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Transforming Teams of Experts into Expert Teams: Eight Principles of Expert Team Performance

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Abstract

Anders Ericsson's seminal research on expert performance spurred a number of streams of research across psychological disciplines. Though his work was primarily focused on expert individual performance, there has been increasing interest over the past several decades on the factors underlying expert teamwork. This paper advances eight principles of expert team performance based on decades of team science research: shared mental models, learning and adaptation, role clarity, shared vision, dynamic leadership, psychological safety, cooperation and coordination, and resilience. In addition, we review a number of team development interventions aimed at building team expertise including team training, simulation, coaching, and debriefing. Accordingly, this paper is divided into three sections addressing (1) how expert teams perform, (2) interventions to develop expert team performance, and (3) a reflection on the role Anders Ericsson's work has played in team science, including a personal reflection from Eduardo Salas on deliberate and guided practice.

Keywords

Team performance, expert teamwork, team development, team learning

Introduction

In their seminal work on expertise, Ericsson and Charness (1994) argued that elite performance is developed, rather than innate. Breaking from the commonly held view at the time that superior performance is genetic or could be identified in childhood, this and Ericsson's larger body of work emphasized the importance of deliberate practice over time in achieving expert performance (e.g., Ericsson et al., 1993; Ericsson, 2002, 2006, 2018). Alongside increasing interest in teamwork over the past three decades, organizations across a wide range of industries have asked similar questions about achieving expert teamwork. Drawing from much of Ericsson's work, research on teams consistently supports the notion that 'a team of experts does not make an expert team' (Burke et al., 2004; Reyes & Salas, 2019; Salas et al., 1997; Salas et al., 2006). That is, team expertise is also not innate. Instead, teams must put effort into combining and integrating their skills, promoting learning over time via practice, and analyzing their environment in ways that support quick and accurate decision-making.

The purpose of this paper is threefold. First, we review the literature on what makes an expert team, identifying eight principles of expert team performance and outlining what expert teams think, do, and feel. In addition, we discuss how expert teams are developed via interventions like training and simulation. Finally, we discuss linkages with Ericsson's work, noting similarities and differences between Ericsson's findings regarding expertise

in individuals and findings from research on team expertise.

Accordingly, our paper is organized in three sections. The first is focused on eight principles of expert teams. The second describes a number of common team development interventions aimed at improving team expertise, typically via guided practice. Our final section links the science of teamwork to Ericsson's body of work on expertise, first discussing how Ericsson's work has informed team science and finally sharing a personal anecdote from Eduardo Salas on an academic debate with Ericsson regarding the distinction between deliberate and guided practice.

The Eight Principles of Expert Teams

Expert Teams Develop Shared Mental Models

Mental models refer to the latent understanding of the task, environment, and team and how these components interact (Salas et al., 2005). At the team level, members hold similar mental models, which serve as the mechanism through which they can achieve implicit coordination (Cannon-Bowers et al., 1993). For example, in a surgical team where nurses and physicians are each experts in their own respective roles, teams that have developed a shared mental model are able to anticipate each other's needs and know who to look to when a problem arises. When mental models are inaccurate or not shared, teams can fail to recognize problem triggers, may skip steps in a task procedure, and can have inefficient communication practices (Salas et al., 2009). For this reason, shared mental models are thought of as a key enabler of team processes, decision making, and performance in expert teams (Cannon-Bowers et al., 1993; DeChurch & Mesmer-Magnus, 2010; Mathieu et al., 2000).

Shared mental models are not inherent and can take a great deal of task and team familiarity to cultivate, even in teams composed exclusively of experts. In fact, when teams experience acute stress or face other obstacles, shared mental models are likely to degrade (Ellis, 2006). As a result, teams must actively work together to build and maintain shared mental models—for example, by discussing how each individual will contribute to the team's goals and the most effective strategies for combining efforts (Fiore et al., 2003). Processes for doing so are akin to the concepts of reflective thinking and meta-cognition in individual learning and performance processes discussed in the expertise literature (Ericsson & Lehmann, 1996; Gurtner et al., 2007).

Teams can be intentional about developing and maintaining shared mental models via *team reflexivity*, which is the extent to which teams overtly reflect on their objectives, strategies, and processes (West, 1996). Team reflexivity describes a team's efforts reflecting on and adapting strategies, and it is especially important for teams facing complex tasks (Gurtner et al., 2007). Like reflective thinking and meta-cognition in expertise research, team reflexivity tends to be represented by explicit, rather that implicit, processes. These processes require strategic implementation of team development interventions (e.g., pre-briefing, team huddles, team coaching) to create an opportunity for the team to 'get on the same page' and discuss their mental representations of the team and its tasks (Stout et al., 1999). Eccles and Tenenbaum (2004) also highlight the importance of coordinating processes like those involved in team reflexivity to support shared knowledge and team coordination in their conceptual framework of coordination in sports teams. Just as improving individual performance requires deliberate practice, expert teams work deliberately to build shared mental models.

Expert Teams Learn and Adapt to Situational Demands

Team learning describes the acquisition of knowledge and skills in a team, particularly how teams of individuals collectively learn to work together, improve, and adapt (Edmondson et al., 2007). Teams build knowledge and skills in a variety of ways, including through formal training, as well as informal experience working together through challenges. This touches on a central tenet of Ericsson's work in that his theory involves the development of expertise through effortful, deliberate practice (Ericsson et al., 1993).

Similar findings exist in the teams literature in the area of adaptive expertise. Adaptive expertise in teams is the ability to integrate the existing declarative and procedural knowledge in a team to make predictions about a unique situation and create new strategies to address demands 'on-the-fly' (Hatano & Inagaki, 1986; Smith et al., 1997). It is true that individual members must have the knowledge and adaptive capacity to be experts, but as a team they must be proficient at integrating that expertise to coordinate action. Not only do members of expert teams know how to respond to developing issues with swift coordination, but they can also anticipate each other's needs with minimal explicit communication because they hold shared mental models (Entin & Serfaty, 1999; Cooke et al., 2000). In a study of flight crews, Orasanu (1990) found that high performing teams built shared mental models of the task and everyone's responsibilities via effective communication. This means that being part of an expert team requires both individual expertise in the domain, as well as a shared understanding of the task at hand, the technology and equipment, the context, teammate responsibilities and progress, and how all of these components interact in any given situation (Cannon-Bowers et al., 1993; Orasanu & Salas, 1993). This is what allows teams to adapt to situations in a coordinated fashion.

Burke et al. (2006) outlines the process of team adaptation, which begins with recognizing the cues that situational demands have shifted and ends with team learning. Expert teams recognize the triggers that lead to failure and then set in motion a plan to address them. Burke et al.'s model of team adaptation also highlights the importance of having situation awareness at each step in the team adaptation process. Situation awareness is key for jobs in which safety is a primary concern. Poor situation awareness was found to be a leading cause of errors in military aviation (Hartel et al., 1991). Endsley (1995) outlines a multi-phasic process of situation awareness that involves being aware of situational components in a given space and time and how they are relevant to the team's mission currently and in the future, and anticipating how events will unfold. At the team level, situational awareness involves each individual member's awareness, as well as sufficiently overlapping mental models held among members (Salas, Cannon-Bowers et al., 2001). Team situation awareness and mental models are components of shared cognition that allow expert teams to adapt and shift their strategies to fit the demands of the environment.

Expert Teams Have Clear Roles and Responsibilities

One particular barrier to developing shared cognition is the absence of clearly defined roles and responsibilities on the team. Without clear roles, teammates have no reliable framework for predicting each other's actions and it can quickly become confusing who is responsible for what when novel situations arise. In a study of air-traffic controllers, LaPorte and Consolini (1991) found that having an understanding of each other's responsibilities allowed teams to flexibly adapt to shifting situational demands and fluctuating workloads to maintain performance. Role clarity contributes to the accuracy of team mental models, which makes it a foundation of shared cognition and adaptability.

Having clear roles also allows teams to develop an effective transactive memory system (TMS). TMSs are the underlying cognitive structures within teams for information storage and retrieval, and in order for them to function effectively, team members must be aware of where expertise lies and who to go to for specific knowledge (Lewis, 2004). Moreland et al. (1998) found that teams that are trained together have more accurate TMSs than those trained apart. In other words, teams that are trained together gain an understanding of each other's roles and responsibilities, which allow them to develop a more efficient system for knowledge exchange. In addition to knowing where expertise lies on a team, a TMS also signals to members what they themselves are responsible for knowing so that they understand how their teammates will rely on them (Lewis, 2004).

Relatedly, research on rugby teams suggests that when team member roles are ambiguous, performance suffers due to a lack of efficacy (Beauchamp et al., 2002). Therefore, not only do teams see a negative impact from a poor understanding of other members' roles, but also when individual members perceive ambiguity in their own roles. In a study of US Army soldiers, Bliese and Castro (2000) found that role clarity attenuated the negative impact of work overload on psychological strain in groups with supportive leaders. The researchers concluded that having role clarity serves as a mechanism for being able to have an impact on a situation, while the absence of clarity results in not knowing what to do and having no control in the situation (Bliese & Castro, 2000). Expert teams have members who know their roles and responsibilities and those of their teammates, as well as how everyone's work contributes to achieving the team's mission.

Expert Teams are Motivated by a Shared Vision

Mutually developing a shared vision of the future that is valued and sought-after is key in expert teams (Cox et al., 2003). A shared vision has the important function of setting expectations for the team and how they should perform (Cannon-Bowers et al., 1993). Indeed, Castka et al. (2001) studied management teams in a manufacturing company and found that the teams who performed the best were those who had a clear understanding of their mission. In a longitudinal study, Pearce and Ensley (2004) found that having a shared vision plays a central role in innovation effectiveness, as well as in decreasing social loafing, which is the tendency to shirk one's duties and rely on teammates to do the work. A vision provides both direction and a source of motivation.

Trusting everyone's desire to achieve the shared vision aids in team members' understanding that the mission comes before any interpersonal disagreements or conflict with personal goals (Zhang & Chiu, 2011). Expert teams share a mutually desired and beneficial vision of the future that motivates them to perform well together. A shared vision also gives them a clear and common purpose to base their work on. While research has provided evidence of the particular benefits of creating a shared vision as a team effort with everyone's input (Cox et al., 2003), much of the effort involved in supporting motivation towards a shared vision rests upon the team leader. Motivating the team towards a shared vision is a key feature of the transformational leadership style and is discussed in the next section.

Expert Teams Have Effective and Dynamic Team Leadership

Leadership is a skill in itself, separate from the skillset required for the technical aspects of a job. For leaders, technical expertise may be less important than being able to direct and coach a team to success. Much of the research on effective leadership focuses on the transformational leadership style. As discussed above, transformational leaders are astute in getting the team to rally behind a vision for the future and managing their affect to support desired behaviors and effective performance. Meta-analyses show consistent relationships between transformational leadership and a variety of positive outcomes such as performance, satisfaction, and commitment (Judge & Piccolo, 2004).

Transformational leadership has traditionally dominated the literature as a powerful predictor of important outcomes, but it does not include any concept of morals or ethical behavior that also characterize effective leadership. Recent work shows that one leadership style is predictive of performance beyond transformational leadership, and that is *servant leadership* (Hoch et al., 2018). Research on servant leadership describes the concept as being aware of and showing concern for the needs and well-being of subordinates, and through meeting those needs first, organizational objectives are achieved (Bass, 2000; Greenleaf, 1977). Expert teams have leaders who both inspire a vision and are empathetic towards their situations, putting follower needs above the needs of the organization.

When it comes to the leadership functions that drive adaptive expertise in teams, dynamic leadership has been theorized as key. Adaptability hinges on the ability of leaders to gauge and leverage team member expertise; thus, leaders must adjust their focus and behavior in leading teams as new phases of development and different contextual demands arise (Kozlowski et al., 2009). Sometimes, the leader may not be a formal role at all, but rather shared among members of a team and shifting with task demands (DeRue & Ashford, 2010). Shared leadership is a concept in which leadership roles are distributed amongst team members, and meta-analyses show an overall positive relationship between effective shared leadership and team performance (D'Innocenzo et al., 2016). Expert teams understand the functions of leadership and are able to leverage the capabilities of each member to address situational needs as they arise.

Expert Teams are Positive and Psychologically Safe

Not only do members of expert teams believe they can succeed, but they also have a general preference toward working as a team, known as *collective orientation* (see Driskell et al., 2010). Having a collective orientation is essential for team success (Salas et al., 2005). Preliminary research suggests that teams with members who are collectively oriented may have better team communication, overall teamwork, and satisfaction (Muramoto, 2015; Park, 2004). Expert teams also contain team members who have trust in one another's ability to fulfill their roles, yielding greater performance and effectiveness (Breuer et al., 2016; De Jong et al., 2016). The importance of trust is especially true for teams with limited familiarity who need to swiftly coordinate to succeed, such as flight crews and emergency response teams (Wildman et al., 2012).

Moreover, expert teams also trust in one another's intentions to put the team's goals above any individual agendas, allowing for a climate of psychological safety (Edmondson et al., 2001). Psychological safety is the degree to which a team feels it is safe to speak up with questions, suggestions, concerns, or other ideas without fear of ridicule, embarrassment, or any form of retribution, facilitating team learning and performance (Edmondson, 1999; Frazier et al., 2017). When psychological safety is low, team members can refrain from speaking up with suggestions for improvement in an effort to 'stay in their lane', and they often avoid admitting to errors. Psychological safety enables unadulterated communication within teams that is necessary for the development of expertise. It is often at risk when there is a salient hierarchy between team members, making it difficult for members with less power or rank to speak up (Nembhard & Edmondson, 2006). As a result, the task of maintaining a climate for psychological safety falls largely upon the team leader to solicit input from all team members and to model a norm of sharing and accepting constructive criticism as well as challenging the status quo.

Expert Teams Cooperate and Coordinate

For individuals, expertise involves the ability to execute actions exceptionally well in a particular domain. For teams, expertise involves each individual member performing exceptionally *as well as* the team's ability to coordinate their actions to achieve a common goal. Research on team processes is focused on the behavioral components of expert performance; that is, whether teams effectively set goals, monitor progress toward those goals, and provide members with feedback and support to maintain performance (Marks et al., 2001). Links between these behavioral processes and team performance have robust empirical support (LePine et al., 2008).

Though a wide range of team processes are vital to team performance, team cooperation and coordination are key for achieving expert performance. Team coordination involves interactions between team members and their environment, and it is improved when teams possess similar mental models (Entin & Serfaty, 1999). Coordination allows teams to draw most effectively from individual members' expertise by aligning individuals' tasks and goals with their knowledge, skills, and attitudes (KSAs).

Similarly, team cooperation, which is sometimes conceptualized as the absence of conflict, contributes to expert team performance. When teams behave cooperatively, they are more likely to share information and effectively distribute relevant expertise amongst team members (Mesmer-Magnus & DeChurch, 2009).

In sum, expert team performance is driven more by the ability to engage in effective teamwork behavioral processes than the degree to which team members possess specific expertise. In teams that have achieved peak coordination and cooperation, even if not all members are experts, they are able to work together and strategically coordinate their behaviors to achieve expert performance.

Expert Teams are Resilient

Experts thrive where others would collapse under pressure. They do not get discouraged with the prospect of failure, but approach challenges with their superior knowledge and ability to learn from unideal situations. To be an expert, one must be resilient to hardship. Psychological resilience refers to the phenomenon of having a positive adjustment to adversity that threatens well-being or performance (Luthar et al., 2000). Resilient workers have a large capacity to cope with adverse conditions and show minimal negative impact in performance or other important outcomes. They have also been found to be more engaged and committed to their jobs, more satisfied in their roles, and less likely to leave the organization (Shin et al., 2012; Youssef & Luthans, 2007). At the team level, resilience can be seen in the trajectory of team performance levels as teams encounter and recover from challenges (Gucciardi et al., 2018). Resilient teams are able to overcome adversity with minimal disruptions to performance while maintaining team well-being and viability (Chapman et al., 2018; Hartwig et al., 2020).

Some researchers assert that resilient teams outperform others through collectively held positive emotions, such as optimism, satisfaction, and enthusiasm (Meneghel et al., 2016). Certainly, expert teams are more positive and collectively oriented, as discussed above, which enables a host of resources that foster resilience, such as social support and access to instrumental skillsets of others (see Fredrickson, 2013). Research suggests that resilient people also use positive emotions to resolve issues surrounding stressful experiences and adapt, yielding greater learning and improved performance (Tugade & Fredrickson, 2004). Similarly, expert teams may remain resilient through maintaining a positive outlook that allows them to make the best of challenging circumstances and adapt to adversity.

Interventions to Improve Expert Teamwork

In addition to understanding what makes an expert team, researchers have now spent decades investigating a number of interventions to help develop expertise. While Ericsson's work focused primarily on deliberate practice (Ericsson, 2006), developing team expertise tends to rely on guided practice through interventions such as team training, coaching, debriefing and/or simulation (Burke et al., 2004).

Team Training

Team training describes a systematic set of learning initiatives for building teamwork knowledge, skills, and abilities, and is typically led by a knowledgeable instructor who outlines training performance goals and guides trainee practice (Salas, 2015). While much job training is focused on teaching individuals how to do their job, team training focuses specifically on teaching employees how to become more effective at working together (Salas et al., 2008). Research finds that team training can be incredibly effective in improving the performance of individuals and teams (Salas et al., 2008; Salas, Burke et al., 2001). In a series of studies with naval aviators, Salas et al. (1999) found that crew resource management training can enhance team performance via several teamwork mechanisms, including improved situation awareness behaviors. Endsley and Robertson (2000) also report on the effectiveness of team training geared at

improving team situation awareness. Accordingly, team training has been successful in reducing errors across a variety of industries including aviation and the military (Bisbey et al., 2019), and participating in team training even contributes to saving lives in healthcare (Hughes et al., 2016).

Best practices for team training are well documented and are backed by theoretical and empirical support. For example, the primary goal of team training should be transfer, which describes the extent to which behaviors learned in training are implemented on the job (Baldwin & Ford, 1988; Lacerenza et al., 2018). Research suggests that transfer can be improved by focusing on training design features, trainee characteristics, and characteristics of the work environment (Baldwin & Ford, 1988; Blume et al., 2010). In the process of designing a training program, it is important to conduct a needs analysis to identify the elements that require training, the KSAs necessary for teamwork and team task completion, and organizational goals that might influence training success (Brown, 2002; Lacerenza et al., 2018). Information from the needs analysis can be used to ensure a training program is tailored to trainees' needs and environment and that training is focused on relevant tasks, thus increasing the likelihood that transfer will be achieved.

Just as individual expertise is developed through practice, team training often incorporates elements of practice. Effective training delivery typically incorporates information, demonstration, and practice (Salas et al., 2012). While information and demonstration are focused on telling and showing trainees new skills, incorporating practice allows trainees to test out these skills in a safe environment and to receive feedback from a trainer. Diagnostic feedback incorporated into training can help trainees identify strengths and weaknesses and correct undesirable behavior (Kluger & DeNisi, 1996).

Simulation

One common method for incorporating practice with team training is simulation, which describes an artificial or synthetic environment created to parallel a team's experiences with reality (Bell et al., 2008). Historically, simulations have been used most heavily in contexts like healthcare, aviation, or the military, where consequences for mistakes can be deadly (Bisbey et al., 2019). For example, simulation centers with robotic patients, realistic equipment, and recording devices for capturing team performance are increasingly common in healthcare training.

Though simulation can be an extremely effective method for building expertise, simulation is simply a tool and in itself is insufficient for promoting expertise. Effective simulation-based training requires understanding training needs through a needs analysis, performance measurement and feedback, and scenarios crafted based on learning outcomes (Salas et al., 2005). As is the case for team training, a needs analysis or team task analysis are important for creating team training content. For example, a team task analysis helps researchers understand the operational skills needed to complete tasks as well as the skills needed for team coordination (Burke et al., 2004). This information can be used to develop learning objectives and design effective scenarios for simulation.

Team Coaching

Team coaching describes interventions aimed at improving teamwork via feedback from a facilitator or team leader. Coaching is typically defined as a set of behaviors enacted by a leader or facilitator to help the team achieve their goals (Hackman & Wageman, 2005). In general, coaching is process-focused, and builds team expertise by providing feedback on improving teamwork (rather than taskwork) behaviors (Kozlowski et al., 2009). In general, there is consensus in the team development intervention literature that coaching is an effective method for improving team processes and performance (Shuffler et al., 2018).

In practice, coaching often comes in one of two forms (Traylor et al., 2020). Coaching may be conceptualized as leader behaviors intended to help the team reflect or to guide the team toward their goals (Hackman & Oldham, 2005;

Salas et al., 2015). Alternatively, coaching may be implemented as a discrete intervention conducted by the team's leader or by an outside facilitator (e.g., Harmer & Lutton, 2007). In general, studies of coaching tend to find stronger and more consistent positive effects of coaching as leader behaviors on team outcomes compared to coaching interventions (Traylor et al., 2020). However, academic studies of coaching are more limited than many other team development interventions, and more research in this area is necessary.

Debriefing

While team training, coaching, and simulation are often formal team development interventions led by trained facilitators, team debriefs are often led by team members. Team debriefs, or after-action reviews, are team discussions that take place after a performance episode or at salient points throughout the team's life cycle to provide one another with reflective feedback by discussing what went well, what can be improved upon, and an action plan for moving forward (Allen et al., 2018). Debriefing is particularly popular in high reliability organizations, such as aerospace or the military, where errors are costly or may be fatal (Dunn et al., 2016).

Conducting regular team debriefs is a hallmark of expert teams and has been shown in meta-analyses to boost team performance by a magnitude of 25% (Keiser & Arthur, 2020; Tannenbaum & Cerasoli, 2013). Expert teams always debrief to provide feedback and crystallize knowledge moving forward. Debriefing is also a powerful tool for self-correction (Reyes et al., 2018), helping teams reduce errors and continue to build expertise. Other types of reflective activities, such as pre-briefing, which is focused on team planning behaviors, or team huddles, which are focused on assessing current performance and adapting behavior can also be helpful in promoting team reflexivity and performance (Lacerenza et al., 2018).

Although there are many approaches to debriefing, meta-analytic evidence indicates that the most consistent characteristics linked to team debriefing effectiveness are a clear alignment to the team and objective performance review media (Keiser & Arthur, 2020; Tannenbaum & Cerasoli, 2013). That is, the debrief should be focused on the team's goals and work together rather on individual team members' performance. In addition, the most effective feedback provided during a debrief comes from objective criteria. For example, the team might review a video recording of their performance. Team alignment and incorporation of objective media help promote team expertise by focusing team members on teamwork skills and by turning their attention to how they can improve their interactions with others.

Ericsson's Influence

Whereas individuals' expert performance is primarily derived from their own ability to complete a task or engage in an activity, expert team performance requires components beyond individual expertise. Central to expert team performance is a team's ability to strategically combine members' expertise, to build a shared mental representation of the team's tasks and roles, and to maintain awareness of the team's environment. These abilities are largely encompassed by team cognition, a set of emergent team processes that allows teams to effectively collaborate and efficiently solve complex problems (DeChurch & Mesmer-Magnus, 2010; Niler et al., 2020). In this paper, we discussed several components of team cognition including shared mental models, team situation awareness, and transactive memory systems. The study of team cognition represents an extension of the expertise literature built by teams researchers and rooted in Ericsson's influence.

While Ericsson's work on expert performance was focused on developing expertise in individuals, research on teamwork has focused on how teams can efficiently and effectively combine the expertise of their members. For individual performers, expertise is developed through deliberate practice, focused on developing knowledge and skills in a specific domain (Ericsson et al., 1993). In expert

teams, practice is focused on engaging in behaviors that help team members work together. This highlights the important distinction between *teamwork* and *taskwork*. Whereas *taskwork* describes how well team members perform specific tasks, *teamwork* concerns how effectively members work together in a coordinated manner (Crawford & LePine, 2013). The team processes outlined by Marks et al. (2001) are considered teamwork, and these processes are the primary focus of team training in organizations. Indeed, practicing these teamwork processes via team training tends to be effective in improving team performance over time (Hughes et al., 2016).

Ericsson (2020) makes it clear that deliberate practice, by definition, requires a knowledgeable instructor capable of creating an individualized plan of practice and supervising performance episodes in order to diagnose errors and assign countermeasures to remediate less-than-optimal performance. He also asserts that while teachers are essential for determining appropriate goals and the best methods, deliberate practice is performed alone. This specific focus on the individual inherently clashes with practice at the team level and the goal of maximizing performance in teams, because Ericsson believed the strict definition of deliberate practice to be essential in order to understand how *individuals* become experts (Ericsson, 2020; Ericsson et al., 1993).

Although concepts for developing expertise in individuals like *deliberate practice* may not exactly apply to the team level by Ericsson's definition, the findings in teams research certainly mirror similar concepts for turning a team of experts into an expert team. We discuss a few below in the areas of (1) feedback, learning, and adaptation, as well as (2) domain-specific knowledge and working memory.

Feedback, Learning, and Adaptation

Experts at any level know how to learn from every experience and adapt at a moment's notice. Being adaptable to changing circumstances is core to Ericsson's thesis on expertise and expert performance. He asserted that when it comes to debates of nature and nurture, skill development was a more powerful force than the innate talent a person might be born with. When Ericsson discusses adaptation, it is often in a physical sense in that experts obtain physiological and anatomical adaptations specific to their domain and developed over years of deliberate practice (see Ericsson & Lehmann, 1996). He believed that the best way to begin to understand how human behavior adapts is by examining the exception to the 'rules' – expert performers. In doing so, he uncovered the importance of not only consistent and deliberate practice, but in timely and informative feedback.

Feedback is the driving force behind all learning. It is impossible to learn how to improve (or even recognize there is a need to improve) without an indication of where deficiencies lie. At the team level, the basis of building expertise is collective learning. Expert teams know how to optimize their resources by self-correcting in order to learn and adapt (Salas et al., 2008). In a study of surgical teams, Edmondson et al. (2001) found that the teams who were successful in adapting to disrupted routines and implementing a new technological solution were those who had the psychological safety required for the team to effectively learn together. Those who were unsuccessful are those in which team learning did not occur (Edmondson et al., 2001). Teams can further bolster psychological safety and learning by engaging in team deliberate practice, which involves repeatedly practicing classes (Harris et al., 2017). For example, team members might practice challenging their team leader under increasingly difficult circumstances. Moreover, teams that reflect together in team debriefs outperform other teams by over 20% (Tannenbaum & Cerasoli, 2013). In both teams and individuals, experts perform better *and* learn better than non-experts; this is not coincidence. Learning is the cornerstone of developing expertise and adaptability.

Domain-Specific Knowledge and Working Memory

Experts have domain-specific cognitive abilities that allow them to anticipate and react quicker than

the average person. They also have greater working memory capacity that allows them to problem-solve more efficiently. Not only do these KSAs allow them to perform as experts do, but they also lend themselves to further strengthening their capabilities. Moreover, these KSAs allow experts to take what they have learned and apply it across situations within their domain of expertise (Ericsson & Lehmann, 1996). In other words, actions that may seem physically and/or cognitively demanding to the non-expert dealing with an emergency or novel situation are not so difficult for the expert, who has the capacity to see the bigger picture and develop a solution without exerting much additional effort.

Individual expertise is instrumental, but insufficient in achieving expert team performance. This is because expert performance in teams is based not on the achievements of individual performers alone, but on the ability of members to combine their abilities to achieve a shared goal. Teams must focus explicitly on building and maintaining team cognition including shared mental models and situation awareness. Ericsson's research on working memory has shaped how teams researchers think about situation awareness (Ericsson & Kintsch, 1995). For example, in aviation, pilot teams are able to respond quickly to another approaching aircraft by rapidly accessing information from the long-term memory into their working memory to make better and safer decisions (Wickens, 2002). Relatedly, teams must maintain a similar awareness of their team to, for instance, register and respond to a team member who needs assistance.

Deliberate or Guided Practice? An Anecdote from Eduardo Salas

Many years ago, Anders Ericsson and I were both invited to present our research at a medical conference. He presented first, describing his research on deliberate practice. My presentation followed, focusing on simulation-based team training where I highlighted the importance of guided practice. After our presentations, we realized our areas of research seemed to overlap, although our ideas about how people develop expertise through practice were very different. Anders and I began discussing whether deliberate and guided practice were essentially the same concept or whether there were important differences in the two. I argued that guided practice was distinct from deliberate practice in that guided practice is more flexible than deliberate practice, focusing on teams' ability to adapt their behavior to new or changing circumstances, rather than to perform a task under similar conditions. When Ericsson discusses deliberate practice, he describes it as a solo activity wherein an individual practices a behavior repeatedly; examples include playing a song on the piano or kicking a soccer ball. I argue that guided practice is in fact a little different. In guided practice, a facilitator and trainer, or coach, guides teams through an experience, along the way giving feedback on the precise behaviors and cognitions that matter for effective teamwork. For example, medical teams might practice resuscitating a patient in a simulation center, reviewing footage from practice scenarios with a trained facilitator who can provide feedback. Whereas deliberate practice tends to be geared toward individuals, guided practice is better equipped for building teamwork (and other high-order skills).

In the end, we agreed to disagree, but planned to write a paper together on the topic. We exchanged emails beginning to forge our plans and a few months later met to discuss potential collaboration over drinks at another conference. Anders broke the bad news to me: He had decided against writing a paper together because he wanted to stick to his story. To him, deliberate practice was the single path to developing expertise. Despite our disagreement and the forgone coauthored paper, Anders' work on individual expertise development has continued to shape how I think about team expertise.

Conclusion

In this paper, we summarize decades of research on effective teamwork and team performance into eight principles of expert teams (see Table 1). In doing so, we recognize the great contributions of expertise researchers, such as Anders Ericsson, as well as the opportunities their work led to for teams researchers to expand upon a multilevel consideration of expertise and expert performance.

Table 1. Eight principles of expert teamwork

Expert teams…	Key Findings	Key Citations
1. Develop shared mental models.	• Teams with a shared understanding of goals and surroundings are higher performing • Shared mental models developed deliberately through pre- and de-briefing	Allen et al., 2018; DeChurch & Mesmer-Magnus, 2010
2. Learn and adapt to situational demands.	• Adaptive expertise requires teams to integrate members' knowledge and coordinate actions • Situation awareness is a central requirement for team adaptation	Burke et al., 2006; Smith et al., 1997
3. Have clear roles and responsibilities.	• Teams with clear roles are better able to develop transactive memory systems, a core component of team cognition • Team training can help teams clarify roles and develop transactive memory systems	Hughes et al., 2017; Lewis, 2004
4. Are motivated by a shared vision.	• A shared vision helps provide teams with purpose and direction • Teams with a shared mission are more motivated	Cox et al., 2003
5. Have effective and dynamic team leadership.	• Transformational leaders are better able to provide vision and motivate team members • Servant leaders support their team members by showing empathy and providing backup • Teams may also share leadership responsibilities, and this approach leads to better team performance	Bass, 2000; D'Innocenzo et al., 2016; Judge & Piccolo, 2004
6. Are positive and psychologically safe.	• Team members with collective orientation are better team players • Teams that are psychologically safe are more likely to learn from mistakes and catch errors before they occur	Edmondson, 1999; Salas et al., 2005
7. Cooperate and coordinate.	• Effective coordination promotes alignment between team tasks and member knowledge, skills, and attitudes • Team cooperation facilitates information sharing and the integration of members' expertise	LePine et al., 2008; Marks et al., 2001; Mesmer-Magnus & DeChurch, 2009
8. Are resilient.	• Resilient teams can maintain viability and well-being in the face of disruption	Chapman et al., 2018; Hartwig et al., 2020

One of the most interesting phenomena of expert performance is that as experts reach new heights, the proof that it can be done motivates others to achieve the same level of performance. It took only 46 days for someone to beat the record after Roger Bannister ran the first four-minute mile (Taylor, 2018). Over time, records continue to be broken, and expertise continues to rise above formerly known limits. In effect, experts serve as agents of change for the next

generation. In his lifelong work studying experts, Ericsson changed the way psychologists understand the processes involved in developing expertise and the behaviors required to do so. This work led to countless discoveries, not only in the area of individual expertise, but also in understanding what makes an expert team. As the expert of studying expertise, Ericsson has changed the field and allowed new heights to be reached in team science, where his legacy can be seen across work on developing expert teams for years to come.

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Author's Declarations

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