The psychology of bio-banding: a Vygotskian perspective

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Abstract:

In sports, children are typically grouped by chronological age. Age groups are ideal for matching children in terms of experience, cognitive, motor and social development and allowing them to be and compete with their same age peers. They do, however, fail to consider differences in the biological maturity. Strategies are being trialled in football clubs to counteract the effects of individual differences in maturity, such as moving players up or down the age groups and bio banding. These strategies result in players of mixed ages playing together, however there is very little research or guidelines for practitioners regarding the potential benefits or detriments within sport or how best to prepare and develop players in a mixed age group. This paper reviews the literature regarding mixed age groups for school and sport and provides a case study example from an Elite Premier League Academy on how to support players at both ends of the maturity spectrum.

Keywords: maturation; puberty; soccer; growth; athletes.

Traditionally, young athletes are grouped by chronological age for the purpose of training and competition, with specific entry and cut-off dates for membership of each age category. For young footballers in England the prescribed cut-off dates are September 1st to

August 31st of each year; whereas the equivalent cut-off dates for Europe are from January 1st to December 31st. This system is designed to minimise age differences among players to a maximum of one year amongst children born shortly after the cut-off date and children born furthest from the cut-off date (Musch and Grondin 2001). Chronological age groups allow for the matching of children based on playing experience, cognitive, motor and social development, all of which tend to follow age (Bisanz et al. 1995; Much and Grondin 2001). They align players relative to attributes that closely follow age and provide fair competition with equal opportunity for success and age-related development (Helsen et al. 2005). Age groups are not, however, without their limitations. Children of the same chronological age can demonstrate significant variance in biological maturation, confounding the purpose and use of chronological age groupings (Baxter-Jones 1995; Cumming et al. 2017).

Biological maturation refers to progress towards the adult state and is can be defined and assessed in terms of status, timing and tempo (Malina et al. 2004). Maturity status refers to the level of maturation at the age of observation, while timing refers to the age at which specific maturational events occur and tempo the rate at which maturation progresses (Malina et al. 2004; Malina et al. 2015). Children of the same chronological age, and therefore categorised in the same age-group, can vary by as much as five to six years in biological age (Johnson 2015). Players more advanced in maturation tend to have an athletic advantage as a result of greater size, strength, speed and power, especially between the ages of 11 and 14 years when maturity-associated differences in size and function are perhaps the greatest (Malina et al. 2015; Cumming et al. 2017). In comparison, differences in chronological age within age groups (i.e., relative age) are typically no greater than one year. Thus, differences associated with physical maturation within age groups (i.e., size, strength, power, speed) are likely to be much greater than those associated with age (i.e., experience, motor, cognitive and/or social development) (Malina et al. 2007; Johnson 2015).

Aside from physiological attributes, advanced maturation has been shown to have broader implications for child development. Research demonstrates that early maturing boys have a more adaptive-motivational profile (i.e., higher self-esteem & physical self-concept) and are marginally more adept in terms of motor and sport specific skills (Malina et al. 2005; Cumming et al. 2012, 2017). Perceptions of competence are an established driver of participation in sport (Feltz and Petlichkoff 1983). Further, motivation to participate in football has been shown to be related to the iconic value towards the sport, as well as being an exhibition of masculinity (Swain 2000; Cashmore and Parker 2003). Thus, it is possible that early maturing boys gravitate to those activities such as soccer and rugby that demand greater size and athletic aptitude and also hold greater social value (Malina et al. 2015).

Individual differences in biological maturity can create an unequal playing field, where early maturing athletes tend to outperform their later maturing peers due to their physical prowess (Cumming et al. 2017). Consequently, early maturing players within their age group are more likely to be selected for the spine positions, leadership roles, identified as talented earlier, and thus preferentially treated throughout (Bloom 1985; Johnson et al. 2017). Research has consistently evidenced a systematic selection bias favouring early over late maturing boys, especially in sports such as soccer (Meylan et al. 2010; Johnson et al. 2017; Cumming et al. 2017). This bias emerges from the onset of puberty and generally increases in size with age and competitive level (Johnson et al. 2017; Cumming et al. 2017). Although, the physical and functional advantages associated with earlier maturation are attenuated and in some cases reversed in adulthood, there is little to no evidence to suggest the selection bias associated with advanced maturation is reduced or reversed.

Football clubs and National Governing Bodies have employed a range of strategies to account for the challenges presented by individual differences in maturation. Such strategies including the decision to play early and late maturing players up or down an age group,

respectively, and more recently, the practice of bio-banding. The process of bio-banding involves clubs periodically grouping young athletes according to attributes related to growth and maturity rather than their chronological age (Lansley 2016). This strategy of grouping players on the basis of age- and growth-related characteristics is common in most combat sports where young athletes are grouped by age and weight, for the purpose of promoting competitive equity and safeguarding children from injury (Albuquerque et al. 2016). Age and weight specific criterion have also been introduced in a number of collision sports, for the purpose of grouping players (youth rugby and American football) and determining which players are allowed to play specific position (e.g., ball carrier in American football) (World Rugby 2016; Cumming et al. 2017).

The most recent iteration of the bio-banding strategy involves the grouping of athletes relative to biological maturity rather than size. This variation in the strategy makes sense in sports such as soccer, where player performance and selection is more closely associated with maturation than growth status (i.e. height, weight). As with previous bio-banding initiatives, the purpose of this strategy is to not only protect young athletes from injury when severe mismatches in size occur within chronological age groups, but to promote competitive equity and support the identification and development of early and late maturing players (Cumming et al. 2018). Competing against physically matched yet older and more experienced players, early maturing players can no longer rely on their physical advantages and must adapt their game to place a greater emphasis on technical and tactical ability. Conversely, later maturing players who may struggle within their age groups have more opportunity to showcase their talent, utilise their physical and technical skills, and adopt positions of leadership when playing with players matched in maturity (Cumming et al. 2017, 2018; Thomas et al. 2017). Importantly, the process of bio-banding results in teams of mixed age players, providing players with the opportunity to broaden their social circle and compete with new players.

To bio-band athletes, a measure of maturity status is required. Although there are several ways to assess maturity status of athletes, bio-banding generally uses a non-invasive indicator of maturity status, percentage of predicted adult height attained at time of observation (Rogol et al. 2018). To predict adult height, the protocol requires the child's biological parents' heights, the child's chronological age, and an accurate measurement of their current height and weight (Roche et al. 1983; Khamis and Roche 1994). The child's measured height at that moment in time, is then expressed as a percentage of their future adult height to estimate current maturity status. Among children of the same age, children nearer their predicted adult height are assumed to be more mature compared to those further away from their predicted height. Using these percentages of predicted adult height attained at the time of observation, permits the grouping of athletes into maturity classifications (Cumming et al. 2017).

Bio-banding reorganises players from a range of chronological age groups into small percentage ranges of predicted adult height attained. Typical maturity classifications used include 80-85%, 86-90% and 91-95% of predicted adult stature; these bands reflect several phases of adolescent growth, about the time of take-off, the interval between take-off and peak height velocity and the interval of peak height velocity and post-peak height velocity respectively (Thomas et al. 2017; Cumming et al. 2018; Bradley et al. 2019; Malina et al. 2019). Although these bands span the adolescent growth spurt, they are not fixed, and can be modified as required (Rogol et al. 2018). Players are then grouped accordingly, resulting in a group of players of mixed chronological ages but similar biological ages.

A consequence and criticism of bio-banding is that it creates multi-age groups. Criticisms include that such grouping strategies generate substantial differences in developmental attributes associated with age and experience, i.e., motor, cognitive and social development (Song et al. 2009; Gibson 2016; Witts 2019). These differences are, however, no greater than the equivalent differences in physical maturation that exist within single age

groups. While it is important to recognise the potential challenges associated with grouping children of varying age and experience, it is equally important to note that multi-age groups are widely accepted and implemented in many achievement domains (i.e., education, music, arts) and involve youth of varying ages being purposefully grouped together to play, learn and compete together under one teacher for their perceived educational benefits (Veenman 1995). Multi-age groups in education and sport are also quite common in smaller and more remote communities (e.g., Hebrides, Orkney & Shetland) where the populations and/or availability of young children/athletes may be limited (Cornish 2015). The overwhelming majority of research investigating the practice of multi-age groups has been conducted within the context of education, with limited consideration of the benefits and/or disadvantages of the practice in sport. There has been much debate as to whether mixing children of varying ages has positive, negative or inconsequential effects (Veenman 1995, 1996; Cornish 2015). Research in education suggests, however, that multi-aged groups formed with a pedagogical motive are generally beneficial for both younger and older children within the group (Gray 2011).

The mixing of children of different ages in achievement contexts has been shown to benefit both younger and older children; albeit in different ways (Purtell and Ansari, 2018). When younger children play with older children they not only observe and imitate but are able to engage and learn from activities that without the support of older children, they would be unable to do (Gray 2011). The set of activities and skills which young children can only engage in with older more skilled children is referred to as a zone of proximal development (ZPD); a term that was first coined by Vygotsky, a Russian psychologist in the 1930's. Vygotsky proposed that children are most likely to develop their understanding and new skills through interacting with others within their zones of proximal development (Wood et al. 1976; Vygotsky, 1978; Gray 2011). Applied to the context of bio-banding, one could argue that early maturing players, by virtue of competing with and against older yet physically matched peers,

are more likely to be stretched within their zones of proximal development. Further, older yet late maturing players have the opportunity to consolidate their learning and understanding of the game through the process of mentoring and supporting younger players (Gray 2011).

The work of Lev Vygotsky has become the foundation of much research and theory in cognitive development over the last couple of decades, specifically what is now known as Social Development Theory (Schaffer 1996). Vygotsky's theories stress the fundamental role of social interaction in the development of cognition (Vygotsky 1978), young children are curious and actively involved in their own learning and the discovery and development of new schemas. According to Vygotsky (1978), much of the important learning comes from the child and social interactions facilitated and directed by a skilful tutor; known as cooperative or collaborative dialogue (McLeod 2018). When a child seeks to understand the actions or instructions provided and internalises the information, this allows them to learn and use it to guide and regulate their own performance. By learning to do this, a child becomes more competent and learns to act more independently; according to Vygotsky, this type of social interaction involving cooperation and collaborative dialogue promotes cognitive development. Vygotsky's (1978) work highlights the ZPD where a child learns to achieve independence with guidance and encouragement; allowing a child to develop skills they will use on their own, developing higher mental functions (McLeod 2018). Vygotsky (1978) defined ZPD as: "The distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (others)" (p. 86).

****Figure 1 near here****

Adapted from Steve Wheeler, University of Plymouth, 2013

Vygotsky views interaction with peers an effective way of developing skills and strategies to problem solve, being able to learn and develop together to create a greater understanding and applying this to performance (McLeod 2018).

Vygotsky (1981) also highlights the social origins of individuals mental functioning;

> Any function in the child's cultural development appears twice, or on two planes. First it appears on the social plane, and then on the psychological plane. First it appears between people as an inter-psychological category, and then within the child as an intra-psychological category. This is equally true with regard to voluntary attention, logical memory, the formation of concepts, and the development of volition…it goes without saying that internalization transforms the process itself and changes its structure and functions. Social relations or relations among people genetically underlie all higher functions and their relationships (p. 163).

To support this work, Wikley and Bullock (2006) use the notions from Vygotsky (1978) and Bruner (1977) describing the learning process as a "cycle of scaffolding-handover-self monitoring" (p.23). *Scaffolding* occurs when "the learners work with the support of the teacher (i.e., coach, older child) to identify and assimilate knowledge" (p. 23). *Handover* refers to the need in an educational relationship "to move between an interaction that facilitates access to new information and one that encourages self-determination to enable the learner to absorb the new knowledge or skill" (p. 23). *Self-monitoring* refers to a learner being able "to distinguish between the support they are given by the more capable other and their own efforts, and also to assess their performance during the task" (p. 23). This cycle is viewed in the context of metacognition, thinking about thinking, which implies the child is aware and developing

independence for their own learning in order to take the appropriate action (Jones 2006). Through this cycle, the tutor is assisting the child to become more aware of their achievements by guiding them to develop and learn about themselves through clue, hints, explanations, social participation, encouragement, regulating and controlling the child's focus of attention and so on (Lindblom and Ziemke 2003). Vygotsky (1978) also related imitation and learning to the ZPD, arguing that children will imitate and learn to problem solve, when they are in a psychologically safe environment, allowing for growth and development without being judged. This is supported by Vygotsky (1978) "human learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them" (p. 88).

Criticisms have been raised against Vygotsky's work as he did not pay enough attention to the biological factors, neglecting the biological line of development, especially the physical maturation of a child (Lindblom and Ziemke 2003). Despite this, Vygotsky's theory of cognitive development stresses that individual intelligence emerges as a result of biological factors that actively participate in a physical and social environment. This meaning, the biologically early maturers are also cognitively more developed (Lindblom and Ziemke 2003). Within the context of sport, the late maturing athletes will struggle physically, and potentially psychologically, and with this in mind, it is important to facilitate growth for all athletes, regardless of their physical maturity. It has been previously mentioned that children develop and learn from social situations, thus allowing children of mixed maturity to socialise together develops cognitive skills for all, by learning from peers, and assessing various and different coping mechanisms to deal with various situations.

Opportunities to lead, nurture and teach automatically arise from being the oldest in the group (Brody et al. 1983; Gray 2011); as is the case for the late maturing children in bio-banded activities. Older children in the group take up the responsibility to teach the younger children, and as learning and teaching have been shown to be bi-directional, both the younger and the

older children learn from this; The younger children learn a new concept or skill, and the older children enhance their learning by teaching and explaining the concept to their younger counterparts (Gray 2011). Older children consequently benefit from taking up these teaching and nurturing roles, which they would not be able to develop within an age matched or chronological age group. In line with this reasoning, older late maturing players cited the opportunity to engage in leadership and mentoring behaviours as a primary reason for supporting the integration of bio-banding as part of the Premier League's existing Academy games program (Cumming et al., 2018).

Despite the benefits for both older and younger children within age mixed groups, there seems to be a continuous struggle to deliver this type of set-up. Parents of older children often worry their child will not be pushed or challenged enough and will therefore not reach their potential; equally parents of younger children within an age-mixed group are often anxious their child will not be able to keep pace with the older children and their child will therefore fall behind (Cornish 2015). Research has shown, however, that mixed age classes have no detrimental effect on academic achievement (Veenman 1995), children tend to develop other skills than just academic grades (Cornish 2015) and they tend to have a more positive attitude towards themselves, others and school (Veenman 1996; Stone 1998).

****Figure 2 near here****

Adapted from: Literacy Professional Learning Resource – Key Concepts – AusVELS Levels 7 to 10 – Zone of Proximal Development and Scaffolding, 2016)

Alongside Vygotsky's work, Bruner suggests (1966) that in relation to scaffolding, important outcomes not only include problem-solving but also the ability to be creative in ideas to help and facilitate performance for oneself. Furthermore, he suggests that cognitive growth involves an interaction between capabilities and culturally invented challenges to test one's

capabilities (Bruner 1966). Both Vygotsky and Bruner (1977; 1978) agree that the aim is to develop autonomous learners, in the sense that they have the ability to learn and know how to learn and develop. Consistent with this hypothesis, early maturing players reported having to play more creatively and having to find new ways to succeed when competing against older and physically matched peers.

Consistent with the Theory of Embodied Cognition, the football club's philosophy of player development holds that the mind and body must be viewed as interconnected and not independent (Wellsby and Pexman 2014). Embodied cognition (EC) is not a new concept, and holds that sensorimotor experiences play a key role in healthy child development. This proposition is supported through the work of researchers such as Vygotsky and Piaget, who note the importance of the environment and social interactions in relation to cognitive, motor, emotional and social development (Piaget 1952; Vygotsky 1978; Laakso 2011). Researchers have challenged that children use sensorimotor knowledge and interactions with their environment to acquire information, however, the research agrees that embodied experience is relevant for higher-order cognitive functioning (Wellsby and Pexman 2014). The role of embodiment is important for each individual child, regardless of where they are in their biological maturation. EC is known by some theorists as a continuous process as all conceptual representations are composed of perceptual and action experiences (Thelen 2008), and the ongoing development of sensations, action, and language across a child's development is influenced by the experiences that child is exposed to in their environment (Borghi and Cimatti 2010). Therefore, having the ability to bio-band or move children according to their maturation age allows for other environmental exposures which ultimately facilitates learning, growth and development.

As noted, bio-banding involves the grouping of children of similar maturity levels, but of different chronological ages. There is however, in the context of sport, limited guidance as

to how such practices (i.e., multi-age groups) are best structured and/or introduced. At what age should multi age groups be introduced? What are the potential benefits and pitfalls of such practices, and what can the coach do to best support older and younger children in such learning environments? Research exploring the potential benefit and pitfalls of such grouping strategies are largely limited to education, with limited consideration of such practices in the context of sport. Research pertaining to the implementation of multi-age group in sport is limited and, thus, there is very little guidance or literature on how best to prepare and manage these composite groups. The existing guidance currently provided by National Governing Bodies in terms of how to best manage mixed age groupings in sport focussed upon the issues of safety and safeguarding of the young athletes (CPSU Briefing 2015; Basketball England 2018), with limited consideration of the broader implications of such practices. Current NGB guidelines address supervision, physical safety, travel arrangements, and codes of conduct for when groups of mixed aged individuals participate together (CPSU Briefing 2015). Although safety of the children is paramount, guidelines on how best to group, manage, educate and develop children of mixed ages in sport is absent.

Education around the benefits of bio-banding and mixed age groups within sport can remove the stigma and negative perceptions associated with playing in a different age-group. The prospect of playing down an age group may be perceived by players and parents, alike, as a punishment or an indication of poor performances or potential, resulting in feeling of worry and/or inadequacy (Witts 2019). Examples of players who have been late maturing, played down and age group yet gone on to succeed at the highest levels (e.g., Alex Oxlade-Chamberlain, Jesse Lingard) can, however, be used to demonstrate that playing down is not a barrier to development (Witts 2019). Similarly, early maturing boys should be educated on the purpose and benefits of playing against older yet physically matched players and the risk that by not doing so they may neglect the development of their technical, tactical and psychological

skills. Although, advanced maturity has been shown to be unrelated to technical skill (Cripps et al. 2016), early maturing players must continue to develop their technical and tactical attributes to ensure they are a well-rounded athlete when their physical advantage is diminished, when later maturing athletes "catch-up" (Cripps et al. 2016). Finally, players, parents and coaches should also be made aware that bio-banding is just one of a range of teaching strategies that can be used to present players with new learning experiences, challenges and opportunities without the constraints of maturation in a chronological age group (Abbott et al. 2019).

It is important to consider that as a football academy, it is not necessary to bio-band individuals all the time, it is beneficial for children to be within their own age group to learn and develop in various aspects, allowing them to adapt to the environment and deal with the stressors they face. From an evolutionary perspective, the brain evolves to organise and control movement, where individuals learn to assess and predict behaviour. This acceptance and adaptation of behaviour plays a significant role in the individual's ability to survive (Tomporowski et al. 2011). Researchers (Spencer et al. 2006) have also stated that the interaction between sensorimotor integration and the environment plays a critical role in the development of certain cognitive abilities. Firstly, cognition is a result of an individual's ability to interact with the environment. Where they have control over their desired actions (Tomporowski et al. 2011). Secondly, physical structure of how an individual is influenced by the environment constrain the types of cognitive processes available. An individual's behaviour will change and emerge moment to moment, over time, and influence future actions. Therefore, within the context of football, individuals are coupled within age groups and depending on physical maturity will depend on one's perception of the world. This is where research is suggesting that subtle variations in practice routines may influence how children learn and develop, especially through their physical actions and consequences. Having different maturity

in a group can help develop all learners as children have to learn to problem-solve with the resources that they have available to them which fosters development of executive functioning (Tomporowski et al. 2011). However, the evidence collected from various pieces of research has stated that there needs to be mental demands within physical activity for the emergence of executive functioning (Tomporowski et al. 2011).

Within the Football academy environment, the above research has been considered and a facilitative developmental environment has been created to ensure that all maturations cater for cognitive development. From bio-banding players into their maturation age, this allows for various mental process to occur dependent on the physical maturity. With early maturers, players will be physically able to cope with stressors and therefore linking to Vygotsky's model of ZPD, individual's competence physically may not be challenged, therefore feeding boredom and ultimately not developing the cognitive processes. Similarly, late maturing players may be physically challenged too much, causing anxiety and an individual's perception of the environment causing harm to their development. Studies have drawn from arousal theories, hypothesising an inverted U-shaped function between arousal and performance when assessing the consequences of individual bouts of physical activity on cognitive functioning (Tomporowski et al. 2011). Easterbrook (1959) states that these theories predict that performance will improve to an optimal level as arousal increases, but at a certain point performance will start to deteriorate. From all the evidence and research provided, providing bespoke psychology sessions for players maturation age, allowed for the cognitive processes to be developed in according with all theories stated, ultimately working within the ZPD. For example, players that have been banded together as early maturers have sessions to address difficulties and various coping skills that can help accommodate and facilitate to performance. Having the ability to cope with adversity and still being able to perform is something that may be out of the norm and therefore by giving these players the resources to stay within that ZPD

and additionally be able to cope when anxiety may be present. In terms of the later maturers, it is a chance to explore leadership behaviour and address what this may look like as well as creating enhanced self-awareness to embrace the leadership role and responsibilities. Similarly, to the early maturers, psychology sessions are created to provide these players with the correct resources to excel in this area. In line with the research, these bespoke psychology sessions are designed for the 'scaffolding' to take place. Its then working with the multi-disciplinary team (MDT) of staff to ensure that these players can practice utilising the resources they have learnt within a psychological safe environment, allowing them to still have guidance but creating some independence to practice, known as the 'handover' learning process. To continue with the learning process, reflection is required and done through the MDT to ensure that the main objectives were addressed and achieved, reflecting on what went well and what could have been done better. It is also important to gain feedback from the players within those sessions to ensure the objective is met. Feedback has highlighted that players liked the bespoke psychology sessions as players were experiencing similarities and it allowed them to understand that they are not the only ones experiencing anxiety or boredom etc.

Within the Football Club, the psychological support for this particular project lasted six weeks. The project included players from the U14/15 age group. Players who were early maturing within the group (playing up an age group) had bespoke weekly sessions lasting between one to one and half hours. Within this group there were three players playing up an age group for the six weeks. Within the late maturing players there were four players who were playing in the age group below in line with their maturation, who also had bespoke weekly sessions lasting between one to one and half hours. The psychology sessions included the group of players and the psychologist for that age group. All sessions were set up like focus groups, where different challenges were discussed and how to overcome these. A safe space was created where players were able to show vulnerability. Over the latter part of the six-week

intervention, staff members were invited to listen and contribute to sessions, allowing all staff to say the same message as well as hearing various different perspectives. Despite all the formal sessions being within a classroom setting, players had skills to try out on the pitch and in situ. With the MDT staff aware of the skills, they showed encouragement and facilitated the skills being learnt and practiced.

Early maturers coupled to assess various challenges that they may now face when out on the pitch with their maturation age, becoming exposed to situations that they have not experienced before due to their physical stature within their own football age group. For example, dealing with frustrations of being 'bullied off the ball', 'not being physically bigger than others', and 'not being able to control aspects that are out of their control'. Bespoke focus groups were adapted for these early maturing athletes, aiding players to cope with new sensations that were arising for them at the time, especially with the new challenges. Late maturing players focus on standing up and leading, something that they may not have experienced when in their chronological age groups. Being able to show self-efficacy, self-worth and self-esteem will contribute to their mental functions and ultimately performance. The late maturer's focus on leadership abilities, embodying this into approach and identity on to the pitch. Learning to develop new skills and behaviours which ultimately will contribute to performance and help facilitate growth. By creating a safe environment for players to speak over the six-weeks players were able to provide honest feedback about how they found the small groups and the focus solely being on either 'leading and developing these skill sets (late), or coping with adversity and challenge (early)'.

When conducting both the focus groups for the late and early maturing players, although the content changes, the framework stays the same; coming from the embodied approach, players are made aware of their perceptions and how this influences their actions. Players are taken through a journey, despite their environment and stressors, learning how to

assess and accept what is being presented to them. The focus group sessions then provide them with skills to be able to adapt behaviour and apply that into performance. At the club, it is known as the 4A's; Assess, Accept, Adapt, Apply. As research has stated, when aiding and facilitating cognition, a child is improving their perception, pattern recognition, attention, memory, working memory, executive function, concept formulation and reasoning, intelligence, and academic achievement (Tomporowski, 2003). This is when these individuals are working within their ZPD (Vygotsky, 1978). This work supports Wikley and Bullock (2006) "cycle of scaffolding-handover-self monitoring" (p.23). These maturity couplings also provided an opportunity for discussion and social comparison, encouraging peer-learning, problem solving and support, and allowing individual players to realise that others may have had similar experiences (McLeod, 2018).

Conclusion:

Mixed age groups in sport can facilitate learning and development for both the older and the younger individuals. Within the Football Academy, mixed age groups are created with a pedagogical motive, by moving players up or down the age groups or bio-banding. This not only has benefits in terms of reducing large differences in biological maturation but also enables several other learning opportunities for both the older and younger players. Using an MDT approach, the club delivers psychological sessions to permit learning and scaffolding to take place within the mixed-age or bio-banded group. Further research needs to be conducted regarding mixed-age groups within sport.

References

Abbott W, Williams S, Brickley G, Smeeton NJ. 2019. Effects of Bio-Banding upon Physical and Technical Performance during Soccer Competition: A Preliminary Analysis. Sports (Basel) 7(8):193.

Albuquerque MR, Fukuda DH, Da Costa VT, Lopes, MC, Franchini E. 2016. Do weight categories prevent athletes from the relative age effect? a meta-analysis of combat sports. Sport Sci Health. 12(2):133.

Basketball England. 2018. Mixed age group guidance- best practice on different age groups playing and competing. [accessed 2019 Aug 20]. https://www.basketballengland.co.uk/news/mixed-age-group-guidance-best-practice-on-different-age-groups-playing-competing/.

Baxter-Jones ADG. 1995. Growth and Development of Young Athletes: Should Competition Levels be Age Related? Sports Med, 20(2):59-64.

Bisanz J, Morrison FJ, Dunn M. 1995. Effects of age and schooling on the acquisition of elementary quantitative skills. Dev. Psychol. 31(2):221-236.

Bloom B. 1985. Developing Talent In Young People. New York: Ballantine Books.

Borghi AM, Cimatti F. 2010. Embodied cognition and beyond: acting and sensing the body. Neuropsychologia. 48(3):763–773.

Bradley B, Johnson D, Hill M, McGee D, Kana-Ah A, Sharpin C, Sharp P, Kelly A, Cumming SP, Malina RM. 2019. Bio-banding in academy football: player's perceptions of a maturity matched tournament. Annals of Human Biology. 46(5): 400-408.

Brody GH, Graziano WG, Musser LM. 1983. Familiarity and children's behavior in same-age and mixed-age peer groups. Developmental Psychology. 19(4): 568-576.

Bruner J. 1966. Toward a theory of instruction. Cambridge, Mass: Belknap Press of Harvard University.

Bruner J. 1977. The Process of Education. Cambridge, MA: Harvard University Press.

Cashmore E, Parker A. 2003. One David Beckham? Celebrity, Masculinity, and the Soccerati. Sociol. Sport J, 20(3): 214-231.

Cornish L. 2015. Are mixed-grade classes any better or worse for learning? [accessed 2019 Sept 7]. https://theconversation.com/are-mixed-grade-classes-any-better-or-worse-for-learning-38856.

CPSU Briefing. 2015. Involving young people in mixed-aged sport or activity. [accessed 2019 Sept 7]. https://thecpsu.org.uk/resource-library/best-practice/involving-young-people-in-mixed-age-sport-activity/.

Cripps AJ, Hopper L, Joyce C. 2016. Maturity, physical ability, technical skill and coaches' perception of semi-elite adolescent Australian footballers. Pediatric exercise science, 28(4): 535-541.

Cumming SP, Sherar LB, Pindus DM, Coelho-e-Silva MJ, Malina RM, Jardine PR. 2012. A biocultural model of maturity-associated variance in adolescent physical activity, Int Rev Sport Exerc Psychol. 5(1): 23-43.

Cumming SP, Lloyd RS, Oliver JL, Eisennnann JC, Malina RM. 2017. Bio-banding in Sport: Applications to Competition, Talent Identification, and Strength and Conditioning of Youth Athletes. J. Strength Cond. Res. 39(2):34-47.

Cumming SP, Brown DJ, Mitchell S, Bunce J, Hunt D, Hedges C, Crane G, Gross A, Scott S, Franklin E. et al. 2018. Premier League academy soccer players' experiences of competing in a tournament bio-banded for biological maturation. J Sports Sci. 36(7): 757-765.

Easterbrook JA. 1959. The effect of emotion on cue utilization and the organisation of behavior. Psychological Review, 66(3):183-201.

Feltz DL, Petlichkoff L. 1983. Perceived competence among interscholastic sport participants and dropouts. Can J Appl Sport Sci, 8(4):231-235.

Gibson N. 2016. Bio-banding is footballs big idea for developing young talent-and why it might not work. [accessed 2020 May 15]. https://theconversation.com/bio-banding-is-footballs-big-idea-for-devloping-young-talent-and-why-it-might-not-work-64988

Gray P. 2011. The Special Value of Children's Age-Mixed Play. Am. J. Play. 3(4):500-522.

Helsen WF, Van Winckel J, Williams AM. 2005. The relative age effect in youth soccer across Europe. J Sports Sci, 23(6): 629-636.

Johnson A. 2015. Monitoring the immature athlete. Aspetar Sports Medicine Journal. 1:114-118.

Johnson A, Farooq A, Whiteley R. 2017. Skeletal maturation status is more strongly associated with academy selection than birth quarter. Sci Med Football. 1(2):157-163.

Jones RL. 2006. The Sports Coach as Educator: Reconceptualising Sports Coaching. Int J Sports Sci Coa. 1:405-412.

Khamis HJ, Roche AF. 1994. Predicting Adult Stature Without Using Skeletal Age - The Khamis-Roche Method. Pediatrics, 94(4): 504-507.

Laakso A. 2011. Embodiment and development in cognitive science. Cogn. Brain Behav. 15, 409–425.

Lansley P. 2016. 'Bio-banding will create better leaders and people'. [accessed 2019 Sept 10]. https://www.premierleague.com/news/58833.

Lindblom J, Ziemke T. 2003. Social Situatedness of Natural and Artificial Intelligence: Vygotsky and Beyond. Adaptive Behavior. 11(2): 79-96.

Literacy Professional Learning Resource – Key Concepts – AusVELS Levels 7 to 10 – Zone of Proximal Development and Scaffolding. 2016. Education.vic.gov.au. [accessed 20 September 2016, from http://www.education.vic.gov.au/school/teachers/teachingresources/discipline/english/proflearn/Pages/velszopds56.aspx

Malina R, Bouchard C, Bar-Or, O. 2004. Growth, Maturation, and Physical Activity. 2nd ed. Champaign, IL: Human Kinetics.

Malina RM, Cumming SP, Morano PJ, Barron M, Miller SJ. 2005. Maturity status of youth football players: A non-invasive estimate. Med. Sci. Sports Exerc. 37(6):1044-1052.

Malina RM, Ribeiro B, Aroso J, Cumming SP. 2007. Characteristics of youth soccer players aged 13-15years classified by skill level. Br. J. Sports Med. 41(5):290-295.

Malina RM, Rogol AD, Cumming SP, Silva M, Figueiredo AJ. 2015. Biological maturation of youth athletes: assessment and implications. Br. J. Sports Med. 49(13):852-859.

Malina RM, Cumming SP, Rogol AD, Coelho-e-Silva MJ, Figueiredo AJ, Konarski M, Koziel SM. 2019. Bio-banding in youth sports: Background, concept, and application. Sports Medicine, 49: 1671-1685.

McLeod SA. 2018. Lev Vygotsky. [accessed 2019 Aug 05]. https://www.simplypsychology.org/vygotsky.html.

Meylan C, Cronin J, Oliver J, Hughes M. 2010. Talent Identification in Soccer: The Role of Maturity Status on Physical, Physiological and Technical Characteristics. Int J Sports Sci Coa. 5(4):571-592.

Musch J, Grondin S. 2001. Unequal competition as an impediment to personal development: A review of the relative age effect in sport. Developmental Review, 21(2):147-167.

Piaget J. 1952. The Origins of Intelligence in Children. New York: Norton & Co.

Purtell KM, Ansari A. 2018. Classroom Age Composition and Preschoolers' School Readiness: The Implications of Classroom Quality and Teacher Qualifications. AERA Open. 4(1):1-13.

Roche A, Tyleshevski F, Rogers E. 1983. Non-invasive measurements of physical maturity in children. Research Quarterly for Exercise and Sport. 54(4):364-371.

Rogol AD, Cumming SP, Malina, RM. 2018. Biobanding: A New Paradigm for Youth Sports and Training. Pediatrics Perspective. 142(5).

Schaffer R. 1996. Social development. Oxford: Blackwell.

Song R, Spradlin TE, Plucker JA. 2009. The Advantages and Disadvantages of Multiage Classrooms in the Era of NCLB Accountability: Education Policy Brief. Center for Evaluation and Education Policy. 7(1):1-8.

Spencer JP, Clearfield M, Corbetta D, Ulrich B, Buchanan P, Schoner G. 2006. Moving toward a grand theory of development: in memory of Ester Thelen. Child Dev, 77(6):1521-1538.

Stone A. 1998. The Metaphor of Scaffolding: It's utility for the Field of Learning Disabilities. Journal of Learning Disabilities. 3(4):344-364.

Swain J. 2000. 'The Money's Good, The Fame's Good, The Girls are Good': The role of playground football in the construction of young boys' masculinity in a junior school. British Journal of Sociology of Education. 21(1): 95-109.

Thelen E. 2008. Grounded in the world: developmental origins of the embodied mind. In. Overton WF, Muller U, Newman JL, editors. Developmental Perspectives on Embodiment and Consciousness. New York: Taylor & Francis Group; p.99–130.

Thomas C, Oliver J, Kelly H, Knapman H. 2017. A pilot study of the demands of chronological age group and bio-banded match play in academy youth soccer. Grad J Sport Exer Phys Edu Res. 1:s10.

Tomporowski PD. 2003. The Psychology of Skill: A Life-Span Approach. Westport, CT: Praeger.

Tomporowski PD, McCullick BA, Horvat M. 2011. Role of Contextual Interference and Mental Engagement on Learning. New York: Nova Science Publishers, Inc.

Wellsby M, Pexman P. 2014. Developing embodied cognition: insights from children's concepts and language processing. Front Psycholo. 5:506.

Wikley F, Bullock K. 2006. Coaching as an educational relationship. In. Jones RL, editors. The Sports Coach as Educator: Re-conceptualising Sports Coaching. London: Routledge.

Witts J. 2019. Training Secrets of the World's Greatest Footballers: How Science is Transforming the Modern Game. London: Bloomsbury Publishing PLC.

Wood D, Bruner J, Ross G. 1976. The role of tutoring in problem solving. J. Child Psychol. Psychiatry, 17, 89−100.

World Rugby. 2016. Weight consideration guideline. [accessed 2020 June 16]. https://playerwelfare.worldrugby.org/?subsection=64

Veenman,S. 1995. Cognitive and Noncognitive Effects of Multigrade and Multi-Age Classes: A Best-Evidence Synthesis. Rev. Educ. Res. 65(4): 319-381.

Veenman S. 1996. Effects of Multigrade and Multi-Age Classes Reconsidered. Rev. Educ. Res. 66(3): 323–340.

Vygotsky LS. 1978. Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

Vygotsky LS. 1981. “The genesis of higher mental function”, in: Wertsch JV, editors. The concept of activity in Soviet Psychology. Armonk, NY: Sharp; p.144-188.