

Coach ratings of skills and their relations to practice, play and successful transitions from
youth-elite to adult-Professional status in soccer

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Abstract

Elite soccer players (~13 yr) from UK professional academies were rated on technical, tactical, physical and creative skills by coaches at time 1 (T1). Players estimated accumulated hours in soccer practice (coach-led activities) and play (self-led activities) during childhood. Coach-skill ratings were again collected ~2.5 yr later (T2) for players that received a professional contract at ~16 yr. Adult-professional status was determined at T3 (players ~ 20 yr). Skill ratings distinguished across the three “future” groups (Academy-only, Youth-Professional only and Adult-Professional) at both T1 and T2, for all but creative skill. For players that attained youth-professional status, medium correlations were noted between childhood practice and technical and creative skill at T1. Both childhood and career practice amounts were better related to T2 skill ratings than T1. Play was not related to any skills. Within groups of young, youth elite athletes (~13 yr), domain-specific play in childhood, and to a lesser degree practice, were not good discriminators of specific-skills and later “professional” success. The effects of sport-specific practice on the development (and discriminability) of skills takes time to emerge. There was no evidence that additional time in self-led play was related to the development of these skills.

Introduction

Current models of youth development designed to identify and nurture prospective soccer players have been criticized due to their overall inefficiency and lack of predictive utility (e.g., Barreiros, Côté, & Fonseca, 2014). In this paper, we evaluate elements of high level skill development models through a prospective research design. We test whether ratings of soccer skills (technical, tactical, physical and creative), collected from elite-youth players and their coaches, differ across future skill groupings at two key transitions in elite soccer; from youth-Academy to youth-Professional, and then on to adult-Professional. We also assess the relationships between these skills and engagement in childhood soccer activities (soccer specific play and practice).

Conceptual models of high level sports skill development

The Developmental Model of Sport Participation (DMSP, see Côté, Murphy-Mills, & Abernethy, 2012) is a prominent model of sport-expertise development (Bruner, Erickson, Wilson, & Côté, 2010). The DMSP emerged as a counterpoint to deliberate practice theory (Ericsson, Krampe, & Tesch-Römer, 1993). According to this latter theory, there is a monotonic relationship between skill attainment and hours accumulated in highly effortful (cognitive and physical), relevant and purposeful practice, designed with the intention of performance improvement (see also Ericsson & Pool, 2016). Practice activities are proposed to be engaged primarily for improvement, rather than for their inherent enjoyment. As such, early engagement in domain-specific deliberate practice activities is considered necessary for later skill attainment. The DMSP departs from this early engagement in practice framework (termed the early specialization/practice pathway) in suggesting a second, alternative pathway to high levels of skill attainment. This second

pathway, termed the early diversification/play pathway, consists of multi-sport involvement and participation in high volumes of deliberate play activities in both the primary sport and other sports from an early age, followed by specialization during adolescence. Deliberate play activities are assumed to be self or peer-led, highly enjoyable, unstructured games, using rules adapted from the adult form that are typically monitored by the athletes (Côté, Baker, & Abernethy, 2007). Empirical evidence has been provided showing significant support for the important role of practice in later skill attainment (for reviews see XX). There is also evidence that high level skills are promoted by this second diversification/play pathway CAN YOU PROVIDE REFS IN SUPPORT?

A third pathway exists, which provides a more nuanced version of the above two pathways and seems to perhaps provide a better description of development in elite, professional soccer. The “early engagement hypothesis” recognizes the importance of early engagement in sport-specific practice and minimal diversification, (e.g., Ericsson et al. (1993), as well as the importance of early sport-specific play in developing expertise (Ford et al., 2012; Ford, Ward, Hodges, & Williams, 2009; Ford & Williams, 2012). Thus, it is the combination of early engagement in the sport, along with both sport-specific practice and play, which leads to later success at adult levels.

Developmental sport activities and their relations to perceptual-cognitive skills

In several theoretical and empirical papers, early involvement in diversified and play-type activities have been proposed to facilitate the development of psychological skills including; motivation (e.g., Côté, Lidor, & Hackfort, 2009; Côté, Murphy-Mills, & Abernethy, 2012), social skills (e.g., Côté & Erickson, 2015), decision making (e.g., Baker, Côté, & Abernethy, 2003; Berry et al., 2008; Roca, Williams, & Ford, 2012) and creativity.

There has been some evidence to support these ideas, whereby positive relationships have been demonstrated between engagement in both non-sport specific and sport-specific play activities and perceptual-cognitive skills, provided that the sports share similar underlying structures (e.g., participation in related invasion games, Baker et al., 2003; Berry et al., 2008).

The accumulation of high volumes of soccer-specific play has been related to performance on laboratory-based assessments of perceptual cognitive skills; including tactical decision making and anticipation (e.g., Roca, Williams, & Ford, 2012; Williams, Ward, Bell-Walker, & Ford, 2012). In these studies, skilled performers also accumulated more hours in soccer practice compared to less skilled counterparts. The authors suggest that the combination of practice and play offer opportunities to innovate, improvise and respond strategically in game-related contexts, which mirror the same underlying structures involved in match play (e.g., Williams et al., 2012). Similar ideas regarding play has been forwarded by Côté and colleagues, albeit they suggest that these same motoric and perceptual-cognitive skills can be developed predominantly through engagement in other sports and play activities, without any of the potential drawbacks associated with sport-specific practice (e.g., increased injury, psychological burnout, see Côté & Erickson, 2015; Côté et al., 2012).

Creativity, characterized by the generation of several solutions to a given problem which can be denoted as surprising, rare and or original, is viewed as a highly desirable characteristic in soccer (Memmert, 2015; Memmert, Baker, & Bertsch, 2010). As a higher order component of expertise, Ericsson & Lehman, (1999) hypothesize that creativity can only be attained once an individual has mastered the skills within their domain through

sustained practice. As a counterpoint to this view, optimal creative development is thought to be developed through initial predominant involvement in deliberate play and diversified experiences during childhood (Santos, Memmert, Sampaio, & Leite, 2016). Deliberate play activities are thought to afford more opportunities to experiment with new ideas, movements and techniques, more than structured deliberate practice activities (Bowers, Green, Hemme, & Chalip, 2014; Côté et al., 2012; Memmert et al., 2010). Some empirical support has been provided in support of these claims, showing relations between hours accumulated in deliberate play activities and creativity in team sports, including soccer (Koslowsky & Botelho, 2010; Memmert et al., 2010).

Despite these few correlational studies showing support for play as a precursor to later creative play, some authors have argued that the benefits of engagement in play are overstated (MacNamara, Collins, & Giblin, 2015). Although these authors acknowledge that there may be some psycho-social benefits to play, they argue that cognitive and motor skill development is best served via effective practice design, instruction and feedback from expert practitioners (see also Ericsson et al., 1993). In keeping with this viewpoint, published reports suggest that tactical and technical skills are related to hours accumulated in soccer-specific practice (Huijgen et al., 2009; Kannekens et al., 2009). In a cross-sectional comparison of academy and non-academy soccer players in the UK, perceptual-cognitive expertise in soccer (i.e., memory and decision making), in children as young as 8 yr, were attributed to hours in high quality sport-specific practice (Ward & Williams, 2003). However, no data were gathered on sport-specific play in this latter study.

Relations between various skills and adult-success (professional status) in soccer

Several authors have investigated the predictive capabilities of individual soccer skills at the youth level to determine future professional status; including technical (e.g., Höner, Votteler, Schmid, Schultz, & Roth, 2014; Huijgen, Elferink-Gemser, Post, & Visscher, 2009), tactical (e.g., Kannekens, Elferink-Gemser, Post, & Visscher, 2009) and psychological (e.g., Zibung, & Conzelmann, 2014) skills. Although assessments of skills have generally been based on specific (objective) tests, decisions regarding selection to professional status are typically based upon the subjective opinions of coaching staff (Cushion, Ford, & Williams, 2012). Further, the external validity of testing procedures used to isolate specific soccer skills from the game have been criticized as they rarely reflect complexity and contextual factors involved in match play (for reviews, see Ali, 2011; Unnithan et al., 2012). To date, few researchers have made comparisons between multiple skills to assess which one(s) differentiate at the youth level, and later impact selection to the adult, professional level (for exceptions, see Huijgen et al., 2009; Vaeyens et al., 2006). Such comparison allows for conclusions about which skills are important (or at least valued) within an advanced group of players for later success.

In this study, we assess relationships between soccer-specific practice and play activities during childhood and current evaluations of technical, tactical, physical and creative skills, which are considered fundamental for advancement in the sport (Höner et al., 2014; Huijgen et al., 2009; Kannekens et al., 2009; le Gall, Carling, Williams, & Reilly, 2010; Memmert, 2015; Williams & Reilly, 2000). Consistent with deliberate practice theory, we predicted that early exposure to high amounts of soccer practice would be related to all assessed skills. Yet, there was reason to expect that increased time in soccer-specific play activities in childhood would be positively related to ratings of tactical

and creative skill, arguably differentiating successful from non-successful athletes at the highest levels (e.g., Memmert et al., 2010; Roca et al., 2012; Williams et al., 2012).

We studied elite-youth soccer players in the UK at three-time points over a 5 year period to determine how well coach skill ratings at age ~13 yr related to attainment of youth-Professional status at ~16 yr and progression to adult-Professional status at ~19 yr. We expected that the future professional groups would be rated as more skillful in general, particularly the adult-Professional group. Our predictions about group differences in individual skills were somewhat exploratory. There was reason to expect that tactical/creative skills would better distinguish future adult Professional players (e.g., Memmert, 2015). Due to a decline in maturational/relative age advantages as players progress to adult levels (especially within select groups of elite athletes to start), we did not expect physical skills to distinguish across the 3 groups (e.g., Helsen et al., 2012).

Methods

Participants

Altogether, 102 male, elite youth players participated from the youth academies of five professional soccer clubs in Scotland. They were born in 1996/1997 ($M_{\text{age}} = 13.XX$ yr; range 13-15 yr). Only signed players from these professional clubs, which were competing at the highest level of youth soccer in Scotland, were recruited to participate. As part of an earlier study on motivation with a larger age-range of athletes, these 102 youth players had completed questionnaires pertaining to childhood soccer practice and motivation for playing (Hendry et al., 2014). At this time, the players and the coaches also provided evaluations about their soccer-related skills (T1 = Oct. 2011). We followed up these individuals over two further time points, which were ~2.5 years apart. The second time

point was in May 2014 (T2), when some of the players had been offered a full-time professional contract at age 16 yr ($n = 26$; $M_{\text{age}} = \text{XXX}$; 16-18 yr). Coach and player skill evaluations were further gathered at this time. Players that did not progress to T2 we termed the “Academy-only” group ($n = 76$) and no further data were collected from this deselected group, whereas players that progressed were termed youth-Professional players.

The third time point was in October 2016 (T3), which corresponded to the time when the youth-Professional players would have been offered adult professional contracts to play first team soccer in the UK at age 19 yr ($n = 9$; $M_{\text{age}} = \text{XX.XX}$; 19-20 yr). As such, the youth-professional players were further subdivided into the Adult-Professional group and “Youth-Professional only” group ($n=17$).

Procedure

At T1(all players) and T2 (Professional-Youth players only), participants completed a practice history questionnaire (see details below), providing estimates of hours spent in soccer practice and soccer play in childhood (5-12 yr) and up until their current age where relevant. The T2 questionnaire was a truncated version of the T1 questionnaire, focusing on soccer activities between T1 and T2 (~2.5 yr). Coaching staff, (including age group coaches and academy Directors, $N = 8$) provided ratings of technical, tactical, creative and physical skills for each player at T1. At T2, coaches ($n = 6$) from the original cohort repeated skill ratings on the selected players. Players also provided this information at T1. All coaches were fully licenced to UEFA standards and ratings were made relative to average standards of Academy players at a similar age.

At T3, only information concerning selection to adult Professional, first-team soccer was recorded, as provided by academy Directors and coaches. Parents provided passive

consent for their sons to complete the practice history questionnaires before players gave written assent. During initial data collection (T1), participants agreed to be contacted again for future follow up. All procedures adhered to the guidelines of the lead university ethics' board.

Measures

Practice Questionnaires

An adapted version of the Participation History Questionnaire (PHQ, e.g., Ford, Low, McRobert, & Williams, 2010; Ward, Hodges, Williams & Starkes, 2007) was used to ascertain career practice and play estimates. This method of collecting practice history data through prompted recall is regarded as one of the best available methods for obtaining developmental activity histories from elite and developmental athletes (see, Hopwood, 2015). In the questionnaire, operational definitions and examples of organised practice and play were provided and explained to all participants by the research team. Practice was operationally defined as organised soccer-specific activities conducted with a coach/adult engaged in with the primary intention to improve skills/performance (e.g., group soccer practice). Play was operationally defined as unorganised soccer-specific activities that were self/peer-led and were not conducted with a coach/teacher (e.g., street soccer). Further examples of each activity type were given by the research team. Players recorded: (i) number of organised practice sessions/week; (ii) average duration of each session; and (iii) hours/week in soccer play. The estimates were for a typical week/training session and solicited from 5 years of age to present age in 2-year intervals (e.g., 5–6 yr, 7–8 yr). This method of ascertaining data in 2 year intervals is mostly to aid in efficiency in data collection, especially important for young children. Significant breaks from soccer were

recorded and linear interpolation was used to estimate play and practice data during intervening years. Accumulated hours in each activity were calculated by multiplying hr/session, by number of sessions/wk, by weeks of activity/yr (~46 wk in a season), subtracting reported weeks lost through illness/injury.

Reliability and validity of the soccer activity estimates were established through procedures detailed in [Hendry & Hodges \(in review\)](#). These pertained to player-player (within the questionnaire and across T1 and T2), player-parent (T1, $n = 15$; T2 $n = 4$) and player-coach ($n=8$) reliability based on the strength and similarity of the practice and play estimates (see recommendations by Atkinson & Nevill, 1998; Hopwood, 2015). All relationships were moderate to high and increased with proximity to current age.

Skill ratings

Coaches used a 5-point scale (1 = poor to 5 = excellent) to rate each player relative to other players at an age and skill-appropriate level at T1 and T2. The use of subjective coach ratings to assess skill have been used in previous expertise research as a valid and reliable method of skill in the absence of more robust or valid measures of soccer skills (e.g., Ali, 2011; Unnithan et al., 2012). Operational definitions of skills were provided and explained by the research team to aid interpretation by all participants.

Tactical skills were defined by the player's ability to make fast and accurate decisions in relation to the ball, team-mates and opposition (e.g., Elferink-Gemser et al., 2004). Technical skills related to the basic motor aspects of skill including; passing, dribbling, shooting or kicking (e.g., (McMorris, 2004). Physical skills referred to the conditioning necessary to play effectively, such as endurance, speed and strength (e.g., Baker et al., 2003). Creative skills were defined by a person's overall flair and originality in

making decisions and displaying unusual skills (e.g., Memmert et al., 2010). At T1 only, players were asked to rate their own skills relative to others of a similar age and skill.

Although we expected the ratings for the players to be higher overall than the coaches, this allowed for some validity check.

Statistical analyses

Although the skill ratings data were not normally distributed based on the Shapiro-Wilks test, the magnitude of the skewness for each variable (T1 and T2) was less than 1, (Bulmer, 1979), indicating only a tendency towards positive skewness. Further, there were no significant differences in homogeneity of variance between the groups. Taking these factors into consideration and the fact that the sample size was greater than 40, we chose to use ANOVA methods for our analyses due to the robustness of this technique to violations in normality, especially when the other conditions detailed above are met (Glass, Peckham, & Sanders, 1972; Pallant, 2007).

Player and coach skill ratings

For coach and player ratings of skill, intra-class correlations (*ICCs*) indexed the strength of the relationship between variables and percent agreement (*PA*, based on division of the smaller by the largest value for each pair, multiplied by 100) was calculated as an indicator of similarity between measures. To test for differences between player and coach ratings of skill at T1, we ran a 2 Role (player/coach) x 4 Skill-type, mixed ANOVA with follow up Tukey HSD post-hoc tests.

Group differences in skill ratings

MANOVA analyses were used to compare the three “future” groups (Academy-only, Youth-Pro. only or Adult Pro.) for coach ratings of all skills at T1 and T2. Separate,

pre-planned contrasts allowed comparisons between: 1) Academy-only players and future Professional players (T1); and 2) the two Professional groups (Youth-Pro. only & Adult-Pro., T1 & T2). Separate Group (Youth-Pro. only, Adult-Pro.) X Time (T1, T2) repeated measures ANOVAs were conducted to assess change in ratings across time as a function of group. Partial eta squared (η_p^2) are provided as measures of effect size. Bonferroni adjusted pair-wise comparison were used for post-hoc analyses.

Relations between skill ratings and soccer activities

The hours accumulated in soccer practice and play in childhood were correlated with the all skills using Pearson's correlations. Separate analyses were run on coach skill ratings collected at T1 and T2 (career estimates were also correlated with ratings at T2). Separate analyses were run on the Academy-only (T1 ratings) and Professional players (for T1 and T2 ratings). Due to differences in "n" between groups, we focus reporting on *rs* >.30, deemed a medium effect size (Cohen, 1992).

Results

Player and coach skill ratings

At T1, coaches rated the players on average as moderately skilled ($M = 3.4$, range = 2-5), based on comparisons to other "Academy" players (see Table 1). Technical skill received the highest rating ($M = 3.53$) and tactical skill the lowest ($M = 3.26$). These ratings were comparable to those given by the players, although as expected, mean ratings were higher among the players ($M = 3.70$). This "role" effect was statistically significant, $F(1, 2.33) = 34.19, p < .001, \eta_p^2 = .11$. Although there was a main effect for skill-type, $F(1, 2.33) = 15.53, p = .01, \eta_p^2 = .12$, with lower ratings for tactical than technical and physical skills ($ps < .05$), there was no Role x Skill-type interaction, $F < 1$. Player-coach ICCs (whole

sample) were moderate (.35-.50), yet all were statistically significant and all *PAs* were high (88.5 – 99.27%). Within subgroup ICCs were generally stronger, especially for the Professional-youth players; technical ($r = .61, p = .01, 95\% \text{ CI } [.29, .81]$), creative ($r = .74, p = .01, 95\% \text{ CI } [.49, .88]$) and tactical skills ($r = .44, p = .04, 95\%, \text{ CI } [.06, .71]$).

Group differences in skill ratings

Figure 1 (left side) presents the skill ratings at T1 for the Academy-only group and ratings at T1 and T2 for Professional youth players. On the right of the figure, professional groups have been divided into Youth-Pro. only and Adult-Pro. for T1 and T2 ratings.

MANOVA comparing the three different groups, based on T1 skill ratings, was significant, $F(8, 178) = 2.84, p = .01, \text{ Wilks' } \lambda = .79, \eta_p^2 = .11$. Univariate, pre-planned contrasts showed significant differences between Academy-only and Professional players for tactical ($p = .04, d = 0.76$), technical ($p = .02, d = .50$) and physical skills ($p = .03, d = .61$), but not creative skill ($p = .33$). Adjusted pairwise comparisons indicated that professional players were rated higher than Academy-only players (p 's $< .02$). Comparing across Professional groups, the only significant contrast was for creative skill, ($p = .02, d = 1.08$). Contrary to expectations the Youth-Pro. only group was rated higher in creative skill than the Adult-Pro. group ($p = .02$).

A second set of analyses were run comparing T1 and T2 ratings for the two Professional groups. Separate Group X Time mixed ANOVAs showed significant Group x Time interactions for tactical, $F(1, 24) = 14.71, p < .001, \eta_p^2 = .38$; technical, $F(1, 24) = 12.77, p < .01, \eta_p^2 = .32$; and creative skill, $F(1, 24) = 22.16, p < .01, \eta_p^2 = .48$ but not for physical skill, $F(1,24) = 2.22, p = .15, \eta_p^2 = .09$. For tactical and technical skills, pairwise comparisons indicated that Adult-pro.'s scored higher than the Youth-pro only group at T2

only (p 's $< .02$). Tactical and technical skill ratings decreased from T1-T2 for the Youth-pro only group ($p = .01$). Within the Adult-Pro group, tactical skill increased across the same period ($p = .01$) but there was no increase in technical skill ($p = .09$). Creative skills were higher in the Youth-pro only group compared to Adult-pro's at T1 ($p = .01$) but groups were similar at T2 ($p = .23$). Creativity scores were higher at T1 than T2 for the Youth-pro only group ($p < .001$), however an opposite pattern was shown in the Adult-pro group ($p = .01$). For physicals skills there was a main effects of time, $F(1, 24) = 5.21, p = .03, \eta_p^2 = .18$, Pairwise comparisons indicated that physical skill decreased from T1 to T2 ($p = .03$).

Relations between skill ratings and soccer activities

There were no significant relationships between accumulated hours in childhood soccer activities (5-12 yr) and T1 skill ratings (see Table 2). However, within the Youth-Pro. group there were medium sized correlations between practice and technical and creative skills, ($>.30$). For play, all correlations were low ($<.17$). For % hrs in play relative to practice, the correlations were negative ($-.22$ to $-.27$, for creative, technical and tactical skills), although none were significant or $>.30$.

The relationships between hours in childhood soccer activities with T2 ratings of skill for Professional-youth players are displayed in Table 3. Although for the whole sample, correlations were moderate and not significant, within the Youth-Professional only group there were significant correlations between practice hours and technical ($r = .71, p = .002, 95\% \text{ CI } [.50, .84]$) and creative skill ($r = .62, p = .01, 95\% \text{ CI } [.36, .79]$). For Adult-Professional players ($n = 9$), there was a positive correlation between childhood practice and physical skill ($r = .64, p = .05, 95\% \text{ CI } [-.04, .86]$) and a surprising negative relation

between practice and technical skill (also seen in the whole sample, though neither were statistically significant).

Consistent with T1 ratings, there were no significant associations between childhood play and skills ratings at T2. The only moderate, positive relation, was for physical skills ($r = .30$, 95% CI [-.03, .57] whole sample) and a moderate, negative relation for technical skill ($r = -.33$, 95% CI [-.01, .65], Youth-Professional only). For the Youth-Professional only players, accumulating proportionately more hours in soccer play was negatively related to tactical ($r = -.55$, $p = .04$, 95% CI [-.82, -.09]) and technical skill ($r = -.52$, $p = .04$, 95% CI [-.80, -.05]).

Accumulated hours in career practice (start age to T2) were correlated with T2 ratings of technical ($r = .50$, $p = .01$, 95% CI [.12, .67]), tactical ($r = .49$, $p = .01$, 95% CI [.19, .71]), and creative skills ($r = .43$, $p = .03$, 95% CI [.12, .67]), for the whole sample of professional players. Medium to large correlations were evidenced within the Youth-Pro. only group between career practice and tactical ($r = .69$, $p = .01$, 95% CI [.31, .88]), technical ($r = .76$, $p = .01$, 95% CI [.44, .91]) and creative ($r = .60$, $p = .03$, 95% CI [.25, .81]), skills. There was also a large correlation between career practice and physical skill within the Adult-Pro. group ($r = .75$, $p = .02$, 95% CI [.25, .92]). Career soccer play did not significantly correlate with any measure of skill, although within the Adult-Pro. Group, there were medium to high positive correlations between play and tactical and physical skills.

Discussion

We report relationships between developmental soccer activities and ratings of technical, tactical, physical and creative skills, as well as the ability of these skills to distinguish

success in elite soccer (i.e., attainment of a professional contract at adult and/or youth levels). We expected that skill would discriminate across the two transitions, such that the more successful athletes would receive higher ratings at T1 and T2 respectively (adding to their general validity). We also expected that the skill ratings would be related to childhood practice and potentially play, particularly with respect to creative skill for the latter.

Although T1 ratings discriminated Academy-only players from later professional players, showing their general predictive validity, they were not sensitive to individual differences in hours of accumulated soccer practice or play (see also Hodges & Starkes, 1996). T2 skill ratings discriminated the two Professional groups, with higher ratings for the Adult-Pro group in comparison to the Youth-Professional only group. For the professional athletes, skill ratings were positively related to practice (and negatively related to the proportion of play vs. practice). The within-group correlations for the youth-Professional players are particularly significant given that we would expect players to become more alike and harder to distinguish as they progress through elite ranks. However, hours in soccer play did not show expected correlations with ratings of tactical and creative skill (or any skill) at any time point.

Overall, there were few relations between skill ratings provided at T1 and hours accumulated in sport specific play and practice during childhood. In keeping with deliberate practice theory, only sports-specific practice showed any relation to ratings of skills at T1. However, these correlations were small to moderate and mostly within the later youth-professional players (for technical and creative skills). Childhood soccer practice was related to technical and tactical skill ratings provided at T2, particularly within the youth-

Professional only group. These results suggest that the effects of sport-specific practice on the development (and discriminability) of skills takes time to emerge.

Sport-specific play experiences during childhood (5-12 yr) are thought to comprise conditions that facilitate the development of motor, perceptual-cognitive and creative development (e.g., Côté et al., 2012; Ford et al., 2012). We were unable to fully support this proposal at the within group level, at least to the extent whereby relationships between variables were statistically significant. Although we failed to see any significant relationships between childhood play with creativity (e.g., Bowers et al., 2014), the sport specific nature of our creativity measure may have accounted for the lack of consistency across studies. Accumulated hours in soccer practice proved to better discriminate coach skill ratings, particularly career practice (i.e., start age until T2). These findings align with the assertions made by MacNamara et al. (2015) that motor skill development may be best served via effective practice design, instruction and feedback from expert practitioners. While we do not discount the importance of sport-specific play in developing soccer expertise (e.g., Ericsson & Lehman, 1999; Ford et al., 2009; Ford et al., 2012; Hendry & Hodges, in review), these data suggest that the refinement of high level skill commensurate with mastery, and a pre-requisite for creativity (e.g., Ericsson & Lehman), are developed primarily from engagement in sport-specific practice designed and implemented by trained practitioners (e.g., MacNamara et al., 2015). Consequently, for performance attainment and skill development these data do not support ideas that childhood deliberate play activities should take precedence over practice (*cf.*, Côté & Hancock, 2014). However, we fully acknowledge the benefits of a more diversified approach, including deliberate play, for

continued participation and positive youth development (e.g., Côté & Hancock, 2014; Côté, Murphy-Mills, & Abernethy, 2012).

From a skill development perspective, sport-specific play may have other benefits related to increasing overall soccer activity volume and providing opportunity to “practice” foundational elements of skill in a self-paced environment. However, we speculate that the specific constraints surrounding soccer play activities such as the age, and skill level of participants, allied to the game format may have a significant impact on skill acquisition through play. We suggest that carefully structured sport-specific practice, which emphasizes small-sided competition under various constraints and with access to coach feedback, is as or more likely to develop desirable technical, tactical and creative skills, as sport-specific play or even sub-optimal practice conditions (e.g., Hendry & Hodges, 2013). Previous studies have shown similar relationships between accumulated sport specific practice amounts and assessments of technical and tactical skills (e.g., Huijgen et al., 2009; Kannekens et al., 2009). However, hours in soccer-specific play have been shown to explain more of the variance in laboratory-based assessments of tactical skills, including decision making and anticipation, than soccer practice (e.g., Roca et al., 2012, Williams et al, 2012). Although it noteworthy that both sport specific practice and play were significantly related to overall tactical accuracy (Roca et al., 2012).

Reflecting the dynamic nature of youth development, skill ratings changed over time. From T1 to T2, ratings of physical skill decreased (when judged relative to others within their cohort), whereas for all other skills the change in ratings depended on the skill group. For future Adult-Professionals, tactical and creative skill ratings increased, whereas for the Youth-Professional only group, tactical, technical and creative ratings decreased.

Given that the groups were not different at T1, it may be that the period between 13-16 yr is a significant period for skill refinement and discrimination, where evidence of strong(er) perceptual-cognitive skills starts to show. These skills may have been less important for younger athletes whereby tactical acuity is of less importance. Moreover, differences in physical maturity start to even out following peak height velocity at ~13 yr (Neinstein & Kaufman, 2002), potentially allowing for greater discriminability in factors other than speed and strength. The fact that T1 ratings were not good predictors of success at the adult level underlines difficulties associated with attempting to earmark potential future experts using pre-adolescent data (e.g., Barreiros et al., 2014).

Differences in physical skills were only noted when comparing the Academy-only to the Youth professional groups at T2 (~16 yr), but there were no differences between Youth and Adult professional groups (~19 yr). Thus, for the transition to Youth-professional, physical skills matter for selection (as do tactical and technical skills), such that concerns over selection bias towards more physically capable players in adolescence appear valid (e.g., le Gall, Carling, Williams, & Reilly, 2010). A minimum standard of physical competency is likely necessary to play professional soccer, but in terms of distinguishing players at the highest level, physical skills appear to be of less importance for the transition to adult professional status.

As to whether skill measurements (i.e., an objective test vs. coach ratings) contributed to the discrepancies in findings is unclear. The fact that something can be measured objectively, does not make it a more valid measurement of skill (such as a reaction time test, cognitive recall test), nor necessarily more discriminatory (for critiques, see Ali, 2011; Unnithan et al., 2012). Despite their subjectivity, coach evaluations are key

determinants in future decisions about successful progression to professional youth and adult status (e.g., Cushion, Ford, & Williams, 2012). They are by their very nature discriminatory, accounting for the complexity in skills inherent in soccer match-play (e.g., Williams & Reilly, 2000). We are cognizant of the fact that a greater range of coach ratings would have aided the reliability. However, player ratings of skill showed good agreement with coach ratings, even though players rated themselves more highly than coaches (*cf.*, Fogarty & Else, 2005). Moreover, the skill ratings were based on different cohorts of athletes, across different clubs and were provided by different coaches. The fact that these ratings had discriminatory power is therefore significant when considering these sources of variance. That said future research may wish to replicate this general research design using a combination of subjective and objective measurements of skill.

There are several limitations with the current paper. Retrospective recall methods can be prone to recall error and bias (e.g., Hodges et al., 2004). However, the prospective design allowing us to collect data at intervals close to the recorded time-period, and the “eliteness” of our sample, provides further validity to these data in comparison to previous studies requiring adults to reflect upon childhood activities. T2 data collection was recorded at a different time of year in comparison to T1 and T3. However, the 2.5 yr intervals allowed us to assess in real time the factors influencing the separate transitions of interest within the study. One final discussion point concerns the operational definitions of skill and soccer activities. Although our operational definitions of skill were simple, we felt that they were appropriate to the age and intellectual capacity of participants. Further, a team of trained researchers were on hand to aid participant comprehension and elaborate when necessary. Sport specific play was distinguished from practice based upon distinctions

between unstructured, self-directed activities and structured/coach-led activities respectively. We did not isolate activities based on the reason for engagement (fun vs. improvement; *cf.*, Ford et al., 2009). Of course, self-led activities can consist of any activity that could in principle be considered play or practice. Coaches in this study reported that ~50% of practice time involved some sort of semi-structured or unstructured “free-play”. Therefore, to argue for one or another type of practice during childhood may not be fruitful since activities within the various “practice” or “play” definitions are potentially so varied. Future research may wish to investigate the underlying perceptual-cognitive and motor components of each activity type with the development of specific sports skills.

In conclusion, what should be emphasized from our data is that high quality, structured, sport-specific practice, positively contributes to the development of skills more so than unstructured, sport-specific play activities, which are not necessarily designed in a way to maximize skill development. While we accept the role of ancillary of soccer-specific play in developing expertise (e.g., Ford et al., 2009), these data emphasize the importance of quality, coach-led practice designed to improve performance in developing sport-specific skills throughout childhood and adolescence (e.g., Ericsson et al., 1993; MacNamara et al., 2015).

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Table 1. Average coach and player ratings (SDs) at T1 for technical, tactical, physical, and creative skills across the Academy-only (Acad), Professional (Pro) and Youth-Professional only (YPro) and Adult-Professional (APro) groups.

	Technical		Tactical				Physical				Creative					
	Acad	Pro	YPro	APro	Acad	Pro	YPro	APro	Acad	Pro	YPro	APro	Acad	Pro	YPro	APro
Ratings:																
Coach ratings	3.37	3.96	4.12	3.67	3.13	3.58	3.59	3.56	3.34	3.85	3.76	4.00	3.36	3.70	4.00	3.11
(SD)	0.77	0.77	0.78	0.71	0.89	0.86	0.87	0.71	1.00	0.61	0.70	0.50	0.88	0.88	0.70	0.50
Player ratings	3.80	4.04	4.10	4.00	3.57	3.88	3.94	3.86	3.71	3.68	3.56	3.43	3.67	3.83	3.81	3.57
(SD)	(.72)	(.64)	.68	1.0	(.60)	(.58)	.57	.69	(.87)	(.85)	(.96)	.78	(.94)	(.76)	.63	.98

Table 2: Pearson r correlations between T1 skill ratings for all players assessed at T1 as well as separately for the Academy-only (Acad) group and players selected to play professional-youth at T2 (Pro) and Accumulated (Accum) practice /play during childhood as well as % of overall time in play relative to practice (Play %).

	Technical			Tactical			Physical			Creative		
	All	Acad	Pro	All	Acad	Pro	All	Acad	Pro	All	Acad	Pro
Correlations: Childhood (5-12 yr).												
Accum practice	.11	<i>-.04</i>	<i>.33</i>	-.06	-.20	.15	-.07	-.16	.01	.05	-.10	<i>.36</i>
Accum play	.06	-.11	.04	-.12	-.14	-.17	-.06	-.11	.04	-.11	-.16	.01
Play %	.04	-.03	-.23	.20	-.08	-.27	.16	-.03	.04	.10	-.16	-.22

Correlations >.30 have been italicized (medium effect size, Cohen, 1992).

Table 3. Pearson r correlations between T2 skill ratings for all professional players (Pro) and for the subdivided, Professional-Youth only (YPro) and Adult-Professional (APro) groups and Accumulated (Accum) practice /play during childhood (and Play % as a function of play+practice) and across the player's career.

	Technical			Tactical			Physical			Creative		
	Pro	YPro	APro	Pro	YPro	APro	Pro	YPro	APro	Pro	YPro	APro
Correlations: Childhood (5-12 yr).												
Accum practice	.31	<i>.71**</i>	<i>-.56</i>	.23	<i>.37</i>	.01	<i>.29</i>	<i>.25</i>	<i>.64</i>	<i>.39</i>	<i>.62**</i>	<i>-.10</i>
Accum play	.16	<i>-.04</i>	<i>.11</i>	.01	<i>-.32</i>	<i>-.18</i>	<i>.30</i>	<i>.04</i>	<i>.23</i>	<i>.06</i>	<i>-.04</i>	<i>-.02</i>
Play (%)	<i>-.09</i>	<i>-.52*</i>	<i>.40</i>	<i>-.17</i>	<i>-.55*</i>	<i>-.11</i>	<i>.09</i>	<i>-.03</i>	<i>-.32</i>	<i>-.22</i>	<i>-.45</i>	<i>-.02</i>
Correlations: Whole career (5 yr -T2).												
Accum practice	<i>.50*</i>	<i>.76**</i>	<i>.04</i>	<i>.49*</i>	<i>.69**</i>	<i>.45</i>	<i>.21</i>	<i>.16</i>	<i>.75*</i>	<i>.43*</i>	<i>.60*</i>	<i>.10</i>
Accum play	<i>.20</i>	<i>-.12</i>	<i>.38</i>	<i>.17</i>	<i>-.18</i>	<i>.07</i>	<i>.34</i>	<i>-.09</i>	<i>.56</i>	<i>.05</i>	<i>-.20</i>	<i>.23</i>

* = significant correlation at $p < .05$ level, ** = significant correlation at $p < .01$ level. Correlations $> .30$ have been italicized (medium effect size, Cohen, 1992).

Figure Caption

Figure 1. Mean skill ratings (tactical, technical, physical and creative) for the Academy-only group (T1 only) and all Professional (pro.) youth players (T1 & T2, left-side). The professional youth groups are subdivided on the right side into the Youth-Professional only, and Adult-Professional groups (T1 & T2).

Figure 1

