A Good Pair of Hands
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Abstract

Background: Skilled surgeons and talented trainees are often said to have ‘a good pair of hands’. What does having a ‘good pair of hands’ mean to orthopaedic surgeons? What attributes are required for surgeons to have a ‘good pair of hands’, and can they be taught?

Methodology: Grounded theory methodology was used to study the qualitative nature of the meaning of a ‘good pair of hands’. This generated an explanatory theory about the meaning of a ‘good pair of hands’.

Results and Discussion: Despite myths that some surgeons are born with a ‘good pair of hands’ it is evident from this study that the surgeons do not believe this. In line with Expertise-theory, attaining and maintaining a ‘good pair of hands’ relies on sustained deliberate practice. In an environment where clinical opportunities to gain experience rapidly are decreasing, the use of simulation may help enable deliberate practice, with a progression of the challenge-point as experience increases. Using principles of social learning theory, good trainers can provide decreasing levels of support or ‘scaffolding’ and appropriate feedback to facilitate this. Trainees can learn to have the attributes of good surgeons; they plan operations thoroughly beforehand and prepare their patients, teams and themselves; everything feels familiar, so operations flow seamlessly with good progression. They have good three-dimensional awareness of tissue planes and likely hazards in their path. Their operative-technique is definite, well-paced, ordered and logical, using sharp dissection with a knife. Based on social learning theory there are several ways that trainers could help surgeons develop a good pair of hands; these are discussed.

Introduction and Background

The ultimate accolade for a surgeon is to be judged by their peers as having ‘a good pair of hands’. This familiar term is often used to describe an excellent, gifted trainee or colleague. A surgeon with a ‘good pair of hands’ is one that doctors would recommend to their friends and relatives, or choose for their own treatment. It is also used of a trainee who shows promise, with no concerns about their operative ability or progress. Having a ‘good pair of hands’ is a highly desirable quality, at the heart of what it is to be a surgeon.

Historical perspective

‘The conditions to be met by all surgeons ...
First, he must be educated
Second, he must be deft
Third, he should be ingenious,
Fourth, he must be indulgent’
Guy de Chauliac, Chirugia Magna, 1363
Guy de Chauliac, the ‘father of modern surgery’ popularised the use of the word ‘Surgery’, in the fourteenth century; derived ‘from Cheir, meaning hand, and ergeia, meaning operation.’ ¹ His treatise, Chirurgia magna, reflects a holistic concept and characterisation of what it is to ‘be a surgeon’ rather than to ‘do surgery’. In addition to the knowledge and attitudes of a good physician, de Chauliac emphasised the importance of surgeons being deft and skilful, with slim fingers and strong hands’ ¹.

Sir Robert Jones, the founder of modern orthopaedic surgery in the last century was renowned to be an excellent surgeon, regularly performing 20 orthopaedic cases on his operating list each week ², ³. William Mayo described Sir Robert Jones’ surgical expertise; “He is expeditious, yet neglects not the smallest detail, and his wonderful experience enables him to do wizard-like operations with a precision which is startling” ⁴. Others described how Sir Robert Jones’s hands ‘seemed to become almost plastic and almost to blend with the material on which they were working’ ⁵.

A ‘good pair of hands’ may mean different things to different people; it could refer to de Chauliac’s ‘slim fingers and strong hands’¹, or an artist’s creativity, a musician’s fine motor skills, a juggler’s coordination, or a magician’s sleight-of-hand. Some relate the phrase to craftsmanship; working skilfully with tools like a carpenter, or with bare-hands like a potter. Others may visualise the safe pair of hands of a professional rugby player, or airline pilot, or the confidence and charisma of an assured actor.

Apprenticeship versus competence-based training

‘In many places they would ask students to write an essay on the origin of the word shoelace, or give them a multiple choice question on the design of shoelaces, or even ask them to describe the steps in tying a shoelace.

Whereas really the only way of doing it is showing you know how to tie a shoelace.

R Harden, 2012 ⁶

The concept of a ‘good pair of hands’ relates to the questions what are the attributes of a good surgeon and what defines a competent surgeon. When questioned, master surgeons agreed that the important factors for competence in surgeons are, firstly, cognitive factors, then personality factors, then dexterity, although all three domains were thought to be important⁷. However, technical-competence was more determined by dexterity, than personality or cognition⁷. This contrasts with Schueneman⁸ who found that in General Surgery, psychomotor skill is not the biggest determinant of surgical performance; non-verbal, visio-spatial problem-solving abilities were more important. This may be different for Orthopaedics, but this has not been specifically assessed.

Traditionally surgeons have passed on their craft using the apprenticeship model (although the efficacy of this model is disputed by some who highlight differences between traditional apprentices and trainee surgeons)⁹. In the last twenty years, social changes inside and outside surgery mean that the traditional model of apprenticeship has become less easy to apply and this has affected surgical training. Objective standardised assessments have been
developed to assess a wide range of competencies, delivered through a network of assigned educational supervisors, clinical supervisors and annual review of competency progression (ARCP) by a panel. Detailed curricula are formally approved and published by the General Medical Council and regularly updated with specific competency levels for various aspects of surgeons’ practices.

The advantage of assessing a competency is that it can be measurable; potentially this makes it legally and publicly defensible. Many studies have attempted to find a way to define and assess competence and competency. Arora et al. found that surgical trainees have different perceptions from their trainers on the importance of the roles required to be a competent surgeon.

The notion of competence is being more critically examined now, with particular relevance to surgical education. Lingard argues that ‘competence’ has become a ‘god term’, and that this has been given a status which is now not questioned. She suggests that, through repeated use and familiarity, such ‘god-terms’ become suggestive of a natural, universal and inevitable order of reality. She highlights the danger that these ‘god-terms’ are assumed to reflect reality, however, such a term may select, or even potentially deflect from, reality, hiding important truths. Lingard emphasises the need to continually question and revise what is meant by competence, and recognise the limitations of aiming for standardised competence as the ultimate goal. She stresses that while competence is an individualist term, clinicians work in teams that may consist of competent individuals, yet not work as a competent team. Indeed, some competent teams may be affected by an incompetent individual.

Hodges also demonstrates that competence is a shifting concept that changes over time, according to discourse. DeCossart and Fish emphasise the essential difference between ‘competence’ and ‘competency’; ‘competence’ being a holistic statement about a person, ‘competency’ being one aspect of their ability to perform a task, assessed at one point in time.

Zibrowski found that the individual assessments of competencies detract from the overall assessment and concept of competence; trainees viewed individual competencies as being mutually exclusive. Others stress the inherent danger of the sum of the parts (competencies) adding up to less than the whole (competence). Kneebone warns of the danger in stripping down skills into their component parts (which he calls ‘simplification’) losing the complexity of human unpredictability as an immeasurable requirement for competence. Recent events reported in UK media have highlighted the danger of having signed-off competencies, but not having a holistic approach; in particular, lack of compassionate care highlighted in the Francis report. The distinction between confidence and competence is also very important; the former does not necessarily follow the latter. A preoccupation with competence is bought at the expense of professionalism, and the ‘tick-box’ evaluation of different competencies is not always appropriate for assessment of professionals.
Craftsmanship

‘every tool has two ends,
one working on the material,
the other on the man’
Halsham, 1907

There has been a resurgence in the concept of Craftsmanship, which ‘has become fashionable again’. This has been promoted by authors, sociologists and philosophers re-emphasising the worth of manual and technical skills. For example, Crawford’s best-selling book makes ‘the case for working with your hands, (or why office work is bad for us and fixing things feels good)’. Sudnow, a social anthropologist, explores this through his own experience learning to play jazz-piano in his book; Ways of the Hands. His detailed classic description of skill development uncovered many of the processes involved in developing a complex motor skill. Within modern Craftsmanship literature there is a movement away from a romanticised, idealistic view of craftsmen who lived in a bygone golden age. Instead there is a real sense of a community of practice of craftsmen; part of craftsmanship is to comprehend, and be able to work with the in-built character and properties of the material. This is reflected in Mayo’s description of seeing Robert Jones at work.

This ‘desire to do a job well for its own sake’ is proposed as a template for living. In the healthcare context Dornan notes that Sennett identified that ‘good (Craftsman-like) work …focus on relationships’ and contrasts this with other ways of working, such as ‘Fordism’, which devalues ‘illogical’ tacit-knowledge; ‘listening ‘to old men’s chatter’ that allows health professionals to ‘glean clues that might escape a diagnostic checklist’ is not encouraged’. These holistic characterisations of Craftsmanship contrast with an atomistic competency-based approach which is replacing the traditional Apprenticeship based model. This has important implications for improving surgical skill; some aspects of surgical practice exist among the surgical community as shared understandings (e.g. a ‘good pair of hands’) and may be used by practitioners to informal evaluate surgical competence, which resists objective measurement.

Many surgeons recall training with Sir Robert Jones in an Apprenticeship training. There is great value of having a Master, with years of experience, work with, and observe an Apprentice. Having supervised many trainees, the Master is in an excellent position to make judgements about the current knowledge, skills and attitudes of a trainee, and be a mentor. Master surgeons soon understand if a Trainee has potential; i.e. are they trainable? This assessment of ‘potential’ is not a quantity that can be effectively assessed by objective measures of competence.

The objective of this study is to explore and understand the concept of ‘a good pair of hands’ amongst current trauma and orthopaedic surgeons. How might shared internal characterisations and definitions of surgical skill and competence inform objective measures of such skills? Learning how surgeons characterise a ‘good pair of hands’
has important potential implications for improved evaluation and development of surgical skill. A literature review demonstrated that there are no published scientific articles on this topic.

Research questions
Primary aim: to illuminate the meaning of a ‘good pair of hands’ to Orthopaedic Surgeons.
Secondary aims: to show how this understanding will inform a better learning and assessment of operative skills in Trauma and Orthopaedics.

Methodology
Surgical education, particularly in the operating theatre, involves the social interaction of trainees and trainers despite the practical nature of our speciality. To establish in-depth understanding of a potentially complex concept requires a qualitative study method to answer an ontological question (philosophical study of the nature of being, existence, or reality). These methods may be unfamiliar to orthopaedic surgeons as the vast majority of research in orthopaedics is quantitative.

I conducted semi-structured interviews with consultant trauma and orthopaedic surgeons who are trainers. Qualitative techniques were chosen over quantitative methods as the topic is informed by shared meanings and understandings. Consequently, it is less amenable to stipulative-like categories which typically characterise a quantitative approach. The purpose of exploring these shared meanings of what constitutes ‘a good pair of hands’ is to see in the ways this could potentially inform surgical practice, training and assessing surgical trainees.

I used Grounded Theory, ‘a systematic, inductive and comparative approach for conducting enquiry for the purpose of constructing theory’ about social patterns. It emerged as a method of generating a theory from research, ‘grounded’ in the data. Its purpose is to reflect the real world, rather than test abstract concepts in an idealised world-model. This is based on the work that was originally developed by Glaser and Strauss which others have subsequently refined and revised.

There are very few Grounded Theory studies published in Trauma and Orthopaedics such as a study on the experience of surgeons using PACS systems. However, this methodology has the potential to allow the authentic voice of the participant to be heard. Glaser and Strauss stated that Grounded Theory is ‘derived from data and illustrated by characteristic examples of data’. It involves on-going collection, interpretation, verification and conceptualisation as the data are collected, differentiating it from other research methodologies.

Semi-structured interviews inevitably provide after-the-event accounts of experiences, or hypothetical scenarios, whilst I sought to ground the research in the real world. Data may be distorted by recall error, or ‘reconstructed’ by participants for various reasons. Bias may arise owing to the participants’ desire to please interviewers, or other
motivations. The main alternative approach considered was an observational method, which offers direct information about behaviours, but less about experiences and descriptions of shared understandings and meanings. Observational methods may also be biased by the ‘Hawthorne effect’ whereby awareness of being watched, changes the behaviour of those observed. Interviews were chosen over observation because of their advantages of time-efficient gathering of rich data about experiences and behaviour; these advantages were felt to outweigh their limitations.

Participant selection
In line with Grounded Theory, purposeful sampling was performed, selecting trainers in Trauma and Orthopaedics whom I felt had a ‘good pair of hands’, and who thought deeply about teaching and assessing operative skills. Grounded Theory requires a small number of interviews representing authentic views of participants until ‘saturation’ of the theory is achieved. The aim was also for as much variety as possible within the subspecialty (Table 1).

Table 1 - Participants

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<thead>
<tr>
<th>Subspecialty</th>
<th>Hospital</th>
<th>Practice</th>
<th>Gender</th>
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<tr>
<td>Tumour</td>
<td>University teaching</td>
<td>Pure elective</td>
<td>Male</td>
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<tr>
<td>Spinal</td>
<td>University teaching</td>
<td>Mixed elective/trauma</td>
<td>Male</td>
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<tr>
<td>Spine, hip &amp; Trauma</td>
<td>District General</td>
<td>Mixed elective/trauma</td>
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<td>Reconstructive</td>
<td>University teaching</td>
<td>Pure Elective</td>
<td>Male</td>
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<tr>
<td>Upper limb</td>
<td>District General</td>
<td>Mixed elective/trauma</td>
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<td>Paediatric</td>
<td>University teaching</td>
<td>Pure elective</td>
<td>Female</td>
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<td>Knee surgeon</td>
<td>District General</td>
<td>Mixed elective Trauma</td>
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<td>Trauma</td>
<td>University teaching</td>
<td>Pure Trauma</td>
<td>Male</td>
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<tr>
<td>Child and young adult</td>
<td>University teaching</td>
<td>Pure elective</td>
<td>Male</td>
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Ethical considerations
The study was approved by Imperial Medical Education Ethics Committee before any interviews were performed or data were collected. Informed consent was given by the participants. Confidentiality was assured and maintained though the storage of data on a secure computer.

Data-analysis
Open-ended, semi-structured interviews were selected as an appropriate method to build understanding of the meaning of a ‘good pair of hands’. These were recorded on digital devices. A semi-structured interview sheet was used to introduce the question, and then explore interviewees’ responses further, basing the questions on positive and negative examples from their experience of observations of teaching and assessing surgeons. Interviews typically were between 25 -45 minutes. From interviews transcripts, recurrent themes were identified codes, categories and concepts were derived that created a conceptual-framework to illuminate the meaning of a ‘good
pair of hands’. These were developed as interviews proceeded, in line with Grounded Theory \(^{31}\), and memos kept to help analyse and conceptualise data and create a conceptual framework.

**Results**

The interviewees demonstrated many different approaches in expressing what a surgeon with ‘a good pair of hands’ meant to them. All drew from personal experiences. Generally, they looked for examples of good surgeons from their own mentors, and occasionally from peers or trainees who they admired. Examples of poor surgeons were generally drawn from less able trainees. Some surgeons referred to aphorisms and quotations from historical figures within and outside surgery; many made comparisons with other disciplines of work, music and sports. Recurring metaphors included the production of a magician’s illusion and travelling on a journey.

On the basis of the emergent themes it was possible to propose the implications for teaching and assessing surgical ability. Overall the initial coding produced 984 lines of coding which was clustered into 198 codes. As the interviews and memos were analysed, various categories emerged (Table 2).

**Table 2 - Categories**

<table>
<thead>
<tr>
<th>‘A good pair of hands’ – categories</th>
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<tr>
<td>Difficult definition</td>
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<td>Nature or nurture</td>
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<tr>
<td>Making difficult things look easy</td>
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<td>The effect</td>
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<td>The Set-up</td>
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<td>The Method</td>
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<td>The Secret</td>
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Difficult definitions

All of the surgeons recognised the term, ‘a good pair of hands’. They were all able to talk about this term freely and had well-developed ideas about the nature of a good operative surgeon. It was clear that this term did have meaning for all, an important notion to surgeons: ‘It’s extremely important to surgeons ...they pride themselves in having good hands’ (GPH9); it was a feature that surgeons were able to identify when it was present in other surgeons, and it was also obvious when it was absent. However, it soon became apparent that although interviewees had difficulty defining this feature, they could recognise it. ‘It’s very difficult to define, and almost immediately you work with a doctor you know if he has good pair of hands or not’ (GPH5)

Nature or Nurture

During the course of early interviews it became clearer why the notion of ‘a good pair of hands’ was difficult to define; a double-meaning emerged, with an inherent conflict of two concepts:

1. The innately-talented individual, born with the gift or natural talent of dexterity, motor control or visio-perceptive skills.
2. The able surgeon, who has acquired the skills, knowledge, and attitudes of a surgeon that means that they know what needs to be achieved and are able to achieve it.

Innate talent - ‘Gifted hands’

All interviewees referred to the definition of a surgeon who was born with a ‘gift’ or ‘natural’ innate ‘talent’ to perform surgery. This concept was usually attributed by interviewees to other people, and surgeons distanced themselves from owning this as their own definition. When surgeons referred to ‘gifted’ individuals, it was considered an exceptional innate quality that only a few surgeons possess. If they felt it did exist, most surgeons believed that only a small percentage of the ability to operate was due to innate ability - often quoted at 10%.

Despite this, most surgeons agreed that having natural dexterity is not an important factor in being a good surgeon. It was suggested that in surgery these people may have had an advantage or head-start over those who were not gifted. There was much more to doing an operation well. A potential negative aspect of a ‘gifted’ individual was that they may be overconfident or ‘Cavalier’ (GPH8) and cover up lack of proper planning with bluff. Conscientiousness was a much more important quality.

This concept of a naturally gifted individual was invariably described as being a myth; none of the surgeons said that they believed in it. However, they felt that it was commonly held by other surgeons and in particular by trainees. Despite the fact that innate talent for surgery was largely regarded as being mythical, there seemed to be general agreement that is a spectrum of some natural abilities, inherited through combinations of genes. This gave people a natural talent that made it easier to perform surgery. These gifts included qualities such as dexterity, coordination, or the ability of perceiving objects better in three dimensions. This idea of a gifted person at one end of an ability spectrum was often compared with sporting ability. Sporting analogies from rowing, hockey, cricket, golf and tennis were used to describe and explain the concept. 'Sportsmen can make something look terribly easy that you know is
remarkably difficult’ (GPH2). Regarding an Olympic rower; ‘I can’t tell you why he is good, but the boat goes faster when he is in it’ (GPH4).

At the other end of the spectrum, surgeons agreed, there were a small percentage of people who were ‘cack-handed’, ‘inept’, or ‘useless with their hands’ (GPH6), and they would never become surgeons. ‘Some people are clumsy and ...won’t be good surgeons...that bottom 10%’ (GPH4). This ‘weeding out’ would occur either through selection processes, i.e. they would not succeed in a surgical career, or by self-selection; they were not motivated to follow a surgical career.

This question of whether a naturally-gifted individual exists was raised by all surgeons. It was suggested that it is difficult to discriminate between innate ability and learned ability (from prior experience). Most interviewees felt that this may be derived, not from their genes, but from life-experiences before reaching surgery. Prior experience could include hobbies and crafts that children did growing up, well before starting surgery; ‘sewing classes’ (GPH2), ‘design technology’ (GPH2), ‘fixing bicycles’ (GPH8), ‘working in a father’s workshop’ (GPH8). This experience could give potential surgeons familiarity with using tools, understanding of how to handle and use tools effectively. Relevant experience also included toys that children played with, growing-up; an interest to ‘play a lot of Lego® from a very young age; you’re more likely to build things with your hands’ (GPH3), and ‘playing with Meccano®’ (GPH9). Relevant experience may also come from sport, providing the ability to value ‘team effort... that dexterity to throw and catch a ball, take a risk’ (GPH7).

Most surgeons agreed that, rather than any innate talent, there are skills that are relevant to the practice of surgery, involving using your hands that were learned before surgical career, (rather than before being born). Two surgeons (GPH4, GPH8) referred to current notions of expertise acquisition35 and specifically referred to Syed’s book ‘Bounce’ which develops the theme of deliberate practice amongst many elite sportsmen, who may have been otherwise attributed with innate talent. Surgeons agreed that this applied to surgical skills too.

The able surgeon - ‘Hands-on experience’

Having largely disputed the definition of ‘a good pair of hands’ as being the direct result of innate talent, all interviewees preferred the definition of the able surgeon; someone who had gained experience and acquired the skills, knowledge, and attitudes of a surgeon; ‘having the demeanour of a surgeon’ (GPH7). This surgeon has a clear vision before and during an operation what needs to be achieved and is able to achieve that aim effectively. The interviewees were more prepared to admit ownership of this definition (rather than the myth of a gifted person).

It was recognised that the majority of people could learn to develop these surgical attributes through sustained deliberate practice. I think that it totally fits with surgery ... that you need to spend 10,000 hours practicing surgery’ (GPH4). Interviewees also acknowledged that inexperienced surgeons all looked like they did not have ‘a good pair of hands’ but that this could be improved with learning. Developing necessary knowledge, skills and attitudes of a surgeon was considered to be difficult and one that did involve a large element of self-selection. The motivation to
do this, being prepared to put in the effort and time was the hallmark of surgeon. Much of this expertise is gained from previous relevant experience outside the operating theatre, sometimes, in childhood. ‘Something we don’t take into account is what people have done before they start learning to be surgeons’ (GPH2) ‘[not sure] whether I learned from my dad, [or] because I have his DNA’, ... ‘I know that there are some things that I do in theatre that I did directly with bits of wood as a kid’ (GPH8).

Other experience could be gained shortly before the surgeon requires operative-skills e.g. learning to slickly tie surgical-knots by practising at home - ‘taking a suture home and doing it around the handle of your beer mug’ (GPH4) a form of simulation. One surgeon, (GPH 9) described how he gained experience of micro-surgery by doing animal-work and placental blood vessel-work during quieter time on-call with spare microscopes. The important part of this learning for him was that it was in a non-stressful environment, with minimal consequences from making errors. By doing this in the hospital laboratory whilst on-call, there was good availability of time, equipment, and tissue.

One of the interviewees (GPH9) also emphasised that the manner of coaching was important, referring to his experience of coaching rowers. Deliberate practice is most effective when getting help from others to improve performance (coaching). Repeated practice alone is not sufficient as one risks repeating the same error time after time. Sometimes previous patterns of behaviour must be taken apart and a new method learned (GPH2). It was also noted that practical skills were not related to general ‘intelligence’.

**Making difficult things look easy**

Operations performed by a surgeon with ‘a good pair of hands’ were universally described as being ‘smooth’ or ‘comfortable’ (GPH1-9). Watching a good surgeon operate, each step appeared to flow and looked effortless. This was described repeatedly as the ability to perform tasks ‘efficiently’, or ‘slickly’, ‘with economy of movement’. This concept of being effortless, smooth and efficient was a recurrent theme. ‘There are some things that are very hard in surgery, and you are at your limits. But you should not be there very often....you want to do things to stay inside your comfort zone’ (GPH9). ‘Making something which is not easy, appear easy’ (GPH3). ‘If you make things easy, they are easy, but it’s hard work making things easy’ (GPH6). This was achieved by the surgeon staying in their ‘comfort zone’ rather than operating at the limits of their ability. An analogy was of driving a fast car and not slowing down for corners; it looks and feels uncomfortable and is harder to keep control.

This reflected the notion that surgeons with ‘a good pair of hands’ made difficult things appear easy. Operations are performed with a straight-forward approach, no repeated steps and without any resistance or encountering any difficulty. This was in contrast to surgeons without good hands who make tasks look difficult and stressful; rather than follow the direct path to a goal. Poor surgeons meet with resistance, took a difficult path, had poor sense of progression, or the wrong approach.
In the same way, sportsmen can ‘read’ a situation and anticipate what is about to happen, appearing to have a magical ability to read the opponent’s mind. It was suggested that they can achieve this by picking-up subconscious clues, using cognitive mechanisms such as ‘chunking’ perceptual information. This creates the illusion of an innate gift; in reality they have well-developed concepts of the process, situation and possible outcomes through experience and practice.

During interviews, this ability of surgeons to make hard things look easy led to the comparison with magicians creating an illusion. With a smooth movement of the hand, good magicians can make a manoeuvre look deceptively simple, so observers miss the complexity of what happened – ‘sleight of hand’. The tricks need to be made explicit to understand what is really happening. What happens during the performance in real time is the result of much more unseen prior work.

From accounts of the great illusionists of the last 100 years, it is evident that there are three essential ingredients that illusionists use to achieve their magic: making them look smooth, comfortable and confident. These are known as ‘the effect’ ‘the set-up’ and ‘the method’:

- ‘The Effect’; a clear idea of how the illusion will look and sequence of events to get there.
- ‘The Set-up’, arranged detailed set-up and preparation; time invested beforehand to enable the illusion to run smoothly and purposefully in real time.
- ‘The Method’, always aware of where they are in a clearly defined series of steps; whilst proceeding through these steps and more importantly what they are about to do next.

**The Effect**

To have ‘a good pair of hands’, it is firstly essential that the surgeon has a clear notion of what they want to achieve. ‘Have worked out what they need to do to make that look good’ (GPH 4). This was compared by some interviewees to starting on a journey, with a route mapped-out and destination in mind or ‘abstract conceptualisation’. This is a cognitive process, and attributed to a person’s ability to see ahead – in the ‘mind’s-eye’ of the surgeon. It was also described as ‘connecting your brain with what you end up with...[like] an artist will have a concept of what he wants to see’ (GPH9). This was attributed to a person’s ability to visualise and grasp a concept. Knowing how to do something, like throw a ball, is something that cannot not necessarily be explained, but felt (GPH8).

There was a comparison that a good surgeon like an artist, carpenter, or sculptor was able to manipulate objects in their minds in three dimensions and conceive the end product. Interviewees believed that good surgeons have a clear notion of what they want to achieve and how they wanted to achieve it. Interestingly most surgeons admitted that this is not something that they often discuss with trainees as much as they should. However, it made it difficult
to assess a trainee, unless you had a clear idea of the concepts they held about what they were planning to achieve. For a good trainee this was made evident and gave the trainer confidence in their abilities.

In planning, good surgeons need to not only visualise the final goal, but could work backwards from that point to visualise what the prior steps should be. One surgeon (GPH8) expanded on this feature of planning to suggest that surgeons may look at the steps of an operation in any order. This ability to play with the order in their mind and visualise the steps in any sequence is vital. Understanding what your final goal is, can determine how to best position the patient, how equipment is arranged, where the incision needs to be, and which instruments are needed. It contrasts with the real-time sequential order of event of an operation. Interviewees made reference to drawing out plans. This could be either literal – ‘on a white-board’ (GPH1) ‘or using pen and paper’ (GPH9), but frequently in the head of the surgeon (GPH3). It is not always explicit about what the plan is or the decision making has been done.

The set-up

There was strong consensus that the key for any good operation, as with a magician’s trick, is in the set-up; i.e. ‘active experimentation’ phase. All surgeons considered that preparation is the vital component to a surgeon with ‘a good pair of hands’. For a good operation, as for a good illusion, it appears that things are happening smoothly and with ease, in real time. Unseen time and effort must be put in place beforehand, setting up a particular mechanism or manoeuvre. Specialist tools and devices are used and refined. Manoeuvres or sequence of steps are rehearsed repeatedly until they become familiar.

The essential role of preparation made up a major part of the discussions. Comfort and familiarity were developed during the set-up. The established surgeons I interviewed confirmed that they read through these textbooks the night before the operation ‘I spent long nights sitting up with text books...far more than I'd ever done as a junior’ (GPH1) and they would expect that the trainees would have done so. Many surgeons also confessed that they did not always make this assumption explicit to their trainees or necessarily admit to their trainees that they had been reading up. ‘Consultants plan more than their trainees are aware of’(GPH2). Others thought that their trainees were aware of their planning, and that they were not embarrassed to take textbooks into theatre.

One surgeon referred to a colleague as not needing to plan before cases; ‘He’s an absolute natural...so he’s not a great planner; he will go in and he will get on and the operation will unfold in front of him quite often’ (GPH7). As this statement seemed so inconsistent with the concepts that were emerging on the importance of planning, I asked this colleague if this was true. He was surprised that he was thought of in this way; ‘Of course I plan – I often spend a long time thinking through, and playing with different ways of doing an operation and read up a lot before some cases’. He conceded that sometimes during an operation, he modifies the plan according what he found during the operation. It was evident that this is flexibility and adaptability within an established and rehearsed repertoire, rather than off-the-cuff extemporising.

Several facets of preparation for an operation were important for a successful surgeon:
• **Familiar Anatomy**

Familiarisation with the anatomy, the relationships of structures within the body is a highly valuable factor in performing an operation with ease. For a good surgeon the anatomy should feel familiar; being in familiar territory gives surgeons a sense of being comfortable.

Familiarity may have developed through doing an operation repeatedly; the territory is well known through repeated experience and is achieved pre-reading anatomical textbooks such as *Extensile exposures* or surgical atlases (GPH7). Most interviewees had spent time in the dissection rooms learning through demonstrating anatomy; a long tradition for surgeons (as is bemoaning the demise of anatomy posts as essential training for surgeons). ‘*Things go wrong when you... haven’t studied the anatomy*’ (GPH7). Similarly, having good working-knowledge of the pathology, and how this affects anatomy, was a sign of a good surgeon.

• **Familiar patient**

Another important factor of good set-up and being comfortable was the surgeon knowing the patient well. ‘*They’ve got to have seen the patients, examined the patients, marked the patients, have spoken to the patient and prepared the patient*’ (GPH7). This essential familiarity was gained via detailed history, and being confident of the diagnosis having confirmed this with thorough examination. Junior surgeons look best-prepared if they have properly prepared the patient. If the trainees had not done this before an operation, trainers did not consider that they were entitled to operate on their patients (GPH1, GPH7).

• **Familiar operation**

Choosing the right operation and ensuring that the expectations are correct is more important than being technically good. ‘*For sure, an inept surgeon doing the right operation would do a great deal better than a slick surgeon doing the wrong operation*’ (GPH6). ‘*The decision about what you do is at least as important as how you execute it*’ (GPH9). This was a consistent theme throughout the interviews. Judging which of the operations a surgeon feels most familiar with, and capable of doing well for that patient, i.e. stay within your comfort zone (GPH5).

• **Familiar theatre-list**

The set-up of the operating list was also important. A good surgeon will have considered the length of the procedure, the time of day that the operation was occurring (GPH2), ensuring that the correct equipment is available on the day, there is sufficient time allocated to do the operation, and the team that you are working with understands how and what is going to happen. This has been a major factor in the reasons behind, and safety improvements associated with implementation of the WHO checklist before surgery can start.

• **Familiar tools**
Orthopaedics does involve tools and implements that have been specifically designed for different steps of an operation. Looking comfortable with the tools of the trade is a hallmark of surgeons with good hands. This familiarity may be though general experience of using tools, outlined above, or specific training on courses, or experience in surgical practice.

- **Familiar environment**
  The environment of the operating theatre also affects the surgeon’s ability to operate smoothly and efficiently (GPH7). Having a different team, anaesthetist, or operating in a different geographic location can affect how smoothly the operation looks and feels.

- **Familiar dangers**
  Anticipation of problems and also preparing possible alternative steps is a key component of the preparation for both magician and surgeon alike. This feature of setup is still considered critical today; ‘What a good surgeon does is anticipate where problems are likely to arise’ (GPH4). There is a belief that if these problems are anticipated then they tend not to happen’ (GPH4). ‘If you see a hole in the road, you almost never fall in that hole, you always fall in the hole you haven’t seen in the road; it’s exactly the same with surgery, so anticipating what the holes are is probably the whole secret.’ (GPH6)

**The Method**

The third key concept is that a surgeon with ‘a good pair of hands’ has a clear idea of the steps within an operation whilst doing the operation (i.e. Schön’s ‘Knowing-in-action’ 45). The phrase *manoeuvre*, from the Latin *Manuoperare* (*Manus* – hand and *operari* – to work) is defined as a movement or series of moves requiring skill and care. A good surgeon knows exactly where the steps are; ‘*a series of rather seamless events*’ (GPH1), or ‘*each milestone*’ (GPH3), or ‘*waypoints*’ (GPH4). A repeated theme was that an able surgeon will make good progress, moving efficiently through the steps, completing each step before moving onto the next. The surgeon knows exactly what needs to be done in each step, and what the next step will be. This was in contrast to a poorly-performing surgeon who appears disorganised and aimless; trainers disliked seeing a surgeon going forwards and backwards, not completing one step, making the next step difficult, and needing to repeat steps.

Trainers can recognise a good trainee whilst observing them through the steps of an operation. Nine features of how surgeons work through these steps that were discussed:

- **First steps**
  At the start of the operation good surgeons complete what may seem like trivial steps such as positioning, preparing the skin and setting up drapes. However, it was a vital requirement, related to the set-up, paying attention to these essential first steps to make the operation easy. ‘*If I don’t position the patient and get them where I want, it’s often a little bit harder ... [if they are not] in a pattern that is familiar to me*’ (GPH4).
‘It’s hard work making things easy; getting the incision in exactly the right spot, positioning the patient exactly right, getting your assistants in the right place’ (GPH6). Doing this well meant the rest of the operation was likely to run easily; several surgeons mentioned that physical positioning of patients made a big difference to how the operation runs. Doing this step well is a sign of a good surgeon.

The next important step (although, not the first step) to making the operation flow smoothly and easily is to ensure that the incision is in the right place. The initial incision is often an indicator of how good the surgeon will be. A method to ensure that this is done well was discussed; ‘I always make them draw the incision [on the skin with a pen]... and assess that their scalpel has cut clean along that line that they have drawn’ (GPH2).

- **Good navigational skills**

  Having started, a good surgeon knows exactly what steps are to be followed and aware where they are up to in the steps. A good surgeon ‘knows exactly what each step of a procedure is going to be’ (GPH2), ‘having a good idea of the stages of it [the operation]’ (GPH9), and ‘a step-by-step progression...way points along the way’ (GPH4). This is a process of recalling the steps in-sequence initially has to be quite effortful, but after some time this becomes a learned pattern.

- **Clear direction**

  It is apparent from the way that a good surgeon operates that they are following a logical sequence with a certain order. ‘Things that are done in a logical stage and done positively – that’s something that looks better, and feels as if the surgeon is more confident’ (GPH9). This gives the observer an indication of the surgeon’s skill. Good surgeons would be able to state the reason for any step or action being performed.

- **Flowing well:**

  Each step is purposeful, and is making good progress. Watching a good surgeon it is evident that ‘every action should have a purpose’ (GPH8). Movements, like those of a skilled craftsman, are efficient ‘a steady flow of purposeful movements with nothing untoward no energy expended that was useless’ (GPH4). Less haste more speed; they will complete one step before moving on to the next. This is an acknowledged marker of experts, described as ‘slowing down when you need to’.

- **Looking ahead:**

  They are aware of what the next step will be, and will be aware of what will be needed. ‘It’s not just what you are doing with your hands, it’s how you’re thinking about the procedure, so thinking ahead and know about what steps come next’ (GPH2). This was summarised as; ‘are they feeling their way or are they leading their way?’ (GPH9).

- **Aware of Danger**
A good surgeon has an accurate three-dimensional awareness of where they are and where other dangers are and what their limitations are. Surgeons who do not have ‘a good pair of hands’ are either unsure of directions or of their surroundings and limitations. Trainers are able to recognise a surgeon who is confident in their operating, reflecting good knowledge of the anatomy, physiology, and pathology that they are treating.

**Sharp dissection**

A recurrent phrase used was that surgeons preferred to see the use of sharp dissection, rather than blunt dissection (with scissors spreading out tissues). Whilst it may be considered that gentle spreading of tissues may be safer, blunt dissection can damage adjacent tissues. The use of the scalpel means that you are confident that you know what you are cutting, and have a clear sense of direction, knowing what can be cut.

**Environmentally friendly**

Care of the soft tissues was often referred to as being an important marker of a surgeon with good hands. This was mentioned by virtually every interviewee as an important sign of a surgeon with ‘a good pair of hands’.

**Attending to all steps:**

There are some steps which are exciting and some which are necessary and boring but that a good surgeon ensures that all steps need to be done well, whereas some poor surgeons are impatient: ‘There’s one part of the operation, that’s either the hard bit, or the critical bit, or the bit that you want to do... and the rush through some of the other bits, so then it’s very unpleasant to do’ (GPH9). This does not mean that all steps have to be effortful; it is known that expertise has routine and adaptive components giving attention to all the steps is another aspect of expertise highlighted by interviewees. Whilst there are certain steps that may be less forgiving and need to have a lot of care, it is important not to focus too much on these steps. These steps tend to hold the attention but it is as important to be attentive to the preceding and sequential steps that will make the critical step possible...‘the work that goes in ....before and after’ is just as important but surgeons may not attend to these steps ‘get fed up and bored by that stage’ (GPH4).

**Surgical secrets**

I deliberately asked ‘Do you think consultants plan more than trainees are aware of before an operation?’...responses ranged from no (GPH5) to ‘yes, I think so’ (GPH1), some surgeons needing to justify why not. It would have been interesting to know whether this was due to a perceived lack of time or unimportance. An alternative explanation is that admitting that this is necessary may be an admission of weakness, or burst the bubble of an omnipotent master. Wishing to appear as a surgeon who has ‘a good pair of hands’ may mean that they would not tell the secret of how much preparation has gone into an ‘effortless performance’, and develop a mystique or magic.
Trainers discussed several ways that they provided feedback, e.g. throughout the operation, through encouragement, afterwards by looking at the results of the operation together and using procedure-based assessments to guide reflective discussion in order to improve surgical-technique. However, none of the surgeons mentioned specifically how they would encourage trainees to review or reflect on their performance – the phase that Kolb (1984) called ‘reflective observation’.

Finally, it was noted that in a perfect idealised world every operation would be done perfectly; every time the operation would proceed according to predictable rules. In the real world it is evident that not everyone does operate perfectly well, with a surgeon demonstrating a perfect pair of hands the whole time. In any walk of life it is accepted that perfection is an ideal to strive for, but in the real world this is a rare occurrence. This was neatly summarised by one of the interviewees – ‘A hole in one is a nice way to play golf but that’s not the way you do it’ (GPH8). This led to the discussion that operations do have tolerances. Some surgeons admitted that surgery is not as hard as it is perceived to be, and perhaps this is the unspoken secret of surgeons. It became evident that most aspects of operating are not considered that difficult by most surgeons and, in fact, that it must be humanly possible. If an operation was technically too difficult for most surgeons then it would not be done.

Discussion

Implications from this study

There are six main findings from this study of the meaning of a ‘good pair of hands’ that have implications for recruitment, learning and assessment in orthopaedic surgery.

A surgeon with a ‘good pair of hands’:

1. Is not born, but made
2. May bring relevant experience from life prior to being a surgeon
3. Understands their operative ability relative to the task
4. Depends upon Planning, Preparation, and Performance to make operations look easy
5. Can be judged using an assessment in practice using narrative feedback
6. Will learn best in a community of practice

1. Not born, but made

The interviews reflected research literature that the surgeon with a naturally gifted pair of hands is a myth, but there is a spectrum of ability amongst individuals, and this forms a foundation to build upon. This can be enhanced, developed, or compensated for, with sustained deliberate practice in line with Expertise research. Accordingly we should reconsider our selection processes for surgery to identify those individuals who have the motivation for sustained deliberate practice, (rather than those who have just jumped through the right hoops). With more limited clinical exposure we will need to develop the learning tools to enable deliberate practice, using simulation to gain early experience, with good coaching methodology and feedback to allow sustained improvement.
2. Prior relevant experience

Surgeons bring with them a range of prior relevant experience, from childhood studies and hobbies. Many people with previous relevant practical skills through internal motivation will self-select to practical subjects such as surgery; however, others undertake surgery owing to external motivators, and may be less appropriately experienced. With the variation in previous practical skill, specific basic training may be required to enable them to become familiar with handling tools (e.g. how much to tighten a screw or how best grip a hammer to deliver the correct force).

Lessons can be taken from of the craftsmanship literature, as described by Sennett 29, Frayling 26 and others. For example a Chinese cleaver chef must first learn to cleave a grain of rice. This ‘simple’ task takes practiced skill to apply the correct amount of force, and direct the cleaver accurately, whilst releasing power precisely 29. This may be helped by providing tool-use workshops. An example discussed (GPH8) was of an Orthopaedic playground (play being a good way to learn29) where different principles of using tools can be explored. This has been developed by Gautier in the AO Foundation’s training courses for surgeons 53.

Orthopaedic ‘boot-camps’ have been successfully instigated to give novice surgeons the opportunity to hone essential skills through repeated deliberate practice. These are effective in learning suturing and knot-tying 54 producing levels of skill equivalent to a year in clinical practice. An orthopaedic boot-camp can be effective for residents to quickly acquire and develop skills 55 and retain them 56. It has enabled junior residents to operate at the level of senior residents 56, and is most effective when student-led rather than instructor-led 57; most likely because students can set their own pace and revisit areas where further deliberate practice is needed.

Whilst these primers for surgeons are helpful in gaining a practical understanding, there is a danger in isolating the assessment of a competency in a simulation environment stripped away from the complexities of the real world; described as ‘simplification’23. This approach can interfere with deep understanding, recommending that any simulation should be performed in a more complex environment 23; realism and complexity can be built into later stages of applying these basic skills. There is an optimum ‘challenge-point’ 58 where the learning-potential relates to the skill-level of the surgeon, the complexity of the task and the environment. Finding the correct ‘challenge-point’ will enable surgeons to gain maximum motor learning and develop good hands.

3. Range of operative ability and operation’s tolerance

In understanding the meaning of ‘a good pair of hands’ in the real-world, the interviews unveiled concepts about the range of operative skill of a surgeon and range of tolerances (or demand) of any operation.
For a population there will be a rank order of surgical-ability. The range of surgical-ability within a surgeon’s repertoire will increase with increasing rank order and there is a minimum level of surgical-ability required in order to perform operations (Figure 1, shown in green).

![Figure 1 Rank surgical ability](image)

Operations will also vary in the tolerance, or demand, according to how perfectly they must be done; how much maximum skill is required to achieve satisfactory results. Some operations will be so demanding, or have such little tolerances that even the best surgeons cannot consistently do them: (Figure 2, shown in red).

![Figure 2 Surgical ability versus operative challenge](image)

According to Expertise theory it is possible with deliberate practice to increase the range of surgical-skills, i.e. move surgical ability to the right. The surgeon’s aim is to make the operative challenge as easy (as far left) as possible, creating a comfortable buffer-zone between the range of skills available, and skills required (i.e. their comfort-zone). This is achieved by the planning, mental rehearsal, and prior practice.

A good surgeon will also be aware of their position on the skill-scale and know their limits, and select an appropriate operation.
4. The importance of planning, preparation and performance

**Setting out a plan**

A key finding was the extent to which planning and preparation are important in making an operation look smooth and effortless. Trainers can help trainees by being more open about how and how much they plan for an operation. They could encourage the use of mental rehearsal to plan all the steps before an operation. The trainer should ensure that the trainee has a clear goal and image of what is to be achieved, through explicit discussion of the intended operative plan, the goal and steps beforehand. This will also aid assessment, as the trainer will be able to gauge the extent trainees are doing what they had just agreed to do.

Using educational theory, one surgeon (GPH8) suggested that practical skills-teaching may also be improved by changing the current structure of a teaching session; learning by first just doing the practical, then going through the theory (rather than first having the traditional introductory lecture, or Peyton 4-step technique\(^59\)). Having done the practical skill without understanding it, the theory will be more relevant and easier to apply. This is a form of reflection-in-action\(^60\) - understanding principles. Having done the task, the may be a more natural way of learning; the way that apprenticeships used to work. (GPH8) had observed that more experienced surgeons may only need to pick up certain steps and will gain more from watching a colleague, having had some experience, knowing what the difficulty is and seeing how other people perform the step (‘tricks of the trade’). They may not need any explanation, as they already are on the cusp of learning.

**Planning surgical steps**

Surgeons should consider how they lay out their plans. A surgeon interviewed noted that when he asked trainees to set out a plan of the steps on an operation, they universally set them out in the order that they would do them in real-time. He suggested that a better way would be to plan these steps in reverse, starting from the endpoint to understand what steps are required. (Figure 3)
a. Starting at the lower (darker) plane, the goal is to move to the upper (lighter) plane.

b. There are a number of steps that can be used,

c. Using these steps in the order they present will not necessarily achieve the goal.
d. Using these same steps...

e. ...but starting from the goal and working backwards...

f. ...means that the goal can be achieved and some steps may not be needed
Making seamless progression through steps

Whilst performing operations with a series of steps, a good surgeon is characterised by smooth transitions, progressing through all the necessary steps fully and efficiently. It is also helpful to understand that there may be an exciting step that the surgeon is impatient to perform, but fully completing every step in a logical order will make that difficult step, easier. Not every operation needs to be broken down by cognitive task analysis into its indivisible parts, but surgeons should be aware of what has been completed, and what is coming next. Schmidt and colleagues proposed that there are two methods of solving problems in practice; a rapid, non-analytical method for the majority of problems, and for the minority of problems, a slower, analytical approach. Expressed in another way ‘when things are proceeding normally, experts don’t solve problems and don’t make decisions; they do what normally works’.

Clinical expertise involves the accumulation of information from literature and clinical experience of patients. This information is then classified and organised and can be applied as a ‘script’ to a recognised scenario. This experienced-based pattern recognition, using heuristics has been described as non-analytical reasoning. They suggest that clinical teachers recognise its importance, and strengthen its use through the learning of multiple examples, gained from deliberate experience. However, forward reasoning is only one approach, and backward reasoning i.e. the hypothetic-deductive approach may also be useful.

5. Assessment

During an operation, Trainers constantly need to understand and interpret a trainees’ concept of what is happening. A potentially effective ‘freeze-frame’, or stop-and-tell method of assessment was presented by interviewee (GPH1). This assessment is based on making explicit, thoughts and knowledge and used to explore the cognitive processes accompanying the visible motor output. This method, involving asking a learner what they are thinking when they are doing it, resonates with the model of coaching that Schön refers to as ‘reflection-on-action’ and ‘in-action’. Schön suggested that this was ‘the remedy to mystification in practice’ and will strengthen the learning process.

Forty years ago an observational study was performed amongst orthopaedic residents operating. Distinctive behaviours were recorded and categorised into positive and negative incidents (or ‘critical incidents’). Whilst there was variation in what was considered good surgical technique, the author presented a classification of ‘critical incidents’, or poor surgical technique. Interestingly, comments from interviewees revealed that these ‘critical incidents’ are still the deficiencies in skills that gave concern to 21st century surgeons.

Having a matrix specifying such critical skills, indicating clearly which were performed well or gave concern, may help the trainee to form learning objectives and document improvement. Having an agreed narrative to explain what a good skill would look like could ensure that expectations were agreed and met. Whereas, current assessment
measures are thought to be either non-discriminatory, or ‘mindless tick-box exercises’ 66-7, a narrative-based assessment has been effective in assessing clinical performance 68, and describing competence. The former focuses on measuring the measurable, rather than looking holistically at the competent surgeon but the latter could reflect an immeasurable but nicely-flowing operation; smoothness, effectiveness and feelings of confidence and control.

In reality many current ‘objective’ assessments of trainees by trainers are not really quantitative measures, but qualitative. Trainers then reverse-engineer this to fill in semi-quantitative forms; various boxes are ticked to reflect the overall good impression; ‘Sometimes it is difficult for the trainer to know why the surgeon did something well - it was just recognised as good, and hard for the trainer to say why something looks poor - it just did; therefore, it may be hard to say how [the trainee] may improve’ (GPH4). There are many things that can be measured but this does not tell you how good the surgeon is. Analogous to sports, a team-captain can have all sorts of measurements such as ‘oxygen [consumption]… measure power, and you can measure speed, but that doesn’t actually give you a better player’ (GPH4).

Other methods are emerging; using narratives rather than scores, faculty experts were more consistent in assessing what constitutes excellent, competent, and problematic trainee performance than by previous measurements of resident competencies. Using standardised narratives may more authentically reflect trainers’ opinions of trainees 68. This may lead to a more discerning, better-accepted assessment-tool that depends more fully on the expertise of experienced trainers. Interviewees believed that assessment would be improved from not measuring, but describing; ‘You suddenly think– he’s done that well...I think that the measurement of a ‘good pair of hands’ is really difficult, but I bet if we looked, if you and I sat down separately or together and watched ten surgeons operate we would pick the same ones’ (GPH4).

6. Community of practice

Learning to operate does not occur in isolation, or is solely done though building concepts in ones mind. In keeping with social learning theories, being a surgeon with a ‘good pair of hands ‘depends upon learning the ways of the craft in a community 69. Most interviewees discussed the use of ‘scaffolding’, to let trainees do more of the operation as they gain experience, as described by Bruner 70. This is equivalent to spiralling upwards, doing the same procedure with more responsibility and less support as time passes.

This was expressed in different ways, but ultimately, the trainees are encouraged to imagine what they would do if the supervisor was not there. Whilst trainers are currently highly accessible, this ‘virtual’ responsibility may be a way of trainees gaining confidence. This has parallels with the way other learning communities allow apprentices to gain increasing legitimacy to participate 71. This is how apprenticeship currently is conceptualised by sociologists. Despite the rule of competency-based training, the apprenticeship system seems to be as valued today as it ever has been, for helping trainees acquire a ‘good pair of hands’.

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Summary

Why is it every time I ask for a pair of hands, they come with a brain attached?

Henry Ford (1863-1947)

A century ago Robert Jones founded the speciality of orthopaedics and emphasised the necessity for orthopaedic training, helping to set up many of the orthopaedic training schemes in the United Kingdom. In addition to his many accomplishments nationally, as a surgeon he was recognised to have great experience, expertise, charm, and ‘a good pair of hands’.

In the modern competence-based training environment, there is a danger of discarding all of the advantages of the apprenticeship-based training that Sir Robert Jones promoted. According to constructivist learning theory such apprenticeships would now be recognised as gaining legitimate peripheral participation in a community of practice. Having, and learning to have, ‘a good pair of hands’ is gained as part of a social process. Based on this social learning theory and expertise theory there are several ways that trainers could help surgeons develop a good pair of hands by:

- Promoting the learning of craft skills.
- Selecting trainee surgeons on the basis of their potential rather than their experience.
- Promoting the use of sustained deliberate practice and modern coaching methods.
- Specifically, during an operative session:
  - Discussing the intended operative plan beforehand, ensuring that trainees have a clear goal and image of what is to be achieved.
  - Planning steps in reverse from the final goal to understand all essential steps.
  - Using mental rehearsal of those steps before an operation.
  - Being explicit about the amount of preparation that experts use, either through reading, drawing-out plans, or in a surgeons’ mind.
  - Assessing against pre-agreed individualised set of steps, with narrative feedback.
  - Making improvements with targeted deliberate practice, using simulation and coaching techniques.

Attending to the social aspect of learning frees us from the ‘Henry Ford’ quantitative world of competency and measurable efficiency quoted above. Instead it will allow us to develop the deeper values of Sir Robert Jones who recognised the attributes of an able orthopaedic surgeon who had ‘a good pair of hands’:

In addition to operative skill, it demands special qualities of mind; a mechanical aptitude and untiring perseverance and patience

Sir Robert Jones, 1921
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