Training Derived from Expert Performers: The Extractable Components of Deliberate Practice and the Expert Performance Approach

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Abstract

The work of K. Anders Ericsson had a great impact on many domains, as illustrated in the current special issue of the *Journal of Expertise*. In this article, we describe the impact that Ericsson's work had on training development, specifically deriving training based on the study of expert performers. We first review the rationale for deriving training based upon expert performers. We then provide an overview of how to derive the training, along with examples of the techniques' success. We then identify remaining issues and questions for further consideration by scholars moving forward in the in this area. The issues include perceptions that (a) advocates for using deliberate practice are taking an extreme view, and (b) deliberate practice activities are too rigid and drill-like to be widely applicable. The questions for consideration are as follows: (a) What combination of screening, along with application of practice and resources, is needed to maximize performance? (b) Is it possible to separate early involvement from "natural" abilities as the source of observed performance differences? (c) Will widespread implementation be possible given resource needs and funding? and (d) What percentage of the general population is interested in maximizing potential? Finally, we conclude with a personal reflection of working with Anders.

Keywords

Deliberate practice, training, expert performance approach, representative tasks, training development, K. Anders Ericsson

Introduction

As demonstrated by the collection of articles in the current special issue, the impact of K Anders Ericsson was broad and far-reaching. Penetrating the public consciousness, his work helped bring awareness to the tremendous amount of resources and effort that typically goes into reaching the most elite levels of performance (Harris & Eccles, 2021; Harwell & Southwick, 2021; both this issue). Also, the issues highlighted by Ericsson often were misinterpreted by many among the general public and intensely debated in academia. The influence of his work extended across a great multitude of domains, some of which are covered at length in the present special issue. Ericsson's body of work also had an impact on training individuals of varied skill levels with the goal of improving their performance. Some of these applications are featured in the articles of the current special issue in relation to medicine (McGaghie et al., 2021, this issue), sport (Young et al. (2021), this issue) and as applied to teamwork training, in general, (Bisbey et al., 2021, this issue). However, we want to direct attention specifically to the extractable components of deliberate practice and the expert performance approach applicable to developing training. The general approach outlined below has been deemed Expert Performance-based Training (ExPerT; Ward et al., 2013), and expert-based training (XBT; Fadde, 2009). The underlying premise of these approaches is that through the analysis of expertise and expert performers, techniques and training can be derived that allow the acceleration of performance development across individuals spanning the range of levels of existing performance (see also Hoffman et al., 2013). Thus, the topic of deriving training based on the analysis of expert performers, and their developmental trajectory, is well deserving of inclusion when recognizing the impact of Ericsson's work.

The Rationale of Deriving Training from Expert Performers

While the amount of variance in performance explained by engagement in deliberate practice activities continues to be debated (e.g., Ericsson & Harwell, 2019; Macnamara et al., 2014; see also Harwell & Southwick, 2021, this issue), one point agreed upon is that deliberate practice is necessary to reach high levels of performance (e.g., Campitelli & Gobet, 2011). An underlying question for the current debate is what is the interaction between engagement in deliberate practice activities and individual differences? For example, some researchers have suggested that because individuals vary in the amount of time that it takes to reach elite performance levels, deliberate practice is less important for explaining performance than was originally proposed (e.g., Campitelli & Gobet, 2011; Hambrick et al., 2014). Despite the ongoing debate regarding possible variability in the amount of time and effort required to reach elite levels of performance (e.g., Ericsson & Harwell, 2019; Hambrick et al., 2018; Lambado & Deaner, 2014), it would clearly be advantageous to maximize return on investment when engaging in deliberate practice activities. There is evidence that skill development can be accelerated by approaches that involve (a) isolating and identifying critical moments during performance that provide an advantage to the expert performer, which then can be extracted for training (e.g., Fadde, 2016; Williams et al., 2002), and (b) tracing the developmental path (historical practice profile, access to coaches and resources, etc.) taken by the skilled performer (Shadrick & Lussier, 2004; for an overview, see Harris et al., 2013). Both of these approaches allow for acceleration of performance by speeding up the natural progression of skill development by presenting less skilled performer with the information identified as being a critical component of the performance advantage demonstrated the expert performer (where to direct attention during a tennis serve), and/or by providing developmental opportunities similar to those in which the expert performer engaged in order to provide a similar path that has been identified as having been successful for development of expert performance (Fadde, 2009; Ward et al., 2013).

A section below is dedicated to providing examples of success for this approach, but we begin with examples of the application of this approach. For example, an aspiring author looking to improve writing skills could practice using an established technique of writing multiple novels using themes identified in the works of established writers and then throwing away the practice novels upon completion. In fact, the successful author Joyce Carol Oates adopted this approach as a college student, and "would write a novel longhand, then turn the pages over, writing another novel on the flipside. Both novels would then be tossed in the trash" (Kellogg, 2006, p. 397).

In another example, Miller et al (2008) sought to assess and improve performance of psychotherapists and applied the principles of deliberate practice (Ericsson et al., 1993) to the field of psychotherapy, identifying what the authors called "supershrinks." These practitioners were identified as being the highest-level performers based on metrics such as the remarkably higher improvement rate of client, along with dropout rates remarkably lower than the average clinician (by 50% in each case). Relevant to the present topic, an analysis of these highest-level performers provided insight into what the best therapists were doing relative to their peers, including actively seeking feedback from their sessions and diagnoses then engaging in deliberate practice with the goal of further improving their performance. Using what they had identified, the researchers developed training that allowed therapists to improve their performance relative to their own baseline performance. Critically, this training has been widely successful, and across the range of diagnoses.

Similar success using this approach has been found in an array of domains such as sport (e.g., Williams et al., 2002; see also Harris et al., 2020) and minesweeping (Staszewski & Davison, 2000). Relevant to the present discussion, training derived from analysis of what the most skilled minesweepers *actually did during detection* (rather than following standard instructions) resulted in more than doubling in performance of recently but fully trained minesweepers. Additionally, researchers are developing surgical training for at least two surgical training centers based on the study of expert performers, and they have completed the first phase of identifying what separates the most skilled surgeons from lesser skilled surgeons via protocol analysis (Korovin et al., 2020). The success of the latter remains to be seen, but the success of deriving training from expert performers has a solid history of improving performance, including training in medicine (e.g., McGaghie et al., 2011). Moreover, this approach can be used to improve existing training via ongoing, iterative tweaking of existing training, or to develop training from scratch (e.g., Harris et al., 2013).

More broadly, a rationale for deriving training from studies of expert performers is the overall structure imposed within the framework of the Expert Performance Approach (the points are stated below) because of its reliance on objective measurements of performance and subsequent assessment of training efficacy. Such structure is important when incorporating any type of training in order to assess effectiveness for the trainee and to continuously monitor the overall long-term effectiveness of the training itself. The stated curriculum and/or goals of a training program can vary greatly, as well as how progress is measured. Such individualization is not problematic, but a lack of an existing curriculum can be problematic when training approaches are widely adopted, such as the proliferation of simulation in medicine (see Harris et al., 2013; Harris et al., 2020). As recently as the past decade or so, 75% of surgical training simulation centers did not have a specified curriculum (Korndorffer et al., 2006).

Where simulators are considered part of the training process, the simulator in isolation will not lead to performance improvement—no more than an individual driving a car without specifications will somehow get to Cleveland. Moreover, critics will point to lack of performance improvement from engaging in simulation with no curriculum as evidence that simulation not useful as a training technique (e.g., Harris et al., 2013). We now turn to describing some of the critical elements to consider when deriving training from expert performers: (a) objective measures of performance, (b) importance of representative tasks, (c) assessing how expert performers perform and developing training, and (d) assessing effectiveness of training via objective measures on representative/real-world tasks.

Objective Measures of Performance

A foundational component of Ericsson's Expert Performance Approach (EPA; Ericsson & Smith, 1991) is the use of objective measures to identify expert performers (see Ericsson & Charness, 1994, for additional discussion). Ericsson proposed that expert performers should be identified via reproducible performances on tasks representative of the domain of interest (Ericsson & Smith, 1991; more on representative tasks in the next section), and not on measures such as reputation or time in a domain as the sole criteria. This stipulation generated a fair amount of debate, with criticisms such as all not all domains have easily quantifiable measures of performance or that the definition was too restrictive to capture a wide range of performance (e.g., Hoffman, 1998).

Regardless, objective measurement of performance is a foundational component of the Expert Performance Approach, allowing implementation of the techniques described in the present manuscript. Without quantifiable and objective measures, stratification of performers based on performance would not be possible, the crucial pieces of performance providing a performance advantage to the expert performer would be more difficult to identify, and there would be greater difficulty identifying what to extract from the expert performers' performance for application to training development. Representative tasks are an important tool for the overall process and the next topic of consideration.

Importance of Representative Tasks and Identifying Expert Performers

Representative tasks are tasks intended to capture the essence of performance within a given domain (Harris et al., 2020). The intent behind the conceptualization is that the representative tasks can be performed under controlled conditions and are standardized across performers (Ericsson & Ward, 2007). Such representative tasks allow for studying the most elite performers and allow stratification of performers based on skill/performance level. In some cases, the representative task is a given task in its entirety, such as a 100-meter sprint. In this example, the entire task of sprinting 100 meters allows identification of the most elite performers (i.e., fastest times) and categorization of the performers based on time to complete the task. This type of representative task is a whole task example of a representative task and modifications are not required in order to use this type unless further decomposition of the task is a goal of the researcher. Other representative tasks are subcomponents of a larger task, such as returning a tennis serve, which allow identification of skill differences among performers (Ericsson & Ward; see also Harris et al., 2020, for a review).

In many domains, representative tasks exist that can allow for identification of expert performers and classification of performers based on the outcome on the representative tasks. Examples of existing representative tasks are found in domains such as sprinting (fastest time) or typing (words typed per minute). In other domains, existing measures allow confident identification of expert performers, such as rankings in sales (number of sales or dollar amount generated), tennis, or chess. In these latter examples, however, there are subcomponents that could better fit the definition of a representative task; e.g., techniques with clients (sales), returning a serve (tennis; Ericsson & Ward, 2007), or selecting the best next move on an in-game chessboard (chess; de Groot 1946/1978; Ericsson, 2004). In these examples, performance on the representative task should reflect the existing measures of elite performance (e.g., chess ranking) that allowed for identification.

Assessing How Expert Performers Perform and Developing Training

The use of representative tasks can serve two important functions with regard to developing training from the study of elite performers. The first is to demonstrate that performance differences can be recorded and that performers can be classified on that basis: e.g., percentage of serves returned or not, selection of the best next move or a less ideal selection, or most words typed in given amount of time. As noted, performance on representative tasks should reflect objective overall rankings. The second important function is that representative tasks allow identification of the critical factor that separates the performers into different skill levels, which is often called the mediating mechanism (e.g., Ericsson & Williams, 2007). In other words, an attempt is made to pinpoint the exact origin of the expert performers' advantage.

Examples of using protocol analysis for pinpointing these mediating mechanisms were mentioned above. For example, researchers used eye-tracking devices to identify where the most skilled tennis players looked while returning a tennis serve (Williams et al., 2002). This visual location information was then used to develop training for less skilled players, which significantly improved their performance on returning serves. In another example, researchers studying baseball were able to use visual occlusion methods to pinpoint the part of the pitcher's motion that was most critical to providing an advantage to the most skilled batters in terms of their anticipation of the trajectory of the pitch (Paull & Glencross, 1997). Moreover, Fadde (2016) used this information to develop a training program for a university baseball team that led to the team leading their conference on most batting-related performance metrics. Think-aloud reports are another protocol analysis tool that can be used to capture the thought processes of performers during performance to determine differences in strategy between skilled and less-skilled performers (e.g., Ward et al., 2011). Additionally, once identified, the skilled performers' developmental path can be uncovered and incorporated more widely; for example, the method of training used to improve chess performance (Shadrick & Lussier, 2004), or the training techniques of elite athletes that were effective can be shared (hitting a million balls per year; Agassi, 2010).

Assess Effectiveness of Training via Objective Measures on Representative/Real-World Tasks

An inherent advantage of a framework requiring objective measurements to identify skilled performers is that an assessment of training effectiveness can rely on the same measures. Training devised to increase the number of words typed per minute or the percentage of tennis serves returned can be deemed effective based on those same measures. In an excellent example, Fadde's (2016) training based on visual occlusion studies improved batting performance during training sessions and in the "real world" as the team led the conference in most of the batting metrics. Moreover, training techniques deemed ineffective because they do not lead to performance increases can be modified or replaced altogether. As evidence accumulates that particular techniques are effective, sharing them will lead to performance gains for a wider range of individuals and the processes can be further refined. We now consider some of the remaining issues and questions moving forward.

Remaining Issues and Questions Moving Forward

One of the tasks given to the authors of manuscripts for the special issue was to identify remaining issues and questions moving forward for their particular area. In this section, we briefly discuss some of these remaining issues and questions pertaining to training derived from expert performers. The issues include perceptions that (a) advocates for using deliberate practice are taking an extreme view, and (b) deliberate practice activities are too rigid and drill-like to be widely applicable. The questions are (a) What combination of screening along with application of practice and resources is needed to maximize performance? (b) Is it possible to separate early involvement from "natural" abilities as the source of observed performance differences? (c) Will widespread implementation be possible given resource needs and funding? and (d) What percentage of the general population is interested in maximizing potential?

The Perception That Advocates for Using Deliberate Practice Are Taking an Extreme View

This perception is rooted in the original article proposing the concept of deliberate practice (Ericsson et al., 1993), as well as other explanations of the origins of elite performance, such as giftedness as being mostly the result of engagement in deliberate practice activities (e.g., Ericsson et al., 2007). However, it would be very surprising if most of the trainers and scholars using or advocating for deliberate practice actually hold this extreme view. Arguably, most have found deliberate practice techniques to be effective and are seeking to maximize the benefit of training. That is not to say that strong advocates for an extreme nurture approach do not exist, but to paraphrase Hambrick and colleagues (Hambrick et al., 2018), few scholars would seriously argue that individuals begin performance in a domain on equal footing. It could be argued that an extreme view of nurture is scholars taking the position of being unable to separate environmental influences from natural endowments when the environmental influence occurs at a young age. We would characterize this as an agnostic approach instead. In other words, scholars arguing for the inability to separate early environmental influences from natural abilities are assuming that environmental influence exerts a strong influence on performance, but natural abilities presumably are influential, with either environment or natural ability potentially exerting the greatest influence. As Ackerman (2014) notes in his coverage of investment theory, early investment leads to stable characteristics and aptitudes. It seems reasonable that the 4-year-old child with a measurable advantage in some given domain could have already received a year of practice in that domain relative to the other 4-year-old child in the room.

Perhaps more concretely, the starting point of the performer relative to another can be of little interest to the researcher or trainer, as long as performance is improving as projected. For example, medical students are already pre-selected, having passed rigorous undergraduate courses and a competitive admissions process. A benefit of the mastery learning with the deliberate practice model of training medical students is that the end-goal can be specified, and trainees can reach the goal by moving through the process as is appropriate for the individual (e.g., McGaghie, 2008). The additional hour on a simulator or the few additional attempts needed to reach mastery are of less concern than reaching the end-goal of being able to perform. Importantly, it is the iterative process with feedback provided by the training that allows everyone to reach the next identical starting point for the next end-goal.

Similarly, professional and other elite athletes have already separated themselves from other performers. Coaches likely appreciate being able to use deliberate practice techniques in order to move the athlete to the next performance level. Moreover, not engaging in intense and consistent practice would lead to falling behind their peers with regard to performance. If an athlete is completing all practice activities in a sandpit in order to create additional stress and effort requirements, then other athletes will need something with the same level of rigor, if not the exact same activity. As noted by Young and colleagues (Young et al., 2021, this issue), a 1% difference in performance can be the difference between a world record and not qualifying for an event.

Practically speaking, a patient likely would not care how a physician developed the ability to avoid damaging adjoining tissue during surgery, or a fan of an athlete or team would not necessarily be concerned with how the amazing play or performance became possible—whether it came naturally or through training.[1] The perspective outlined in this subsection was intended to counter the view that advocates engaging in deliberate practice activities are proposing an extreme view. Rather than an extreme stance, the perspective seems to be one that keeps the view of individual differences and their role in performance from venturing into an extreme stance. While individuals will not enter a domain with equal footing, factors such as working memory capacity, reaction time, and running speed could all provide hypothetical (dis)advantages for an individual. However, there is no direct mapping between many tasks and such factors; the initial advantages must be adapted to the task and honed from there. An individual with excellent hand-eye coordination must harness and hone that ability to become great with a hacky sack, or someone with excellent rhythm must still develop his or her skills for playing an instrument. Thus, advocating for deliberate practice should not be seen automatically as taking an extreme approach moving forward.

The Perception That Deliberate Practice Activities Are Too Rigid and Drill-Like to be Widely Applicable

Another issue related to extracting training from the study of expert performers is the perception that the practice activities advocated by the approach are rigid and repetitive. For example, Fadde and Klein (2010) proposed deliberate performance, suggesting that deliberate practice is limited to drill-like activities, and is of limited use when applied to novel, dynamic, or even daily real-world tasks. Although some deliberate practice activities are repetitive and drill-like (e.g., Agassi's hitting one million balls a year; Agassi, 2010), Harris et al. (2017) proposed creating training/deliberate practice activities that allow performance to take place in dynamically evolving situations that mimic actual events. This is accomplished by creating simulations that allow for great flexibility and potential for exploration in how the performer responds and variation in ways the scenario could unfold. For example, a nurse could experience a range of scenarios in which they must intervene to administer emergency treatment to a patient; multiple iterations of a sudden drop in blood pressure or a fallen patient with vastly different situational circumstances. This example is illustrative of the class-of-task argument (Harris et al.) in which the class of task remains constant while the iterations experienced during training is varied. Scholars and trainers should continue to develop activities that provide experiences with dynamically evolving situations as deemed relevant, and to continue to accumulate evidence for these techniques.

What Combination of Screening Along with Application of Practice and Resources Is Needed to Maximize Performance?

While there has been a call to move beyond a dichotomous nature versus nurture approach (Ackerman, 2014; Hambrick et al., 2018; Ward et al., 2017; Young et al., 2021, this issue), this question continues to be heavily debated. Advocating an extreme nurture view, Ericsson et al. (2007) proposed that screening is of little importance and that observed differences were primarily the result of engagement of deliberate practice activities. Other researchers have advocated for screening to determine individual differences as an additional tool for best determining how to direct resources (Moreau et al., 2019). At the root of this debate is whether early screening tools are predictive of later performance, a proposal deemed to be unreliable, if not impossible (see Ackerman, 2014). Ackerman states (p. 15):

> [I]t should be easy to see that it is nearly impossible to identify individuals at an early age who will go on to achieve expert/elite performance, unless either the base rate is much higher (e.g., 50% of individuals go on to achieve this level of performance), or the test has an extremely high validity (e.g., the correlation between the predictor measure and the criterion of expert/elite performance approaches 1.0).

Ackerman goes on to state that predictor measures are not invalid, and that such statements do not suggest that deliberate practice is of greater importance. However, given such considerations of the shortcomings of such screening/identification measures to predict future elite performers, it seems counterproductive to exclude individuals based primarily on screening measures. For example, it was noted by Ackerman that we often fail at predicting high level performers once they have been involved for decades (e.g., low level prospects in athletics who go on to be tremendously successful), so redirecting a novice away from a domain based on a screening measure does not seem to be advisable. Researchers will continue to seek answers to this general question.

Is It Possible to Separate Early Involvement from "Natural" Abilities as the Source of Observed Performance Differences?

A related remaining question is whether it is possible to separate capabilities enhanced by early involvement in a domain from "natural" abilities. This question is complex in that it is both related to, but also distinct from, the larger nature versus nurture discussion. For example, two scholars on the opposite end of the nature versus nurture continuum could be making the case that nature or nurture was wholly responsible for differences in performance. However, it is extremely difficult to isolate the evidence to support such stances because of the inherent interplay of both environmental and natural factors, along with the inability to fully control for one or the other (e.g., true random assignment or similar). In other cases, scholars acknowledging the potential influence of both nature and nurture on performance still will find the concepts to be intertwined to a degree that they are difficult to untangle.

Harris and Eccles (2021, this issue) argue that the distinction does not necessarily matter because sufficiently early involvement would provide stable individual characteristics with regard to aptitude and motivations (i.e., investment theory; Ackerman, 2014) to the point that the two are inseparable (Harris and Eccles). Pragmatically, if we are not very good at predicting who will be the best performers using screening measures then why bother trying to weed out children as young as 3-4 years old? Twin studies (e.g., Hambrick & Tucker-Drob, 2014) provide potential insight into heritable traits, and there has been interesting progress in exploring the interaction of genetic and environmental contributors to performance (see Hambrick et al.'s, 2020, section on genetic and environmental influences for a review). Nevertheless, the applicability of research helping separate early involvement versus "natural" ability will require continued attention. For example, Hambrick et al. (2020) noted that it is unlikely that research will uncover a single genetic factor explaining expertise and that environmental influence, such as practice, could activate gene expression. This latter point makes it particularly risky to attempt to weed out beginning performers based on early screening and attempts at identification of who has the greatest potential to be an expert performer. It is also possible that is this type of gene activation is responsible for the emergence of the stable traits and aptitudes proposed in investment theory, meaning that premature removal of an individual from a particular domain could be removing someone with a strong natural foundation that will never be expressed.

Will Widespread Implementation Be Possible Given Resource Needs and Funding?

The expert performance-based training approaches covered in the present manuscript have been shown to be tremendously effective (e.g., Fadde, 2009; Staszewski & Davison, 2000). A potential downside is that these approaches can be quite labor- and resource-intensive. When done correctly, the multiple steps each require identification and assessment of both expert performers and trainees. Moreover, protocol analysis techniques alone require recording and analyzing verbalizations, which is a laborious process (see Charness, 2021, this issue). The monetary cost is particularly relevant when considering training or simulation centers. For example, start-up costs for a full-scale medical simulation center can run well into the millions (e.g., Kapadia et al., 2007).

Arguably, the benefits of designing training based on studies of expert performance ultimately outweigh the costs, but a full discussion requires consideration of resource costs. Barriers to incorporating training derived from the study of expert performers, such as the implementation and assessment of deliberate practice, are numerous (see McGaghie et al., 2021, this issue; Harris et al., 2017). Chances are that the accumulated value of the overall benefits will lead to widespread adoption of applying training based on skilled performers via simulation and other means. Such a development would reflect the same cycle experienced in aviation simulation in which skepticism eventually ceded to acceptance, including the requirement that pilots log a minimum number of hours within a simulator to complete their certifications (e.g., Trunkey & Botney, 2001; Tsuda et al., 2009). Nevertheless, the question remains whether there will be widespread adoption of the training approach described in the present manuscript. Research is needed now to help provide evidence for and against the efficacy of the approach.

What Percentage of The General Population Is Interested in Maximizing Potential?

This particular question is far reaching in both the percentage of the population for which it is applicable and the intersectionality with many of the other issues discussed in the special issue. Humans are generally capable of developing a passable level of skill reasonably quickly for most domains (100-200 hours of practice, Ericsson & Pool, 2016) particularly when competing with other novices who have recently entered the domain. The Nobel laureate Herbert Simon (e.g., Simon, 1972) proposed the term "satisficing" to describe a willingness to take a satisfactory, rather than optimal, solution when available. Applied to performance, many happily take a similar approach of being satisfied with current levels and are not concerned with seeking opportunities for improvement. Moreover, satisficing can occur among individuals with the greatest potential since as many as 60% of students labelled as gifted are not maximizing their potential (e.g., Ronksley-Pavia & Neumann, 2020). Interventions are suggested as a means to get these gifted students reengaged in order to continue progress towards reaching the potential of the individual. The message here is that challenging and nurturing environments are needed to maximize potential, even for the individuals with the greatest potential. If a lack of a challenging environment could stymie the performance of a category of such high caliber, would the same risk not be in place for individuals who are not at this high level? Future research can continue to explore these considerations.

Future Directions

The issues and questions outlined above were intended to help specify needs to be addressed as the discussion regarding the use of expert performers to derive training moves forward. A multitude of issues and questions remain related to the study of expert performance, as suggested in the present manuscript and throughout this special issue. Others have suggested that it might be best to consider deliberate practice as a somewhat esoteric tool that can be used, with limits, as applicable to specific aspects of expert performance (e.g., Young et al., 2021, this issue). We argue that the approach of developing and using training derived from the study of expert performers need not await the conclusion of such debates, as long as the technique of extracting training from expert performers continues to be useful; that is, where prolonged engagement in identified practice techniques continues to lead to performance improvements.

The proper implementation of expert performance-based training is also important, and the pitfalls of unstructured training were discussed above. In addition to the need for an expert performance led curriculum or strategy for training (Harris et al., 2013), the trainers must also understand the process. The trainers must be capable of doing more than "going through the motions," and capable of recognizing when adjustments to training are required. This component of monitoring the ongoing effectiveness of training potentially can be augmented by artificial intelligence or other computerized assessment. One of the best ways to ensure that trainers are well trained, resources are appropriate, and training effectiveness is maximized is to adopt the proposed approach at a system level. McGaghie and colleagues (2021, this issue) make the case for widespread, systemic implementation of such an approach in the domain of medicine. The proliferation of skills training camps and ongoing refinement of athletic training techniques suggest some degree of system-wide adoption. Other domains should consider adopting such widespread implementation. It remains to be an empirical question as to whether such implementation will result in widespread performance improvements, potentially raising the bar of what can be expected in terms of attainment for future performers.

Concluding Remarks in Remembrance of K. Anders Ericsson

The first time that I, Kevin Harris, met Anders, I was a very green graduate student working at Mississippi State University with a former colleague of his, Gary Bradshaw. When introduced to Anders by Gary at a conference, I unceremoniously responded with an upward head tilt and a nonchalant, "What's up?" While this response unintentionally conveyed my relative youth and inexperience, I remember Anders being very cordial. Flash forward a few years and only then did the true risk of such an odd greeting for an academic heavyweight become clear to me. By this point, I was in discussions with Anders to become his doctoral student and was a more seasoned student with a much greater understanding of his place in the academic landscape.

If Anders remembered that earlier encounter, he never mentioned it or appeared to hold it against me. In fact, one of the lingering memories that I have of Anders is of his kindness and dedication to nurturing up-and-coming scholars. I was a first-generation college student from a public high school and in need of significant improvements, yet he never once made me feel as if I was less than anyone else. At this point in the mid-2000s, it was already commonplace for national media outlets to visit our laboratory at Florida State University to do a story or for us to be notified that Anders was out of the office because he was speaking in some city overseas. Despite his level of recognition and acclaim, I frequently witnessed him stand up from our meetings to don his tie and suit jacket so that he was ready to teach his undergraduate class. He took teaching very seriously and truly cared if students in his laboratory and classroom were learning. His stature as a researcher makes this dedication to teaching even more impressive.

His teaching style was gentle yet effective—the kind of guidance that makes learning fun. This approach undoubtedly came from the pedagogical model provided by Anders' own father. Anders shared stories of his father pointing out natural phenomena and asking him to explain what was being observed and why it was happening (e.g., the ridges left on the sand by a wave). The next step was to have Anders's research the phenomenon and compare his proposed explanation with what was actually happening. These exercises potentially were the origins for Anders's strong curiosity, and he cultivated an appreciation for curiosity and seeking answers with his students.

Anders's impact on academia via research deservedly has been discussed extensively in the special issue. In addition to being an academic giant, some of my enduring memories of Anders will be his mentorship, kindness, and dedication to teaching. I also vividly remember a pile of papers on his desk being stacked so high that a fellow researcher was only just able to stop them from tipping over and falling on him (I think that it was Mark Williams, an author of a paper in this special issue). Others have mentioned Anders's penchant for offering a quarter dollar wager during academic debates. Personally, I am forever changed for the better for his mentorship and the opportunities that came from working with Anders. May the impact of his work and memory of Anders continue to endure.

Endnotes

1. Demonstrating that performance can be improved via deliberate practice and related training activities is important knowledge to share broadly.

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