teacher believes mental practice is important						
41.	I analyse my performances to find out what I did well and what I did badly						
42.	Before I arrive at the performance venue I am encouraged to mentally rehearse my performance						
43.	I often stop trying when I find a task difficult						
44.	I believe that you can never learn from losing						
45.	Even a minor setback shakes my confidence						
46.	I listen and learn from the people around me						
47.	When I make a mistake I find it difficult to get my focus back on task						
48.	My coach / teacher ensures that I know the steps I have to take to maintain my progress						
49.	I consider my weaknesses and work hard on these in practice						
50.	My coach / teacher doesn't push me to overcome difficulties						

How much is this statement like what you do in your activity		*Very unlike me*	*Unlike me*	*A bit unlike me*	*A bit like me*	*Like me*	*Very like me*
51.	I set myself challenging goals that I have to work hard to achieve						
52.	My coach / teacher uses practice to build my confidence in my own ability						
53.	I find it difficult to overcome my feelings of anxiety when I perform						
54.	I imagine myself handling the arousal and excitement associated with competition						
55.	I am expected to include imagery in my preparation						
56.	We practice coping with setbacks so that I can stay confident						
57.	I often keep thinking about the mistakes that I have made and let this interfere with my performance						
58.	When I have to do something that worries me, I imagine how I will overcome my anxieties and perform successfully						
59.	I am encouraged to try things out in my head first						

8. Appendix 8 – ECFC Academy Player Profiling Annual Report

Four Corner Model Component	Coaches Review Score							Seasonal Progress
	1	2	3	4	5	6	7	
Mental								
Attitude								
Bravery								
Competitiveness								
Work rate								
Reactions								
Commitment								
Communication								
Concentration								
Emotional Control								
Confidence								
Physical								
Endurance								
Balance								
Quick feet								
Strength								
Pace								
Power								
Technical								
Receiving								
Passing								
Dribbling								
Turning								
Shooting/Finishing								
1v1 Defending								
Crossing								
Heading								
Tactical								
Awareness								
Movement								
Positioning								
See danger								
Decisions								
Ready to Attack								
Ready to Defend								
Game understanding								