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# Practice under pressure: what neurology can learn from anaesthesia

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## ABSTRACT

Performing a stressful task under pressure is challenging. Strategies to optimise our training must focus on learning a skill correctly, and then practising that skill sufficiently to avoid compromising that performance in the cauldron of the clinical environment. This article discusses ways of doing things better, based on practical strategies employed in anaesthesia, but developed primarily in elite sport and the military. It involves taking a skill, practising it until it becomes a habit and over time making it part of normal behaviour. The philosophy is simple (but difficult to apply): control what you can control and always do your best. The best summary of this strategy is: learn it right, practise it right, perform it right.

I am a consultant obstetric anaesthetist who has a subspecialty interest in management of patients with a difficult airway. In this clinical domain, skills and decisions often need to be made and performed accurately under significant time pressure. Over the last 10 years, I have tried to develop better ways of training (working with a sports psychologist and an ex-captain in the special forces) so that our performance as clinicians is less likely to be affected by that pressure. Physicians, including neurologists, faced with similar pressures may find the model helpful.

## SCENARIO

**It is the start of a normal operating list. The first patient, a fit healthy mother of two, needs a general anaesthetic. While starting the normal anaesthetic procedure and having paralysed the patient, there is difficulty oxygenating her with bag and mask. The anaesthetist attempts to intubate her but cannot see any normal anatomy. There is a real struggle to oxygenate the patient as her oxygen saturation becomes critical—she is dying. . ..**

A straightforward skill in a highly pressured environment. How do we ensure that we do the best job that is possible? Many think of safety as the absence of accidents and incidents. There has been considerable focus in medicine of the importance of human factors on medical performance.[1 2] Our usual approach aims to ensure that as few things as possible go wrong. In this paper, I focus on a different approach: *ensuring as many things as possible go right*.[3]

The preparation for this event might be summarised as:

1. Learn it right
2. Practise it right
3. Perform it right

### Learn it right

Thinking is slow, effortful and uncertain. We find successful thinking pleasurable because of the link between long-term memory and working memory. The critical thinking involved in improving subsequent performance is tied to background knowledge, both physical and cognitive.

The simplest model of the mind considers working memory as a bridge or bottleneck between long-term semantic and procedural memory and the output or skill; this has implications for learning teaching and performance. In the 1950s, Miller proposed[4] that at any one moment you could only remember 5–9 (7±2) elements of information as a measure of working memory: interestingly, this is in keeping with the original limit on the number of digits in telephone numbers. In 2000, studies reduced the number of

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**Box 1 Ingredients for learning and performing a skill successfully under pressure**

1. Learn the right thing (to have the right knowledge)
2. Practise the right thing, noting the four components of practice:
   a. Physical
   b. Cognitive
   c. Practising with teams
   d. Decision making
3. Understand the working memory model and how stress affects its function
4. Have the correct equipment
5. Perform the skill: there is no point in practising a skill if we cannot perform it in the environment where that skill is required
6. Sleep

**Box 2 Some of the subskills required for lumbar puncture**

Learn the anatomy (beforehand)
Understand the pharmacology of what we are doing (beforehand)
Know how to set your tray up for the lumbar puncture in such a way that it is very difficult to make a mistake, so that the skill flows
Ensure that we can manage ourselves and our emotions when we are struggling to get that particular spinal needle in ('what ifs')
Understand the function of the needle (pencil point or Quinke, needle length, introducer: how do these features map to the patient's anatomy, etc)
Know how to manage the stressed patient
Optimise the function of our assistants
Use appropriate sterile technique
Know of various collection techniques
Know and understand the possible complications

items in working memory from 7 to 4.[5] This number decreases further when we are under stress.

So what is the working memory a bottleneck between? Well, it is a bottleneck between our performance of a skill (eg, cannulation/spotting a sick patient/assessing acute stroke/intubation) and our long-term memory. The *function* of the model is determined by the content we put into our long-term memory. Experts are much better at performing particular skills than novices because of the huge volumes of information held in their long-term memory, ensuring they can work quicker and are less affected by the damaging effects of stress.[6 7]

So if we are 'learning it right', what do we learn, how much should we learn and why do we not learn? When I qualified in 1986, the mantra was, 'See one, do one, teach one'. I was advised, *'If you're not sure what you're doing, put on a mask of relaxed brilliance'*. The reality is that the job that we do can be incredibly stressful, and that stress can completely mar the successful performance and outcome of a skill.

As professionals. we must consider how to improve our performance. Our patients can reasonably expect our performance to be selfless, skillful and trustworthy. Maintaining these three components requires discipline, commitment and vigilance.

Focusing on the working memory box, consider what information or knowledge we should put in it when learning and teaching. Here, we must distinguish between inflexible content and rote learning. A nice example of rote learning is a 7-year-old's definition of 'equator' as *'a menagerie lion running around the Earth through Africa'*.[8]

A more benign cousin to rote knowledge is what I would call 'inflexible' knowledge. On the surface it may appear rote, but it's not. And, it's absolutely vital to students' education: inflexible knowledge seems to be the unavoidable foundation of expertise, including that part of expertise that enables individuals to solve novel problems by applying existing knowledge to new situations—sometimes known popularly as 'problem-solving' skills.[9]

It is worth asking ourselves what kind of knowledge do we want? Do we want knowledge with deep understanding or superficial knowledge that we can just parrot?

It is interesting to consider certain skills that we may not do as well as we might. For example, how well do we tie our shoelaces? The purpose of a correctly tied shoelace is to stay tied. Some of us tie our laces correctly (reef knot) while others tie them incorrectly (slip knot), almost certainly based on the technique taught as a child.[10] In clinical practice, this may manifest as performing an important skill incorrectly, without even knowing it is incorrect.[11]

### Practise it right

*Having learnt it right, we must then practise it right.*

If we think how anyone became really good at performing any skill, the word that first comes to mind is *practice*, but it is more nuanced than that (see box 1).

The aim is to take a skill, practise it appropriately and deliberately so that it becomes a habit; as we embed that practice over many years, it starts to become part of our behaviour (mastery). Anders Ericsson,[12] a retired professor of expertise who has spent his life looking at how experts become experts, describes five steps to mastery:

1. Practise deliberately (see below)
2. Repeat, repeat, repeat
3. Seek constant critical feedback
4. Focus ruthlessly on where you need help and where you can improve

5. Prepare for the process to be mentally and physically exhausting

In order to 'practise it right', I divide 'practice' into its four components: physical, cognitive, teamwork and decision making/planning.

Putting the four together, let us start to develop context-specific training. Ericsson[12] considers that becoming an expert requires 4 hours of practice a day, 250 days a year for 10 years. Syed[13] summarised this as 'The ten-thousand-hour rule'.

My personal philosophy around learning skills and performing them well is simply stated but difficult to follow:

"*Control what you can control, then do your best*".

### Physical practice

In reality, we do not always control what we can control. Consider cannulation technique—the ergonomics of successful cannulation are often not considered as part of the skill. How many doctors kneel down to cannulate a patient? And if they fail to cannulate successfully, do they blame the failure on the patient or do they blame it on not having optimised their environment?

So how can we embed deliberate practice as part of our job? Deliberate practice has a purpose, which is to ensure that our practice is focussed on improving subsequent performance. A challenge that I set for myself and my trainees: can they insert 30 cannulae successfully in a row, without making a mistake? Every time they make a mistake, their count goes back again to zero. The process of continually trying to improve our performance enables improvement of our success rate and is true reflective practice.

In order to improve our practice, we need feedback, and that feedback ideally should be objective: video assessment is especially useful. As we improve at something, we need to set goals beyond our current levels of performance in order to continue improving. Once we get good at something, how do we maintain that skill? The aim should be to develop automaticity. Consider a skilled batsman's ability to find gaps in a well-set cricket pitch—he did not start by learning how to hit in a particular direction, he started by learning how to hit the ball (inflexible knowledge). Then, he hits thousands and thousands of balls, before moving on to tailor the accuracy of those particular shots. So how can we practise as clinicians? We can use simulator laboratories to practise both physically and cognitively. I have designed both low-fidelity and high-fidelity scenarios to improve the automaticity of those skills, without harming patients. Additionally, it is possible to use point-of-view video glasses in a clinical scenario (with appropriate consent) to video both performer view and assessor view. Such footage improves the objectivity and feedback (or feed-forward) that we can give to our students.[14] As a clinical supervisor, I have learnt three interpretations of video evaluation that may be completely different:

- The performer's point of view
- The assessor's point of view
- What actually happened (video)

### Cognitive practice

Cognitive practice also comprises three separate skills: practising visualisation, practising the 'what ifs?' and practising under stress (stress management).

A. *Practising visualisation* involves a cognitive walk through of the skill before performing it. As Cliff Reid[15] says, *'We have the most sophisticated, 3D, high fidelity, all immersive simulator in the known universe…in our head'*. For visualisation to be useful, we have to use the skill and practise it.
B. *Practising the 'what ifs'* might involve asking oneself, "What if this happens?…I'll do this, aah *but can I do this?*" An example of such an internal conversation might be: what if the patient has a cardiac arrest?…..(Well I know CPR)…..can I put in a cannula? (yes, but I'm not very good)…I need to call for help (where is my help?)…and so on.

The problem is that we do not all have 10 000 hours to become experts at everything: so can we refine this process? Kaufman[16] suggests that there are 10 useful basic principles. All are worth considering but I shall focus on only two.

*'Focus your energy on one skill at a time'—multitasking is a myth.*[17] One of the most stubbornly persistent phenomena of the mind is that when you do two things at once, you do neither of them as well as when you do them one at a time. Our brains are just not wired to multitask well. When people think they are multitasking, they are actually just switching from one task to another very rapidly, and every time they do that there is a cognitive cost. So focus on one skill at a time!

*'Deconstruct skills into subskills'*. When trying to teach someone how to perform a particular skill, we often find that individual skills have too many components to fit into the working memory. For example, imagine performing a lumbar puncture on a 14-year-old who is terrified and unwell. If we teach this skill in its entirety to a novice, the learner's working memory will become rapidly overwhelmed and almost certainly they will fail the task. So we need to divide such skills into subskills (see box 2).

Breaking the skill into separate subskills makes it easier to learn and subsequently to perform. Some subskills overlap with other scenarios (particularly the 'manage yourself' and 'manage your patient' subskills, which are relevant to all skills that involve patients).

*The importance of accurate inflexible content*

In the past, I would teach as follows: first, 'do this, because of this'; second, 'do this, because of this' and third, 'do this, because of this'. By the time I had got to number three, the learner had forgotten what number one was. What I do now is to teach the inflexible content first. For example, when teaching fibre optic intubation, I brief the learners as follows: "I'm going to teach you *five* things and until you have learnt those five things and can do them, I am not even teaching you *why* there are five things or why those five things are important."

C. Practising under stress (stress management)

In practical terms, using accurate inflexible content teaches the learner the skill quicker (on manikins). That successful performance then maps to a successful performance on the patient. However, as the instructor increases the stress of the trainees' working environment, failure creeps in. I allow trainees to practise on manikins until they can do the skill smoothly, then pressure them to do the same skill quickly on manikins, then perform the same skills smoothly on patients; once they can do this I just say that I am timing them to see the effect of time pressure (if any) on their performance.

When I ask learners *why* they failed, they say, 'It's because you stressed me'. As an instructor. I can then objectively demonstrate to them it was because they did not perform one or more of those inflexible components of success.

Teamwork practice

The third component of 'Practise' is practising in teams. This is very important in terms of optimising the human factors, minimising mistakes and ensuring that we work from the same script.

Some of the simple things we can do at work in terms of improving our personal and team performance revolve around avoiding being hungry, angry, late or tired (HALT). As a leader, we may optimise our colleagues' performances but may ignore/compromise our own. So we should teach our team to monitor our performance.

Decision-making practice

So what else can you practise? Try to answer this question in 10 seconds:

A bat and a ball together costs £1.10. The bat costs £1 more than the ball. How much does the ball cost?

I suspect that most of you answered 10 p, an answer on second thoughts that is obviously wrong (if the ball cost 10 p and the bat costs £1.00 more than the ball, then the bat would cost £1.10, giving a grand total of £1.20). So your first decision is fast, but wrong; hopefully your second is slower but correct. This example is taken from Kahneman and Tversky in 'Thinking Fast and Slow'.[18] They summarise the two decision-making processes into a fast, gut process (System 1), which is very energy efficient, and a slow cortical process (System 2), which is much more energy sapping. We probably make thousands of decisions every day and if we made them all using our cortex, the significant cognitive processing involved would drain all your energy resources. It is not that one system is good and the other is bad, they are just different. Being aware of the way that these different systems work ensures that we can develop the potential to optimise our decision making, even just by considering our decision making as a skill that can be honed and improved (see 'what ifs' above).

Experts probably have a slightly different approach to decision making in that they use an accelerated slow process. Their ability to use pattern recognition with the large quantities of data and schemata in their long-term memory enables them to make rapid and often accurate decisions in the complex environments they have expertise in. It also makes them vulnerable to bias.[19]

## At work

So, how can we embed this practice in our daily work? Start by thinking about our thinking. For skills that we carry out a lot, develop automaticity. From my perspective, a good example of this is the neurological examination, which, when performed by an experienced neurologist, is a thing of beauty; performed by an anaesthetist it is clunky and slow (or absent). Additionally, the cognitive processing power required actually to use the data provided by the examination is compromised.

It is useful to embed the rule of 30 into our clinical skills: trying to perform the skill 30 times in a row without making a mistake.

We should mentally rehearse our day on the night before or that morning. When doing a particularly difficult case (and this is where I find System 2 thinking especially relevant), I write down the case as if it were a long case in an exam. This helps to ensure I do not omit certain tests that I wanted to do and will maximise the performance of skills that I want to perform well.

Additionally, we should stress test our thinking and perform what Klein[19] calls *premortem or prospective hindsight:* assume that the worst thing that could have happened to that patient *has* happened to that patient; we then fast-forward 1 month and have an imaginary discussion with the coroner (using visualisation again). We will say, "I did this because…". Now,

if we are still happy with our decision, then carry on; but if we are not, then reconsider.

### Perform it right

#### Equipment

Team Sky Bradley Wiggins' bike (for the hour record) had one gear, no brakes and one purpose—it was designed to go as fast and far as possible for an hour. Expensive but totally fit for purpose. Contrast that with an example from the National Health Service: a pair of needle holders was provided to a labour ward that did not actually grip the needle used when sewing up episiotomies, thwarting the midwives' attempts to sew the incisions.

#### Sleep

Sleep is the single biggest performance enhancing agent. Shift work and long hours combined with worrying about clinical and non-clinical work will compromise performance. Littlehales describes some strategies to optimise sleep.[20]

## CONCLUSION

So what can we improve in our jobs and lives? Well, there are lots of things that we can improve in terms of marginal gains. We can look at the way we plan our day; we can approach details appropriately and attend to them and we can look at the controllable factors and look at how we identify them and control them. We can analyse data, look at logic over emotion and process over outcome. We can improve the way that we train and are trained and can improve our equipment. If we improve just 1% in all of those factors overall, we can improve our learning, our practice and our performance, leading to enhanced care of our patients.

To summarise, if we learn it right and practise it right, we are much more likely to perform it right. The take-home message beautifully summarised by Peter Doolittle on TED[21] is:

"The message from a working memory capacity standpoint is this—what we process we learn. If we're not processing life we're not living it. Live life".

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### Key points

- Control what you can control and do your best
- Learn it right
- Practise it right
- Perform it right



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