# 30
# DELIBERATE PRACTICE IN SPORT

*Paul R. Ford, Edward K. Coughlan, Nicola J. Hodges, and A. Mark Williams*

Many observers wonder how expert athletes are able to achieve, maintain and improve upon their outstanding performances. The majority of people agree that engagement in practice is an important part of this process. In this chapter, we review a particular type of practice activity known as *deliberate practice*. Deliberate practice is both an activity in sport and a scientific theory. We start the chapter with an outline of the theory and a review of the original research study that introduced it conducted by Ericsson, Krampe and Tesch-Römer (1993). In the second section, we briefly define deliberate practice as an activity in sport and review the research on it with athletes. In recent times, deliberate practice has become a somewhat maligned activity and theory (e.g., Hambrick, Oswald, Altmann, Meinz, Gobet, & Campitelli, 2013; Tucker & Collins, 2012). We believe the scientific interrogation of theories and concepts is an important part of their development, and should be encouraged. Therefore, in the third section of the chapter, we review the concepts associated with deliberate practice that have been subject to criticism. We address some misinterpretations of the research findings from studies that have examined deliberate practice. In the final section, we detail the concepts of deliberate practice that we consider essential parts of the acquisition and improvement of expert performance in sport.

## Deliberate practice theory and supporting data

The theory of deliberate practice is a framework that details how practice can lead to improvements in performance and the attainment of expertise. The theory has been detailed in several articles and book chapters elsewhere by Ericsson (1996; 2003; 2006; 2007; Ericsson et al., 1993; Ericsson & Towne, 2010). The seminal paper published by Ericsson et al. in 1993 introduced and provided tests of deliberate practice theory. They examined the activities that violinists and pianists who were enrolled at music academies in Berlin had engaged in since starting in the domain. In a first study, two of the groups were students studying the violin in the West Berlin Music Academy. These students were divided into "best" and "good" violinists based on assessments of current performance by the professors, with the "best" group expected to make a professional career as members of the top orchestras in the world. They were compared to the lowest skilled group who were studying to be music teachers in the education department. A fourth group took part, comprising of middle-aged professional violinists playing in world-class orchestras in order to provide data on a current expert group. In a second study, two groups of pianists were studied who were either young adult experts from another Berlin music academy or age-matched amateurs.

The data from these studies was intended to inform about two key aspects of deliberate practice theory. First, the *monotonic benefits assumption* or how practice increases over time and

its relation to performance and attainment. Second, the *ratings of deliberate practice* or how this activity is defined.

### *Monotonic benefits assumption*

A key part of deliberate practice theory is the 'monotonic benefits assumption', which holds "…that the amount of time an individual engages in deliberate practice activities is monotonically related to that individual's acquired performance level" (Ericsson et al., 1993, p.368). Monotonic means that two or more variables increase or decrease together, so that in this case when deliberate practice amounts increase, then so will performance (Everitt & Skrondal, 2012). Experience alone is not thought to be sufficient for improvements in performance to occur and typically the attainment of expertise in a domain requires engagement in deliberate practice across 10 years or more. Based on this assumption the central claim of their framework is that "…the level of performance an individual attains is directly related to the amount of deliberate practice accumulated" (p.370). In the two studies of musicians, participants retrospectively recalled in interviews and diaries the amount of hours spent in music activities between starting in the domain and the current time. The amount of hours accumulated in solitary music practice by 18 years of age was compared between groups. The focus on solitary deliberate practice activities was due to it being rated by the violinists as the most relevant to improving their performance. There were other activities that were rated by the violinists as being highly relevant to improving performance, including group practice, taking lessons, and music theory, but these were not included in the accumulated hours analysed in these studies.

The mean start age of participants in violin practice was 7.9 years of age and for expert pianists, 5.8 years of age, providing some support for the idea that the attainment of expertise requires engagement across 10 years or more. Figure 30.1 shows that by 18 years of age the best violinists in the Academy and the middle-aged professional violinists had accumulated 7,410 and 7,336 hours in solitary deliberate practice activities, respectively.

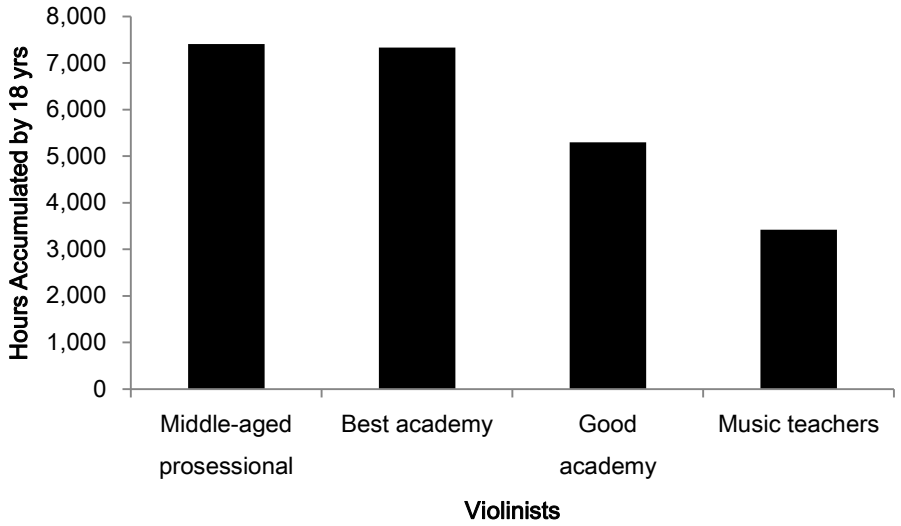


*Figure 30.1* Hours accumulated in solitary deliberate practice by 18 years of age for violinists who are middle-aged professionals, best in academy, good in academy, and music teachers (adapted from Ericsson et al., 1993).

In comparison, by the same age, the good violinists had accumulated 5,301 hours, whereas the music teachers had accumulated only 3,420 hours. The accumulated solitary deliberate practice for each violinist group was positively related to their current level of attainment, supporting the central prediction that performance level is directly related to the amount of deliberate practice accumulated. For all four groups, the reported amount of practice increased monotonically with

age. In their second study, expert pianists had accumulated 7,606 hours of solitary deliberate practice by 18 years of age, which was significantly more than the amateur pianists, who had accumulated only 1,606 hours. Moreover, accumulated solitary practice hours by 18 years of age were highly related to current performance by the pianists on music tasks (e.g., tapping and movement coordination measures), independent of skill group.

In summary, these data reported in Ericsson et al. (1993) provided support for the positive relationship between accumulated deliberate practice and performance or attainment level. Moreover, both weekly and accumulated practice amounts increased in a monotonic fashion with age. However, there was no data collected to show that practice amounts increased in a monotonic relationship with performance, in accord with the monotonic benefits assumption. Their measures of performance and attainment were only determined at one time point (i.e., current skill level), not across development. They state that sports, such as individual track and field events, may provide an opportunity to repeatedly measure the performance of individuals as they develop, albeit researchers are yet to do this and relate it to practice amounts.

### *Ratings of deliberate practice*

Deliberate practice was predicted to differ from other activities by being more relevant to improving key aspects of current performance, more effortful, yet relatively low in inherent enjoyment (Ericsson et al., 1993). To test these predictions, the musicians were asked to rate various activities that were either music-related (e.g., solo performance, group performance, solitary practice, practice with others) or everyday activities believed to be common to everyone (e.g., household chores, shopping, leisure, sleep). These activities were presented to all violinists who were required to estimate how much time they had spent on each activity for "the most recent typical week" (p. 373). Participants were required to rate on a scale of 1 to 10 how relevant each activity was to improving their musical performance, how much effort was required to do the activity and their level of enjoyment experienced when engaging in the activity (without allowing the outcome of the activity to influence their rating). There were no between-group differences in the activity ratings for relevance, effort, and enjoyment. Rating scores for each activity were collapsed across groups and compared against the grand mean for all activities to determine whether they were significantly higher or lower.

For the musical activities, solitary practice had the highest rating for relevance to improving performance. In comparison, solitary playing for fun was given one of the lowest ratings for relevance. The other musical activities that were rated higher for relevance than the grand mean rating of all activities were practice with others, taking lessons, solo and group performance, music theory, and listening to music. All of the musical activities that were rated higher than the grand mean for their relevance to improving performance were rated higher than the grand mean for effort, except for listening to music. These same music activities were not rated differently for enjoyment compared to the grand mean for all activities, except for group performance and listening to music, which were rated higher. Sleep was the only everyday activity that scored higher for relevance than the grand mean. These ratings formed the criteria for defining the characteristics of deliberate practice.

The ratings are linked to three potential constraints inherent in long-term engagement in deliberate practice (Ericsson et al., 1993). The motivational constraint is based on the premise that performers are motivated to engage in deliberate practice because of its value to improving their performance and that engaging in that activity is not inherently enjoyable. Therefore, beginning engagement in deliberate practice requires that performers are already participating in the domain and are motivated to improve performance. The effort constraint holds that engaging in deliberate practice requires the full attention of the performer to be maintained across the entire period of the activity. Therefore, antinomy exists between the requirement to maximise the amount of deliberate practice engaged and the somewhat limited duration that full attention and high effort can be maintained during bouts of this activity. The need to be able to quickly recover

from bouts of deliberate practice so that more of this activity can be engaged in was made particularly salient by Ericsson et al. (1993). They showed that the best violinist groups tended to sleep more than the music teachers, particularly taking short naps in the afternoon. The associated prediction was that being unable to recover will lead to exhaustion in the form of mental and physical fatigue, as well as injury. Finally, the resource constraint is related to support from the family and significant others, such as coaches and teachers suitable for the stage of development of the performer. Other resources in terms of facilities, time and equipment are required in order to engage in deliberate practice activities.

In recent versions of the theory, the notion of "arrested development" has been included to describe the plateau in performance that occurs for many performers (Ericsson, 2003, 2007). Some performers become competent at a task or domain and are satisfied to remain at that current level of performance. In contrast, future expert and expert performers are not satisfied with being merely competent and, as a consequence, they plan and engage in deliberate practice activities that are highly relevant to improving their current performance and its weaknesses. Moreover, only some individuals have the motivation to consistently engage in deliberate practice to improve their performance (Ericsson, 2013a). It is their engagement in this activity (and motivation to do so) that continues to improve their performance beyond its current level or plateau. These differences in the quality and quantity of deliberate practice between expert performers and other performers illustrate how experts continue to improve performance across time. Expert performers are hypothesised to maintain cognitive control over their performance so that they can consistently improve it, with only some parts of performance being automated (Ericsson, 2013a).

## Deliberate practice studies with athletes

Deliberate practice in sport is an activity engaged in by some athletes with the intention of improving specific aspects of competition performance. It is usually sport-specific activity (e.g., tennis activity for tennis players), but this depends on the aspect of performance being improved. It can include more generic activities, such as strength, fitness, or mental skills training. It requires a prior analysis of competition performance so that key aspects that are limiting performance and require improvement are identified and improved (e.g., Jones, 2012). These aspects include any of the physical, psychological, tactical or skill aspects of the sport and athlete, as well as the equipment used by the athlete in the sport.

The first test of deliberate practice theory using athletes was a comparison of adult, male, Canadian international and club-level Olympic-style wrestlers (Hodges & Starkes, 1996). Wrestlers started the sport at 13 years of age on average, later than Ericsson et al.'s (1993) musicians who had started around 7 or 8 years of age. Ten years later, the international wrestlers had accumulated 5,882 hrs of practice compared to 3,571 hrs for the club wrestlers, demonstrating the same positive relationship between practice and attainment shown by Ericsson et al. (1993). When practice data were examined at as a function of years wrestling, weekly hours per week increased in a monotonic fashion with age and differentiated across the skill groups after ~6 years in the sport. It was practice time with others that differentiated the groups, however, rather than solitary practice as reported for the musicians. Moreover, two of the four practice activities that were rated highest for their relevance to improving performance by the wrestlers were also rated as highly enjoyable (i.e., mat-work and working alone with the coach). These data served to question the hypothesis that deliberate practice comprises activities that are not high in inherent enjoyment. Fitness activities (weights, running) were, however, rated high for relevance and low for enjoyment. These findings were subsequently replicated in a study of Belgian international, national and provincial soccer and hockey players (Helsen, Starkes, & Hodges, 1998). Across the two sports, nine of the fourteen sport-specific practice activities (technical skills, tactical skills, games, practice alone with a coach) were rated significantly higher than the overall mean for their relevance to improving performance, as well as inherent

enjoyment. Again, fitness activities (running) rated high for relevance, were rated as less enjoyable.

The deliberate practice studies conducted with athletes since 2000 have generally used the same methods as Ericsson et al. (1993). The data has generally supported the idea that practice and skill level are positively related and that practice amounts increase in a monotonic fashion with age, supporting deliberate practice theory. More-skilled athlete groups have accumulated more hours in practice in their sport compared to lesser-skilled athlete groups (for recent reviews, see Baker & Young, 2014; Ward, Hodges, Williams, & Starkes, 2004). In studies where researchers have had athletes rate their practice activities for relevance, effort and enjoyment, in general, fitness activities (e.g., weights, flexibility) have again been rated high for relevance, but low for enjoyment, whereas sport-specific practices rated high for relevance are rated high for enjoyment (e.g., Law, Côté, & Ericsson, 2007; Young & Salmela, 2002). Other researchers have examined the practice activities of elite youth or adolescent athletes (e.g., Ford, Ward, Hodges, & Williams, 2009; Ford et al., 2012; Hendry, Crocker & Hodges, 2014; Ward, Hodges, Williams & Starkes, 2007; Weissensteiner, Abernethy, Farrow, & Muller, 2008). Despite the contribution of this research to models of skill development, it is somewhat limited by the possibility that many of the athletes studied will not become adult-elite (yet see Ford et al., 2009, for a longitudinal follow-up).

## Criticisms of deliberate practice research

In this section, we review some concepts that have been associated with deliberate practice and that have been subject to criticism. These are the "10,000 hr rule", the idea that all practice and training is deliberate, the enjoyment tenet of the theory, and the belief that children should engage in deliberate practice.

### *The 10,000 hour rule*

In 2008, a popular science book entitled *Outliers* (Gladwell, 2008) was published. In that book, the author reviewed Ericsson et al.'s (1993) study in a chapter entitled the "The 10,000 hour rule". In that chapter, Gladwell stated that 'researchers have settled on what they believe is the magic number for true expertise: ten thousand hours' (p.40). The book was hugely successful and the idea that it takes 10,000 hours of practice to become an expert performer became popular, such that if someone does 10,000 hours of practice, they will become an expert, whereas if they do not, then they will not. The "10,000 hour rule" appears to emanate from two parts of the Ericsson et al. (1993) paper. First, the average amount of hours of solitary deliberate practice that the best and professional violinists had reached by the age of 20 years was approximately 10,000 hrs (Ericsson et al., 1993). Second, based on previous research in other domains, most notably Simon and Chase's study of chess (1973), it was predicted that 'expert performance is not reached with less than 10 years of deliberate practice' (Ericsson et al., p.372), also known as the "10-year rule" (Simon & Chase, 1973). In 2013, Ericsson (2013b) responded that the "10,000 hour rule" should not be attributed to him and that he does not use the term in his papers.

The main method used by researchers to study accumulated practice is to have current expert athletes retrospectively recall the number of hours they have spent in practice since they began in their sport. Generally, researchers have shown that the number of hours accumulated by expert athletes in deliberate practice and other activities in their sport by the time they reach expert levels is significantly greater than lesser-skilled athletes, but is less than 10,000 hrs. For example, international Belgium professional soccer players had accumulated around 7,000 hrs in practice activities by 20 years of age (Helsen et al., 1998), whereas Australian national team sport players had accumulated on average 3,939 hrs by 19 year of age (Baker, Côté, & Abernethy, 2003). There have been a few exceptions where "10,000 hours" have been exceeded. For

example, Olympic gymnasts in Canada had accumulated 18,835 hrs in practice activities by the age of 16 years (Law et al., 2007). The "10,000 hour rule" as the "magic" amount of time required to become an expert athlete does not appear to be supported by research evidence from sport, although between sports there is considerable variability.

Researchers have shown that the number of hours accumulated in practice in a sport before becoming an expert not only varies between sports, but also varies within the same sample of athletes in the same sport. For example, in the study cited above with Australian national team sport players (Baker et al., 2003) the standard deviation was 1,770 hrs (almost half the size of the mean), ranging from 600 to 6,026 hours of practice by the age of 19 years. The variation of accumulated hours between expert athletes in the same sample suggests problems exists in the method of counting practice hours or that other factors contribute to the development of expert performance. Tucker and Collins (2012) have calculated that hours accumulated in deliberate practice explained only 28% of the variance in dart performance at 15 years into the career of the professional and regional dart players examined by Duffy et al. (2004). Several factors have been forwarded to explain the remaining variance, including genetic differences between individuals (e.g., Tucker & Collins, 2012). In the original Duffy et al. (2004) study, however, the sample size was relatively small ($n$ = 36), so the 95% confidence intervals for the correlation of 0.53 were 0.24 and 0.73. Moreover, the number of hours accumulated by the darts players showed large between-subject variation, with the professional male players accumulating 12,839 hours at 15 years into their career with a standard deviation of 7,780 hours. In a study of Canadian recreational, near elite and elite level swimmers, practice hours again accounted for only 31% and 29% of the variance in the 100-m and 200-m sprint events, respectively (Hodges et al., 2004). However, this increased to 63% of the variance as the distance of the event increased (i.e., 400 m). In the same paper, practice hours for triathletes who swam 1.5 km as part of an Olympic triathlon event accounted for 53% of the variance in times in the swim event, albeit this decreased to 38% for the overall triathlon event. The amount of explained variance increased as the emphasis on speed and power decreased, supporting the suggestion that certain sports or events might be more or less amenable to change with practice.

A potential limitation of previous research on deliberate practice is that very few, if any, researchers have addressed differences in the quality or efficiency of the deliberate practice engaged in, which might be expected to explain a substantial proportion of variance in eventual attainment. Researchers have not taken into account what is being practised, including the aspect of performance being focused upon, how practice is structured, the coaching delivered, or the athlete's current status. Variance in these factors occurring across many practice sessions are likely to magnify differences in the number of hours required to reach expert levels of performance. Because the 'monotonic benefits assumption' is not falsifiable when the quality of practice is used to excuse cases that do not support the premise (Tucker & Collins, 2012), it has been argued that researchers must incorporate more fine-grained measures of the quality of practice into future assessments of practice.

Several other limitations exist in the research conducted on deliberate practice theory in sport. First, variation exists across studies for the age at which the number of hours accumulated in practice is totalled. Many researchers have totalled the hours across career to date, which is from start age in the sport to current age. For example, the mean start age for Belgian elite soccer players was 5 years and their practice hours were totalled to their current mean age of 25 years (Helsen et al., 1998). In comparison, Canadian international and club wrestlers had a mean start age of 13 years and a mean current age of 23 years (Hodges & Starkes, 1996). A 20 year career span (Helsen et al., 1998) compared to a 10 year career span (Hodges & Starkes, 1996) is likely to lead to significant disparities in accumulated practice amounts. Therefore, we recommend that researchers sum accumulated practice hours to the first meaningful milestone achievement of expertise (e.g., first professional contract in sport) or later milestones (e.g., winning World Championships) (for an example, see Baker et al., 2003). Second and related to this point, the definition of expertise varies considerably between studies with some participants being only

semi-professional status or national rather than international calibre, or junior/youth level rather than adult elite. Both of these limitations could lead to unnecessary variation in the reported number of hours accumulated in practice by athletes in these studies. Third, participants in these studies are required to recall hours engaged in practice that occurred many years ago, which may lead to memory errors and bias that will impact variance in the total number of hours accumulated. Fourth, the sports themselves contain a range of characteristics that may affect the number of practice hours needed to be an elite performer. These characteristics include the nature and popularity of the sport, the attributes required to be an expert performer in the sport, the age when peak performance is typically reached, and the extent to which other performers accumulate practice in the domain.

## *Not all practice is deliberate*

In Table 30.1 we have differentiated four types of practice activities that are engaged in by athletes during training. Researchers have shown that a lot of athlete training is not deliberate practice. Based on estimates from weekly activity diaries, Hodges and Starkes (1996) reported that wrestlers invested significantly less practice time in sparring activities, which they rated as their most relevant activity for performance improvement, when compared to other activities that were deemed less relevant, such as warm-up. During training, many athletes engage in *maintenance practice activities*. These activities are designed to maintain their current level of performance, rather than improve it through deliberate practice (Krampe & Ericsson, 1996). During training, athletes also engage in *play activities* that are engaged in with the intention of fun and enjoyment or *competition activities* in which the intention is to win. Researchers have generally tallied the amount of time athletes have spent in all forms of training, as opposed to just deliberate practice activities. Given that training can consist of maintenance, play, competition, and deliberate practice, it is likely that the amount of actual deliberate practice engaged in by athletes has been overestimated.

Table 30.1 Four different types of practice activities that potentially comprise sport training but that differ with respect to the intention of the activity.

| Activity | Main intention | Other main characteristics |
|---|---|---|
| Deliberate practice | To improve aspects of current performance | Relevant to improving performance, effortful, not necessarily enjoyable |
| Maintenance practice | To maintain current performance level | Unknown |
| Play practice | To experience fun, enjoyment, and improvement | Enjoyable |
| Competition | To win | Effortful, enjoyable |

Competition activities are where the athlete must demonstrate their current performance, such as during match play in basketball. Ericsson et al. (1993) categorised competition as work activity and differentiated it from deliberate practice because it is time-constrained, motivated by external rewards, lacked repeated experiences or experimentation, and may lead to less performance improvement. However, a few researchers (e.g., Abernethy, Farrow, & Berry, 2003; Singer & Janelle, 1999) have stated that engagement in competition activity might contribute to the development and improvement of expert performance in sport. Many characteristics of competition activity in sport are difficult to recreate in practice. These include opponent characteristics, the size and structure of the activity, the influence of travel, venue and the crowd, or the frequent bouts of competition activity that occur over relatively short period of time, such as in tennis. Indeed, team sport athletes rate competition activity as highly relevant to improving their decision making and physical fitness (Baker et al., 2003), which may be consequences of its unique characteristics. Moreover, athletes who maintain cognitive control over their performance

(Ericsson, 2013a) may improve more so from competition compared to those who do not, but research is required on this activity to test these hypotheses.

### *Deliberate practice in sport and the enjoyment tenet*

In a number of studies, researchers have shown that athletes rate some types of practice as high for both their relevance to improving performance and high for enjoyment (e.g., Helsen et al, 1998; Hodge & Deakin, 1998; Hodges & Starkes, 1996; Starkes et al., 1996). These data do not fit with the original definition of deliberate practice as being an activity that is highly relevant to improving performance and not inherently enjoyable when compared to other activities. In these early studies, athletes rated sport-specific games and practice as enjoyable, as well as working with a coach. In contrast, it was only general fitness activities (e.g., strength or flexibility training) that fitted the original definition of deliberate practice as being high in relevance and low in inherent enjoyment. A number of reasons have been forwarded to explain why athletes retrospectively rate sport-specific practice activities as enjoyable. First and as above, training can consist of maintenance, play, competition, and deliberate practice activities, so that many activities do not meet the definition of deliberate practice, but are included in these ratings. Second, Ericsson (1996) stated that sport is an inherently social activity and athletes might be rating this social interaction during the activity as enjoyable. In counter to this argument though, sport-specific practice in individual sports, such as figure skating, has also been rated as highly enjoyable. Third, it is possible that athletes might be rating the consequences of the activity as enjoyable, such as improved performance, rather than their in-the-moment enjoyment during the activity (Ericsson, 1996). When these two variables have been differentiated, ratings of enjoyment are generally lower (Hodges et al., 2004; Ward et al., 2007). Fourth, it is possible that the method of retrospectively rating activities that have been engaged in some time ago into a single aggregate score might lead to misperceptions (Coughlan, Williams, McRobert, & Ford, 2014).

In the study of elite triathletes and swimmers detailed earlier, a diary study of all physical activities engaged in during a typical training week revealed enjoyment to be only weakly or not at all correlated to relevance and effort ($rs<.1$; Hodges et al., 2004). For example, a run on one day was perceived as high in effort and relevant to improving performance, but not enjoyable, whereas a similar run the following day received similar ratings for relevance and effort, yet this time was perceived as enjoyable. These ratings were collected soon after the event was completed, were verified with questionnaire data, and the inherent enjoyment of the activity was separated from general feelings of satisfaction with its outcome. Based on these data there is reason to recommend that enjoyment should not be seen as a defining criteria for whether practice is "deliberate" or not. Certain deliberate practice activities, such as those designed to improve weaknesses (e.g., Coughlan et al., 2014) or physical attributes (e.g., weight training, Hodges & Starkes, 1996) are generally not perceived as inherently enjoyable, whereas others are generally rated as more enjoyable, such as sport-specific tactical practice (e.g., Helsen et al., 1998).

### *Children and deliberate practice*

The 'monotonic benefits assumption' has led to the popular belief that the start of engagement in deliberate practice in a sport should occur very early in childhood. However, in the theory, Ericsson et al. (1993) explicitly outline a pre-deliberate practice phase of participation. The first phase of participation in a domain was argued to "…begin with an individual's introduction to activities in the domain and end with the start of instruction and deliberate practice" (Ericsson et al., 1993, p. 369). It was proposed that "…interested individuals need to be engaging in the domain and motivated to improve performance before they begin deliberate practice" (p. 371). The inclusion of this early, pre-deliberate practice stage was mainly based on a collection of interviews edited by Bloom (1985) about the personal skill development of young adult expert

performers across a range of domains in North America. The interviewees included professional tennis players (Monsaas, 1985) and Olympic swimmers (Kalinowski, 1985). Across domains, playful, exploratory and fun activities defined the early or childhood stage of participation, with more serious training starting later in childhood or in early adolescence.

A number of researchers have recommended that youth athletes delay the start of engagement in deliberate practice in a single sport until early adolescence (for reviews, see Côté, Baker, & Abernethy, 2003; 2007; Côté et al., 2012). Childhood engagement in intense deliberate practice and competition in a single sport (known as the 'early specialisation' pathway) has been hypothesised to lead to negative motivational consequences, including reduced enjoyment, overtraining, dropout, burnout and overuse injuries (Baker, 2003; Baker, Cobley, & Fraser-Thomas, 2009; DiFiori et al., 2014; Wiersma, 2000). Some researchers have investigated the consequences for athletes who engaged in an 'early specialisation' pathway. For example, Olympic gymnasts in Canada who engaged in this pathway reported health and injury problems (Law et al., 2007), whereas elite adolescent tennis players cited high training loads, spending too much time in the sport, and a sole focus as some of the multiple reasons for their burnout and dropout (Gould, Tuffey, Udry, & Loehr, 1996; see also Kenttä, Hassmén, & Raglin, 2001; Strachan, Côté, & Deakin, 2009).

In contrast to early engagement in deliberate practice in a single sport, a recommendation has been to keep childhood engagement in playful activity until early adolescence (for reviews, see Côté et al., 2003; 2007; 2012). Playful activity in sport is fun and enjoyable, intrinsically motivating, led by the child and often involves modified versions of the competition format of the sport to meet their needs (also termed 'deliberate play'; Côté, 1999; Côté & Hay, 2002). It includes activities such as street soccer, backyard basketball or mini versions of golf and tennis. Initial and childhood engagement in sport-specific playful activity is hypothesised to benefit skill acquisition, attainment and the intrinsic motivation of participants (e.g., Côté, Murphy-Mills & Abernethy, 2012). In soccer, there has been some evidence in support of the relationship between early engagement in soccer-specific play and later attainment of skill. The amount of soccer-specific play in childhood was greater for adult players with superior decision making skills compared to those with inferior skills (Roca, Williams, & Ford, 2012) and those that signed professional contracts in late adolescence compared to those who did not (Ford et al., 2009). Moreover, both Australian Rules football players (Berry, Abernethy, & Côté, 2008) and Australian Olympic team sport players (Baker et al., 2003) who had superior decision making skills engaged in more playful activities across a number of similar sports during childhood when compared to those with inferior skills. However, Ward et al. (2007) failed to show a relationship between amount of time in play and skill level among elite and recreational youth players. It has been argued that modified versions of the competition format of the sport (e.g., small-sided games) that occur during playful activity contain conditions that promote acquisition of the skills required during later competition performance. Moreover, the 'power law of practice' describes the repeated finding that in the early stages of engagement in a domain there is a relatively rapid improvement in performance, whereas sometime later performance improvement begins to plateau (Newell & Rosenbloom, 1981). It may be that in sport, childhood engagement in playful activity leads to a relatively rapid improvement in performance and motivation. When performance begins to plateau sometime later, future expert performers start to plan and engage in deliberate practice to continue improving their performance.

Childhood sport engagement in playful activity has been hypothesised to lead to positive motivational consequences, including enhanced enjoyment, intrinsic motivation, commitment and perseverance. Few researchers have examined the motivational consequences of childhood engagement in playful activity, particularly for expert adult athletes. An exception to this was a study of elite adolescent soccer players in the United Kingdom (Hendry et al., 2014). Based on estimates of practice and play across three different age groups (up until age 17 years), no relationship was shown between measures of intrinsic motivation and the amount of childhood engagement in soccer-specific play or practice. There was evidence that among the oldest age

group only (i.e., aged 17 years) the years in the elite system were negatively related to current measures of intrinsic motivation, although this might simply be related to the development system, rather than a lack of time in play, or too much practice. Further research is needed to study the link between early childhood engagement in playful activity and motivational outcomes. Longitudinal studies would be the best method to chart the relationship between activity amounts and their impact on both later success and motivation.

Another proposal has been that childhood engagement should entail the sampling of a number of different sports ('early diversification'; Côté et al., 2003; 2007; 2012, see also Jayanthi, Pinkham, Dugas, Patrick, & La Bella, 2012; Mostafavifar, Best, & Myer, 2013; Wojtys, 2013). The childhood activities of some expert athletes have been characterised by engagement in a number of sports, including the primary sport in which they became an expert (Baker, et al., 2003; Berry, et al., 2008; Carlson, 1986; Côté, 1999; Monsaas, 1985; Soberlak & Côté, 2003). In some sports, such as the winter sport of skeleton (Bullock et al., 2009), a late start age in adolescence is relatively common, being preceded by earlier activity in other sports that presumably develop attributes later required in the primary sport (e.g., sprinting transferring to skeleton). Diversity in activities during childhood is predicted to foster motivation by protecting participants against burnout, dropout and overuse injuries, whilst benefitting skill acquisition through the transfer of attributes between sports. Some transfer of attributes has been shown to occur between sports with similar elements, but less so between those with different elements (e.g., Causer & Ford, 2014). The link between engagement in a number of sports in childhood and motivation is yet to receive systematic attention.

## Deliberate practice in sport in the 21st Century

In this final section, we detail the parts of deliberate practice that we consider to be the essential components of the acquisition and improvement of expert performance in sport.

### *Deliberate practice is necessary to improve performance beyond plateaus*

For expert adult and elite adolescent athletes, systematic and consistent engagement in effortful deliberate practice activity is the optimal way to improve upon performance and achievements. It is well established that practice and performance show a strong positive relationship and it is one of the most robust findings in behavioural science (Davids & Baker, 2007). There is a need for researchers to show how deliberate practice causes improvements in performance and its underlying attributes that are beyond those found from engagement in other types of practice activities. For example, performance improvements were examined in expert and intermediate Gaelic football players practicing two different types of kick across pre-, post-, and retention tests surrounding four practice sessions (Coughlan et al., 2014). During the practice sessions, the expert Gaelic football players self-selected to practice the kick they were weaker at. In the delayed retention test that occurred six weeks after practice finished, they had significantly improved their weaker kick score by 17% when compared to their pre-test score. In contrast, the intermediate group self-selected to practice their stronger kick and did not improve between the pre- and retention test (see Figure 30.2).

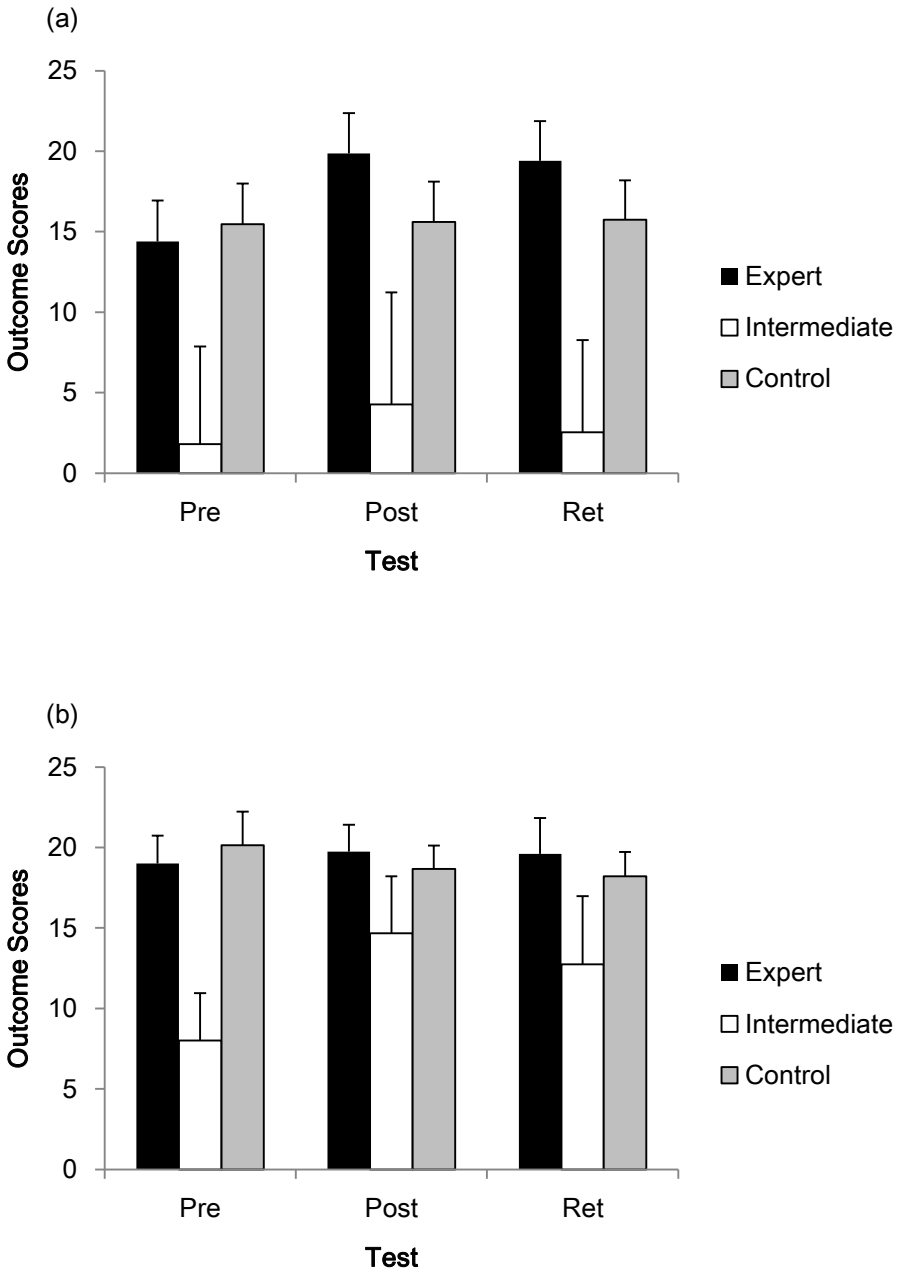


*Figure 30.2* Mean (SD) outcome scores (out of 30 points) for the (a) weaker and (b) stronger kicks of the expert intermediate, and expert control groups for the pre-test, post-test, and retention test (Coughlan et al., 2014).

Moreover, the expert players rated their practice as more effortful and less enjoyable compared to the intermediate group, supporting those predictions in deliberate practice theory. Measuring deliberate practice activity whilst athletes engage in it and recording the associated adaptations, perhaps in a longitudinal manner, are arguably preferable methods to measuring it retrospectively.

### *Deliberate practice has to be of sufficient quality*

The quality of practice will have a major effect on the amount of performance improvement achieved. Factors influencing the quality of the activity include the relevance to improving

current performance of the aspect being practiced. It includes the effort invested in the activity and the associated recovery. Moreover, the quality of the activity is influenced by the structure of the practice and the augmented information provided during it, as well as the athlete's current state in terms of skill level, age, fitness etc. Expert adult and elite adolescent athletes should be engaging in high amounts of quality deliberate practice during training each day, week, month and year. Measuring the quality of practice and providing clear hypotheses about how it differentiates those who become expert performers from those who do not should be a key focus for future research.

### *Expert athletes engage in a deliberate environment, not just in practice*

Researchers have generally taken the view that deliberate practice in sport only occurs during training sessions. However, other activities can be made to and do contain the characteristics of deliberate practice. These include team meetings and reflective team debriefs (Richards, Collins, & Mascarenhas, 2012), athletes observing their sport live or on television, physical fitness training (e.g., Baker et al., 2003; Helsen et al., 1998), competition (e.g., Singer & Janelle, 1999), reflection (e.g., Coughlan, Williams, & Ford, in preparation), recovery practices (e.g., Gill, Beaven, & Cook, 2006; Versey, Halson, & Dawson, 2013), diet and nutrition (e.g., Taylor et al., 2012), and performance analysis sessions (Baker et al., 2003; Helsen et al., 1998; Richards et al., 2012). In these activities, when the intention of the activity is the improvement of specific and key aspects of current performance and the engagement is effortful, then these activities contain the characteristics of deliberate practice. Expert adult and late adolescent elite athletes are hypothesised to engage in all of these activities with the intention of performance improvement. Many of these activities occur during an athlete's time at their sport's organisation, whereas some of these activities occur during the athlete's personal life, such as diet and nutrition, recovery and sleep. These activities in combination have been termed the *deliberate environment* (Ford, Hodges, & Williams, 2013). In a deliberate environment, the majority of decisions and behaviours made by and for athletes across their sporting and personal life are goal-directed and optimised towards improving their competition performance. There has been anecdotal evidence that expert athletes engage in such a deliberate environment during their career (e.g., Farah, 2013; White, 2013). Professional sports organisations play a key role in designing, creating, supporting, managing and improving this deliberate environment (e.g., *deliberate programming*, Bullock et al., 2009). In a deliberate environment, the hours spent in all of these activities, including recovery from them, are predicted to be relatively high, increasing from lower amounts in adolescence to higher amounts in adulthood. The "litmus test" of each activity is the amount of improvement to competition performance and its underlying attributes that it causes.

## Summary

Deliberate practice is both a scientific theory and an activity engaged in by some athletes. As a scientific theory, it has led to a large body of research and has entered popular culture. The main focus of the research and its translation to popular culture has been on the number of hours that expert performers engage in practice across their development. The theory and this research have done much to advance understanding of how expert performance in a domain is acquired and improved upon. Generally, expert performers in sport have accumulated more hours in practice and other developmental activities by the time they achieve that milestone when compared to lesser-skilled performers. The focus on counting the number of hours has led to criticisms of the theory and research, as well as misunderstandings of it in popular culture (i.e., the "10,000 hour rule").

Another focus of the research has been on the characteristics of deliberate practice when compared to other activities. It was originally rated as being more relevant to improving key aspects of current performance, more effortful, yet relatively low in inherent enjoyment (Ericsson et al., 1993). Researchers have shown that athletes rate fitness activities as highly relevant to

improving performance and as less enjoyable than other activities, in line with original conceptions of enjoyment in deliberate practice theory. However, most researchers have shown that expert athletes rate sport-specific practice as relevant to improving future performance, but as highly enjoyable. Moreover, expert athletes often have a period of engagement in enjoyable playful activity in their sport or across sports during childhood and prior to the start of meaningful engagement in deliberate practice in their primary sport.

In the near future, researchers will continue to debate the merits and weaknesses of deliberate practice theory. It is likely that there will be new research designs that allow better insight into the types of practice and activities that best predict performance over short and long time-scales, as well as continuation in sport (e.g., motivation). Researchers should seek to measure deliberate practice and its effects as athletes engage in it, preferably across long time-scales. Another area for further research is to determine the optimal developmental time points to specialize and engage in deliberate practice activities, as well as the continued investigation of the consequences of childhood engagement in a variety of sports or activities that vary in their formal structure and goals, such as play or competition.

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