Project:

An Overview and Critique of the '10,000 hours rule' and 'Theory of Deliberate Practise'

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The Claim

It doesn't matter who your players are – if they train hard enough and long enough they can play at the highest level!

Origins

In 1993, Anders Ericsson, Ralf Krampe and Clemens Tesch-Römer published 'The Role of Deliberate Practice in the Acquisition of Expert Performance' (Ericsson, Krampe, & Tesch-Römer, 1993).

Their article proposes that expert performance i.e. the ability of an individual to perform at the highest level (for example, a footballer playing in the Premier League, the Champions League, or at international level), has little to do with heritable ('innate'/'natural') ability, but is highly dependent on the quantity and quality of practice in their chosen field or domain (e.g. football, a particular position in football). Specifically, a minimum of 10 years, or 10,000 hours, of *deliberate practice.* Deliberate practice (as shall be show) is a very specific and demanding form engagement in the skills and tasks of the domain.

In the period since the 1993 work, Ericsson and (various) colleagues have researched and developed these ideas considerably. There are now innumerably books, journal articles and press reports including, notably, 'The Cambridge Handbook of Expertise and Expert Performance' (Ericsson, Charness, Feltovich, & Hoffman, 2006) and 'Expert Performance in Sport: Recent Advances in Research on Sport Expertise' (Starkes & Ericsson, 2003) (see reading list and references at the end of the document).

As might be expected given the simplicity and empowering nature of their claims, Ericsson and colleagues' ideas have been taken up in the popular scientific literature – notably Daniel Coyle's 'Talent Code', Geoff Colvin's 'Talent is Overrated', Malcolm Gladwell's 'Outliers', and Matthew Syed's 'Bounce'. Inevitably, notions of the '10,000 hours rule' and 'deliberate practice' have entered into the Football Association's and Premier League's thinking – notably through 'The Future Game' publication, and the 'Elite Player Performance Plan'[1]

This research briefing provides an overview of Ericsson and colleagues' ideas, the supportive and critical evidence, and makes some suggestions about what it means for coaches.

[1] http://www.bbc.co.uk/blogs/paulfletcher/2011/02/football_league_fears_over_pla.html

Who is an expert? What is expertise?

Before we consider Ericsson and colleagues' views on the conditions and factors which enable expertise to develop it is important to consider the questions – 'who is an expert?', and 'what is expertise?' – because, as will become clear, the definitions adopted have a significant bearing on the way in which the phenomenon is described, and the recommendations for action.

Historically, there have been different notions about who is an expert, what expertise is, and how expertise is developed. One commonly held view is that an expert is "someone widely recognised as a reliable source of knowledge, technique or skill, whose judgement is accorded authority and status by the public or his or her peers" (Wikipedia, 2005). Expertise then refers to the characteristics, skills, and knowledge that distinguish experts from novices and less experienced people according to general and peer assessment.

Another common perception is that talent is hereditary ('innate', 'natural', 'born') which derives, it is frequently argued, from Francis Galton's 1896 study 'Hereditary Genius' (Galton, 1896/1979) – but may also be a common sense everyday perception of, for example, parents and coaches. Thus, when pundits and supporters talk about Wayne Rooney, for example, they suggest 'he's got natural talent', that is, an hereditary gift he was born with. Another commonly held perception is that experts have prolonged or intense experience in their domain through practice and education.

Question Box

Think about the players you have worked with.

How do you assess whether a player is high performing/expert? What markers do you use?

Which factors are most important in determining playing success – hereditary factors such as 'natural ability', or environmental factors such as 'training and working hard', 'good coaching' and 'supportive parents'?

These common views on expertise, however, have been challenged by Ericsson and colleagues.

- When high profile members of a domain are asked to identify their 'expert peers', for example, the 'coaches' coach of the year', the 'experts' identified often do not perform well when asked to work on specific tasks compared with novices
- There is no evidence, it is argued, of hereditary characteristics as a predictor of future expertise. For example, there is no correlation between IQ and expert performance in fields such as chess, music, sports, and medicine. The exception is height and body size which can be significant in some sports
- Furthermore, extensive professional <u>experience</u>, it is argued, is not a guarantee of expert performance

Expertise: Consistently Superior Reproducible Measurable Performance

To address the issues identified in the previous section Ericsson and colleagues developed a very specific notion of expertise.

First, expert performance produces concrete results. Brain surgeons, for example, must not only be skilful with their scalpels but must also produce **successful outcomes** with their patients. A chess player must be able to win matches in tournaments.

Second, expert performance is **consistently superior** to that of their peers.

Ericsson and colleagues main contribution has been, however, to **emphasise the objective measurement of expertise**. Given the problems with peer assessment identified above, an expert can only be defined as such if the performance and its outputs can be objectively measured in laboratory conditions. Ericsson commonly cites Lord Kelvin: “If you cannot measure it, you cannot improve it.”

In some domains it is relatively straightforward to objectively identify those who consistently produce measurable superior performance. For example, it is relatively easy to determine who is ‘expert’ at 100m sprint in the early years of the 2 10s (Usain Bolt). But who are the best teachers or coaches, for example? How do you measure their performance without relying on performance measures which are highly influenced by the actions of others e.g. students/players?

Ericsson and colleagues address this problem by suggesting that a domain – irrespective of its complexities - can be ‘captured’ using **representative simulated tasks** in the laboratory which, it is argued, mirror real life practice. This can work, for example, for business leaders, artists etc.

Key Point

General conceptions of expertise based on peer recognition and years of experience are challenged by Ericsson and colleagues. To be an expert, they argue, the individual has to consistently perform in relation to objective measurable tasks in a laboratory setting

The Key to Expert Performance:
10,000 Hours of Deliberate Practice

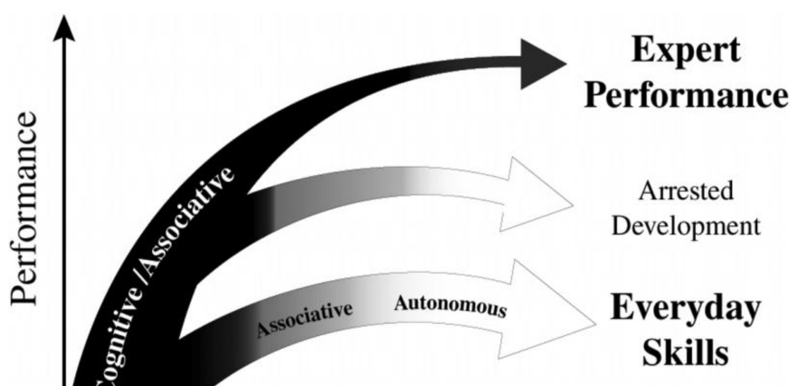
Studies of high performance and expertise have – up until, and including the work of Ericsson and colleagues – consistently identified the **quantity** of experience or practice in a domain as a determining factor:

- In their study of chess, Simon and Chase (1973) suggested that expert players acquire knowledge of patterns of play through experience, and that they require knowledge of about 50,000 patterns (or chunks) to reach grandmaster status. **This takes about 10 years to achieve.**
- In a study of 120 elite performers who had won international competitions or awards in fields ranging from music, the arts, sport, mathematics and neurology, Bloom (1985) suggested that extensive practice was a common feature of their accounts (as well as devoted teachers, and enthusiastic families).

As noted earlier, however, for Ericsson and colleague simply **experiencing a domain for extended periods does not guarantee expert performance** (Ericsson, et al., 1993). They cite evidence from 'wine tasting experts', academia (physics professors), clinical psychologists, and stock brokers (Ericsson, 2006; Ericsson & Lehmann, 1996; Ericsson & Towne, 2010)! For example, wine tasting experts were unable to tell the difference between French and US wines, and performed no better than novices.

Experience, they suggest - for example, observing others, trial and error - provides performance improvements in the initial phases of learning (in what they call the cognitive/associative phases (for more details see Fitts & Posner, 1967)) up to the point where the individual becomes competent or proficient ('Everyday Skills' (Chart 1)). This, they suggest, usually takes about 50 hours.

Chart 1 – The Relationship Between Experience and Performance Against Specific Practice Types (source: Ericsson (2006)).



However, after these initial phases of learning the individual begins to automatize relevant skills and tasks. Individuals reach a stable plateau and are no longer conscious of the way they execute particular skills. Thus, they find it difficult to make intentional modifications and adjustments to performance. When these individuals practice, they focus on the things they already do well, rather than the things they need to improve.

To address issues associated with the automaticity of skill development through experience (and to achieve 'Expert Performance' (Chart 1)), Ericsson and colleagues suggest aspiring performers need to undertake and experience specific practice conditions known as **deliberate practice**. Deliberate practice requires considerable, specific and sustained concentration and effort on maintaining the knowledge and skills that the aspiring performer does well, but also improving and refining those elements that are not done well.

Deliberate Practice – The Key Characteristics

- Goal directed activities (that are highly relevant to performance)
- Active/mindful/effortful/sustained concentration and attention
- Focuses on weaknesses
- Appropriate feedback from self (through observation/comparison) or high quality coach or mentor (challenging, critical, perhaps even painful)
- Appropriate opportunities for repetition and correction of errors
- Finds new ways to undertake the task
- Structured/measurable
- Not inherently enjoyable/motivating
- Does not lead to immediate social or financial rewards
- Not work or play – focused learning, refining old methods
- Starts at an early age (if player wants to compete and perform at the highest level)

Changes

The key characteristics of deliberate practice appear to have changed over the years. Ericsson and colleague initially emphasised the self-directed and solitary nature of deliberate practice (with particular reference to expertise development in music). In more recent years, the role of team training, and the coach/mentor as a provider of challenging critical feedback, has become more prominent in their thinking.

Furthermore, Ericson and colleagues appear to have softened the extent to which deliberate practice needs to be inherently un-enjoyable in a sporting context (with reference to Côté and Hay's (2002) work on 'deliberate play').

Ericsson et al. (1993) suggest that if individuals engage in deliberate practice "the amount of time [engaged] … will be monotonically (in a straight line) related to that individual's acquired performance" (p.728). This means, as Helson, Hodges, Winckel, & Starkes (2000, p. 728) suggest, "barring accident or injury … the more practice the better". There are no genetic or other limits on performance improvements – it is all down to the amount of deliberate practice.

Since deliberate practice involves such a profound attention to skill maintenance and improvement by individuals there is only so much that can be achieved in one day. For example, Ericsson suggests that expert athletes, novelists, and musicians generally find it difficult to concentrate for more than four or five hours at one time (musicians generally practice in 80 minute bursts). Many expert teachers and scientists set aside a couple of hours a day – typically in the morning – for their most demanding mental activities such as writing about new ideas. Thus, deliberate practice not only requires focused involvement but also adequate periods of recovery to prevent physical and psychological staleness and burnout. The amounts per day may seem small but – 2 hours per day deliberate practice – leads to an additional 7,000 hours over a decade.

Quote

"The journey to truly superior performance is neither for the faint of heart nor for the impatient. The development of genuine expertise requires struggle, sacrifice, and honest, often painful self-assessment. There are no shortcuts. It will take you at least a decade to achieve expertise, and you will need to invest that time wisely, by engaging in "deliberate" practice – practice that focuses on tasks beyond your current level of competence and comfort. You will need a well-informed coach not only to guide you through deliberate practice but also to help you learn how to coach yourself" (Ericsson, 2007, p. 116)

Mediating (Cognitive) Mechanisms

As cognitive psychologists, Ericsson and colleagues generally emphasise the cognitive facets of expertise and expertise development e.g. individual level analysis with a specific focus on cognitive characteristics and function, rather than individual level analysis of physical components, or collective level analysis of social components.

Particular emphasis is placed on the acquisition, storage and retrieval of domain specific knowledge. For example, as Williams and Ward (2003, p. 221) suggest "the expert's perceptual superiority over the novice is due to enhanced sport-specific cognitive knowledge structures acquired through years of deliberate, purposeful practice".

Cognitive mechanisms which underpin expert performance include:

- complex and rich encoding mechanisms
- complex and sophisticated representations of domain specific situations (Chi, Glaser, & Rees, 1982)
- interpretation of greater meaning from available information
- more effective storage and access to information
- superior memory performance (notably retrieval from Long Term Working Memory)

- reading the field /superior anticipation skills (not necessarily speed/response times)
- use situational probability data better
- make decisions that are more rapid and more appropriate

Overviews of the evidence supporting the central role of cognitive mechanisms in expertise development are provided by Ericsson & Smith (1991) and Ericsson & Towne (2010). See Williams and Ward (2003) for an overview in sport.

Evaluating the Evidence

Ericsson and colleagues make a number of key claims about expertise and its development:

- Expertise can be captured through questionnaires/diaries and/or representative tasks in laboratory conditions
- Expertise is domain specific - the characteristics of expertise do not transfer (easily) between domains
- Expertise is largely mediated through cognitive mechanisms (rather than through physical or social mechanisms, for example)
- Expert performance has little connection with hereditary 'gifts' or 'talents' – 'experts are not born, they are made' (Ericsson, 2007)
- The development of expertise requires an extended period of 'deliberate practice' – over 10 years, or 10,000 hours
- Practice should focus on goal directed domain specific activities that are highly relevant to performance/focus on weaknesses
- Practice should be active/effortful/mindful/sustained concentration and attention; it is not inherently enjoyable/motivating; and does not lead to immediate social or financial rewards
- Practice should involve appropriate feedback from self (through observation/comparison) or high quality coach or mentor (challenging, critical, perhaps even painful); and opportunities for corrective adjustment
- Since performance peaks at particular ages – 20s, 30s, 40s – some domains require very early focused engagement including volume and intensity of specialised training, opportunities to engage in elite development structures, with access to superior training resources and supportive environments.

The following tables present evidence for and against these claims.

Key Features of the 10,000 Hour Rule and Deliberate Practice: The Evidence

Feature	Supportive Evidence	Critical Evidence	Commentary
Expertise can be captured through questionnaires/diaries and/or representative tasks in laboratory conditions "The virtue of defining expert performance in this restricted sense is that the definition both meets all the requirements for carrying out laboratory studies of performance and comes close to meeting those for evaluating performance in many domains. At the same time it excludes those domains where investigators have been unable to supply a valid measure with associated demonstrations of superior performance" (Ericsson & Lehmann, 1996, p. 277)	• Ericsson and colleagues have proposed/used two basic approaches for understanding the characteristics and development of expertise (1) questionnaires/diaries/retrospective interviews with experts and novices to identify differences in development profiles and histories (e.g. Ericsson, et al., 1993) (2) the 'expert performance approach' which seeks to capture expertise through objective representative tasks/situations in laboratory conditions (Ericsson & Smith, 1991) • There have been numerous examples of questionnaire/retrospective interview approaches in sport and football and these have provided interesting insight into practice histories (e.g. Helsen, Starkes, & Hodges, 1998; Hodges & Starkes, 1996; Starkes, Deakin, Allard, Hodges, & Hayes, 1996; Ward, Hodges, Starkes, Williams, & 153., 2007) • There have been fewer examples of the application of the expert performance approach in sport outside the pioneering studies which proceeded it, for example, de Groot in chess (de Groot, 1978). There have, however, been an increasing number of studies which make detailed assessment of expert skills, and compare these with practice profiles and histories. For example, Weissenteiner, Abernethy, Farrow, & Müller (2008) examined cricketers anticipation skills against	• The questionnaires/diaries methodology has been criticised for its inability to distinguish between practice activities (the micro-structure of practice) – thus all practice has generally been coded as deliberate practice. For example, play, practice, competition, solitary, team based, and coach facilitated activities have all been coded the same (Baker, Côté, & Deakin, 2005; Cobley & Baker, 2010; Helsen, et al., 1998; Ward, et al., 2007) • Retrospective studies analysing performers' practice histories have also be criticised for lacking in accuracy (e.g. Abernethy, Farrow, & Berry, 2003; Deakin & Cobley, 2003; Hodge & Deakin, 1998) • The expert performance approach has been criticised for assuming that complex tasks can be adequately captured in laboratory settings (Abernethy, et al., 2003), and more generally (Archer, 1998; Wachtel, 1973) • The expert performance approach is simply not sensitive enough to domain structure, complexity and variability, the way in which different practice types and other features lead to expert performance. For example, deliberate practice may work as an explanatory framework in simpler structured domains such as music, chess and golf, it may not work for more complex and variable domains as football and hockey (Cobley & Baker, 2010).	• Ericsson and colleagues adopt a model of science which emphasises the objective measurement of expertise components, mediating mechanisms and developmental histories • Though still a mainstream position in cognitive psychology, this model of science has been increasingly criticised in the philosophy of science for over-simplification, over-confidence with particular regard to views on the structure of the social world, causality, and how we can develop knowledge claims (e.g. Sayer, 2000) . As Crust (2010) suggests it provides a 'surface' or 'obvious' explanation • For example, the 'expert performance approach' suggests that expertise and the ability to capture expertise through chosen method are synonymous! The approach suggests the reduction of domain to representative tasks in laboratory conditions against which individuals will excel or otherwise. Thus, the definition of expertise is reliant on the tasks capturing the domain. This may work in some domains e.g. chess but it very dangerous assumption in others e.g. in football and in coaching! • By adopting this model – we get a very narrow conception of domains, domain performance, and latitude for expertise within this context. Domains are treated as if they are highly structured, inherently predictable, and that

Feature	Supportive Evidence	Critical Evidence	Commentary
Expertise can be captured through questionnaires/diaries and/or representative tasks in laboratory conditions (continued)…	practice hours. Ford, Low, McRobert, & Williams (2010) examined cricketers anticipation skills against practice type. Williams, Ward, Bell-Walker, & Ford (2011) examined footballers perceptual-cognitive expertise against practice history	• Definitions of expertise in relation to the domain need to be carefully considered. Some domains are less structured and therefore encourage more latitude for creative solutions (e.g. Memmert, Baker, & Bertsch, 2010) • Abernethy, Farrow, & Berry (2003) suggest that there may be considerable variations in the underlying mediating physical and cognitive mechanisms in relation to the same task in experts. Thus assumptions that expertise is structured and consistent maybe misleading • Abernethy et al. (1993) draw on dynamical systems theory (e.g. Haken, Kelso, & Bunz, 1985) to argue that the understanding of expertise is less informed by stabilities in practice structures than instabilities "the cusps between the emergence of different types of dominant movement patterns" (p.354)	outcomes are at the control of individuals – but we know this is often not the case – notably in coaching • This scientific approach, it methods and conclusions about expertise, also have a direct impact on ideas about developmental influences i.e. practice. Accounts of deliberate practice fail to take into account variations in practice with relation to specific development goals, contextual factors, and micro spatial/temporal variation

Feature	Supportive Evidence	Critical Evidence	Commentary
Expertise is domain specific - the characteristics of expertise do not transfer (easily) between domains	• Ericsson et al. (1993) suggest the general 'abilities' e.g. IQ/positive scores on psychometric tests may have a positive impact on the early stages of development in a domain, but that there is no strong evidence of their long term influence on expert performance – this comes from extensive experience/practice within the domain • Newell & Rosenbloom (1981) suggest early diversification is beneficial to children when they are learning a new skills/activities because of improvements to general capabilities (e.g. fundamental movement skills). However, once these general adaptations have been made training adaptations become much more specific in nature and difficult to attain. At this time training should become more specific and deliberate • Baker, Côté, & Deakin (2005) found that diversified training was valuable only during the early phases of development in ultra-endurance triathletes • Baker & Côté (2006) suggest that the ancillary benefits of early diversification are best achieved in sports with very similar information processing and physical demands • Foster et al. (1995) suggests that cross-training – for example, using swimming to improve running performance – has benefits but not as much as specific domain training • Allard & Starkes (1991) suggests cognitive skills such as pattern recognition are non-transferable and domain specific	• Baker, Cobley, & Fraser-Thomas (2009) suggest the transfer of knowledge and skills between domains has been identified in sports with similar structures, and in cross training where there are similar modes of activity • For example, Smeeton, Ward, & Williams (2004) suggest that football and hockey players were able to recognise attacking situations in their respective sports; volleyball players less so • Abernethy, Baker, & Côté (2005) suggest expert netball, hockey and basketball players more accurately recalled plays from their own and other sports than novices in their own and other sports • Berry, Abernethy, & Côté (2008) suggest that developmental experiences in a range of invasion sports conferred benefits in terms of decision making in AFL players • Flynn et al. (1998) and Mutton et al. (1993) suggest benefits from cross-training which involve activities that share similar muscle groups (e.g. running and cycling) • Excessive domain specialisation can undermine creative development (Memmert, et al., 2010).	• On the evidence presented it is difficult to reach firm conclusions. For example, Baker et al. (2009) suggest the evidence on transfer of knowledge and skills across domains is contradictory, inconclusive and suggest further research is required. • If we are drawn to a conclusion it is that highly structured domains, with fewer active ingredients, and degrees of freedom, probably benefit less from cross domain experiences, where as more complex and dynamic domains benefit more. For example, extensive single domain preparation might be appropriate in chess, but other domains, for example, coaching would undoubtedly benefit from exposure to other areas of life such as experiences of being a parent • There also appears to be benefits of early diversification to support the development of general movement skills, and on-going diversification to support creativity

Feature	Supportive Evidence	Critical Evidence	Commentary
Expertise is domain specific - the characteristics of expertise do not transfer (easily) between domains (continued)…	• Motor behaviour research has not supported the assumption that individual performance on one task can predict performance in another, even when the task appear to rely on the same basic ability (Schmidt, 1983)		

Feature	Supportive Evidence	Critical Evidence	Commentary
Expertise is largely mediated through cognitive mechanisms (rather than physical or social, for example)	• There is significant evidence for the importance of psychological mechanisms in expert performance (Orlick & Partington, 1988; Smith, 1995)	• Player performance is determined by multiple attributes (and not just perceptual and decision making skills) (Berry, et al., 2008) • For example, player performance is facilitated by physical mechanisms (Keogh, 1999; Pyne, Gardner, Sheehan, & Hopkins, 2005) • Social factors are clearly important to expertise development (Bloom, 1985; Carlson, 1988)	• As with other models of expertise (and talent) development (e.g. Gagné, 2003) we suggest the expertise is the product of multiple converging factors – heritable, environmental, physical, psychological, social, luck etc.

Feature	Supportive Evidence	Critical Evidence	Commentary
Expert performance has little connection with hereditary 'gifts' or 'talents' – 'experts are not born, they are made'	• Though there is evidence linking genetic endowments to certain, gross general traits (e.g. intelligence Bouchard (1997)), the refinement of these traits into domain specific abilities (e.g. pattern recognition, strategic thinking) only occurs after years of intense training (Baker, Horton, Robertson-Wilson, & Wall, 2003; Ericsson, 2007). • Researchers have found no reliable differences between static, physical capacities such as visual acuity, reaction time, or memory in predicting expertise, but have found differences in learned, domain specific, information processing strategies (Baker, Horton, et al., 2003) • A high quantity and quality of deliberate practice is sufficient to account for sporting excellence (Ericsson, et al., 1993)	• Environment only explanations of expertise development make the assumption that everyone has the genes necessary for the acquisition of expertise. This notion of 'genotypic equivalency' does not fit with basic evolutionary or genetic theory grounded in the necessity of genetic variability for promoting natural selection over time (Davids & Baker, 2007) • Unitary explanations of behaviour in terms of, for examples, genes or environment, fundamentally misunderstand human development processes (Rutter, 2006) • Human development is a complex interactional/emergent interplay of multiple causal factors – genetic, neurological, cognitive, environmental/social/cultural etc. (e.g. Lewontin, 2000; Noble, 2008; Rutter, 2006; Tallis, 2011) • Almost all biologists (irrespective of their favoured frameworks and perspectives e.g. Steven Pinker (2002) favours genetic explanations) agree that it makes little sense to dichotomise nature and nurture (Al-Khalili, 2011) (see also Baker & Horton, 2004). • The multi-causal and emergent characteristics of sporting development including to elite have been proposed/recognised in a sporting context (e.g. Baker & Horton, 2004; Hackfort, 2006; Johnson & Tenenbaum, 2006; Simonton, 1999; Singer & Janelle, 1999) • From a practical perspective, research	• Ericsson and colleagues seek to understand the characteristics and factors which determine expertise. In doing this they adopt a model of science which emphasises atomistic reductive explanations and readily measurable empirical evidence - mainly quantitative measurement. Thus, when Ericsson and colleagues ask the question 'what are the factors which determine expertise' they are limiting their options *a priori* (before the fact) to atomistic explanations which can be (more) easily measured. This means, for example, if there is no convincing (quantitative) evidence for hereditary factors, and there is evidence for experience and practice then it must be one rather than the other (see Ericsson, et al., 1993 p. 365) • As Rutter and others have convincingly argued the assumptions implied by this model of science are highly questionable. Human development is the product of multiple causal forces which interact in a continuous cycle of inputs, emergent properties, outputs, feedback loops, inputs, emergent properties and so on. Thus, the assumption that we can pick out single factor explanations – e.g. practice components - within this dynamic process fundamentally misunderstands how humans develop • The problem for researchers is the difficulty of undertaking measurement of, for example, gene-environment interactions. Instead, researchers like Ericsson and colleagues measure what

Feature	Supportive Evidence	Critical Evidence	Commentary
Expert performance has little connection with hereditary 'gifts' or 'talents' – 'experts are not born, they are made' (continued…)		with coaches suggests that they believe there is a role for talent in performance development, but that even the most talented prospects must practice hard to succeed (Starkes, et al., 1996) • Some sports researchers make bolder claims about the role of genetic inheritance in expertise development. For example, Sternberg (1996) suggests that 'talented' (e.g. genetically gifted) individuals see larger benefits from the same amount of practice. Those benefiting less from practice would be more likely to be discouraged and reduce their practice and eventually discontinue their engagement. This process would lead to more talented individuals persisting with high levels of practice in a domain and thus creating a false impression that increased practice was the primary cause of superior performance. Baker & Horton (2004, p. 218) make a similar point: "there is no conclusive evidence indicating that training is the only factor. It is likely that innate predispositions facilitate the completion of required amounts of training. For example, an athlete with a genotype allowing them to complete large amounts of high intensity training without suffering injury may be at an advantage over an athlete with a less resilient makeup. However, upon examination it would appear that training was the distinguishing factor between the two athletes" • Some still favour Galton's original hypothesis that though experience and practice are important for improving	they can i.e. environmental influences or practice histories and suggest this provides a sufficient explanation. This is just bad science. If the results of the work were not so morally and ethically agreeable – then it is likely they would provoke as much controversy as gene only explanations • Arguments such as 'no early indicators of success' do not preclude a genetic/biological influence on performance – the initial and continued capacity to adapt to and utilise practice may well be influenced greatly by hereditary factors • A very useful overview of the complexities of this issue is provided by Howe, Davidson, & Sloboda (1998) and notably the responses from a number of eminent thinkers. See also the review by Baker and Horton (2004)

Feature	Supportive Evidence	Critical Evidence	Commentary
Expert performance has little connection with hereditary 'gifts' or 'talents' – 'experts are not born, they are made' (continued…)		performance they are 'genetically' fixed to a certain level above which the individual cannot move • Interestingly, Ericsson and colleagues acknowledge that individuals may differ in predisposition to engage in hard work or motivational qualities. As Simonton suggests, although it usual to think of performance improvement having a significant cognitive component it could equally emerge from "dispositional attributes, such as unusual energy and special interests which maintain the intensity and focus of the required learning and practice" (Simonton, 1999, p. 436). For example, Horsburg, Schermer, Veselka, & Vernon (2009) suggest that mental toughness has a genetic component • Baker and Horton (2004) provide a useful overview of the psychological characteristics necessary to 'get there' as well as 'be there'. See also Holt & Dunn (2004) for an exploration of psychological factors supporting success in football	

Feature	Supportive Evidence	Critical Evidence	Commentary
The development of expertise requires an extended period of deliberate practice – over 10 years, or 10,000 hours There is a monotonic (straight-line) relationship between deliberate practice and expertise (Ericsson, et al., 1993) based on the power law of practice (Anderson, 1983; Newell & Rosenbloom, 1981)	• The link between the development of expertise and time spent on practice is “one of the most robust relationships ever identified in behavioural science” (Baker, et al., 2009, p. 78) • The relationship has been established through, for example, the work of Simon & Chase (1973) in chess (who first used the expression ’10 year rule’), Bloom (1985) retrospective developmental histories of talented performers in multiple domains • A review of the evidence across domains is provided by Ericsson et al. (1993, p.366) • However, Ericsson suggests that simply practising the activities of a domain is a weak predictor of performance - however, 10,000 hours of deliberate practice is a strong predictor (Ericsson, et al., 1993) • Expert violinists accumulated 7,410 hours of practice over 10 years, compared to 5,301 hours for good violinists. Expert pianists accumulated 7,606 hours of practice over 10 years, compared to 6,000 for amateur counterparts (Ericsson, et al., 1993) • In sport, a connection has been established between the number of practice hours (deliberate practice) and expertise (e.g. Baker, Côté, & Abernethy, 2003a, 2003b; Baker, et al., 2005; Helsen, et al., 2000; Helsen, et al., 1998; Hodges & Starkes, 1996; Mischel, 1973; Starkes, et al., 1996). The number of hours accumulated varies considerably by study and sport. For example, in Helsen, et al. (1998)	• Ericsson and colleagues’ methodology emphasises development components which have a high statistical correlation with outcomes e.g. practice. Therefore, this approach tends to simplify or ignore other valuable developmental components (Cobley & Baker, 2010) • Baker (2007) suggests (deliberate) practice is a *necessary* condition of expert performance (i.e. it has to be in place for expertise to be developed), but it is not a *sufficient* condition (i.e. it guarantees expert performance) • Crust (2010) suggests it is too simplistic to suggest that performance improvements occur only through deliberate practice as ‘narrowly’ defined by Ericsson and colleagues e.g. team sport practice involves more than solitary practice • Baker, Côté, & Abernethy (2003a) suggest that different types of practice structure might suit different activities e.g. matt and ice work with a coach in wrestling and ice-skating, solo practice and private lessons for musicians • Cobley and Baker (2010) suggest a diverse range of practice activities (beyond deliberate practice) can account for Ben Hogan’s expertise • Berry, Abernethy & Côté (2008, p. 686) suggest “a number of activities that appear pivotal to the development of sport expertise do not constitute deliberate practice” • Baker, Côté, et al., (2003b) suggest a wide range of informal, relatively unstructured sport activities featured in the development histories of experts in	• A common feature in the performance development and coaching literature is to treat domains (e.g. sports), sessions, goals and other contextual factors as if there is one factor underpinning performance development. For example, Ericsson and colleagues emphasise the importance of deliberate practice. Others recommend other practice structures and coaching arrangements. The reality of performance improvement and training is that goals and contexts vary considerable in and between sessions (North, Muir, Duffy, & Lyle, 2011). Therefore, the environments and activities (practice structure and coaching) will need to change to reflect this. This kind of nuanced approach to practice and coaching is more a rarity in the literature than the mainstream – though there are exceptions (e.g. Abraham & Collins, 2011) • Though it is difficult to argue with Ericsson and colleagues’ views on the quantity of practice, it is perhaps remarkable that such a high profile approach, with such a rich research history and vast publication background, could so infrequently refer to, or reference, wider literatures in relation to the qualities of developmental experiences. For example, human development processes (e.g. Rutter, 2006), learning theories (e.g. Schunk, 2012) and skills acquisition theories (A. M. Williams & Hodges, 2004)

Feature	Supportive Evidence	Critical Evidence	Commentary
The development of expertise requires an extended period of deliberate practice – over 10 years, or 10,000 hours (continued)…	international soccer players had accumulated 4587 practice hours after 10 years, and 6328 practice hours after 13 years. International hockey players had accumulated 8541 practice hours after 10 years, and 10,237 practice hours after 13 years • Jenkins (2010) suggests there is considerable support for deliberate practice in the developmental history of golfer Ben Hogan	teams sports • There are other learning and development theories which account for the evidence e.g. Paquette and Roy (2010) use Moon (e.g. 2004) to look at Ben Hogan • Observing others, engaging in spontaneous fun, and incidental and implicit learning may all contribute to expertise development (Berry, et al., 2008) • In many team sports experience of competition is seen as 'pivotal' to expertise development (Baker, Côté, et al., 2003a; Starkes, et al., 1996) • Baker et al. (2005) suggest, using research from ultra-endurance triathletes, that the relationship between sport specific practice is not monotonic, but non-liner, or a power relationship (Newell & Rosenbloom, 1981)	

Feature	Supportive Evidence	Critical Evidence	Commentary
Practice should focus on goal directed domain specific activities that are highly relevant to performance/focus on weaknesses Note: as indicated earlier, Ericsson and colleagues have softened their view on the importance of 'deliberate practice' and 'deliberate play' in expertise development (e.g. Ericsson, 2007). However, reflecting their original position, we shall present the evidence for deliberate practice in the 'Supportive Evidence' column, and any other evidence in the 'Critical Evidence' column.	• Jenkins (2010) suggests there is considerable support for focusing on weaknesses in the developmental history of golfer Ben Hogan • Baker, Côté & Deakin (2005) suggest sport specific training consistently differentiates experts and non-experts in later stages of development • There is evidence for structured practice activities discriminating between decision-making abilities in AFL (Berry, et al., 2008) • The amount of sport specific structured practice activities (batting practice) differentiated high and low performance cricketers (Ford, et al., 2010; Weissenteiner, et al., 2008)	• Côté & Hay (2002) suggest that children – aged 6-12 years should engage in informal, unstructured, fun, enjoyment and play or 'deliberate play' (if in an organised sport setting) where they can modify rules, with only minimal emphasis on skill development, and that this has no detrimental impact on their development into elite performers (see also Côté, Baker & Abernethy (2007). Support is provided by Côté (1999), Sloberlak & Côté (2003) amongst many others… • There is significant recent evidence for the role of play in expertise development (when combined with sport specific practice) in UK football (Ford, Ward, Hodges, & Williams, 2009; A. M. Williams, et al., 2011) • Research by Greco, Memmert, & Morales (2010) suggests that deliberate play training programmes have a positive impact on tactical intelligence (awareness and ability to implement existing tactical approaches) and tactical creativity (the ability to develop new tactics and approaches) • Deliberate practice and unstructured play-like involvement both have crucial roles for the development of creative behaviour in basketball, handball, field hockey, and soccer (Memmert, et al., 2010, p. 9) • Deliberate practice and deliberate play (in the sampling years) discriminate between decision-making abilities in AFL (Berry, et al., 2008) • Participation in a diverse range of activities including deliberate practice	• There is evidence to support both activities which focus on addressing specific weaknesses, and more general (playful) practice. The relevance of these activities will be determined by the context – goals, athlete histories, developmental stage and so on

Feature	Supportive Evidence	Critical Evidence	Commentary
Practice should focus on goal directed domain specific activities that are highly relevant to performance/focus on weaknesses (continued)…		can contribute to improving performance (Cobley & Baker, 2010) • To improve footballing performance, players undertake a variety of forms of training, all of which are believed to be relevant to the improvement of their overall individual and/or team performance. Cross training (i.e., training using other sports or activities) is routinely used to improve physiological conditioning whereas skills training is typically done in a very sport specific manner (Baker, Côté, et al., 2003a) • Research on elite Canadian figure skating found that athletes often focused a disproportionate amount of time practicing activities with which they were very familiar (Deakin & Cobley, 2003)	

Feature	Supportive Evidence	Critical Evidence	Commentary
Practice should be active/effortful/mindful/sustained concentration and attention; it is not inherently enjoyable/motivating; and does not lead to immediate social or financial rewards	• Experience alone is not a good predictor of expert performance (Ericsson, et al., 1993) • Left to their own motivations/devices performers often find very inefficient methods of practice (Ericsson, et al., 1993) • Practice needs to be motivated, effortful, not enjoyable, structured, focusing on addressing weaknesses, with knowledge of results, and effective feedback (Ericsson, et al., 1993) • Jenkins (2010) suggests there is considerable support for sustained concentration and practice beyond fatigue in the developmental history of golfer Ben Hogan	• The Theory of Deliberate Practice does not take sufficient account of the influence of incidental/tacit learning (e.g. Cianciolo, Matthew, Sternberg, & Wagner, 2006) • Csikszentmihalyi (1990) suggests that there are states of individual engagement in an activity – referred to as 'flow – which have some similarities with deliberate practice e.g. absorption, concentration, but are more unconscious, absorbed, fulfilling and enjoyable, and they can lead to improved performance (Nakamura & Csikszentmihalyi, 2002) • Though generally supporting the deliberate practice framework, Jenkins (2010) suggests – using the developmental history of golfer Ben Hogan - that though practice was hard work it was also inherently enjoyable and (personally) rewarding • Research on elite Canadian figure skating found that athletes rated relevant and effortful activities as enjoyable (Deakin & Cobley, 2003) • Other research has highlighted the fun elements of practice (Côté, 1999)	• There are concerns about the way in which Ericsson et al. (1993) use evidence to support the notion of deliberate practice as the key to performance improvement • The initial arguments focus on a number of oppositional qualities e.g. 'there is no support for inherited talents in expert performance'; 'there is weak evidence for the impact of experience on performance'; 'it is not work or play'; 'therefore it <u>must</u> be a form of practice that provides advantage' • Then a series of arguments are made about the qualities of practice that experts engage in e.g. it is effortful and not enjoyable because it involves prolonged engagement in mindful, boring and fatiguing activities. Practice often involves, is facilitated by, important others. These, and other, factors are then built into the composite (monolithic) structure viz. deliberate practice • Thus, Ericsson and colleagues discount 'other evidence', are left with practice activities, look at those practice activities, find they have commonalities (especially in music) and suggest these practice characteristics are the sole contributors to expertise • But what about the discounted evidence admitted by other frameworks? What about the tacit/non-measurable facets of expertise development? What about the other activities and contingencies which contribute to the overall engagement in the sport? Again, it is bad science to

Feature	Supportive Evidence	Critical Evidence	Commentary
Practice should be active/effortful/mindful/sustained concentration and attention; it is not inherently enjoyable/motivating; and does not lead to immediate social or financial rewards (continued)…			conclude that the most common measurable practice activities in, for example, expert music development are the sole contributors of expertise development

Feature	Supportive Evidence	Critical Evidence	Commentary
Practice should have appropriate feedback from self (through observation/comparison) or high quality coach or mentor (challenging, critical, perhaps even painful); and opportunities for corrective adjustment Note: as indicated earlier, Ericsson and colleagues originally emphasised the solitary nature of deliberate practice as opposed to practice with team mates, or with a coach/mentor/facilitator. This has changed slightly in recent representations of their ideas (e.g. Ericsson, 2007). This point made, and whilst recognising that their ideas have changed, we shall present the evidence for solitary practice in the 'Supportive Evidence' column, and any other evidence in the 'Critical Evidence' column.	• Knowledge of results and appropriate feedback are a precondition of efficient learning (Ericsson, et al., 1993) • Jenkins (2010) suggests there is considerable support for solitary practice in the developmental history of golfer Ben Hogan	• Solitary practice may work in solitary pursuits such as music, chess and golf, but it is much more difficult to understand how it will work in team activities (Cobley & Baker, 2010). • Performance in team sports is dependent upon the cohesive interaction among members of the sports team unit, thereby necessitating training as a group in addition to training alone (Baker, Côté, et al., 2003b) • Team practice was one of the greatest contributors to expertise development in football (as well as greater levels of motivation, dedication and perceived competence in the early years, influential parents and the associated support structure) (Ward, et al., 2007) • Bloom (1985) and Carlson (1988) highlight the importance of family, peers and coaches in developmental processes (Ericsson et al. (1993) argue that these stakeholders encourage individuals who show early promise to engage in deliberate practice) • Deakin and Cobley (2003) suggest for elite Canadian volleyball players, the coach was instrumental of structuring and maintaining the amount and intensity of (deliberate) practice • Rutt-Leas & Chi (1993) suggest that the quality of instruction was an important factor in understanding the differences between expert and non-expert swimmers • Holt, Ward & Willhead (2006) highlight coaching approaches in soccer	• Solitary, team based, and coach/mentor facilitated 'corrective adjustments' are all likely to confer benefits for expertise development. Much depends on the goal and the context

Feature	Supportive Evidence	Critical Evidence	Commentary
Since performance peaks at particular ages – 20s, 30s, 40s (depending on the domain (Lehman, 1953) – some domains require very early focused engagement including volume and intensity of specialised training, opportunities to engage in elite development structures, with access to superior training resources and supportive environments	• Ericsson et al. (1993) suggest engaging in deliberate practice at an earlier age provides an opportunity to accumulate more practice hours which leads to higher levels of performance • These individuals also attract more supporting resources from an earlier age which means it is more difficult for late starters to catch-up • Ericsson et al. (1993) present evidence from music and chess to highlight the early starting age of expert performers – typically in the range from 5 to 10 years old • Helsen, et al. (1998) suggest that elite soccer players generally start playing the sport at 5 years old • Ward et al. (2007) suggests early playful activities and early diversification do not discriminate between experts and novices in football • Re-evaluating Ward et al. (2007), Ford, Ward, Hodges, & Williams (2009) suggest that early diversification does not discriminate between experts and novices in football • There are some physical and psychological reasons to support early specialisation in gymnastics (North, 2011)	• Côté & Hay (2002) suggest early diversification that focuses on fun, enjoyment and development of early competence using a variety of playful sporting activities leads to intrinsic motivation which leads to (and certainly doesn't detract from) sporting expertise • Baker, Côté, & Abernethy (2003a) suggest that a greater breadth of initial sporting experiences, for example, in other sports, provides ancillary benefits which mean that less deliberate, domain specific practice are required for athletes to achieve national team status • Baker & Côté (2006) suggest early diversification in sports may stimulate physiological and cognitive adaptations which lay the groundwork for specialised and cognitive capacities necessary for later expertise • Combined cumulative, or even multiplicative effects of diverse practice could account for expert performance. In this scenario, all or a blend of activities across a given period of time, above and beyond those defined as deliberate practice, would predict skill improvement (Cobley and Baker, 2010). • Motor skill development research supports the notion of an early focus on fundamental movement skills in early childhood to more specific sport-specific skills in adolescence and early adulthood (Seefeldt, 1980; 1982) • Based on sports participation trends in elite athletes, early specialisation is not an essential component of elite athlete development. For example, elite	• Discussions of the strengths and weaknesses of early specialisation are complex and multi-layered • There is little doubt that if an individual decides to specialise in a domain/sport at an early age, and has the right kind of development experiences, this provides significant opportunities for performance improvement which may confer advantages over late starters. However, whether this early engagement leads to expert status/winning at the highest level is hostage to a range of other factors e.g. ability, support, injuries/burnout and luck • Côté and various colleagues have consistently argued that early specialisation is not required for expert performance in many sports and that it is not worth, therefore, the risk of associated disadvantages • We would suggest that simple arguments for and against early specialisation miss many important physical, psychological and social factors which pertain to particular sports/contexts. In some sports/contexts early specialisation might be appropriate/desirable, in others not. Much of the data might also be skewed by opportunities/cultures of early diversification and sampling in individual countries (e.g. it is less available/acceptable to sample multiple sport in Liverpool in England, than it is in Kingston, Canada, or Brisbane, Australia)

Feature	Supportive Evidence	Critical Evidence	Commentary
		athletes often engaging in a number of other sports (Baker, et al., 2005; Carlson, 1988; Côté, 1999; Hill, 1993; Soberlak & Côté, 2003) • Early specialisation is associated with a range of negative consequences in sport – risk of injury, delayed maturation, decreased enjoyment, pressure to win, vulnerability, low self-confidence and self-esteem, compromised social development, eating disorders, burn-out and drop out (for a comprehensive review see Baker, et al., 2009)	

Some Conclusions and Implications

Ericsson and colleagues '10,000 hour rule' and 'Theory of Deliberate Practice' has made a considerable contribution to research and practice whilst at the same time being simplistic and partial.

In the following bullets we will try to capture some of the main strengths and weaknesses of this body of work.

Strengths

1. Ericsson and colleagues' work highlights the importance of extensive practice (in terms of numbers of hours/years) to performance/talent development and the acquisition of expertise. Though this idea was developed through previous research - notably Simon and Chase (1973) and Newell and Rosenbloom (1981) - Ericsson's work has provided this (simple but powerful) idea with increased research support and public profile. In doing this, their work has challenged, discredited, and perhaps even buried an hereditary 'talent' (only) view of expertise

   - In the domain of sport, at least, the hereditary view has been viewed as wasteful, notably, in terms of early selection, and implications for later participation

2. Ericsson and colleagues' work has also focused attention of the qualities of practice, notably, the importance of conscious, deliberative, intentional improvement, and how expertise is mediated through cognitive mechanisms. In doing this, it has stimulated a wider debate about the mechanisms which facilitate the development of expert performance

3. Ericsson and colleagues' work has had significant influence on research, policy, practice and popular thought

   - There is a significant research programme which has both supported and critiqued Ericsson and colleagues' work which has provided considerable and evolving insight into the nature of expert performance and how it develops
   - Through Ericsson and colleague's publications, external profile, and the work of aligned popular scientific writers (e.g. Gladwell & Syed), an important political and social message about individual responsibility and empowerment has come to widespread attention
   - Agencies, such as sports governing bodies, have changed their thinking and practices as a result of the influence of Ericsson and colleagues

4. It has also provided some useful methodological insights.

Weaknesses

1. Though the quantity of practice is a necessary condition of expertise development, practitioners should not be distracted by absolute figures such as 10 years, or 10,000 hours. The latter should be seen as little more than a metaphor for extensive practice in a domain

2. The Theory of Deliberate practice is far too simplistic and one-dimensional to account for expertise development

- There are multiple causal forces - hereditary and environmental - which interact emergently through human (including expertise) development. These interactions are very complex perhaps even impossible to capture (as a result of the length of causal chains and associated feedback loops)
- A range of practice experiences - including but not limited to deliberate practice – influence and underpin expertise development, this includes: in domain, out of domain (especially for early development experiences and creativity)/play and practice
- The practice experiences of individuals wishing to achieve expert status will vary considerably between contexts – domains/sports, goals, environmental and spatial/temporal considerations. <u>There is no one solution – potential 'best fits' depend on performance goals and context</u>

3. Ericsson and colleagues' utilise specific disciplinary, philosophical and methodological assumptions which are increasingly challenged

- Ericsson and colleagues' work is largely situated in the discipline of cognitive psychology – thus there is a significant emphasis on the ideas and methods of cognitive psychology at the expense of other influences (physical, social) and disciplinary approaches
- Ericsson and colleagues' research philosophy – an (extreme) variant of positivistic scientism – has been extensively and perhaps fatally critiqued in the philosophy of social science literature (Sayer, 1984; M. Williams, 2000)
- Notably, Ericsson and colleagues' deployment of ideas around 'objectivity' and reliance on reductive quantitative methods lack sensitivity to the subjective, hidden and tacit influence of expertise and expertise development
- It is these philosophical and methodological assumptions, it is argued, that produce such a narrow simple view of expertise and its development. In other words, the uncritical adoption of a particular research philosophy and method determines to a large degree how Ericsson and colleagues define and measure expertise which, in turn, influences their views on how it is developed. It is inevitable that if you define expertise in a particular way – observable reproducible objective performance behaviours – that you get a very mechanistic view of learning and development
- These philosophical and methodological assumptions also lead to an over confidence about findings, a tendency towards over generalisation, and lack of nuance and contextual detail in accounts
- Ericsson and colleagues' work makes very little reference to research and practice from highly related domains in human development, learning theory and skills acquisition
- Ericsson and colleagues adopt a verificationist model of science rather than one based on refutation (Popper, 1935/1959). For example, Ericsson & Lee (2010) reject evidence that does not fit with their model on 'fun and enjoyment in practice' and 'daily practice duration'. Those who are more critical make apologies for their 'iconoclasm' (e.g. Abernethy, et al., 2003)!
- At its extreme, their work is selective in its referencing and treatment of data to 'prove' the case

Implications for Coaches

This review suggests the following implications for coaches:

1. There is no ‘single theory’ solution to expertise development

   - The Theory of Deliberate Practice is just one of many theories about how human’s develop and improve. Theories are our latest ‘informed best guesses’ about the way in which the world and it human inhabitants are shaped and structured. Other theories make other informed best guesses which emphasis different findings and recommendations

2. For coaches, a crucial consideration is deciding which ideas/theories to apply against athlete goals and contextual considerations

   - Ideas/theories can come from experience, from other coaches, and from academic articles. All have strengths and weaknesses, the key is deciding which one to use, with who, when and why

3. That said, the review does point to some clear implications for coaches:

   - The quantity of practice is one of the most reliable indicators of expertise development
   - Training/practice should be structured according to the goals, players, and context – this means the use of many different practice activities both across and during sessions
   - Practice that involves players consciously engaging and focusing on weaknesses is likely to be beneficial to their development

Suggested Reading

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