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The roles of talent, physical precocity and practice in the development of soccer expertise

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Here we consider the potential contributions of talent, physical precocity and deliberate practice in the development of soccer expertise. After presenting a working definition of 'talent', we examine how coaches perceive and select potential talent. Our findings suggest that much of what coaches see as early talent may be explained by physical precocity associated with a relative age advantage. Finally, as a test of the model of Deliberate Practice, we review the results of studies that assessed the progress of international, national and provincial players based on accumulated practice, amount of practice per week and relative importance and demands of various practice and everyday activities. A positive linear relationship was found between accumulated individual plus team practice and skill. Various practical suggestions can be made to improve talent detection and selection and to optimize career practice patterns in soccer.

Keywords: deliberate practice, expertise, talent detection.

Introduction

It is difficult to watch top players performing in a European or a World Cup game and not ascribe the cause of their outstanding skill to that much envied and somewhat mystical attribute of pure, natural talent. How else could players be so good unless they were born with a special ability to play soccer? Of course, practice is necessary to develop that talent, but practice alone is not sufficient to produce such 'god-like' feet and finesse on the ball – or is it?

In this review, we take an objective look at the evidence for practice alone being responsible for the development of expertise in soccer and other sports. In particular, we examine the validity of 'deliberate practice' (Ericsson *et al.*, 1993) in predicting expertise (i.e. international, national, provincial, local) in light of the evidence favouring alternative explanations such as natural talent or physical precocity. Based on data from empirical studies, the implications of this research for soccer in general are discussed, specifically focusing on issues concerning talent identification and selection, as well as quality of practice.

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The last 6 years have witnessed a resurgence of interest in the area of 'practice' in sport. Traditionally, researchers in motor learning have been interested in practice but more from the standpoint of the 'blocking or random' nature of practice trials, the retention of information from practice, or the general learning curves that result from varying amounts of practice. In motor learning, relatively little work has been done on the efficacy of various forms of real-world practice.

This issue was recently brought to the forefront of expertise research in a seminal paper by Ericsson *et al.* (1993), who proposed a model of expertise based on what they operationally defined as 'deliberate practice'. Through an extensive review of the expertise literature, Ericsson *et al.* concluded that the role of nurture in the development of exceptional performance has repeatedly been delegated to a subsidiary place in explanation of expertise, even though the evidence for genetic factors (i.e. the elusive talent gene) is somewhat equivocal. Subsequently, they proposed and empirically examined within the music domains a theory of expertise based on their key concept, 'deliberate practice'. They defined deliberate practice as any activity designed to improve current performance that is effortful and not inherently enjoyable. It can be contrasted with other activities

that could erroneously be considered practice – play, work and observing others performing the skill. Their primary prediction was that 'the amount of time an individual is engaged in deliberate practice activities will be monotonically related to that individual's acquired performance' (Ericsson *et al.*, 1993, p. 368). To test this prediction and the validity of their deliberate practice definition, Ericsson *et al.* developed a two-part method based on retrospective recall of past practice activities and evaluations of practice-related activities, which we discuss below.

In the case of sport, if practice is the only determinant of expertise, then coaches would be well advised to abandon any notion of talent selection and focus purely on access to facilities and coaches to maximize the potential of the practice environment. Similarly, barring accident or injury, it would suggest the more practice the better. Therefore, the role one sees for practice determines both the philosophy towards development in a sport and also how resources are best managed (i.e. selection and identification of athletes *vs* their training). With this in mind, we review below what is known about the efficacy of deliberate practice in soccer. First, however, research on deliberate practice has raised the question of whether there is a role for talent in the development of soccer expertise.

Does talent play a role in soccer expertise?

'Talent' is both an appealing and common-sense explanation of what underlies skill in sport. By and large, coaches take for granted that differences in talent determine who will succeed. A study of elite figure skating coaches (Starkes *et al.*, 1996) suggested that the best coaches feel there is a role played by talent, but that even the most talented prospects must practise hard to succeed. Elite sport programmes often have elaborate protocols designed to detect talent early and select those individuals with certain physical or personality attributes they feel are most desirable in the sport. In some venues, such as the Canadian National Ballet School, this means selecting children from the age of 7 based on physical maturation, anthropometric characteristics, personality tests, studies of their parents, and so on, all in the hope of discovering those children who, with 10–12 more years of training, will become skilled dancers. For top European soccer teams, it may mean extensive screening and selection of young athletes to be sponsored and supported in team-affiliated junior programmes.

The search for specific talents that underlie certain sport or movement skills is not a new idea. Many taxonomies have been created to try to explain the specific psychomotor abilities that may underlie certain types of skills (Poulton, 1957; Fleishman, 1972; Ackerman, 1988). Past research on motor behaviour has not supported the assumption that an individual's performance on one motor task can predict performance on another, even when the tasks would appear to rely on the same basic ability (for reviews, see Henry, 1968; Marteniuk, 1974, 1976; Schmidt, 1982; Proteau *et al.*, 1987; Starkes and Deakin, 1984; Baba, 1993). In fact, the correlation between performance on similar tasks is routinely low (range = –0.4 to +0.4). Also, research on motor skill training has shown that the amount of transfer in terms of gain or loss in proficiency of a skill as a result of practice on another is generally very low (Henry, 1968; Schmidt, 1982). Over the years, challenges have been made to the talent account that have concentrated on music (Sloboda *et al.*, 1994a,b; Krampe and Ericsson, 1996), sport (Starkes and Deakin, 1984; Starkes, 1987; Helsen and Pauwels, 1993; Starkes *et al.*, 1994; Helsen and Starkes, 1999), chess (Ericsson and Charness, 1994, 1995) and video games (Baba, 1993). In addition, evidence for the modifiability and trainability of certain physiological factors, such as muscle properties (e.g. Tesch and Karlsson, 1985) and heart size (e.g. Elovianio and Sundberg, 1983), question the belief that biological factors other than height (Ericsson *et al.*, 1993) are necessary to attain elite standards of performance.

The most recent and comprehensive review of the role of talent considered the case of musical performance (Howe *et al.*, 1998). The authors considered the case for biological correlates of specific abilities and their role in musical expertise. Following a multidisciplinary and thorough analysis of positive and negative evidence and arguments, they suggested 'that differences in early experiences, preferences, opportunities, habits, training and practice are the real determinants of excellence' (Howe *et al.*, 1998, p. 2). One of the many strengths of the research by Howe *et al.* is that, for the first time, they delineated five properties of talent and then proceeded to evaluate the existing literature with regard to these properties. The properties of talent they suggested are:

1. It originates in genetically transmitted structures and hence is at least partly innate.
2. Its full effects may not be evident at an early stage, but there will be some advance indications, allowing trained people to identify the presence of talent before exceptional standards of mature performance have been demonstrated.
3. These early indications of talent provide a basis for predicting who is likely to excel.
4. Only a minority are talented; if all children were talented, then there would be no way to predict or explain differential success.
5. Talents are relatively domain-specific.

For the first time, an operational working definition of talent has been advanced, one that may be acceptable to researchers yet capture the lay intuition of talent. Unfortunately, two of the identifiable properties suggested, that talent provides a basis for predicting excellence and is domain-specific, are not supported by the current evidence. This is crucial because in sport these are precisely the ones used to justify early identification and selection of talented young athletes. We suspect that this one development in operationally defining talent may in the long term change the course of research on talent in sport. At present, it is difficult to support the notion that sport expertise can be predicted on the basis of any specific measure of talent. By the same token, we have never met a coach who felt he or she was unable to 'see' talent.

Physical precocity and success in soccer

There is no domain in which the role of talent detection and selection in the early years has flourished more widely than in sport in general and in soccer in particular. So the question remains, what is it that coaches look for when they go out scouting for 'talent'? We suspect that early maturation or physical precocity is one important characteristic that forms the basis of talent selection.

Barnsley *et al.* (1985) first demonstrated a strong linear relationship between month of birth (January to December) and the proportion of players in the National Hockey League and two of Canada's 'Junior A' development leagues. In all of these leagues, approximately four times more players were born in the first quarter of the 'hockey year' than were born in the last quarter. More recently, it has been shown that similar asymmetries in birth-date distributions are also apparent in various other professional sports, including American football (Glamser and Marciani, 1990), baseball (Thompson *et al.*, 1991), cricket (Edwards, 1994), ice-hockey (Boucher and Mutimer, 1994) and soccer (Barnsley *et al.*, 1992; Verhulst, 1992; Dudink, 1994; Brewer *et al.*, 1995). These findings in senior players (for a review, see Boucher and Mutimer, 1994) have led us to investigate whether similar asymmetries emerge throughout youth categories and, if so, from what age.

In a first study (Helsen *et al.*, 1998a), we considered over 1200 birth dates of three groups of soccer players in Belgium: professional players performing in the first division from 1993 to 1996, youth players aged 10–16 years who were selected for national youth teams between 1989 and 1995, and youth players (< 16 years) transferred in 1995 to a first division youth team by an official youth transfer ($n = 485$). This last group was constituted from the best players for their respective age groups. Until 1997, in Belgium the selection year started on 1 August (month 1) and ended on 31 July (month 12). Expected birth distributions for each group were calculated from the appropriate years of the general Belgian distribution by group. Results indicated that youth players born between August and October (the early part of the selection year), beginning in the 6–8 year age group, were more likely to be identified as talented and to be exposed to higher amounts of coaching. Eventually, these players were more likely to be transferred to top teams, to play for national teams and to become involved professionally. In contrast, players born later in the selection year tended to drop out as early as 12 years of age. The advantage of being born early in the selection year may relate to physical precocity; that is, players have up to a 12-month advantage in physical maturation over their peers born at the end of the selection year.

Since 1997, and following the guidelines of the International Football Association (FIFA), the Belgian Soccer Federation has adopted 1 January as the start of the selection year; previously, 1 August had been the start. This August to January shift provided the unique opportunity to assess the effect of changes in selection year on soccer success. In one study (Helsen *et al.*, in press), birth dates for national youth league players aged 10–12, 12–14, 14–16 and 16–18 years were compared for the 1996–97 and 1997–98 competitive years. As an extension of this study, we compared the birth dates for the 1996–97 competitive year with fresh birth-date distributions for the 1998–99 season. As can be seen from Fig. 1, the birth-date distributions of the two competitive years are very different.

The results demonstrate a dramatic shift that is even more pronounced than in the first study; suddenly, players born from January to March (the early part of the new selection year) are more likely to be identified as 'talented'. In contrast, players born later in the new selection year (August to October) are much less often assessed as 'talented'. For 16- to 18-year-old players, however, there was no difference in birth-date distributions before and after the change in reference date from August to January. Based on our earlier findings (Helsen *et al.*, 1998a), this latter result is probably due to players born in the first and second quarters of the year (January to July) having dropped out of the sport before age 16. The present data also suggest that these players are no longer represented to the same extent as players born in the third and fourth quarters. Similarly, by age 16, players with birth dates previously at the start of the season have already experienced the accrued effects of better coaching, facilities, better competition and more playing experience from having been selected over the previous 6 years of play.

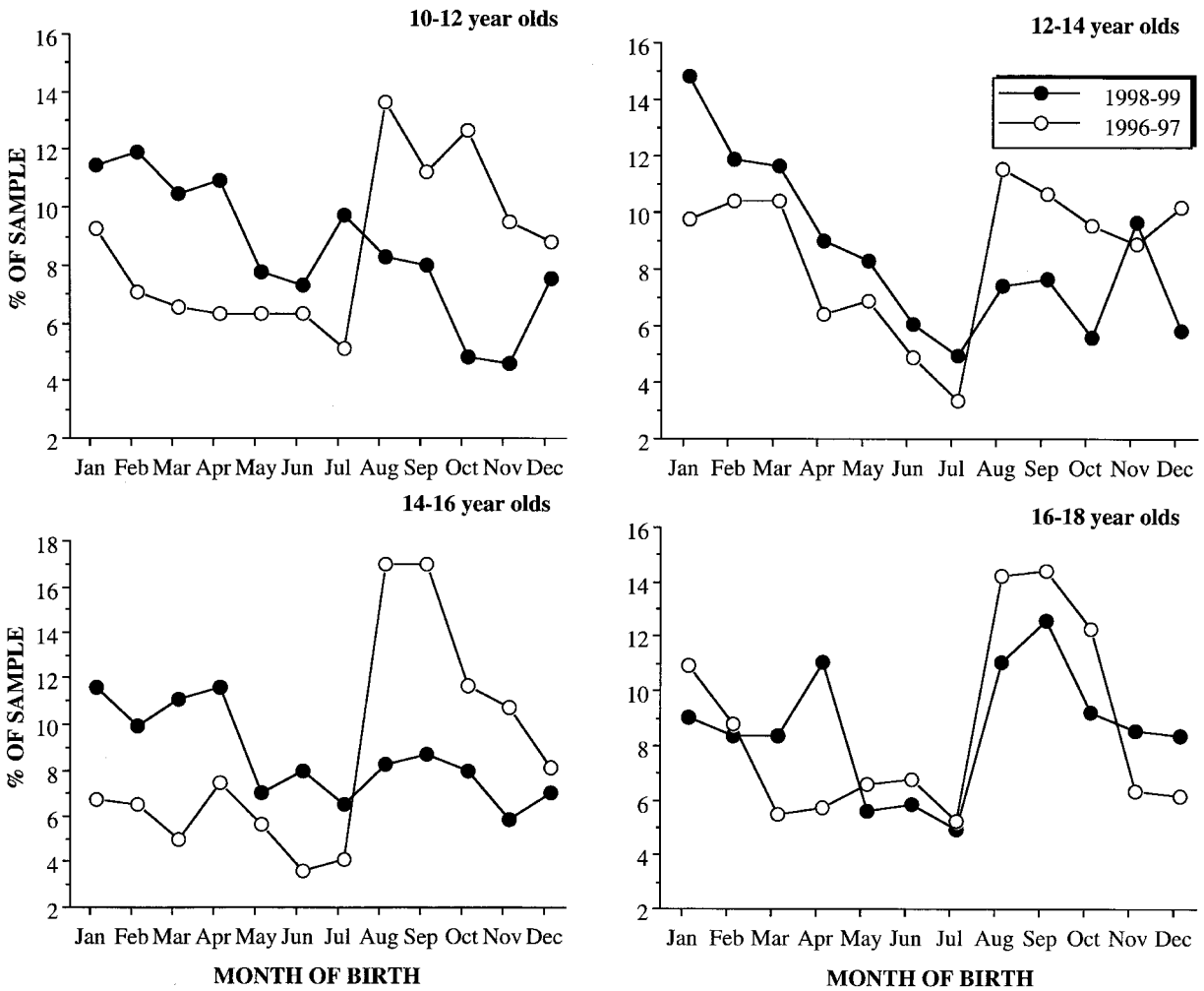

Fig. 1. Birth-date distributions by age category and competitive year (as a percentage of sample size). The 1996–97 data taken from Helsen *et al.* (in press).

Three arguments have been used to explain this relative age effect (see Helsen *et al.*, 1998a). First, current talent identification and selection appear to be influenced significantly by a child's physical attributes rather than soccer skill. Secondly, the organization of youth competition into 24-month bands biases talent selection away from skill or potential skill to physical size. Thirdly, relative to other sports, soccer is highly competitive even at a young age. Ideally, coaches, parents and sport federations should share the desire to provide equal opportunity for all participants. At the present time, however, in a sport like soccer, where advanced physical development is an advantage, the youngest players (biologically and chronologically) are considerably disadvantaged. Many 'talented' children may be overlooked simply because they are born too late in the selection year and are thus less developed physically. In addition, there is also a psychological impact of competing against physically more mature children in the same age group. Confidence and commitment, for example, might be affected by having to compete against physically more advanced children. In this regard, both physical and psychological factors help in identifying why birth date is such an influential factor in selecting 'talent' and perceiving 'lack of talent'.

What role does practice play in the development of soccer expertise?

Most research on deliberate practice in sport has focused on individual sports such as wrestling and figure skating (Hodges and Starkes, 1996; Starkes *et al.*, 1996) or karate (Hodge and Deakin, 1998). Since Ericsson's original studies were on violinists and pianists, it was felt that individual sports represented the closest sport analogy. An overview of the findings suggest that, for individual athletes, there is generally a monotonic relationship between amount of accumulated practice alone and standard performance. This finding is

supportive of the model of deliberate practice, as is the finding that those practice activities most related to actual performance (such as sparring in wrestling or practice of skating or kata routines) are judged the most effortful or demanding of concentration. Unlike Ericsson's musicians, athletes also find their most relevant practice activities (sparring in wrestling, on-ice work with a coach in figure skating) highly enjoyable.

Across these individual sports, the average amount of practice per week varies but is consistently high (26.2 $h \cdot week^{-1}$ in karate, 28 $h \cdot week^{-1}$ in figure skating, 24.9 $h \cdot week^{-1}$ in wrestling). These figures are also close to Ericsson and colleagues' best musicians, who practised approximately 25 $h \cdot week^{-1}$.

It has been difficult to assess the model of deliberate practice in team sports for a number of reasons. First, athletes in sports such as soccer engage in practice designed to address different issues, such as fitness, individual skills, team skills and strategies. Each of these types of practice is pursued both individually and as a team. Therefore, unlike musicians, not all practice is done alone, and not all of it demands full cognitive involvement (i.e. windsprints, stationary cycling or weight training). To assess practice in team sports in a meaningful way, Ericsson's original definition of practice alone has had to be adapted to include all forms of practice.

Recently, we examined the generalizability of the theory of deliberate practice in both soccer and field hockey (Helsen *et al.*, 1998b); here, only the soccer findings are reviewed. The study involved three groups of male soccer players, all of whom played in the Belgian soccer leagues. The international players were all professionals and played in the first division, most of whom had been selected for the Belgium 1994 World Cup squad to play in the USA. The national players competed in the first and second divisions and were all semi-professionals; that is, they all had primary employment outside soccer. The provincial group played in third and fourth division teams. The mean ages of the three groups were similar: 25 ± 0.87 years (mean $\pm$ *s*).

Biographic information revealed that all groups began playing soccer at age 5 and engaged in team practice around age 7, on average 2 years after starting. Specifically, this information also showed that it took professional players at least 10 years to become selected for the Belgian national team. That it takes at least 10 years of practice to attain what is considered an exceptional standard of performance was first documented by Simon and Chase (1973) for chess players. Since then, this '10-year rule' has been confirmed repeatedly in a wide variety of domains such as chess (Charness *et al.*, 1996), sports (Bloom, 1985; Ericsson, 1990; Ericsson *et al.*, 1993; Schulz *et al.*, 1994; Hodges and Starkes, 1996; Starkes *et al.*, 1996; Helsen *et al.*, 1998b) and music (Bloom, 1985; Ericsson *et al.*, 1993). For more recent demonstrations of this 'rule', see Bloom (1985) and Ericsson *et al.* (1993).

One way of viewing how much athletes practise is to consider the number of hours per week typically practised at varying ages. Both the international and national groups reached their peak in terms of hours per week of practice (individual + team practice) 15 years into their careers (20 years of age). Provincial players reached their peak 6 years into their careers (11 years of age). The analyses of time spent in individual practice showed significant main effects of both skill and years into career, as well as a significant skill $\times$ years into career interaction (see Fig. 2a). Six years into their career, there was a significant difference between international and provincial players; this difference remained until 15 years into their careers, at which point the group differences were no longer significant. Indeed, 12 years into their careers, there was a significant decrease in individual practice for the international players.

The analyses of team practice data also showed significant main effects of skill and years into career as well as a skill $\times$ years into career interaction (see Fig. 2b). Significant differences between the different levels of skill were seen at and after 12 years into their careers. Across years into career, team practice only increased significantly and progressively for the international players from 9 to 15 years.

The practice data for soccer indicate that very important career decisions are made around 10 years into one's career. The 9 years point (age 18 years) is a career watershed, when the international players greatly increased the amount of time spent in team practice. We suspect that part of this change relates to the professional development system in soccer. In future, it can be anticipated that, in top teams, youth players will have to decide at an even younger age (e.g. at 16 years) to become involved professionally in soccer or not. Likewise, if players recognize they will not succeed in advancing to the professional leagues, their practice patterns will reflect that and be reduced somewhat. It is also a time when students are entering university or the workforce and they may have relatively less time to devote to practice. Specifically, this means they only practice three or four times per week to prepare for a competitive game at the weekend.

Another way of examining the amount of practice is to consider the number of weeks practice per year and the number of hours per week to derive the accumulated amount of practice at a particular age. This calculation must also take into account the length of the off-season each year. The analyses of accumulated practice showed significant main effects of both skill and years into career (Fig. 3). At 10 years into

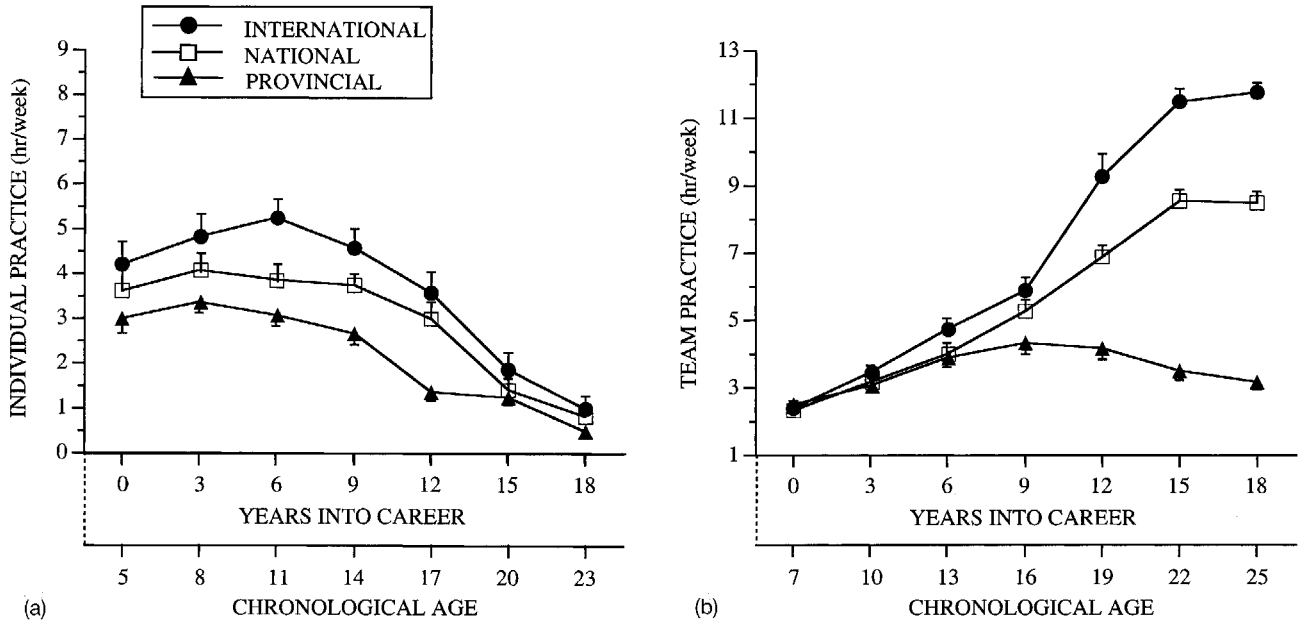

Fig. 2. Hours per week spent in individual practice and team practice as a function of the number of years into one's soccer career and chronological age (mean ± standard error). Reprinted with permission from Helsen *et al.* (1998b).

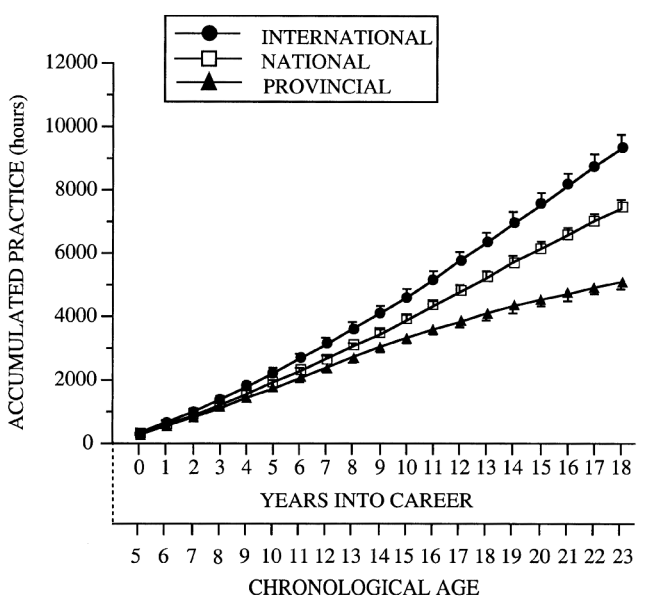

Fig. 3. Accumulated practice hours as a function of the number of years into one's soccer career and chronological age (mean ± standard error). Reprinted with permission from Helsen *et al.* (1998b).

their careers, a significant difference arises between international players (mean = 4587 h) and provincial players (mean = 3306 h). Significant and progressive differences according to each and every level of skill were shown from 13 years on into one's career. At 18 years into their careers, international, national and provincial players had accumulated 9332, 7449 and 5079 hours of practice respectively. These data clearly indicate that practice is a major feature of the development of soccer expertise.

We previously concluded that selection in soccer appears to be based in part upon physical maturation. In this regard, we thank an anonymous reviewer for pointing out that the validity of that finding may be questionable, as it was based on data for individuals who had been chosen predominantly on the basis of their physical maturity. Factors other than practice may be shown to determine the development of expertise if the physical maturation bias is removed.

It is possible to subdivide accumulated practice to determine the relative amount of time spent in team versus individual practice. Starkes (in press) reported that, for soccer, approximately 64% of practice is spent in team practice. For less able players (provincial standard), practice appears to be more evenly distributed between teamwork and practice on one's own. For international players, relatively more time is spent in team practice. This is important because it goes beyond our general knowledge that expertise requires 10 years to develop and for the first time suggests the kind of practice athletes engage in at 10 years and beyond. This finding is also in accord with the Sport Commitment Model of Scanlan and colleagues (Carpenter *et al.*, 1993; Scanlan *et al.*, 1993a,b), in that 10 years appears to be a watershed after which significantly more personal investment of time and effort must be devoted if an individual is to reach international or national standard.

As mentioned earlier, another cornerstone of Ericsson and co-workers' model is that deliberate practice is always relevant, demands effort and is not inherently enjoyable. Elsewhere, we have noted that athletes find a number of components of practice highly enjoyable. For soccer players, the most enjoyable aspects of practice are all team-related and include work on technical skills, games and tactics. Of everyday activities, players enjoy watching soccer, active and non-active leisure. The things they like least in practice are running, game analysis and cycling. These findings are consistent across levels of skill.

When asked what aspects of practice are most relevant to their soccer performance, players suggest that running, working with a coach one-on-one, games and tactics, technical skill work and adequate sleep are all precursors to good performance. They also cite the most effortful physically and mentally demanding parts of their practice and everyday activities as: running, working with a coach one-on-one, working on tactics and technical skills, coaching other athletes, studying and active leisure. Across sports (soccer, field-hockey, wrestling and figure skating), we are beginning to understand that those aspects of practice that are (1) most relevant to the real game and (2) most physically and mentally demanding are also the most enjoyable for the athletes.

These findings replicate those from other sports (e.g. Hodges and Starkes, 1996) but contradict the original definition of deliberate practice based on studies with musicians (Ericsson *et al.*, 1993), where it was proposed not to be inherently enjoyable. Hodges and Starkes (1996) have pointed out that, even within Ericsson and colleagues' original data, the ratings for practice alone and with others were actually higher than the overall mean. As with wrestling, team sports like soccer are inherently social activities that are both competitive and physical in nature, all of which athletes find enjoyable. Ericsson's (1996) explanation for this discrepancy in terms of enjoyment is that practice in sports is inherently social and it is this social aspect that individuals find enjoyable not the practice itself. Were this the case, it would be difficult to explain why team sport players working on their own on technical ball skills still continue to rate this activity as highly enjoyable. In addition, figure skaters rated on-ice training as both highly relevant and enjoyable, even though it is performed alone. The importance of enjoyment in the activity also accords well with the Sport Commitment Model (Carpenter *et al.*, 1993; Scanlan *et al.*, 1993a,b) and with the work of Côtè and Hay (in press). In examining children in sport, Côtè and Hay suggested that athletes progress to activities that are considered less enjoyable, reaching what they term the 'investment stage'. This is contrasted to a preliminary 'sampling stage', in which activities are undertaken with the intention of having fun, so-called 'deliberate play'. Thus, while deliberate practice may be rated in relative terms as being enjoyable, the enjoyment generated from actual practice may have decreased.

These developmental progressions have received preliminary support from a comparative study of provincial and international gymnasts (Beamer *et al.*, in press). Beamer and colleagues found that provincial standard gymnasts actually started gymnastics earlier than international gymnasts, but the provincial athletes continued to participate in other activities and did not reduce the amount of time they spent in play activities. The lack of progression to the 'investment stage' (Côtè and Hay, in press) subsequently resulted in a large reduction in the number of deliberate practice hours over the course of their careers compared with the accumulated practice hours of international gymnasts. This is probably why it is rare to find individuals who are internationals in more than one sport, unless of course there is a significant transfer of skill between the two activities. It is simply impossible to devote the necessary practice hours to more than one skill.

Summary and conclusions

Although the notion of talent as being predictive of eventual soccer expertise is intuitively appealing and would be supported by most coaches, there is little evidence of any specific underlying ability that is predictive of later soccer expertise. Significant advances in the operational definition of talent (Howe *et al.*, 1998) may permit more rigorous testing of the relationship in future. The fact that most coaches feel they can 'see' talent gave rise to our consideration of the basis for youth transfers and selections.

In a sport like soccer, where there are age categories and competition begins at an early age, there is a distinct advantage for children whose birth date falls near the beginning of the competitive season. Before 1997, when the beginning of the season was August, we saw a significant proportion of youth transfers born in the first quartile of the season. In 1998, when the beginning of the competitive season was changed to January, there was an immediate change in those perceived as 'talented'. Within 1 year, the profile of youth transfers had shifted. Now a larger proportion of successful athletes had their birth date in the January to March quartile. The only exception to this was the oldest age group (16–18 years), probably because they had already accrued the benefits of having been selected. In contrast, those born in the last quartile of the competitive season are more likely to drop out, and this was the case from as early as 12 years. This provides a second reason

for the lack of shift to January for the 16–18 year group. The relative number of competitors is low by 16 years because many athletes in the last birth-date quartile have already dropped out.

We suggest that the reason that birth date makes such an important contribution to coaches' assessment of talent is the relative benefit it affords in terms of physical maturation. A 1-year difference in birth date creates substantial variation in physical precocity or maturation. Thus coaches' determination of talent seems to be heavily weighted in terms of physical maturation and not technical skill or team play. As long as standard of competition in soccer is tied to birth-date-determined age categories, this bias is likely to persist. With respect to this relative age effect, several solutions are suggested. First, an awareness of the dramatic impact of the relative age effect may change the way in which players, parents, coaches and sport federations perceive potential 'talent' and predict success. A corresponding change in mentality, favouring speed and technical skills, seems to be the key factor to any other set of proposals. Secondly, Barnsley and Thompson (1988) have suggested a reduction in the age range of the age groupings, an alteration of cut-off dates for the activity year, and a requirement for 'quotas' of children born throughout the activity year on any high-calibre competitive team. In the first and second divisions, perhaps the average age of any selected team should be half the age group range. This would not only minimize the relative age effect, but also normalize the amount of accumulated practice in any 24-month age band. Finally, as we have noted previously (Helsen *et al.*, 1998a), the current competitive organization of youth sports should be questioned in terms of such issues as the optimal age at which rankings might come into play, alternative classification criteria to skill and age (e.g. height and weight) and optimal age at which definite physical skills (e.g. body contact and sliding-tackle) can be used.

From work on deliberate practice we note that, as soccer players develop, they routinely devote more hours of practice each week. This is not only consistent with other domains, but also necessary and desirable. The deliberate practice data suggest that most players of the Belgium 1994 World Cup team practised about 14 h per week at the time of testing. In comparison with individual sports, this is relatively low (on average 25 $h \cdot week^{-1}$). To optimize the standard of play, an increase in the absolute amount of practice per week from an earlier age (e.g. 16 years of age) and throughout a player's career might be desirable. We are also cognisant that the assessment of deliberate practice by means of accumulated practice is a rudimentary approach to assessing one's practice patterns, or 'bean counting' as some might call it. It could also be that soccer is such a physically demanding sport, that there must be an optimal trade-off between the hours spent in physical practice and rest, if only to avoid injury and overtraining. Therefore, it would be interesting to conduct a similar study in other European countries to quantify the amount of rest time and practice time in soccer and compare the results with those of the present study. Elsewhere, the need for a more detailed review of what actually goes on in practice has been advocated (through time–motion studies and analysis of the microstructure of practice; Starkes, in press). To date, this kind of in-depth analysis of practice has not been conducted in soccer.

From a practical standpoint, if one were to speculate on the possible use of this kind of data, a couple of scenarios emerge. Within a particular country, a soccer governing federation might poll players of varying skill. These data could then be compared with sets of similar data. This would allow a comparison of how much team and individual practice players within that national federation pursue in comparison with others and relative to success rate. If deliberate practice is indeed directly related to standard of performance, then one could always recommend that a higher absolute number of hours of practice might improve performance. In soccer, many hours are already spent in team practice; however, as commitment to a professional career deepens, individual practice clearly suffers. Once players become involved professionally and, as a consequence, have more time for their 'job', greater amounts of individual training could more readily be maintained. Individual practice sessions on each of the players' physical, technical or tactical weak points should in future go hand in hand with efficient team practice sessions.

On an individual basis, it might prove personally interesting for team sport participants to perform their own retrospective recall of practice and compare how their personal practice history compares with the data from large samples of athletes within each sport. The large sample of data can then be used to set realistic practice goals for performers who are falling short of the average practice times that are estimated by a standard of performance they wish to aspire to.

Given that the most predictive parameters of skilled behaviour are inevitably the result of domain-specific knowledge and practice, two main implications should be considered for coaching practice. The first is to provide equal opportunities for success to all children; the second is to be aware of the importance of the optimal content and amount of practice. The subjective feeling children have or do not have of becoming more skilful and thus more successful because of practice, might be a key factor in becoming a top-class player. In this regard,

further experimentation is needed on the motivational underpinnings of career practice patterns.

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