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CHAPTER 8

Practice and Play in the Development of Sport Expertise

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There is a long history of interest across a range of skill domains in understanding and cultivating expert performance. Much of the interest has stemmed from attempts to determine the relative contribution of genetic and environmental/experiential factors to high-level human achievement—work that has emanated largely from the nature-nurture distinction first proposed by Sir Francis Galton in 1874. Work on the genetic basis of expert performance in sport is in its relative infancy, and it would be surprising if there were not some significant hereditary contribution to expert performance (e.g., see Bouchard & Malina, 1997; Singer & Janelle, 1999); nevertheless, most researchers accept that the type of experiences athletes have throughout their development is enormously influential in determining to what degree individual potential (or *talent*; Durand-Bush & Salmela, 2001) is realized and expertise is attained.

In this chapter, we examine the role that different developmental experiences play in the realization of exceptional performance in sport. We focus in particular on the respective contributions that both the amount and type of formal and informal learning opportunities may make to the development of expertise. To this end we draw a working distinction between learning activities that may be regarded as *practice* and those that may be more accurately regarded as *play*. We reserve the use of the term *practice* for organized activities in which the principal focus is on skill development and performance enhancement and use the term *play* to describe activities undertaken primarily for intrinsic enjoyment but that may nevertheless ultimately contribute to the acquisition of expertise.

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The chapter is organized into five major sections. The first two sections examine, in turn, propositions regarding the links between practice and skill development, and play and skill development, introducing key concepts such as Ericsson, Krampe, and Tesch-Römer's (1993) notion of deliberate practice and Côté's (1999) notion of deliberate play. The third and major section of the chapter examines the respective contributions of practice and play to the development of sports expertise, drawing evidence from three major methods for obtaining retrospective profile information from experts: (1) qualitative interviews, (2) training questionnaires, and (3) quantitative interviews. The fourth section briefly discusses issues related to early specialization and early diversification. The fifth section reviews two environmental factors, relative age and birthplace, that have been associated with increased early exposure to sport and the achievement of elite performance. In the final section of the chapter a tentative framework is presented to help integrate existing knowledge on the role of practice and play and provide direction for future research endeavors.

PRACTICE AND SKILL DEVELOPMENT

Practice is uniformly regarded in the motor learning literature as the variable having the greatest singular influence on skill acquisition, yet there remains a host of unsatisfactorily answered questions as to how much and what type of practice is necessary and is best for the development of expertise. Much of the experimental work on the relationship between practice conditions, learning, and performance has been conducted using laboratory tasks in which the changes in performance are recorded over a rel-

atively small number of trials and untrained individuals (novices) are used as participants. Such approaches have proven useful in addressing such issues as variability of practice (e.g., C. H. Shea & Kohl, 1991), distribution of practice (e.g., Stelmach, 1969), segmentation and fractionation of practice (e.g., Wightman & Lintern, 1985), and transfer and contextual interference (e.g., Lee & Magill, 1983; J. B. Shea & Morgan, 1979) for the learning of new skills (see Lee, Chamberlin, & Hodges, 2001, for a comprehensive review) and have also helped to determine the nature of the relationship between the quantum of practice and performance.

One of the most salient relationships in the behavioral sciences is the positive association between time spent in practice and improvement in proficiency. Although alternatives exist, one of the most empirically sound profiles of the relationship between practice and achievement is commonly referred to as the *power law of practice* (Newell & Rosenbloom, 1981). According to this position, the relationship between these two variables follows a power function where rapid increases in achievement are evident during initial stages of practice, but over time these increases become more difficult to sustain. Although practice eventually becomes asymptotic, longitudinal examinations of practice over time indicate that improvements continue even after years of involvement (e.g., Crossman, 1959).

Although laboratory studies of practice have contributed to our understanding of the early phases of acquisition of new skills, such studies have been constrained in what they can contribute to the understanding of expertise. This is largely because expertise may require literally millions of trials and typically a decade or more of regular, sustained practice to acquire (Chase & Simon, 1973)—a time frame that makes typical laboratory studies logistically difficult, if not impossible. Because experimental work examining acquisition of expertise in a prospective, longitudinal manner is fraught with logistical difficulties, the bulk of the knowledge regarding the relationship between practice quantity and type has come, by necessity, from studies in which the practice histories of experts are determined retrospectively. Much of this research has been profoundly influenced by the work of Anders Ericsson, which draws together a fundamental interest in memory performance (e.g., Ericsson, Chase, & Faloon, 1980) with an interest in exceptional performance in applied cognitive tasks such as those underpinning performance in chess and music.

In 1993, Ericsson, Krampe, and Tesch-Römer produced a seminal paper on the role of practice and expert development that shaped a great deal of the research that followed.

Their position (based on the work of Simon & Chase, 1973, and others) was that with proper attention to what they called "deliberate practice" one could prevent performance improvements from leveling off, thus circumventing the asymptotic effects that underpin the power law of practice. Deliberate practice was operationalized as any training activity (a) undertaken with the specific purpose of increasing performance (e.g., not for enjoyment or external rewards), (b) requiring cognitive and/or physical effort, and (c) relevant to promoting positive skill development. Ericsson et al. suggested, on the basis of an intensive examination of the training and performance of elite musicians, that the relationship between time spent in deliberate practice and performance was monotonic (i.e., linear) rather than a power function. Moreover, they contended that the primary factor distinguishing performers at different skill levels was the number of hours spent in deliberate practice, thus attributing to deliberate practice a causal role in the attainment of expertise. For instance, in their examination of violinists, experts were shown to have accumulated more than 7,400 hours of deliberate practice by 18 years of age, compared to 5,300 hours for intermediate-level performers and 3,400 hours for lower-level performers.

Despite deriving the deliberate practice proposition primarily from data collected on musicians, Ericsson and his colleagues have repeatedly contended that it also applies to the development of expertise in other domains, including sport (for a recent review, see Ericsson, 2003). There is a growing body of evidence to support this contention from chess (e.g., Charness, Tuffiash, Krampe, Reingold, & Vasyukova, 2005), as well as from some sports (e.g., Deakin & Cobley, 2003; Helsen, Starkes, & Hodges, 1998; Hodges & Starkes, 1996; Starkes, Deakin, Allard, Hodges, & Hayes, 1996). There is, however, some controversy as to definitional aspects of deliberate practice, especially in relation to the contention that practice must be deliberate to be beneficial, and to the proposition that practice alone rather than in combination with other activities or hereditary factors sets the limits to performance (e.g., see Abernethy, Farrow, & Berry, 2003; Baker & Horton, 2004; Sternberg, 1996).

PLAY AND SKILL DEVELOPMENT

Recognizing that athletes tend to first experience sport through fun and playful games, Côté (1999) coined the term *deliberate play* to characterize a form of sporting activity that involves early developmental physical activities that are intrinsically motivating, provide immediate

gratification, and are specifically designed to maximize enjoyment. Deliberate play activities such as street hockey and backyard soccer are regulated by rules adapted from standardized sport rules and are set up and monitored by the children or by an adult involved in the activity. Furthermore, it is a form of physical activity that differs from (a) the physical play activities of infancy and early childhood (Denzin, 1975; Pellegrini & Smith, 1998; Piaget, 1962), (b) the specific pedagogical games/play designed to improve performance (Griffin & Butler, 2005; Launder, 2001), (c) the “structured practice” activities typical of organized sport, and (d) deliberate practice activities (Ericsson, 2001; Ericsson et al., 1993).

Deliberate play shares the contextual characteristics of more primitive forms of physical activity play such as running, climbing, jumping, and rough-and-tumble play (Denzin, 1975; Pellegrini & Smith, 1998; Piaget, 1962), yet displays more organized and unique behavioral patterns. Pellegrini and Smith showed that physical activity play such as rough-and-tumble play in young children (a) improves control of specific motor patterns; (b) contributes to children’s endurance, strength training, and economy of movement; and (c) contributes to children’s regulation of emotions and cognitive performance. In the same way, the learning of motor skills through deliberate play can be illustrated with older children and more complex sport skills. For example, the availability of a basketball hoop in her driveway may incite a 7-year-old to pick up a ball and try to shoot the ball into the hoop. The first attempts at throwing the ball into the hoop will usually be unsuccessful; however, after a few attempts, the child will eventually be successful at shooting baskets. Subsequently, the child will simulate more complex play situations such as running and shooting to keep the activity enjoyable, challenging, and interesting. This playful activity will eventually evolve into more complex games such as shooting baskets with a friend and playing one-on-one and three-on-three basketball. Although not specifically designed to improve performance, learning occurs when children are involved in deliberate play activities, just as learning occurs in more primitive forms of physical activity play seen in younger children (Pellegrini & Smith, 1998).

When compared to organized sport practice and deliberate practice, the informality of deliberate play allows children to play sports with minimal equipment, in any kind of space, with any number of players, and with players of different ages and sizes. This kind of environment is easily created and does not require adult supervision, coaches, officials, specialized equipment, time limits, or uniforms

that are characteristic of organized sport and structured practice. Deliberate play situations allow children the freedom to experiment with different movements and tactics and the opportunity to learn to innovate, improvise, and respond strategically. It also allows children to perfect skills that would not be practiced in organized situations where all the players are of similar size and skill level and where the playing surface does not present any natural obstacle. For example, playing a modified form of baseball in a backyard (a surface that is not always smooth) with opponents who are older may incite a child to develop speed, ball-handling skills, and creative moves that would allow the child to be successful and have fun.

Pellegrini and Smith (1998) proposed that in play, children recombine behaviors and develop flexible strategies. This flexibility and creativity become important factors in the development of elite athletes, especially in team sports settings (Côté, Baker, & Abernethy, 2003). From a skill acquisition perspective, deliberate play serves as a way for youth to explore their physical capacities in various contexts and at a minimal cost in terms of resources. Table 8.1 summarizes differences between deliberate play and deliberate practice in terms of disposition, context, and behaviors for children’s involvement in sport. The definitions of deliberate play and deliberate practice provided in Table 8.1 were tabulated from the literature on play (Côté et al., 2003; Pellegrini & Smith, 1998; Rubin, Fein, & Vanderberg, 1983; Smith, Takhvar, Gore, & Vollstedt, 1986) and deliberate practice (Ericsson, 2003; Ericsson et al., 1993).

After considering the differences between deliberate play and deliberate practice, one may wonder about the importance of deliberate play in an athlete’s development of skill. A recent study (Berry & Abernethy, 2003) focused on the early activities of Australian Rules football players, comparing 17 elite players classified as expert decision makers and 15 elite players classified as nonexpert decision makers. During childhood, the expert decision makers invested a greater amount of time in deliberate play activities compared to structured practice activities, which was not the case for the

Table 8.1 Differences between Deliberate Play and Deliberate Practice

Deliberate Play	Deliberate Practice
Done for its own sake	Done to achieve a future goal
Enjoyable	Not the most enjoyable
Pretend quality	Carried out seriously
Interest on the behavior	Interest on outcome of the behavior
Flexibility	Explicit rules
Adult involvement not required	Adult involvement often required
Occurs in various settings	Occurs in specialized facilities

nonexperts. Moreover, qualitative analyses allowed the authors some insight into the context in which deliberate play took place. For example, Berry and Abernethy reported the following quote from an expert decision maker:

We used to play out in the backyard, backyard footy, backyard cricket, backyard basketball, and soccer. All types of sport you know, if someone's outside it would be one-on-one marking competition, stuff like that, where you do it, time and time again. (p. 52)

A key area where involvement in deliberate play and structured practice are considerably different is in the amount of time that youth spend actively engaged in the activity. Deliberate play activities involve an engagement of time in physical activities that is difficult to match with any kind of structured practice. When youth play street basketball two-on-two for 1 hour there are few periods of waiting or off-task time such as one would find in a structured practice. The athletes' time on task or actual engagement in physical activities in practice has been investigated in sports such as volleyball (Brunelle, Spallanzani, Tousignant, Martel, & Gagnon, 1989; McKenzie, 1986), ice hockey (Trudel & Brunelle, 1985), soccer (Boudreau & Tousignant, 1991), and tae kwon do (Brunelle et al., 1989). These authors reported that athletes' time-on-task rates varied between 25% and 54% of the total practice time. The time off task during practices usually included athletes waiting around to perform the next drill, coaches setting up equipment, or athletes transitioning from one drill to another. Although there are obvious advantages to having a coach who provides athletes with feedback about their performance, monitors success, and provides immediate instruction, it is unclear whether, during early stages of development, the benefits of this structured environment are superior to the benefits one gains from engagement in deliberate play activities.

From a motivational perspective, children get involved in deliberate play because of their own interest in the activity, as opposed to external reasons such as improving performance and winning medals (Soberlak & Côté, 2003). This type of early involvement in sport may help children become more self-directed in their participation in sport. Motivational theories based on self-regulation (Ryan & Deci, 2000; Vallerand, 2001) support this idea and predict that early, intrinsically motivating behaviors (e.g., play) have a positive effect over time on an individual's overall motivation and ultimately the individual's willingness to engage in more externally controlled activities (e.g., delib-

erate practice). In a retrospective longitudinal examination of baseball players' training, the amount of deliberate play from ages 6 to 12 was positively related to the amount of specific baseball training after age 13 (Gilbert, Côté, Hara-da, Marchbanks, & Gilbert, 2002). These results suggest that early deliberate play activities could be beneficial in the development of motivation to pursue intense training in a specific sport.

As reviewed by Pellegrini and Smith (1998), physical activity play during childhood establishes a range of cognitive, motor, and social experiences that have immediate and delayed benefits. As well, sport participation through deliberate play provides children with a broad foundation of motor skills that help them overcome the physical, cognitive, and social challenges of various sports, as well as their main sport (Côté et al., 2003). As sport around the world becomes more institutionalized and organized (De Knop, Engström, & Skirstad, 1996), it is important to provide youth with opportunities to get involved in deliberate play activities.

Because talent detection research has not been able to isolate variables that predict accurately which young athlete will eventually reach the highest level in sport (Durand-Bush & Salmela, 2001), elite athletes can be distinguished only after the fact. Consequently, retrospective studies that analyze playing activities and training patterns of elite athletes remain one of the primary sources of information to enhance our understanding of the development of talent in sport. These studies are reviewed next.

EVIDENCE ON THE RESPECTIVE ROLES OF PRACTICE AND PLAY IN SKILL DEVELOPMENT

Expertise researchers have used a variety of research approaches to trace the training activities and developmental pathways of elite-level athletes. Qualitative interviews, training questionnaires, and retrospective/quantitative interviews are three distinct approaches, each with unique strengths and limitations. A summary of research using these methods is provided in this section.

Qualitative Interviews

In their pioneering research, Bloom and colleagues (1985) interviewed elite tennis players and swimmers. They found that elite athletes started their involvement in sport by trying different sports in a playful and fun environment. This type of environment gradually changed to include specialization in the main sport and more practice time as the athlete

moved from the early phases of involvement to the middle and later years. The athletes were provided with stimulating environments at home and with coaches who guided their development.

In a qualitative study of socialization into elite sport, Carlson (1988) analyzed the development of 10 elite tennis players in Sweden and compared their training activities with a control group of 10 subelite players. He found that the players in the control group specialized in tennis at a younger age (age 11) than the elite players (age 14). Furthermore, between the ages of 13 and 15 the players from the control group played more tennis than the elite players did. The elite players practiced more tennis only after the age of 15. Carlson concluded that early specialization and "professional-like training" in tennis did not favor the development of elite players; instead, an all-around sport engagement was more important before adolescence. Similar results were found in Stevenson's (1990) examination of international athletes from Canada and England and Hill's (1993) study of professional baseball players.

Similar to Bloom and colleagues (1985), Côté (1999) identified three stages of development specific to sport from childhood to late adolescence: the sampling years, the specializing years, and the investment years. The qualitative data obtained from athletes and parents were also consistent with sports socialization studies (Carlson, 1988; Hill, 1993; Stevenson, 1990), indicating that play and early diversification were important building blocks of children's physical, cognitive, and emotional development in sport. For a developmentally appropriate approach to elite performance in sport, Côté recommended a progression from play and involvement in various sports during the sampling years to more sport-specific practice activities during the specializing and investment years.

To gain more insight into the later years of elite athletes' training, Orlick and colleagues (McCaffrey & Orlick, 1989; Orlick & Partington, 1988) interviewed international-level athletes to assess their actual practice behaviors and perceptions of their training. The athletes consistently mentioned the need to focus on specific training goals and repeatedly emphasized the importance of "concentration" and "intensity" in practice. This activity, labeled "quality practice" by Orlick and Partington, shares many characteristics with deliberate practice, which was subsequently proposed by Ericsson et al. (1993). In a follow-up study, McCaffrey and Orlick reported that expert golfers' (i.e., professional tour golfers') current practice activities included elements of "quality practice" and were qualitatively different from the activities of other professional, but less skilled golfers (i.e., golf professionals at golf clubs).

In a study of elite athletes who won at least two gold medals at separate Olympics and World Championships, Durand-Bush and Salmela (2002) found early patterns of development that were similar to those found by Orlick and Partington (1988) and Côté (1999). Furthermore, Durand-Bush and Salmela proposed the "maintenance years" as a stage that followed Côté's investment years, in which athletes achieved the highest level in their sport (e.g., gold medal at Olympics). During the maintenance years, the athletes indicated that they focused their effort on improving small aspects of their performance instead of increasing the number of hours in practice.

Overall, qualitative studies on the development of elite athletes show distinct stages of development involving different types of activities and resources. More specifically, the early years of involvement for elite athletes were usually characterized by the introduction to various sports through playful activities that focused on elements of enjoyment and immediate reward. Following this stage was a period that focused more on sport-specific training and more objective measures of achievement and performance. Then a period of investment and maintenance was required, which usually was characterized by individuals' complete submersion in training activities and devotion to developing a high level of performance. Identification of these qualitatively different stages toward elite performance has facilitated more quantitative research investigating the type and structure of activities that elite athletes engage in during their development.

Training Survey Questionnaire

Starkes and colleagues (Hodges & Starkes, 1996; Starkes et al., 1996) initiated a line of research aimed at investigating more precisely the training patterns of athletes at different levels of achievement. To accomplish this task, they designed a retrospective questionnaire, based on Ericsson et al.'s (1993) deliberate practice framework, to gather detailed data on the past practice activities of athletes. In the questionnaire, athletes were asked to estimate how much time they engaged in practice-related activities during their development and to rate different aspects of a large number of specific practice and everyday activities. The activities were rated for "relevance to improving performance" and "how enjoyable the actual activity was" (Hodges & Starkes, 1996, p. 407). Athletes were also asked to rate the activities in terms of physical effort and mental concentration.

This questionnaire was used in studies of international wrestlers (i.e., World Championship or Olympic participants), club wrestlers (i.e., university or provincial-level participants), and members of the Canadian national and junior

national figure skating teams (Hodges & Starkes, 1996; Starkes et al., 1996). The results showed that both international wrestlers and elite figure skaters increased their weekly amount of practice per week as they progressed into their careers. International wrestlers had accumulated significantly more practice time with others than club wrestlers at 6 years into their careers. Interestingly, activities that the wrestlers and figure skaters rated as highly relevant to improvement and highly effortful (i.e., concentration or physical effort) were also rated as highly enjoyable. Using a comparable questionnaire, similar patterns of training and ratings of practice activities were found in other individual sports, such as karate (Hodge & Deakin, 1998) and middle-distance running (Young & Salmela, 2002).

In a similar study of team sport athletes, Helsen et al. (1998) examined international-, national-, and provincial-level soccer and field hockey players. Athletes estimated the amount of time they spent practicing during their soccer and field hockey careers and rated sport-specific practice activities and everyday activities on their relevance to performance improvement, physical effort, mental effort, and enjoyment. Results for the soccer players demonstrated that at 15 years of age, total accumulated practice time could be used to distinguish between the international and provincial players, and between all three groups by 18 years of age. For the field hockey players, accumulated practice time could be used to distinguish between the international and provincial players from age 25 on, and between all three groups by age 27. Consistent with the earlier findings with wrestlers, figure skaters, runners, and martial artists, types of practice activities that were rated by the athletes as most relevant for improvement of performance tended to be judged as requiring more concentration and were also rated as being more enjoyable by both soccer and field hockey players.

Although the relationship between hours of training and level of attainment appears robust, Van Rossum (2000) used cross-sectional data of a large sample of elite Dutch field hockey players to demonstrate that estimating the number of hours of sport-specific practice may not be sufficient to account for different levels of performance in sport. Van Rossum highlighted the limitation of retrospective questionnaires that focus only on sport-specific practice activities as the sole determinant of expert performance in sport, an issue that had been previously raised from qualitative studies of elite athletes.

To address this methodological issue, Ward, Hodges, Williams, and Starkes (2004) used a questionnaire that assessed the contribution of organized practice, play, and other activities in the development of young elite and sub-

elite soccer players (ages 9 to 18). Their findings showed that play and involvement in non-sport-specific activities did not discriminate between players' skill level; however, the amount of organized practice did. The results of Ward et al. suggest that early specialization with sole involvement in activities that are aimed at improving performance (i.e., deliberate practice) during preadolescence was the most effective path toward the development of elite performance in soccer. These results offer a different perspective from that of Van Rossum's (2000) and other qualitative studies that highlight the importance of play and involvement in other sports in the early development of elite performance in sport.

By focusing mostly on practice activities, retrospective questionnaire studies have provided consistent findings about the training activities of elite athletes that can be generalized across sports. First, athletes start their involvement in their main sport by practicing 2 to 5 hours per week, and this amount increases to approximately 25 to 30 hours a decade later. The consensus from questionnaire studies is that a monotonic relationship exists between the number of hours spent in relevant practice activities and the level of performance attained by the athlete. Second, when answering a retrospective questionnaire, athletes rated practice activities that are high in effort as also being high in enjoyment. Côté, Ericsson, and Law (2005) proposed that the contradictory ratings of enjoyment between these studies and Ericsson et al.'s (1993) study with musicians could be due to the differing methods that were used to elicit the information. Ericsson et al. asked their subjects to ignore the consequences of the activity and to focus on the inherent enjoyment, whereas the questionnaires used in the sport research typically instructed participants to evaluate the "enjoyment derived from the actual activity" (Helsen et al., 1998, p. 18). The latter instructions might measure a different construct, because participants might confuse the enjoyment of the results of the activity (improving performance) with the enjoyment of the activity itself (Ericsson, 1996). Results from a recent investigation by Hodges, Kerr, Starkes, Weir, and Nananidou (2004) support this conclusion.

Retrospective Quantitative Interviews

Because questionnaires may not prompt participants to think about an answer in a way that an interview question does, the responses on a questionnaire can become more reactive and less contextualized. This suggests that when obtaining information retrospectively, it is important to provide participants with cues that will facilitate their recollection of habitual, regulated behaviors represented as

either extended events or lifetime periods. Côté et al. (2005) recently discussed these issues and proposed an interview procedure where questions could be adjusted to the particular background and development of the athletes studied, and yet the information would still be collected in a standardized manner. The design of the interview procedure was based on the original study of deliberate practice (Ericsson et al., 1993) and was further guided by the theoretical frameworks of deliberate practice (Ericsson, 1996, 2003) and the developmental model of sport participation (Côté, 1999; Côté et al., 2003; Côté & Hay, 2002). The purpose of this standardized interview approach is to collect retrospective longitudinal data on variables that athletes are known to be able to report accurately.

Using this method, Baker, Côté, and Abernethy (2003b) assessed the developmental activities that led to elite participation among a group of expert decision makers from Australian national teams and a comparative sample of nonexpert decision makers drawn from the same sports. They found that from age 5 to 12 both experts and nonexperts increased their participation in extracurricular activities; however, this was followed by a rapid decrease in other activities from approximately age 13 onward for the expert athletes, marking their entry into the specializing years. A comparable reduction of involvement in various activities after age 13 did not occur for the nonexpert athletes. The reduction of activities for the expert athletes continued until approximately age 17. After age 17, the expert decision makers were involved in an average of three sporting activities. Furthermore, Baker et al. showed that expert athletes accumulated hours of sport-specific training similar to that of nonexperts until approximately 10 years of involvement in their sport (around age 15, or the beginning of the investment years). After age 15, the rate of sport-specific practice accumulation by experts escalated dramatically beyond that accumulated by nonexperts. Consistent with Van Rossum's (2000) data with Belgium field hockey players, Baker et al. also found that the number of hours of reported sport-specific training by expert athletes (4,000 hours, on average) was far short of the 10,000 hours of deliberate practice reported for expert musicians by Ericsson et al. (1993). Baker et al. also indicated that participation in other sports (e.g., sports where dynamic decision making is necessary) during early phases of development may have augmented the physical and cognitive skills necessary for the athletes' primary sport.

The same Australian athletes were asked in a follow-up study to rate their training activities on a scale from 0 (no help) to 3 (very helpful) with respect to perceived useful-

ness in developing essential component skills in perception, decision making, movement execution, and physical fitness (Baker, Côté, & Abernethy, 2003a). Competition and video training were perceived by players as being the most relevant activities for developing the perceptual and decision-making skills necessary for expert performance in team sports; individual instruction with a coach and practice alone were considered the most relevant activities for developing movement execution skills; and aerobic training and competition were regarded as the most relevant for developing physical fitness. Organized training also ranked consistently as an important activity for developing all four components contributing to successful player performance in team ball sports. Practice alone, individual coach instruction, organized training, video training, and aerobic training are all highly relevant, structured activities that require large amounts of cognitive and/or physical effort and certainly satisfy most, if not all, of the criteria for deliberate practice activities in sport. One important point of contention, however, concerns the athletes' ratings of the significance of competition to skill development. The benefits of participation in competition have not been considered in the deliberate practice studies performed to date, yet in the Baker et al. study, competition (i.e., match play) was rated as the most helpful form of training for the development of perceptual and decision-making skills and was also ranked high for developing skill execution and physical fitness. Although competition does indeed require great amounts of cognitive and physical effort, it is not strictly designed (as deliberate practice is) with either the singular or principal purpose of improving specific components of performance.

Baker, Côté, and Deakin (2005) studied ultra-endurance triathletes, stratified into three groups based on previous finishing times: experts, middle of the pack, and back of the pack triathletes. The results did not support a monotonic relationship between training hours and performance. Instead, the relationship between practice and performance was more akin to a power function (Newell & Rosenbloom, 1981). For example, the middle of the pack and back of the pack athletes were separated by 2,000 hours of practice, and the middle of the pack athletes and experts were separated by 6,000 hours. Because the differences in performance across the groups were similar (i.e., approximately 2.5 hours of overall finishing time), these findings show that performance improvements become more difficult as one progresses in skill level. In addition, experts were not distinguishable from their nonexpert counterparts in terms of their practice hours until after approximately 20 years of

age. This suggests that although the deliberate practice framework is quite capable of differentiating expert ultra-endurance triathletes from nonexperts based on total hours of sport-specific training, it is not capable of distinguishing them during early stages of development, at least based on retrospective estimates. The analysis of early stages of development for these athletes suggests a considerable depth of sport experience with the expert and middle of the pack triathletes performing around 5,500 hours of other sport participation and the back of the pack accumulating nearly 3,500 hours in other sports.

Contrary to findings for triathletes and team sport athletes, Law, Côté, and Ericsson (in press) found that two groups of elite rhythmic gymnasts (Olympic group, 2nd in the world, and international group, 17th in the world) were involved in few other sports and play activities throughout their development. The average accumulated hours of gymnastics training (including ballet, technique, routine, and conditioning) at age 16 was significantly higher for the Olympic group than for the international gymnasts. Elite rhythmic gymnasts engaged in long hours of practice at younger ages than subelite gymnasts. However, the cost of this intense training was reflected in the Olympic gymnasts experiencing lower levels of "fun" during training and reporting poorer health and more injuries than the International gymnasts. In sum, the elite gymnasts who specialized at younger ages experienced more negative outcomes in the form of physical injuries and less enjoyment than elite gymnasts who specialized at older ages.

Using a modified version of the Ericsson et al. (1993) interview procedure, Duffy, Baluch, and Ericsson (2004) investigated the training activities of professional and amateur dart players. Results showed that professional players invested significantly more time in solitary practice than did amateur players, and amateur players played league darts significantly more often than professional players. The authors suggested that deliberate practice was the sum of solitary practice and practice with a partner. However, the context of solitary practice and practice with a partner in darts was not described by the authors and may not have met the definitional criteria of deliberate practice.

To clarify athletes' involvement in play or practice throughout their development, Soberlak and Côté (2003) asked professional ice hockey players to define the different contexts of their involvement in the sport. The authors showed that, although professional ice hockey players spent more than 10,000 hours involved in sport and physical activity from age 6 to 20, approximately 3,500 of these hours were spent in play-like activities (deliberate play). In con-

trast, an average of only 3,072 hours was spent in structured practice hockey activities. Furthermore, these athletes spent approximately 2,300 hours playing other sports and just over 2,400 hours playing organized games. Soberlak and Côté showed that the majority of the athletes' involvement in structured practice activities occurred during the investment years (2,215 hours), and the highest number of hours in deliberate play activities and in other sports was during the sampling years (2,618 and 1,404 hours, respectively). More specifically, the majority of deliberate play hours was accumulated prior to the age of 15, whereas the majority of deliberate practice hours were accumulated after that point.

Ericsson et al. (1993) theorized that it would be impossible for a late starter to overcome the early advantage of someone who began deliberate practice at a young age and maintained a steadily increasing pattern of engagement. However, investment in activities that are high on effort and concentration and low on enjoyment at a young age may also lead to dropout (Baker, 2003; Wiersma, 2000). To further understand the impact of early activities on investment and dropout in training, Wall and Côté (in press) examined the early activities (ages 6 to 13) of two groups of elite ice hockey players; one group was still invested in ice hockey, whereas the other group of players had just withdrawn from participating. The authors interviewed the elite players' parents about their sons' involvement in organized practice, deliberate play, and other sports from ages 6 to 13. Results indicated that both the active and the dropout players enjoyed a diverse and playful introduction to sport. Furthermore, the active and dropout players invested similar amounts of time in organized hockey games, organized hockey practices, and specialized hockey training activities (e.g., hockey camps and hockey play). However, analysis revealed that the dropout players began off-ice training (for the purpose of improving hockey performance) at a younger age and invested significantly more hours per year in off-ice training at ages 12 to 13. These results, along with Carlson's (1988) study of tennis players in Sweden, indicate that engaging in more training activities at a young age may have negative implications for long-term sport participation and the development of expertise in sport.

In a review of retrospective interview studies, Côté et al. (2003) proposed that the structure of deliberate practice and other activities in sports changes qualitatively as a function of the age of the child athlete. Generally, activities associated with the best learning and motivational environment in the early years of an athlete's development are different from optimal learning and motivational activities in the later years. Consequently, it is important to examine the

type of activities (i.e., play or practice) that athletes engaged in at various stages of their development and elicit the reasons (i.e., for enjoyment or to improve performance) that athletes engaged in these activities instead of asking for subjective ratings. Studies reviewed in this section show that reducing the acquisition of expert performance in sport to involvement in a single form of activity (i.e., deliberate practice) fails to acknowledge important developmental and motivational assets acquired from involvement in play and other sporting activities.

IMPLICATIONS FOR EARLY SPORT ACTIVITIES: TO SAMPLE OR TO SPECIALIZE?

Support for early involvement in organized practice and deliberate practice is based on two assumptions that have yet to be confirmed. The first is that during early stages of development, future experts distinguish themselves from future nonexperts with regard to training quantity and quality. However, retrospective studies that assess practice patterns throughout development generally indicate that differences between elite and subelite athletes do not occur until later in development. For instance, Hodges and Starkes (1996) found that training-based differences between elite and nonelite wrestlers did not occur until approximately 18 years of age. Further comparisons of expert and nonexpert athletes in soccer (Helsen et al., 1998), field hockey (Helsen et al., 1998), and triathlon (Baker et al., 2005) found that training-based differences did not occur until 13, 15, and 20 years of age, respectively. Prior to these ages, the groups appeared quite similar with respect to training exposure. Exceptions exist in Ward et al.'s (2004) study of young English soccer players and for sports where peak performance occurs at early ages (i.e., before biological maturation), such as women's gymnastics (Law et al., in press) and

women's figure skating (Deakin & Cobley, 2003), which indicate differences in sport-specific training between elite and subelite athletes as early as age 7. However, as outlined earlier, this level of involvement during early periods of development can have significant negative consequences for continued sport participation.

A second assumption for promoting investment in sport-specific practice at a young age is that organized practice and deliberate practice are superior to play and involvement in other sporting activities. However, there is evidence from interview studies that some athletes who were involved in play activities and who had a diversified sport background still reached an elite level of performance in sport (e.g., Baker et al., 2003b, 2005; Bloom, 1985; Carlson, 1988). For instance, Baker et al. (2003b) found a significant negative relationship between athletes' involvement in additional sporting activities and the amount of sport-specific training needed to achieve expertise.

Our understanding of the mechanisms by which diversification and play influence skill development is limited, although transfer of learning and cross-training research provides some insight. Thorndike (1914) suggested that "identical elements" between tasks were transferable (see Singley & Anderson, 1989, for a more recent application of Thorndike's theory). On the other hand, a transfer-appropriate-processing view (Lee, 1988) suggests that positive transfer may occur when the processing requirements of the training and practice tasks are similar to those of the competition and performance environment. Schmidt and Wrisberg (2000) suggested that transferable elements could be categorized into movement, perceptual, and conceptual elements, although there is considerable evidence (e.g., Loy, Hoffman, & Holland, 1995) that a physical conditioning category should be added to this list of transferable performance elements (see Table 8.2). Researchers have also

Table 8.2 Classification of Elements That May Be Transferable across Sports

Elements	Transferable Aspects	Example
Movement	Biomechanical and anatomical actions required to perform a task.	Throwing a baseball overhand and an overhand serve in tennis.
Perceptual	Environmental information that individuals interpret to make performance-related decisions.	Field hockey and soccer both require participants to accurately interpret the actions of their opponents in order to be successful.
Conceptual	Strategies, guidelines, and rules regarding performance.	Gymnastics and diving share conceptual elements (e.g., similar rules).
Physical conditioning	Physiological adaptations across similar modes of training.	Short-term interventions of combined run-cycle training are as effective as running alone in increasing aerobic capacity.

Source: *Motor Learning and Performance: A Problem-Based Learning Approach*, by R. A. Schmidt, and C. A. Wrisberg, 2000, Champaign, IL: Human Kinetics. Reprinted with permission.

suggested that the effects of cross-training and transfer are most pronounced during early stages of involvement (Loy et al., 1995). For instance, any form of aerobic exercise can cause the general physiological adaptations that occur at the onset of a physical training program; however, the more trained an athlete becomes, the smaller the relative improvement from cross-training. By this reasoning, a variable participation during early stages of development may be equally beneficial to specific forms of training in achieving the physiological adaptations necessary for increases in cardiorespiratory fitness.

A diversified approach to early athlete development may not be at odds with monotonic or power profiles of the practice-proficiency relationship. During initial stages of development, increases in performance occur due to rapid improvement in general capabilities. With prolonged practice and training over time, improvements become much more specific in nature and more difficult to attain. During initial exposure to the task, however, the same general adaptations may be produced through similar activities that share the same elements. For instance, Abernethy, Baker, and Côté (2005) recently showed that experts from different sports consistently outperformed nonexperts in their recall of defensive player positions, suggesting that some selective transfer of pattern recall skills may be possible. From a physical conditioning point of view, childhood involvement in running or cycling will produce the same general physiological adaptations (e.g., increases in blood volume and maximal cardiac output) as sport-specific involvement. Once general cognitive or physical adaptations have been made through play and involvement in various sport activities during childhood, training should become more specific. A model of this relationship according to Côté's (1999) stages of sport participation is presented in Figure 8.1.

It is clear from retrospective studies of athletes' development that the amount and type of training performed throughout an expert athlete's development is dependent on the specific demands or capacities underlying performance in the sport as well as the age at which performance of these abilities reach their peak. Sports with abilities that peak later in development can allow greater flexibility during early development than sports with abilities that peak earlier. But eventually, all future expert athletes must adopt a program of training that focuses on deliberate practice, as it appears that without a long-term commitment to high-quality training, athletes will be unable to attain elite levels of performance. However, coaches and parents should consider the consequences of high levels of structured training during early development, as these experi-

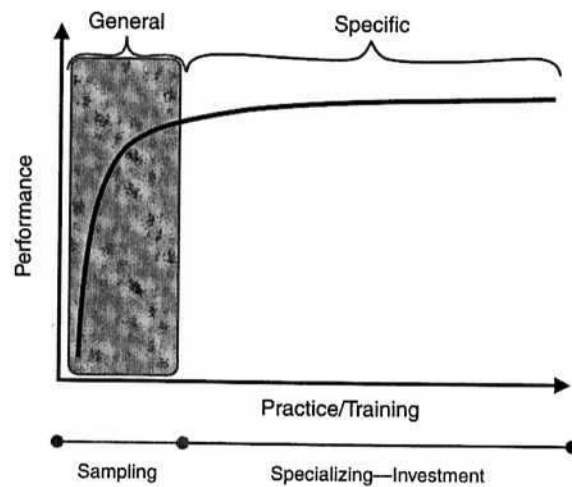


Figure 8.1 Proposed role of diversified early involvement in the development of sport expertise. The power law of practice proposed by A. Newell and Rosenbloom (1981) is represented by the solid line. During the sampling stage (i.e., the shaded area), adaptations are general in nature. Once these general adaptations have taken place, training should become more specific so that positive adaptations are perpetuated (i.e., during the specializing and investment stages). *Source:* "Shifting Training Requirements during Athlete Development: The Relationship among Deliberate Practice, Deliberate Play and Other Sport Involvement in the Acquisition of Sport Expertise" (pp. 93–110), by J. Baker and J. Côté, in *Essential Processes for Attaining Peak Performance*, D. Hackfort & G. Tenenbaum (Eds.), 2006, Oxford: Meyer & Meyer. Reprinted with permission.

ences have a profound influence on involvement in sport and physical activity across the life span.

The next section reviews environmental variables that have been linked to elite performance in sport and sheds some light on the type of environment that best promotes play and practice in the early years of an athlete's involvement in sport.

ENVIRONMENTAL FACTORS THAT ELICIT AND SUPPORT PRACTICE AND PLAY

Profiles of elite athletes have shown a pattern of training that changes throughout development. Important developmental changes that occur include the number of sporting activities athletes are involved in and the number of hours invested in deliberate play, structured practice, and deliberate practice. Some children will benefit from situations that provide them with more opportunities to get involved in sports at an early age. The relative age effect (see Musch & Grondin, 2001, for a review) and the size of the city or region in which an athlete develops (Côté, MacDonald,

Baker, & Abernethy, in press; Curtis & Birch, 1987) are two contextual variables that have been associated with increased early exposure to sport and the achievement of expertise.

Relative Age Effect

The relative age effect shows that the older one is relative to one's peers in the same grouping or junior sport team (i.e., the greater one's *relative age*), the greater the probability of eventually becoming an elite athlete (Baxter-Jones & Helms, 1994; Dundink, 1994; Helsen, Hodges, Van Winckel, & Starkes, 2000). Studies examining birthdates of professional and elite athletes in baseball (Thompson, Barnsley, & Stebelsky, 1991), ice hockey (Barnsley & Thompson, 1988; Boucher & Mutimer, 1994), soccer (Barnsley, Thompson, & Legault, 1992; Dundink, 1994; Glamser & Vincent, 2004; Helsen, Van Winckel, & Williams, 2005), cricket (Edwards, 1994), swimming (Baxter-Jones, 1995), and tennis (Baxter-Jones, 1995) have shown a skewed birth date distribution favoring players that were born in the first half of the sport year.

The most compelling hypothesis about the relative age effect suggests that older children in a group will be provided with environments that facilitate the improvement of their skills early in their development because they are more mature or physically larger (Musch & Grondin, 2001). For example, bigger and more mature athletes may have an early advantage over smaller athletes in several sports because their physical abilities, such as running, throwing, and jumping, are better developed. Accordingly, a coach is likely to select these more mature athletes and put them in more decision-making roles (i.e., point guard, quarterback), where they get more opportunities for playing and practice. Furthermore, because of their early success, athletes that are born in the first quarter of their sport year may receive more encouragement, feedback, and support from parents, coaches, and peers. This type of social environment may motivate them to play and invest more in their sport outside of regular organized practice sessions. In sum, the relative age effect is a phenomenon that favors athletes born early in their sport year by providing them with additional time on task.

Although the relative age effect has been observed in several sports and at different levels of development, the effect has not been found in American and Canadian professional football (Daniel & Janssen, 1987), National Basketball Association players (Côté et al., in press; Daniel & Janssen, 1987), or American professional golfers (Côté et al., in press). Golf is a sport where age-related factors

such as size and weight may be less likely to influence performance. In addition, the structure of youth golf in the United States does not have as strict age groupings as other organized youth sports, such as ice hockey and baseball. On the other hand, because American and Canadian football and basketball are sports where size, weight, strength, and coordination are critical elements of success, one would expect the relative age effect to be present. The organizational structure of youth football and basketball in the United States and Canada may explain the absence of a relative age effect in these sports. Typically, young American and Canadian football players are classified into different levels according to weight instead of chronological age, therefore eliminating the evidence of a relative age effect in football. The absence of a relative age effect in U.S. basketball may partially be explained by a "grade fail exemption" rule present in U.S. high school basketball. The grade fail exemption allows three older players per team to play with players of the same grade if they fail a grade. This exemption allows older players to play with younger players and may eventually eliminate the relative age effect in professional basketball. Finally, the beginning of organized play in American and Canadian football (and in golf) is likely to occur at an older age, which would limit the amount of time that footballers (and golfers) can benefit from a possible relative age advantage.

Birthplace Effect

Another environmental variable that has recently received attention in sport expertise research is the city size where elite athletes gain their formative experiences. This variable may have a significant influence on how athletes are first exposed to sports, which, like the relative age effect, can limit or benefit performance.

In his qualitative study of the development of tennis players in Sweden, Carlson (1988) concluded that elite players predominantly came from rural areas and that these areas provided the athletes unlimited opportunities to participate in sports. Another study by Curtis and Birch (1987) examined the city size of the birthplace of Canadian and U.S. Olympic hockey players and Canadian National Hockey League players. They found that for Canadian players, rural areas of fewer than 1,000 inhabitants and cities with more than 500,000 inhabitants were underrepresented in relation to the expected proportions of the population in the same age range. An analysis of the birthplace of 2,240 Canadian and American professional athletes in basketball, baseball, ice hockey, and golf also showed a birthplace bias toward smaller cities, with professional ath-

letes being overrepresented in cities of fewer than 500,000 and underrepresented in cities of 500,000 and over (Côté et al., in press). The best odds of becoming a professional athlete in the United States were found for cities with populations between 50,000 and 99,999.

Drawing on the existing evidence about factors known to be important to expert development in sports, we can propose possible factors and mechanisms that may contribute to the birthplace effect (Côté et al., 2003; Ericsson et al., 1993). The effect could be primarily due to skill acquisition factors related to the quality and quantity of play and practice afforded by the physical environment of smaller cities. The quality of play and practice could be a key factor because the physical environment of smaller cities is more conducive to unstructured play activities between children and adults of different ages and to experimentation with various forms of sporting activities (Kytta, 2002). The quantity of play and practice in smaller cities could also be a factor because smaller cities present fewer safety concerns, easier access to open spaces, and fewer competing sources of leisure time usage by children. Another factor that may contribute to the birthplace effect is the more intimate and, likely, less competitive psychosocial environment of smaller cities. Smaller cities may offer increased opportunities to experience early success in sport, which, in turn, may increase self-efficacy and the motivational drive to play and practice.

The big fish, little pond effect (BFLPE; Marsh, 1987) is a theoretical framework specific to academic self-concept that may be useful in explaining how the psychosocial environment of smaller cities promotes the development of talent in sport. The BFLPE occurs when equally able students have lower academic self-concept when they are put in an environment where they compare themselves with more able students (i.e., at a top academic high school). On the other hand, the same students will have higher academic self-concept when they compare themselves with less able students (Marsh, 1987; Marsh & Tai Hau, 2003). Within the framework of the birthplace effect in sport, a young athlete who excels in sport in an average small city league could be perceived as a "big fish in a small pond" and, accordingly, have a high sport self-concept. This high sport self-concept likely drives the young athlete's commitment to stay involved in sport and facilitates the acquisition of a greater quantum of play and practice. If placed into a more selective sport program, characteristic of bigger urban center sport systems, this same athlete would be in a "larger pond with larger fish" (i.e., other excellent athletes who may be more skilled). This scenario would provide this ath-

lete with a different frame of reference that, according to the BFLPE, would lower his or her sport self-concept and likely reduce his or her commitment to sport. The BFLPE is an appealing hypothesis that is supportive of the birthplace effect data in sport.

Given the contextual similarities between the relative age and birthplace effects, it is plausible that these factors may interact in promoting athlete development. This relationship was examined by Côté et al. (in press), and no evidence of moderation/mediation was found. Furthermore, Côté et al. showed that birthplace has a considerably stronger influence on talent development than relative age in major U.S. and Canadian sports. However, the birthplace effect requires examination in other countries and other sports to determine the generalizability of this effect.

The relative age and birthplace effects highlight the importance of the early years of a child's involvement in sport as a foundation for the development of motivation, skill, and talent. Also, it demonstrates the remarkably enduring effect that early sport experience may have on the likelihood of expertise being ultimately achieved. The relative age and birthplace effects support an environment that provides ample opportunities for youth to experience high-quality play and practice activities in their early involvement in sport. Accordingly, various researchers (Bloom, 1985; Côté, et al., 2003; Wylleman, De Knop, Ewing, & Cumming, 2000) have integrated studies on the development of talent in sport and have proposed models that demarcate the stages in athletes' paths to expertise (Durand-Bush & Salmela, 2001). In the next section, we offer directions for future research and present a working model that has recently been proposed to explain the longitudinal changes that occur in play and practice activities in the development of talent in sport.

TOWARD AN INTEGRATED FRAMEWORK FOR UNDERSTANDING THE ROLE OF PRACTICE AND PLAY IN SKILL DEVELOPMENT

It is clear from this review that studying the development of expertise in sport is a much more complex task than studying learning in controlled laboratory environments. In a recent review of the motor learning literature, Wulf and Shea (2002) distinguished between learning *effectiveness* and learning *efficiency*, both being important issues in the study of complex motor skills and the development of expert performance in sport. Learning effectiveness focuses on factors that influence the acquisition of motor skill; learning efficiency focuses on the factors that influence

the acquisition of motor skills at less cost (Wulf & Shea, 2002). Unlike consideration of learning effectiveness, a focus on learning efficiency also considers the psychosocial (i.e., drop out, burn out) and physical (i.e., injury, health) costs associated with training and the development of expertise in sport. An *efficient* model of sport expertise development would limit the costs associated with long-term investment in sport; an *effective* model would focus on learning independent of the costs that may be involved.

The framework of deliberate practice developed by Ericsson et al. (1993) is an example of a model that is based on learning effectiveness. Ericsson et al. suggested that it would be next to impossible for a late starter to overcome the early advantage provided to those who begin deliberate practice at a young age and maintain high amounts of deliberate practice hours over time. The deliberate practice framework largely downplays the psychosocial and physical costs associated with this type of practice, especially in the early years of an athlete's involvement in sport.

Although the positive relationship between training and elite performance is consistent in sport research, several other dimensions of the theory of deliberate practice have not been supported (Abernethy et al., 2003). In particular, research (for reviews, see Baker & Côté, 2006; Côté et al., 2003) has shown that considering only deliberate practice training in athlete development does not adequately characterize the complexity of the relationships among developmental, motivational, and psychosocial aspects of human abilities. One model that does highlight the importance of developmentally appropriate training patterns and social influences is Côté and colleagues' developmental model of sport participation (DMSP; Côté, 1999; Côté et al., 2003; Côté & Hay, 2002).

Côté and Fraser-Thomas (2007) recently proposed a modified version of the DMSP illustrating more clearly the possible sport participation trajectories of the model. These trajectories are outlined in Figure 8.2 as (a) recreational participation through sampling and deliberate play, (b) elite performance through sampling and deliberate play, and (c) elite performance through early specialization and deliberate practice. The different stages within a trajectory are based on changes in the type and amount of involvement in sport, deliberate play, and deliberate practice. Two of these trajectories, recreational participation and elite performance through sampling, have the same foundation from ages 6 to 12. After the sampling years, sport participants can choose to either stay involved in sport at a recreational level (*recreational years*, age 13+) or embark on a path that focuses primarily on performance

(*specializing years*, ages 13 to 15; *investment years*, age 16+). These two trajectories have different outcomes in terms of performance but are likely to lead to similar psychosocial and physical health benefits. A third possible trajectory consists of elite performance through early specialization (right side of Figure 8.2). Although this trajectory leads to elite performance, it has also been shown to result in a reduction in both physical health (i.e., overuse injuries) and enjoyment (e.g., Law et al., in press).

Recreational Participation through Sampling

The recreational outcome of the DMSP was examined in a retrospective study of active and inactive adult females (Robertson-Wilson, Baker, Derbyshire, & Côté, 2003). Results indicated that active females participated in significantly more physical activities than inactive females from age 6 to age 18, but no significant differences were found between the two groups in terms of their involvement in other nonphysical structured leisure activities, such as music and art. From ages 6 to 12 (i.e., sampling years) the active females participated in a variety of sports that focused primarily on deliberate play activities. These years were considered essential building blocks for their continued recreational sport participation. The recreational years (age 13+) are usually seen as an extension of the sampling years, with the primary goals being enjoyment and health. Activities during the recreational years can involve deliberate play and deliberate practice, with sport programs being flexible enough to adapt to individual interests and ages. In terms of outcomes, the physical and psychological benefits of recreational participation in sport, such as enhanced health and increased enjoyment, have been consistently supported through various studies (see Berger & Motl, 2001, for a review).

Elite Performance through Sampling

For youth interested in a more performance-oriented path, a second trajectory of the DMSP suggests that specialization begins around age 13, after the sampling years. The specializing years (ages 13 to 15) are seen as a transitional stage to the investment years (age 16+). During the specializing years, youth engage in fewer activities (which include both deliberate play and deliberate practice), whereas during the investment years, youth commit to only one activity and engage primarily in deliberate practice. This trajectory toward elite performance in sport has been supported by various qualitative and quantitative studies (e.g., Baker et al., 2003b, 2005; Bloom, 1985; Carlson, 1988; Côté, 1999; Soberlak & Côté, 2003). Athletes who follow this tra-

jectory tend to experience positive physical and psychosocial outcomes (e.g., physical health, sport enjoyment; Korell & Côté, 2005); however, more studies are needed that directly measure the physical and psychosocial outcomes of elite performers who sampled in their early years in sport.

Elite Performance through Early Specialization

In sports where peak performance is achieved before puberty (e.g., women's gymnastics, figure skating), early specialization is often necessary to reach elite performance. Several studies support early specialization as a suitable

path toward elite performance (e.g., Law et al., in press; Ward et al., 2004). Elite performers who specialize at an early age usually skip the sampling years and, consequently, do not always experience the enjoyment associated with sampling and playing (Law et al., in press). In fact, there is reasonable empirical support for the notion that early specialization is associated with higher levels of attrition at all levels of ability (Gould, 1987; Gould, Udry, Tuffey, & Loehr, 1996; Korell & Côté, 2005; Wall & Côté, in press). Furthermore, an early focus on structured training can have negative effects on developing athletes' physical health

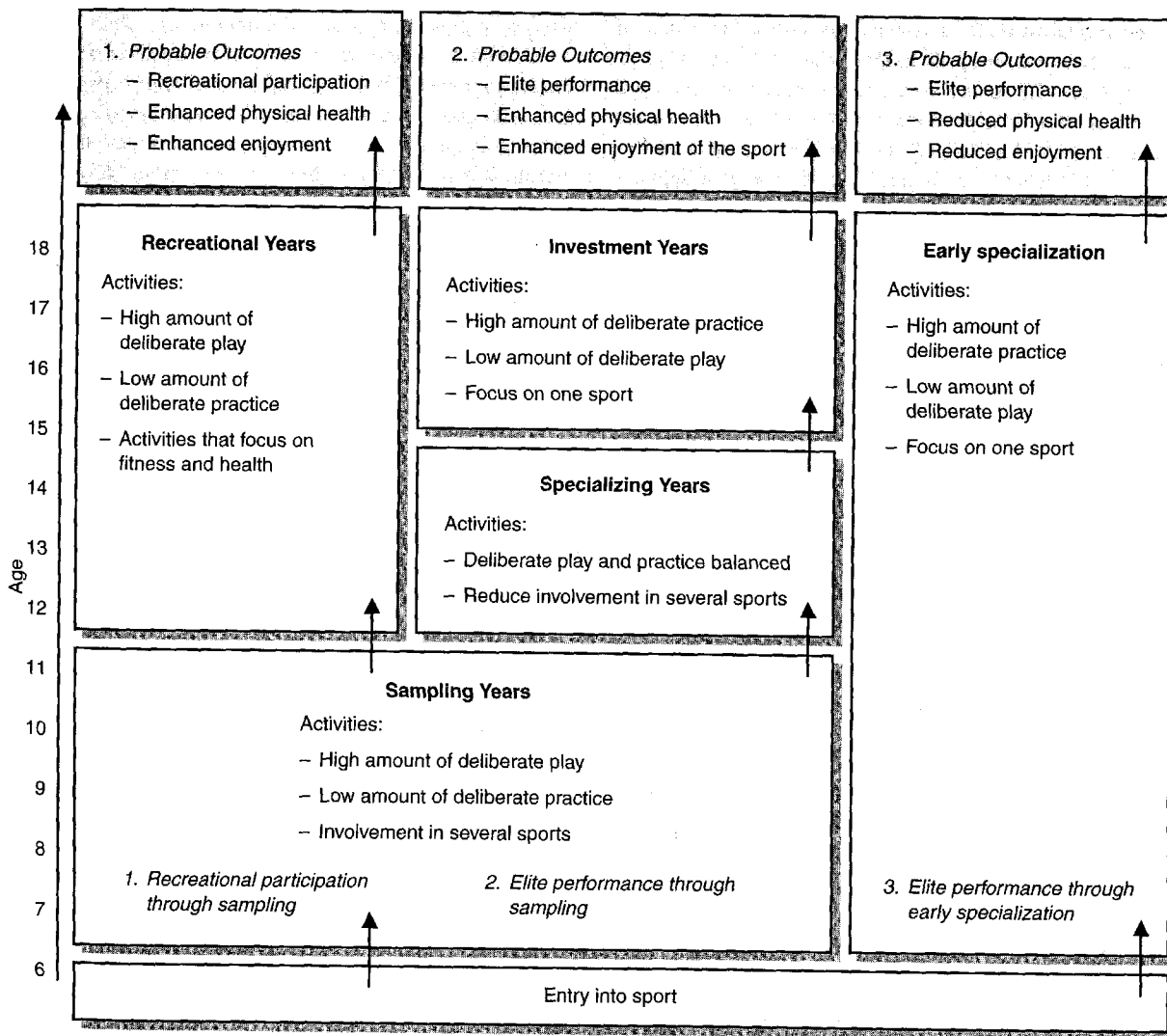


Figure 8.2 Developmental model of sport participation.

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(Caine, Cochrane, Caine, & Zemper, 1989; Law et al., in press). For example, excessive forms of training during crucial periods of biological development can significantly increase the risk of overtraining injuries (Caine et al., 1989; Dalton, 1992). More developmental studies that focus on the benefits and costs associated with early specialization are necessary to fully appreciate the value of this trajectory.

Other Trajectories

Opportunities for horizontal movement across stages (e.g., going from investment to recreational) should be provided for participants so that they can change their level of participation at any age if they so desire. Unfortunately, in many sports, it is difficult for a 16-year-old to invest in a sport if he or she has not been specializing in that sport since approximately age 13. However, in some sports, such as ultra-endurance triathlon, investment in adulthood is possible (Baker et al., 2005). Sports with later ages of peak performance, such as ultra-endurance triathlon (peak at approximately age 30), have more flexibility with regard to the type of activities performed during the teenage years. In sum, the differing ages of peak performance in various sports may be a critical constraint on the type of training performed during an athlete's development (Baker & Côté, 2006).

Summary

Overall, the DMSP provides a useful framework to assess the learning environments that lead to various performance and developmental outcomes in children. Although not all the outcomes of each of the different trajectories of the DMSP have been directly tested, enough support exists to suggest developmental patterns that can be further tested through retrospective research. By considering factors other than accumulated amount of practice, the DMSP allows researchers to address questions of learning efficiency and learning effectiveness. A youth sport framework that focuses on learning efficiency should consider the various pathways that children follow in sport and consider the dropout rate of each trajectory. Concerted effort is required from physical education teachers, coaches, and parents to ensure that children learn skills and stay motivated to continue their participation in sport at either an elite or a recreational level.

CONCLUSION

This chapter focused on how expert athletes spend their time in sport throughout their development. We reviewed literature on practice and play, the two fundamental learning activities that have been shown to contribute to chil-

dren's skill development in sport. Ericsson et al.'s (1993) study of musicians and subsequent studies with athletes (Helsen et al., 1998; Hodge & Deakin, 1998; Hodges & Starkes, 1996; Starkes et al., 1996) strongly support the contention that deliberate practice is a major determinant of expertise. On the other hand, child development research (e.g., Pellegrini & Smith, 1998; Russ, 2004) has consistently highlighted that play activity teaches important adaptive abilities necessary for the acquisition of new skills. The playful environment that expert athletes experience during their early involvement in sport may largely explain their early learning and exceptional motivation, which leads to subsequent learning and involvement in deliberate practice (Côté et al., 2003).

We examined retrospective studies that have been conducted to trace the training profile of athletes' development in sport. Studies using qualitative interviews, questionnaires, and quantitative interviews were reviewed. One consistent finding of these studies was that without a long-term commitment to high-quality training, athletes are unable to attain elite levels of performance. However, results are not consistent when describing the activities that should be favored in the early years of athletes' involvement. Several studies have supported a developmental approach that does not focus solely, in the early years, on sport-specific deliberate practice but emphasizes playing activities and the sampling of various sporting activities. These different trajectories toward elite performance raise questions regarding the optimal environment that should be provided for the early development of elite performance in sport. Accordingly, we presented some implications of early sampling and specializing. Furthermore, we outlined possible mechanisms that could potentially explain how sampling different sports and playing in the early years can lead to elite performance. We provided evidence from two environmental factors, relative age and birthplace, that support a type of early developmental experience in sport that increases children's opportunities for success.

Finally, we presented a model of development in sport that highlights the changing environments of athletes and has implications for the design of sport programs. Different trajectories of sport participation are suggested, with unique outcomes in terms of performance and physical and psychosocial consequences. The trajectories are differentiated by different types of involvement in sport at different ages. In our search to develop elite-level athletes, we need to be conscious not only of the acquisition of sport skills but also of optimizing the health of young athletes through continued participation in sport.

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