



Carolina's HealthCare System

One

Push Your Performance to the Next Level: Evidence-based Methods for Surgical Performance Optimization

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Associate Professor of Surgery, CHS

Surgical & Research Director, Carolina's Simulation Center

Learning Objectives

At the end of this presentation you will be able to:

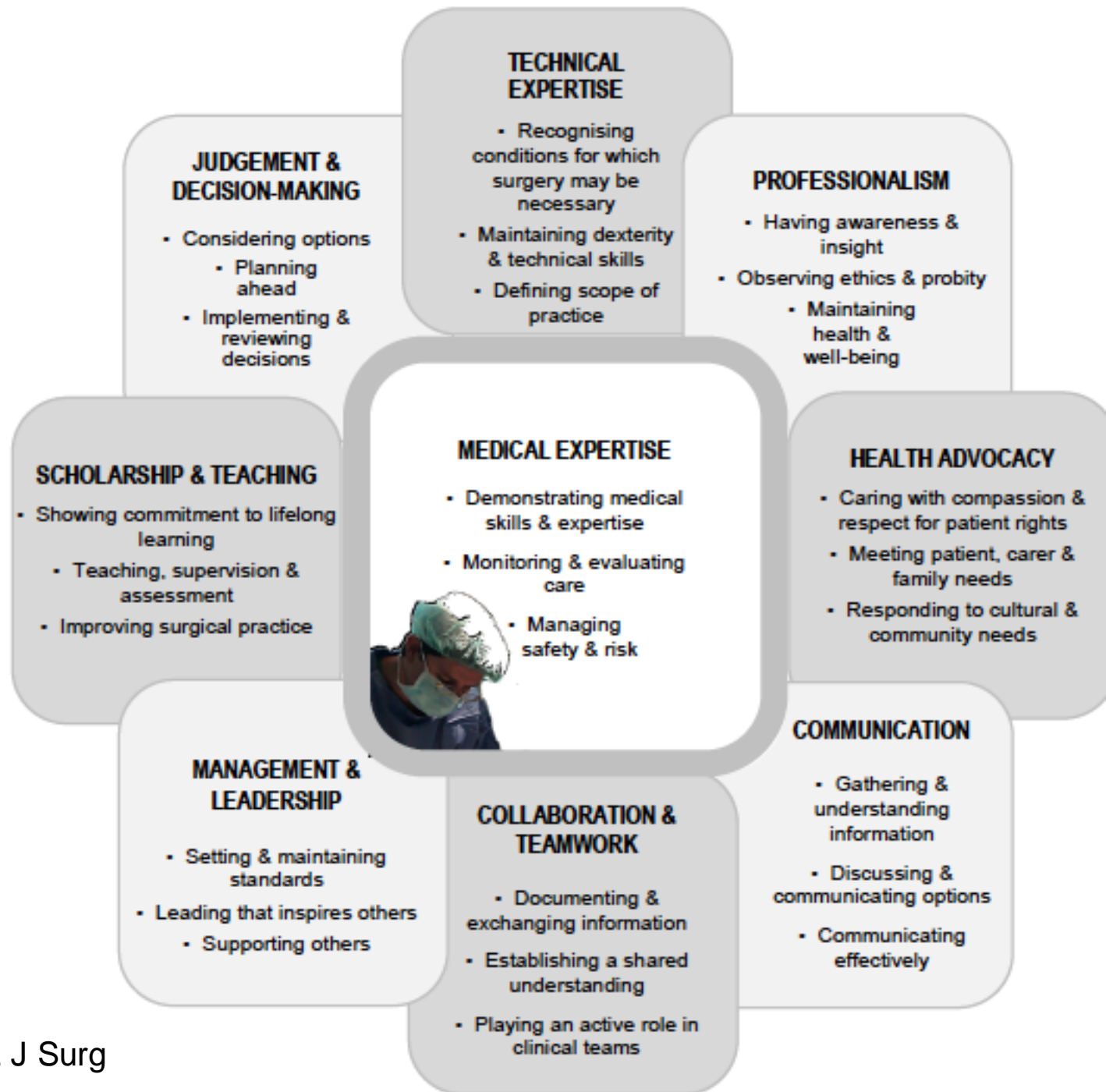
1. Identify the factors impacting the acquisition and decay of surgical skill
2. Discuss the importance of objective performance assessment and coaching for performance improvement
3. Describe surgical performance enhancing strategies
4. Recognize the benefits of simulation training for surgical skill acquisition in laparoscopic and robotic surgery





R.A.C.S.

Surgeon's Competencies



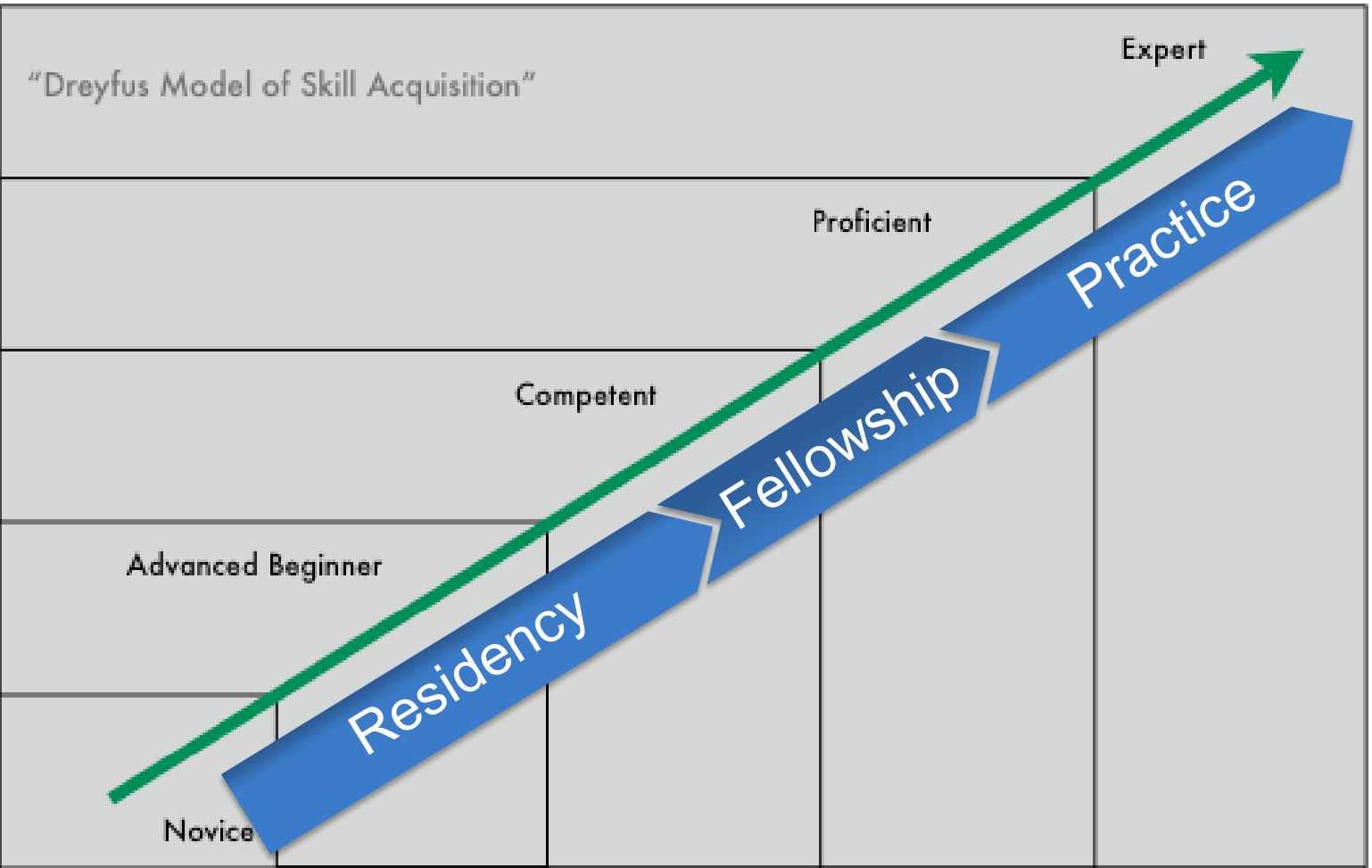
Responsibility extends to others and the environment.

Sense of responsibility increases with experience.

Sense of responsibility arises from actively making decisions.

Still does not experience personal responsibility.

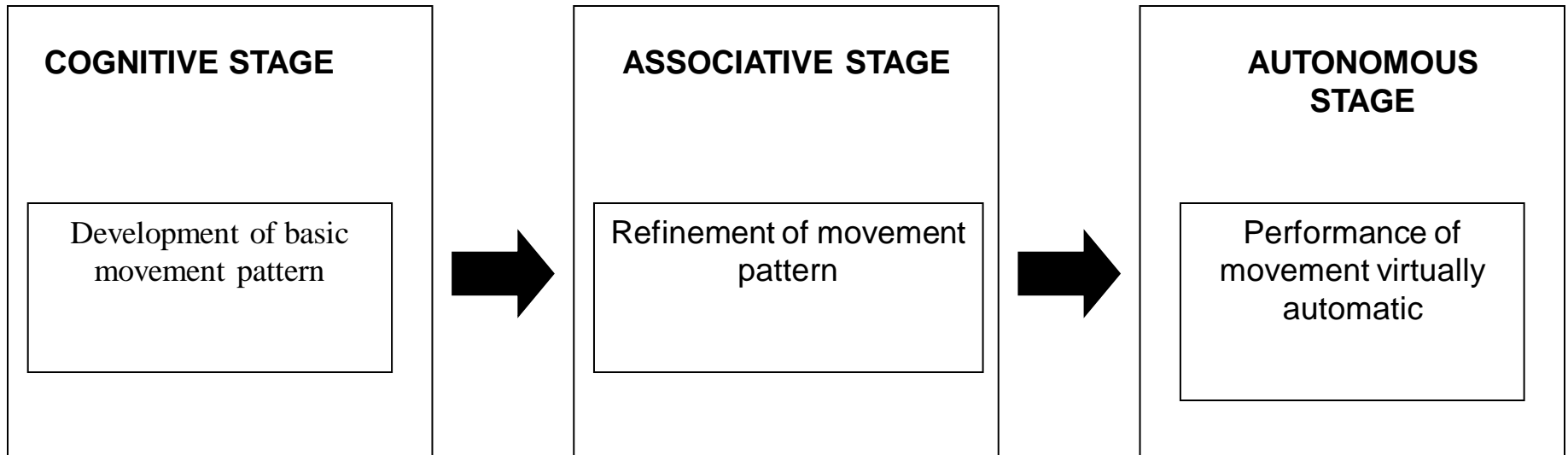
Only feels responsible to follow the rules.



Scope of vision & Range of capability

Follows specific rules for specific situations. Rules are not conditional.	Begins to create and identify conditional rules. All decisions still follow rules.	Learns organizing principals. Information sorting by relevance begins.	Uses pattern recognition to assess what to do. Uses rules to determine how to do it.	No analysis or planning. Pattern recognition extends to plan as well as action.
"Only capable of following the rules"	"Rules have nuance and become conditional in nature"	"Higher order rules shape contexts and conditions"	"Intuition aides in identifying the situation; the actions are governed by the principals"	"Just does what works."

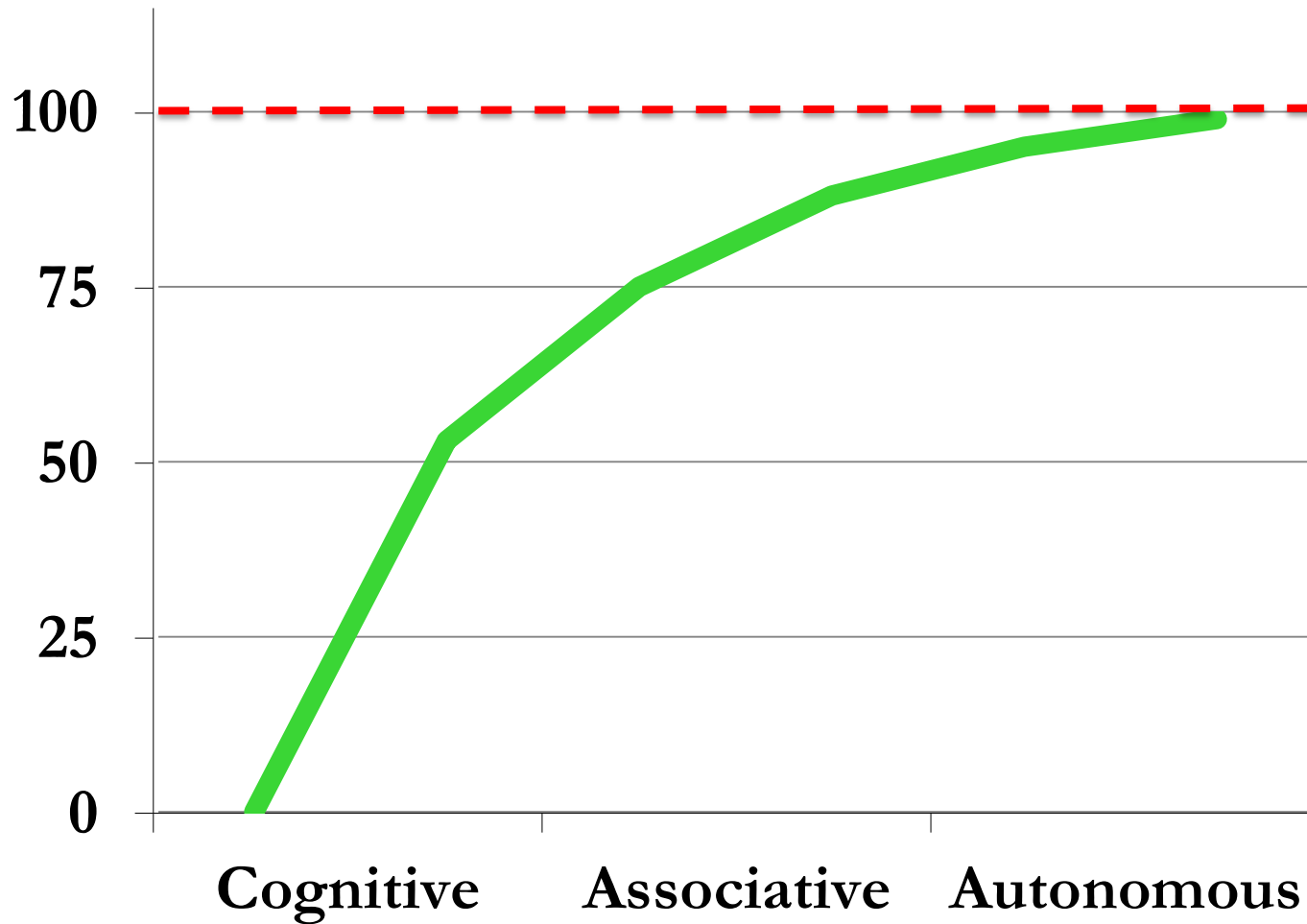
How We Acquire Psychomotor Skills



Fitts and Posner (1967)

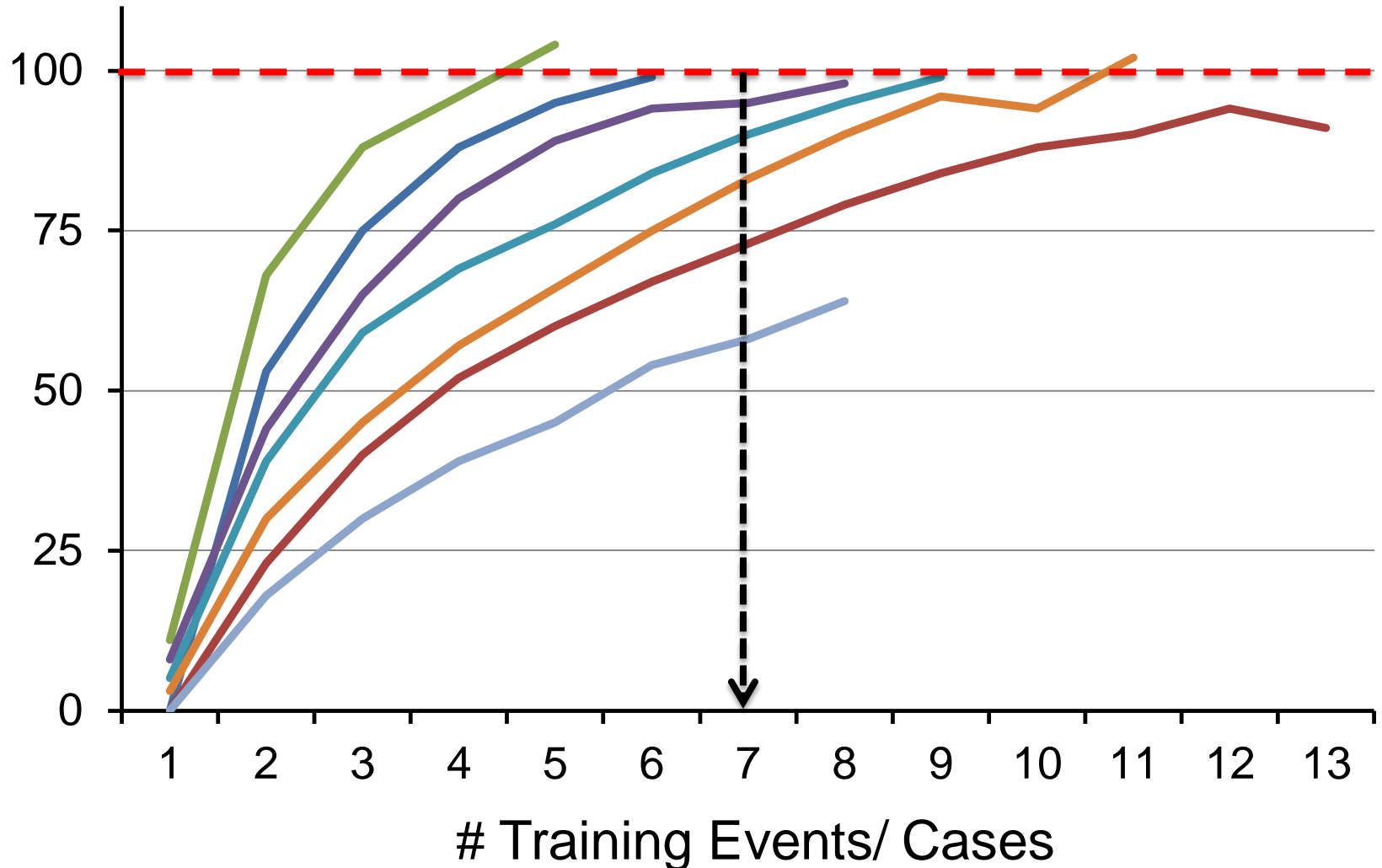


Performance Changes During Skill Acquisition



Acquisition of Skills by Individuals

Why Case Numbers Don't Work



What is the End Product of our Current Training Paradigm?

- We “produce” Surgeons of Variable Skill
 - Learning Curve Phenomenon: surgical literature replete with evidence on existing learning curves after training completion and their negative impact on patient outcomes
 - High number of graduating residents who pursue fellowships
 - Own experience with surgical fellows
 - Complications related to inadequate education



Importance of Video-based Surgical Performance Assessment

Video-based peer assessment of bariatric surgeon skill (n=20)

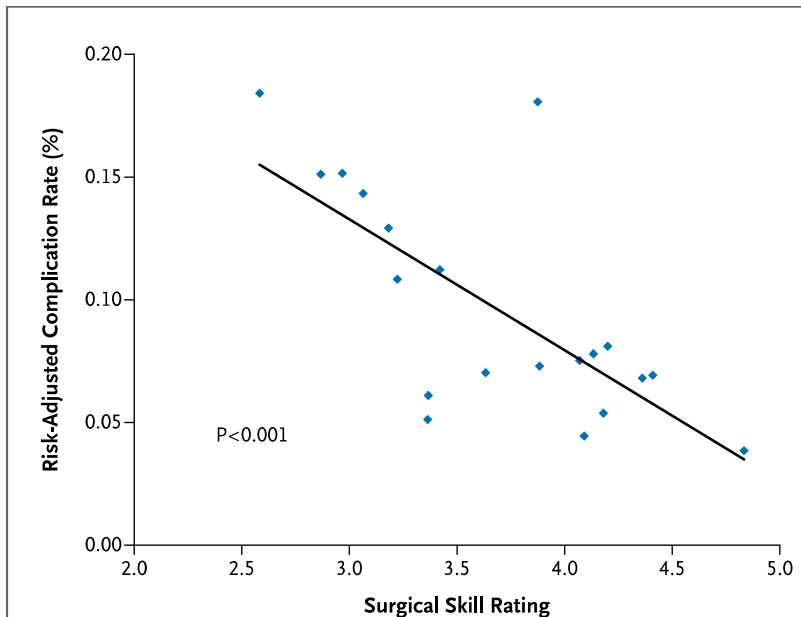


Figure 1. Relationship between Summary Peer Rating of Technical Skill and Risk-Adjusted Complication Rates after Laparoscopic Gastric Bypass.

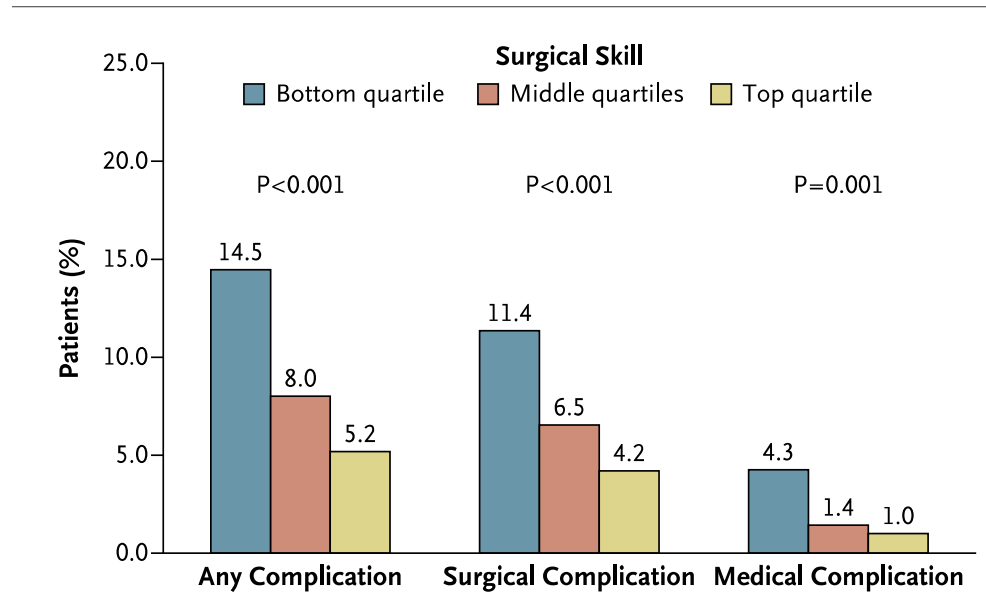


Figure 2. Risk-Adjusted Complication Rates with Laparoscopic Gastric Bypass, According to Quartile of Surgical Skill.

Birkmeyer JD et al 2013 NEJM



Prerequisites for Optimal Skill Acquisition

- Internal Motivation – Desire to Learn
- Deliberate practice
- Feedback on performance
- Goal oriented training with overlearning
- Task deconstruction/ appropriateness



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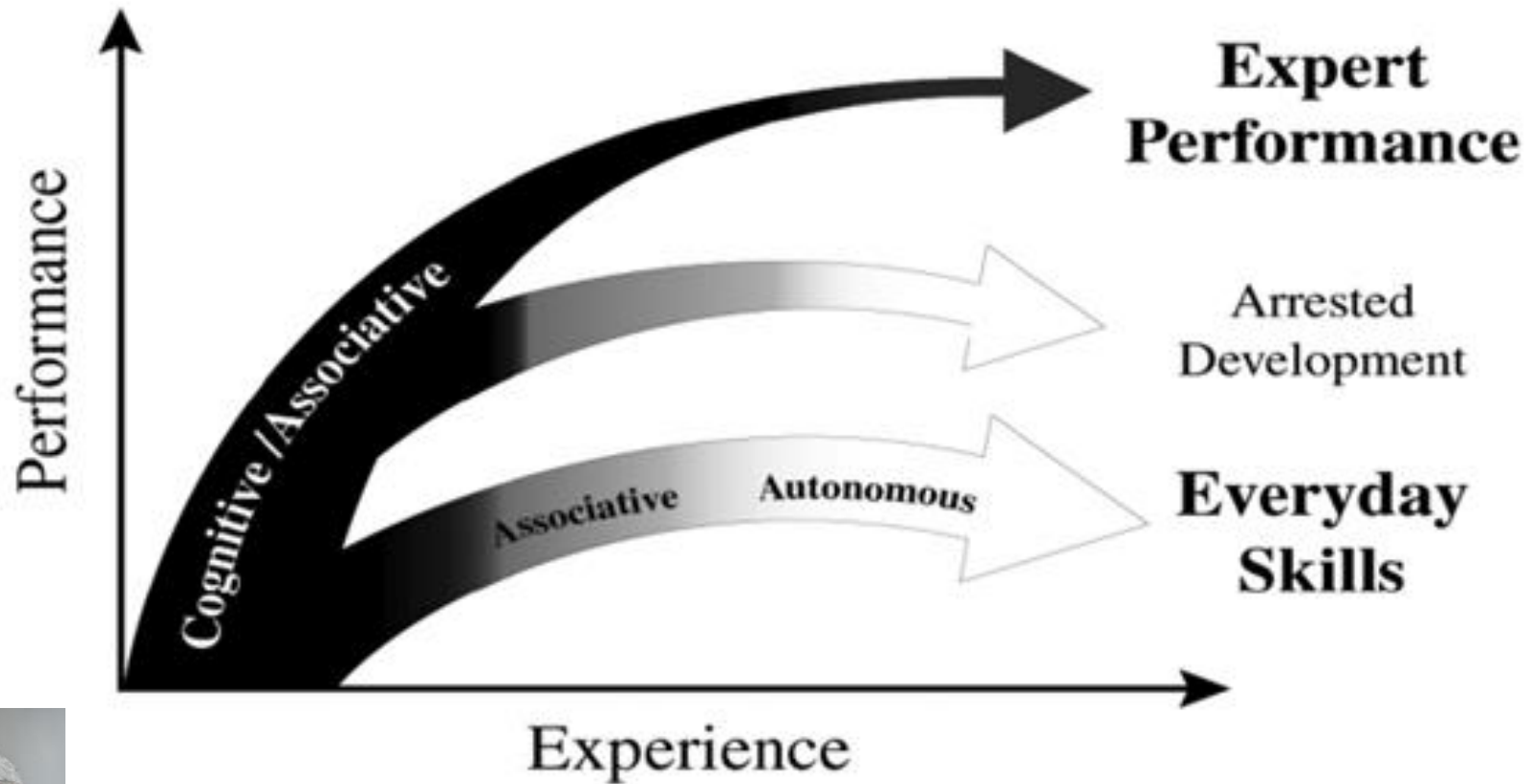


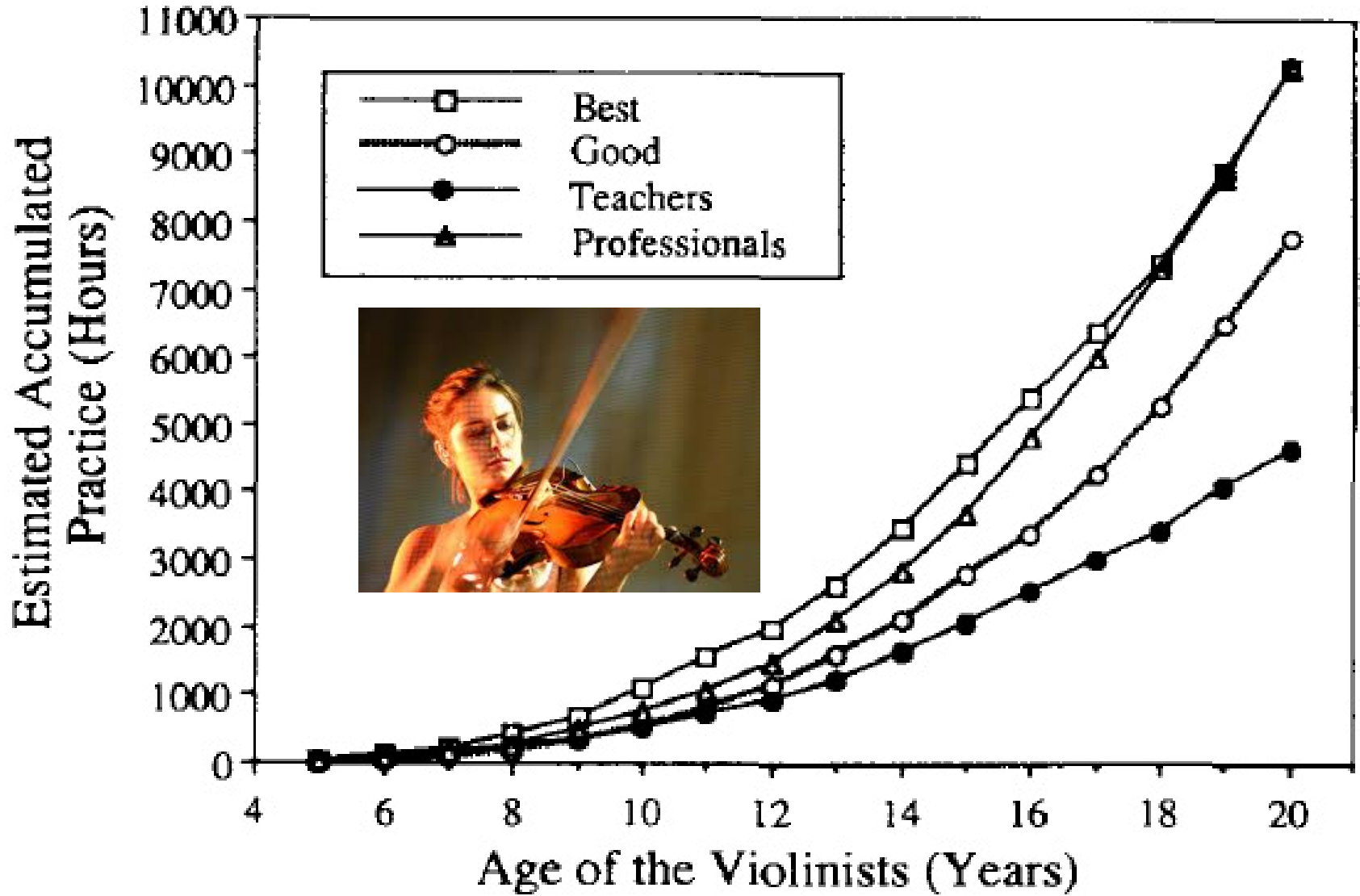
Deliberate Practice

Refers to a form of training that consists of focused, grueling, repetitive practice in which the learner continuously monitors his or her performance and subsequently corrects, experiments, and reacts to immediate and constant feedback, with the aim of steady and consistent improvement

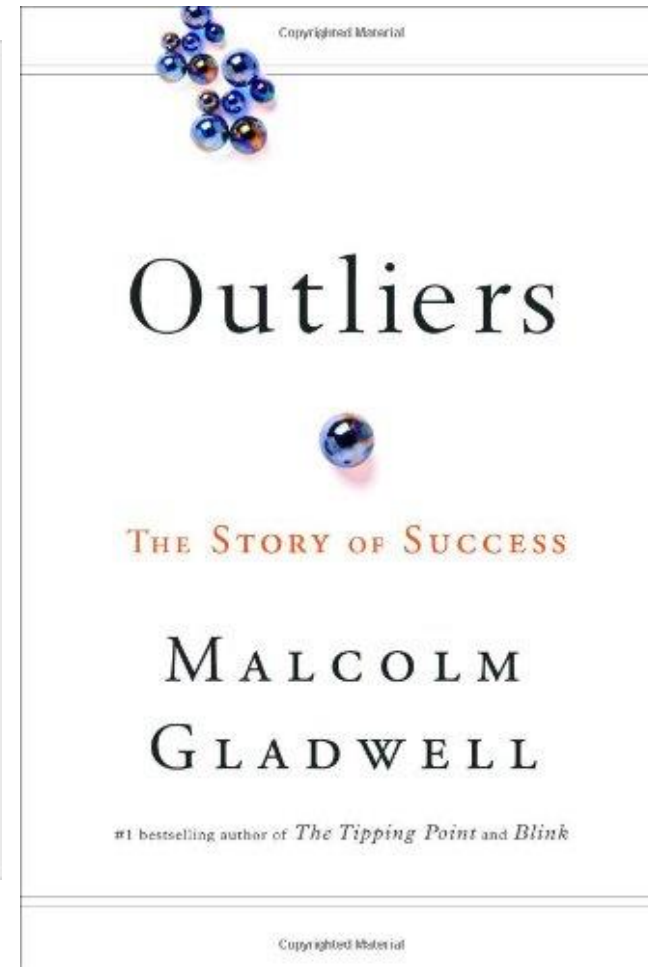
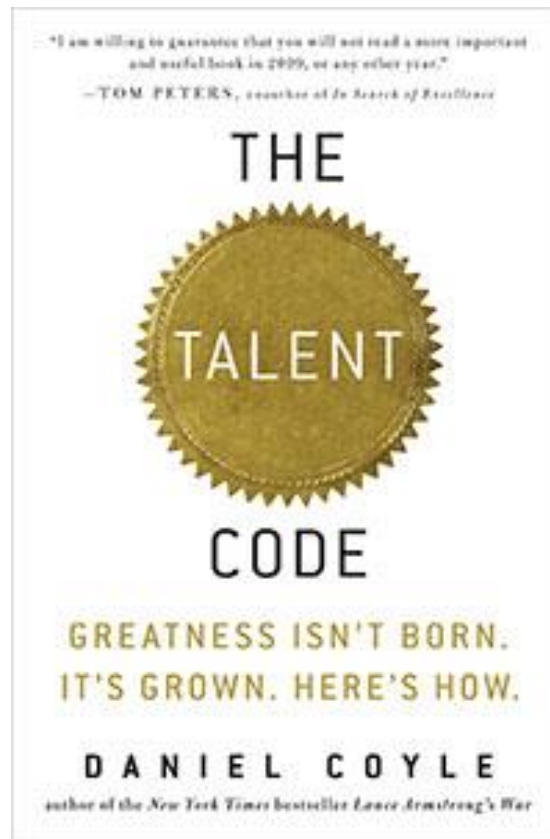
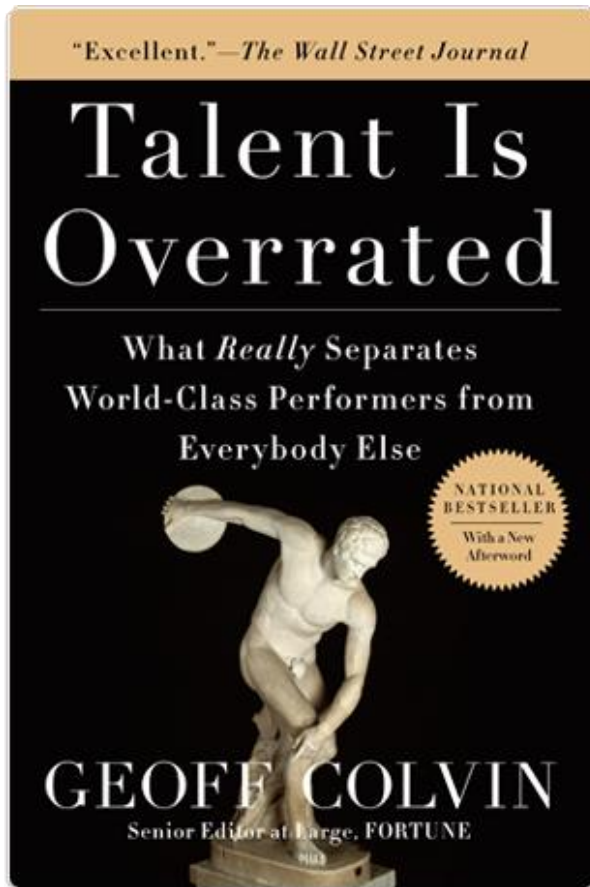


Difference Between Experience and Deliberate Practice





Frequent Popular Science Writing Topic



Deliberate Practice Important BUT...

Research Article

ASSOCIATION FOR
PSYCHOLOGICAL SCIENCE

Deliberate Practice and Performance in Music, Games, Sports, Education, and Professions: A Meta-Analysis



Brooke N. Macnamara¹, David Z. Hambrick², and Frederick L. Oswald³

¹Princeton University; ²Michigan State University; and ³Rice University

Psychological Science

1–11

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DOI: 10.1177/0956797614535810

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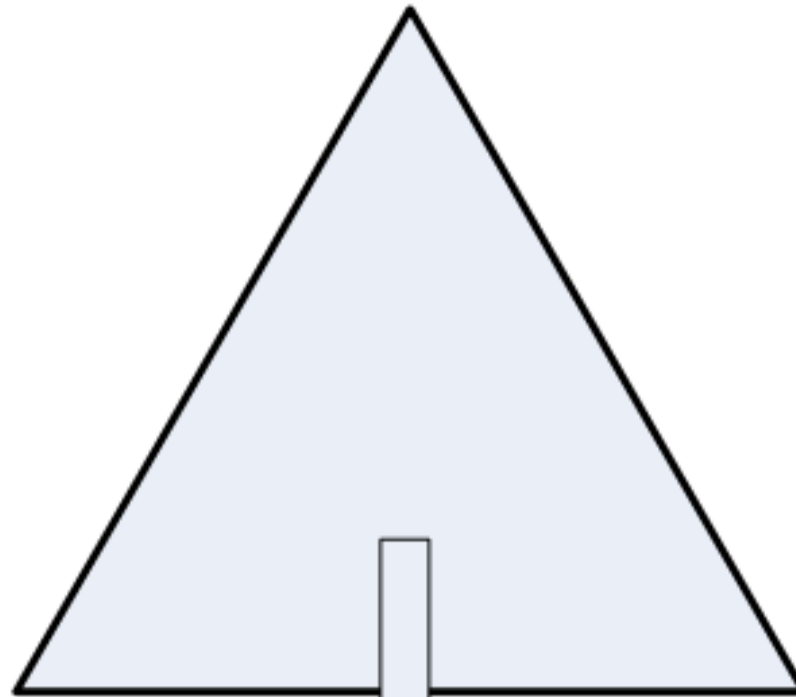


- Assessed the effect of deliberate practice in 88 studies
- Deliberate practice is important but only partially explains the variance in individual performance (in up to 26%)



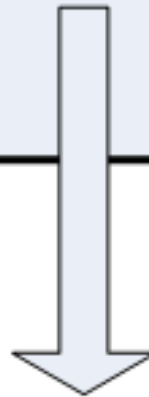
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**Opportunities
& Support**



Innate Talent

**Deliberate
Practice**



**Expert
Performance**



Prerequisites for Optimal Skill Acquisition

- Internal Motivation – Desire to Learn
- Deliberate practice
- **Feedback on performance**
- Goal oriented training with overlearning
- Task deconstruction/ appropriateness



Performance Feedback

- Feedback refers to the return of performance-related information to the performer
- Intrinsic vs. extrinsic or augmented
- Its purpose is to both reinforce strengths and foster improvements in the learner by providing insight into actions and consequences and by highlighting the differences between the intended and the actual results of their actions
- Essential for learning; focusing attention to what's important
- Inappropriate feedback may hinder skill acquisition

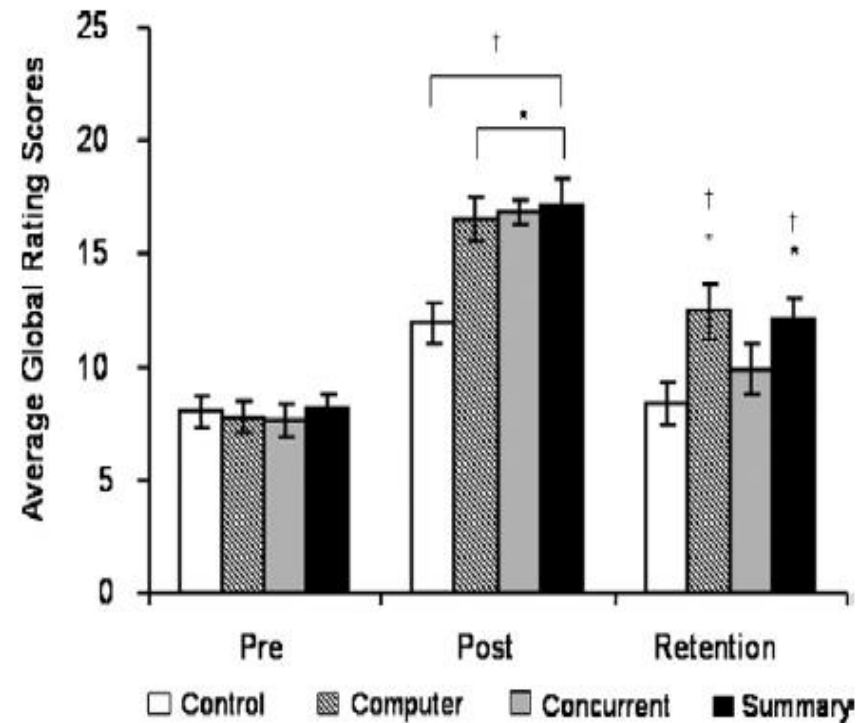


Importance of Feedback

- Provision of feedback on performance has a beneficial effect on technical performance

Hull et al 2012 JACS

- Effective feedback
 - Specific
 - Timely
 - Appropriately delivered



Xeroulis et al 2007 Surgery



What is the Quality of the Feedback we Provide to our Residents?

- Jensen AR, Wright AS, Kim S, Horvath KD, Calhoun KE. Educational feedback in the operating room: a gap between resident and faculty perceptions. *Am J Surg*. 2012 Aug;204(2):248-55.
- Rose JS, Waibel BH, Schenarts PJ. Disparity between resident and faculty surgeons' perceptions of preoperative preparation, intraoperative teaching, and postoperative feedback. *J Surg Educ*. 2011 Nov-Dec;68(6):459-64
- Hutul OA, Carpenter RO, Tarpley JL, Lomis KD. Missed opportunities: a descriptive assessment of teaching and attitudes regarding communication skills in a surgical residency. *Curr Surg*. 2006 Nov-Dec;63(6):401-9.
- Alken A1, Tan E, Luursema JM, Fluit C, van Goor H. Feedback activities of instructors during a trauma surgery course. *Am J Surg*. 2013 Oct;206(4):599-604.
- Surgery faculty provide limited feedback that is rarely specific and timely but believe they are doing a great job; surgery residents disagree



Coaching

- Helping others expand and apply their skills, knowledge and abilities
- Providing objective and constructive feedback to help a “coachee” recognize what works and what can be improved

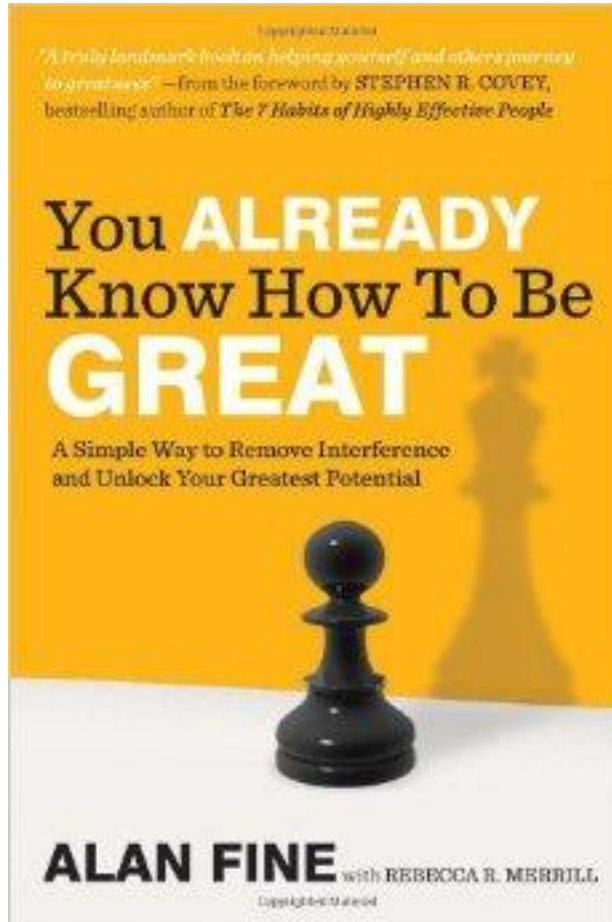


International Coaching Federation

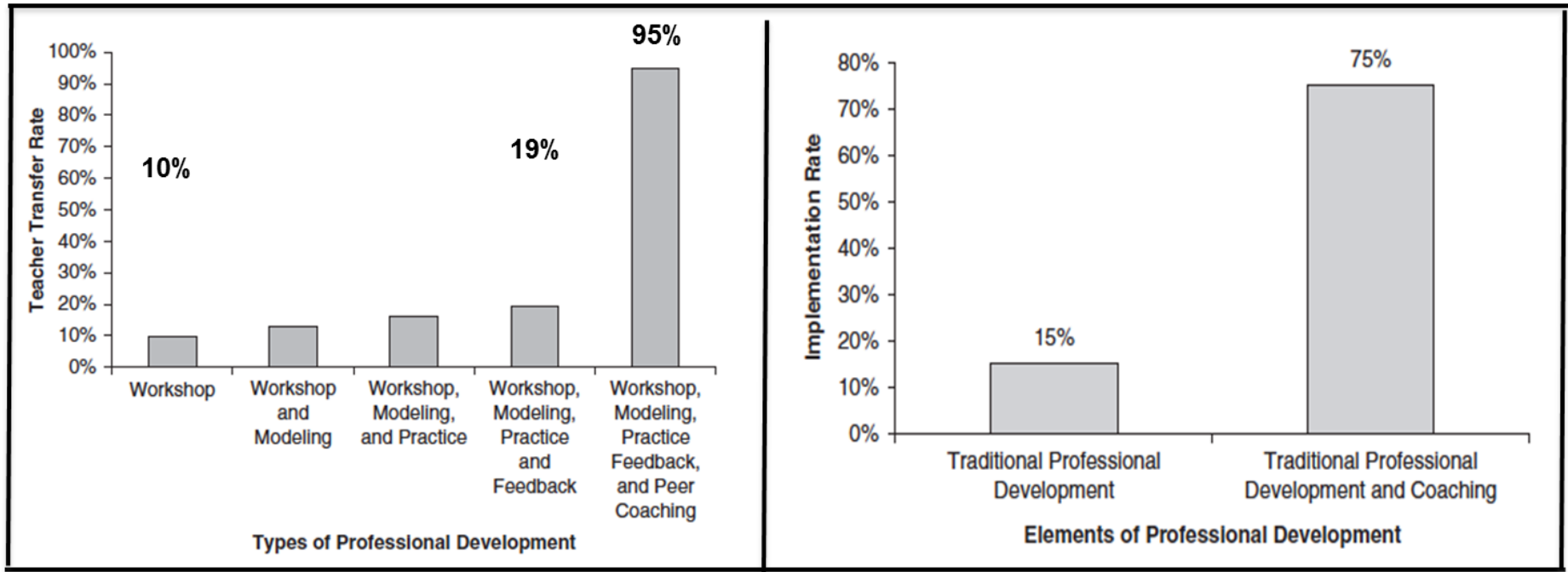


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Coaching Elements- the GROW model



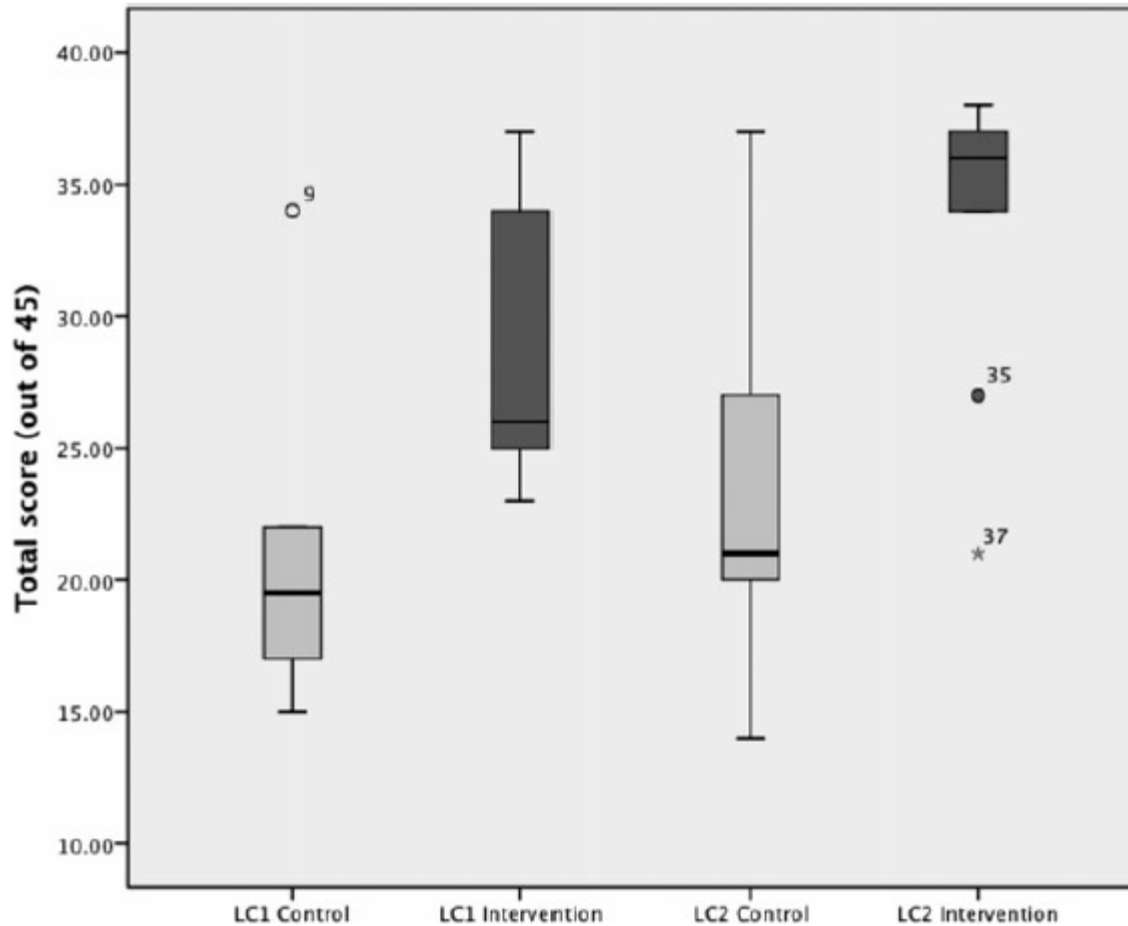
Is Coaching Effective?



Cornett & Knight 2008. Research on Coaching



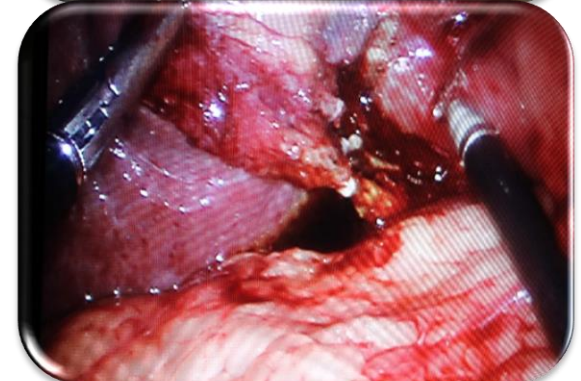
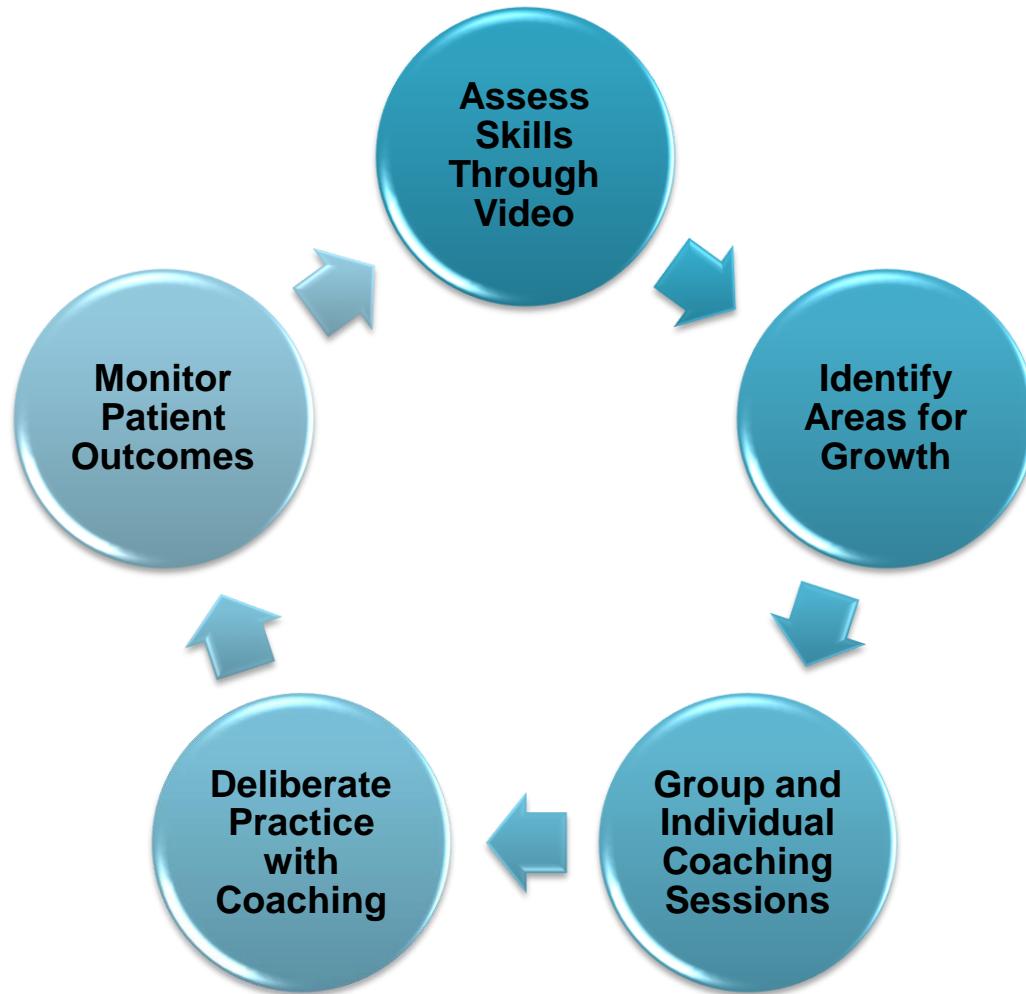
Is Coaching Effective in Surgery?

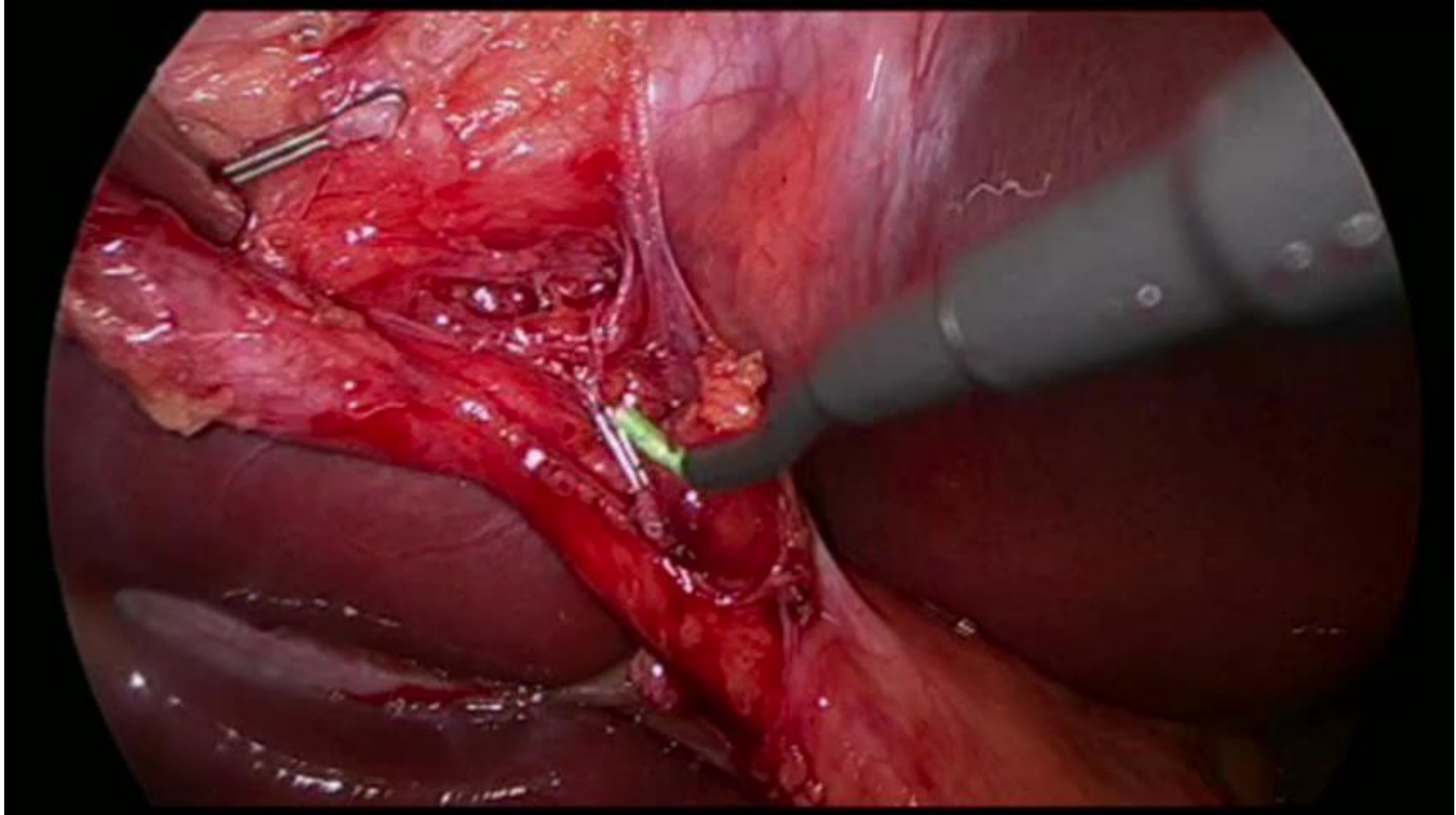


Singh et al 2015 Ann Surg

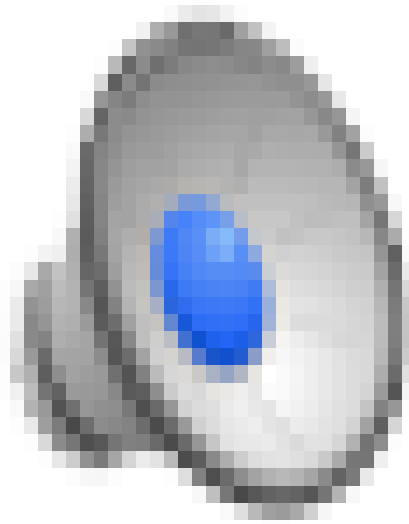


CHS Model for Ongoing Learning & Coaching





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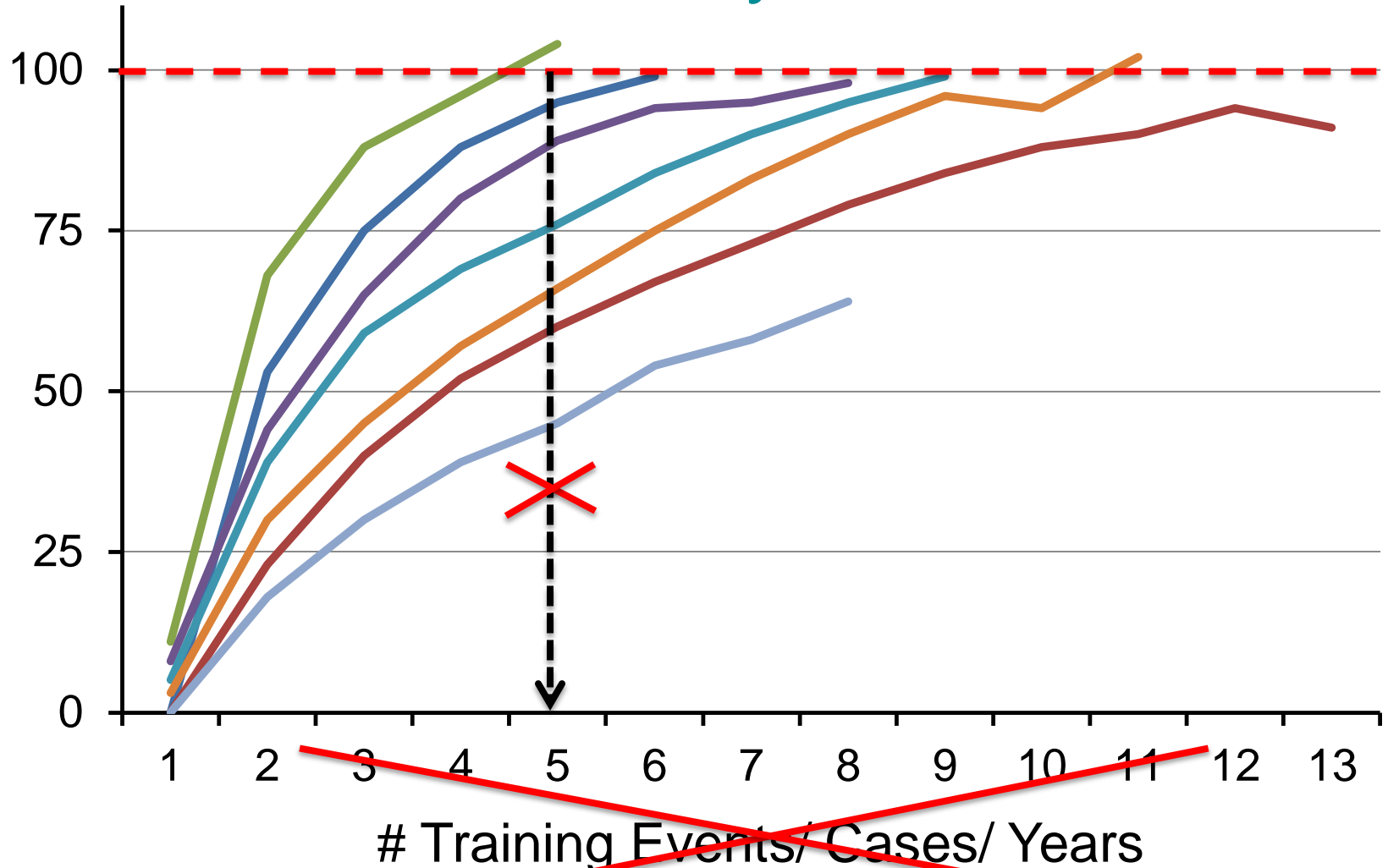
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Prerequisites for Optimal Skill Acquisition

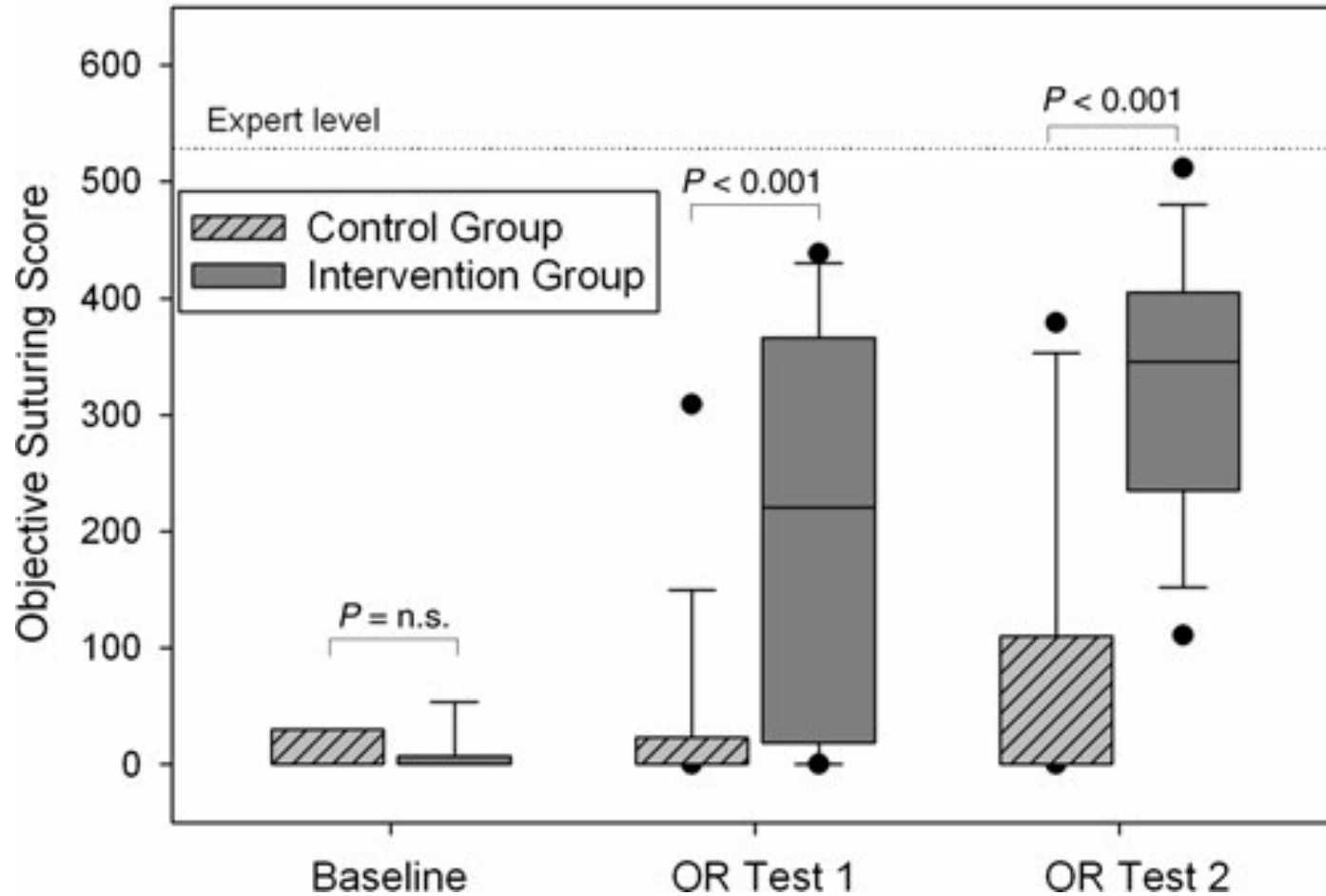
- Internal Motivation – Desire to Learn
- Deliberate practice
- Feedback on performance
- **Goal oriented training with overlearning**
- Task deconstruction/ appropriateness



Goal Oriented Training: Proficiency-based



Going Beyond Proficiency: Effect of Overlearning on Performance



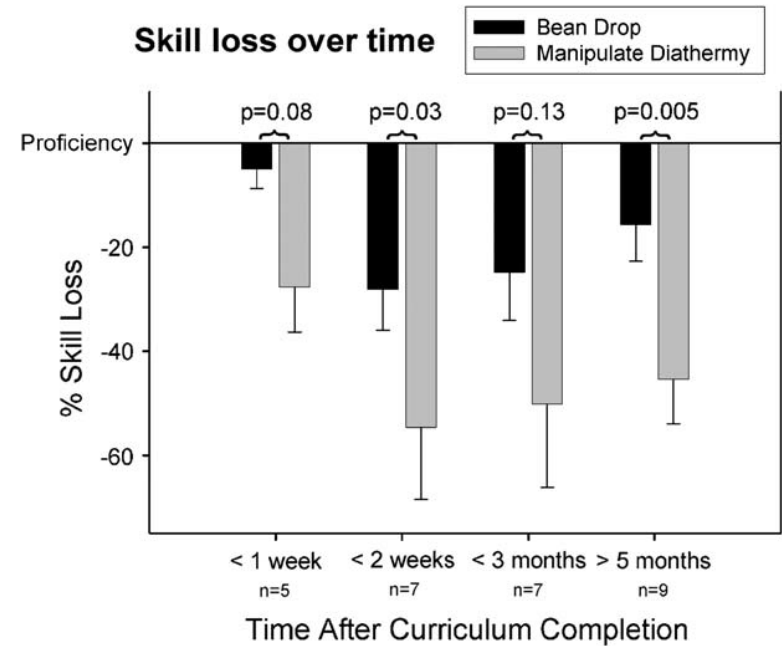
Stefanidis D et al Ann Surg 2012



What Factors Affect Skill Decay?

- The longer the period of nonuse the greater the decay
- Overlearning (most important factor) improves skill retention
- Accuracy tasks > speed-based tasks
- Cognitive tasks > physical tasks

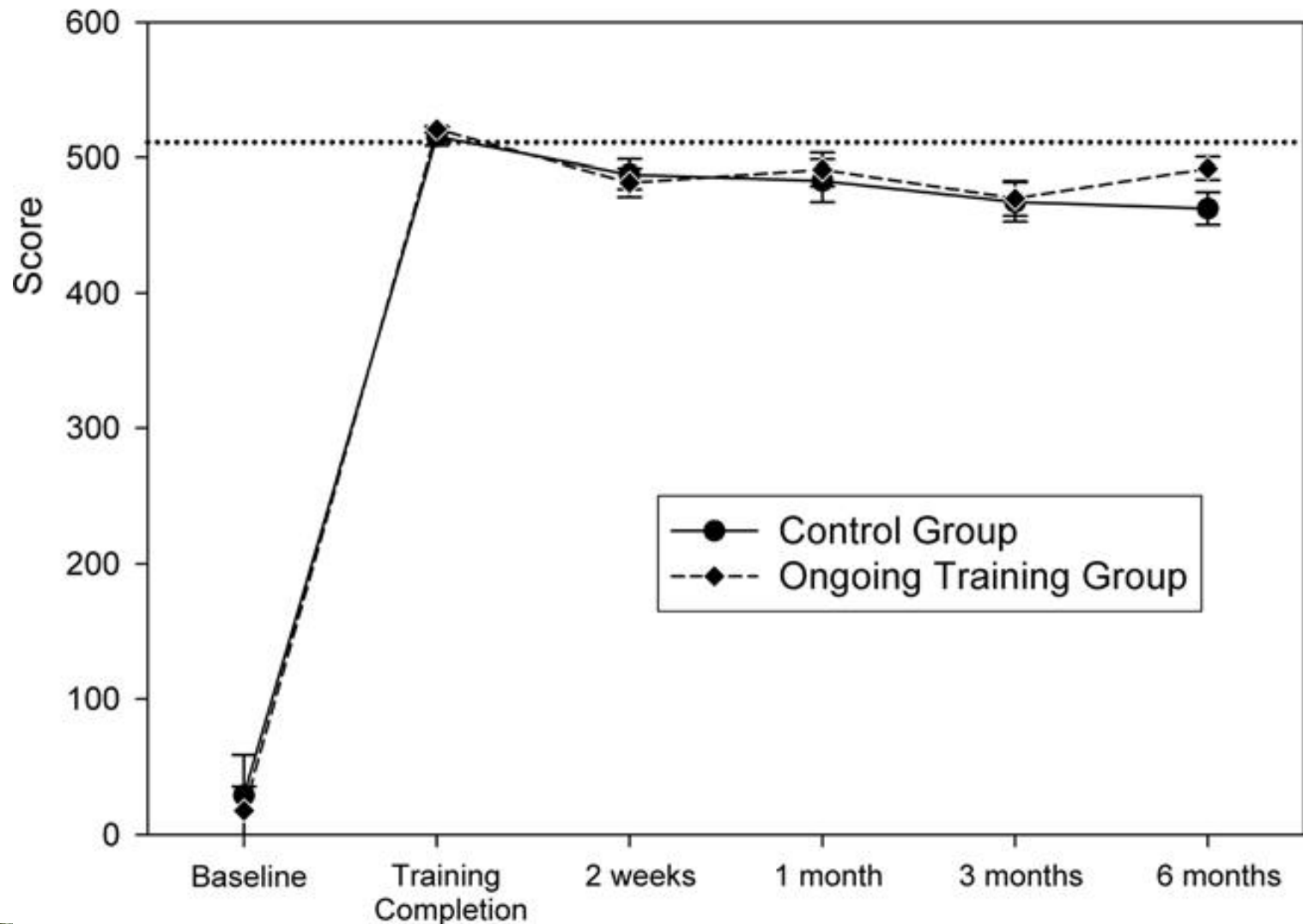
Arthur et al 1998 Hum Perform



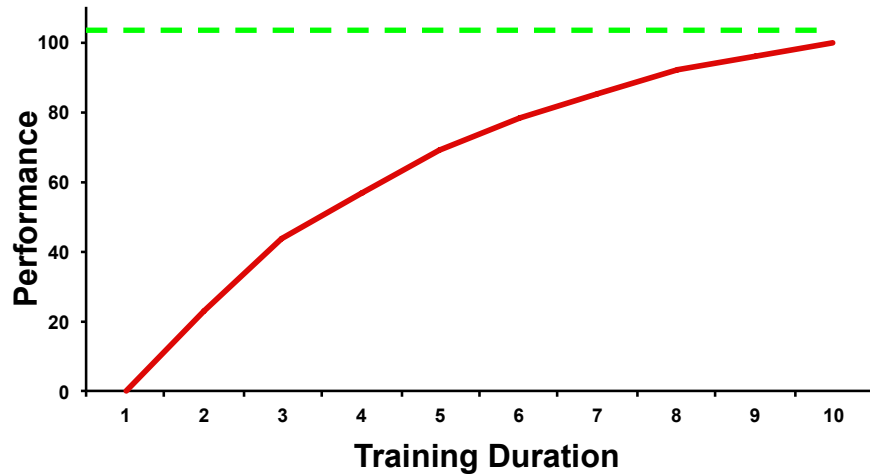
Stefanidis et al Surgery 2005



Impact of Maintenance Training on Performance



Simulation allows all these principles to be put in action

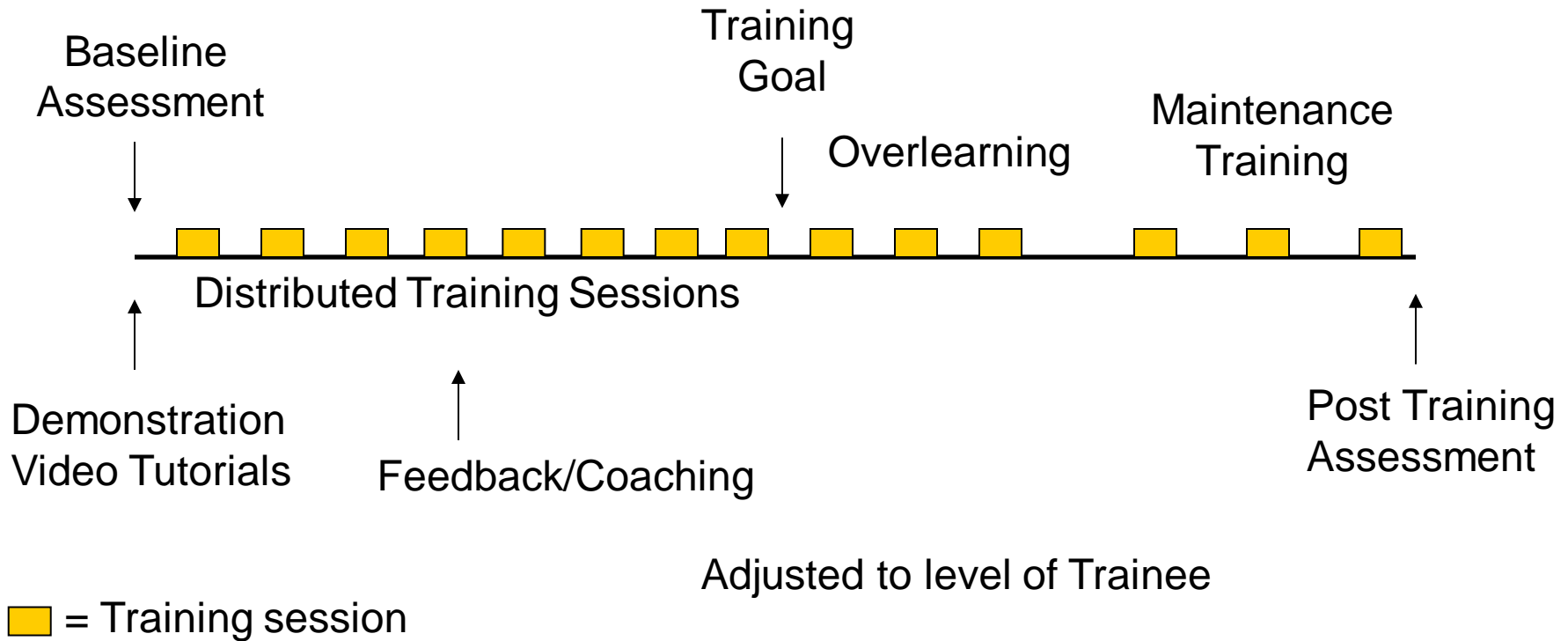


Learning Curve of New Skills



Optimal Skills Curriculum Design

The Value of Simulation



Simulation-based Curricula



- Fundamentals of Laparoscopic Surgery
 - Established; required for ABS certification
- Fundamentals of Endoscopic Surgery
 - Established; required for ABS certification in 2017
- Fundamentals of Robotic Surgery
 - Validation recently completed: results being analyzed; may be required in the future



Should all procedures move to this paradigm?



Modules of the FRS Curriculum

FRS RETURN TO CASE LIST HELP

INTRODUCTION TO SURGICAL ROBOTIC SYSTEMS

CASE OUTLINE ROBOTIC SYSTEM ADVANTAGES :: Information Amplification 2 of 9

The surgeon sits in control at the console and sends information to the team (verbal commands), or data to the instrument(s) by moving the manipulator handles. Because all the data must go through the computer, the robotic system can amplify this information (data) to enhance the surgeon's psychomotor skills/performance beyond normal human physical limitations. Examples include:

- The video image can be increased in size to give the surgeon magnified vision
- The use of "false coloring" (infra-red, ultraviolet, etc.) to "see" structures, properties (e.g. heat) and functions (e.g. blood flow) not visible to the human eye
- Hand motion scaling and tremor elimination that provides the surgeon with a precision of less than 100 microns facilitating the performance of minimally invasive surgery by helping overcome some of the inherent limitations of laparoscopic surgery

Module 1: Introduction to Robotic Surgical Systems

FRS RETURN TO CASE LIST HELP

DIDACTIC INSTRUCTIONS FOR ROBOTIC SURGERY SYSTEMS

COURSE OUTLINE PRE-OPERATIVE PHASE :: Setting Up The Robotic System 3 of 12

Setting up the robotic system involves configuring components so that they will have the workspace required for the operation and anticipate an accurate, safe and optimal positioning of the robot relative to the patient. Operational requirements are dependent on the particular case, surgeon, discipline and preferences.

The set up specifically requires:

- Proper positioning of the robotic manipulators relative to the patient (or patient surrogate, such as animal, cadaver, phantom or skills station).
- Calibration of the camera, patient side manipulators and the master manipulators.
- Configuration of patient arms according to the requirements of the procedure.
- Selection of other surgeon preferences on the surgeon's console.

Module 2: Didactic Instructions

FRS RETURN TO CASE LIST HELP

PSYCHOMOTOR SKILLS CURRICULUM

CASE OUTLINE TASK 4: RAILROAD TRACK :: Skills & Metrics 2 of 2

Skills Assessed

Primary:

- Needle holding and manipulation
- Wrist articulation
- Atraumatic tissue handling

Secondary:

- Eye hand instrument coordination
- Suture handling

Measurements and Metric

- Time to complete closure of incision and tie knot (seconds)
- Complete wound approximation
- Precision of needle placement onto dots along the incision (mm distance from center of dot)
- Amount of eversion (mm)
- Wound tension (no gap of wound edges)
- Secure knot at completion of suturing (no slipping)

Module 3: Psychomotor Skills Curriculum

FRS RETURN TO CASE LIST HELP

TEAM TRAINING & COMMUNICATION SKILLS

CASE OUTLINE POST-OPERATIVE PHASE :: Undocking 2 of 3

The undocking of the robot will be the reverse of the setup, and include safe removal of all instruments from the operative site, powering the robot down, undocking of the robot from the vicinity of the patient, and moving all ancillary equipment (towers, energy sources, etc.) away from the patient. Only then would it be safe to reposition the patient and transfer to a gurney.

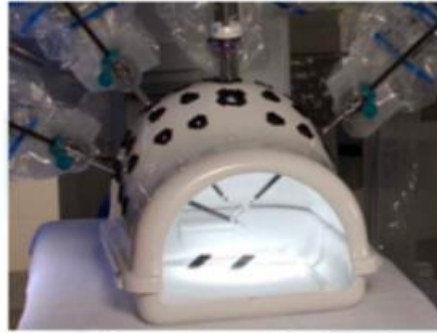
- Did the surgeon check all instruments?
- Have the instruments been cleared?
- Have the instruments been removed?
- Were all foreign bodies removed?
- Have the trocars been disconnected from the robot arms?
- Have trocars been removed by direct visualization (when possible)?
- Is the specimen management and wound closure complete?
- Has the robot been carefully moved away from the patient and a path cleared for transfer of the patient?
- Has the patient been safely transferred to

Module 4: Team Training and Communication Skills

FRS Psychomotor Tasks



Final Physical Model



Abdominal Shell



Instrument Insertion



Ring Tower Transfer



Knot Tying



Railroad Track



4th Arm Cutting

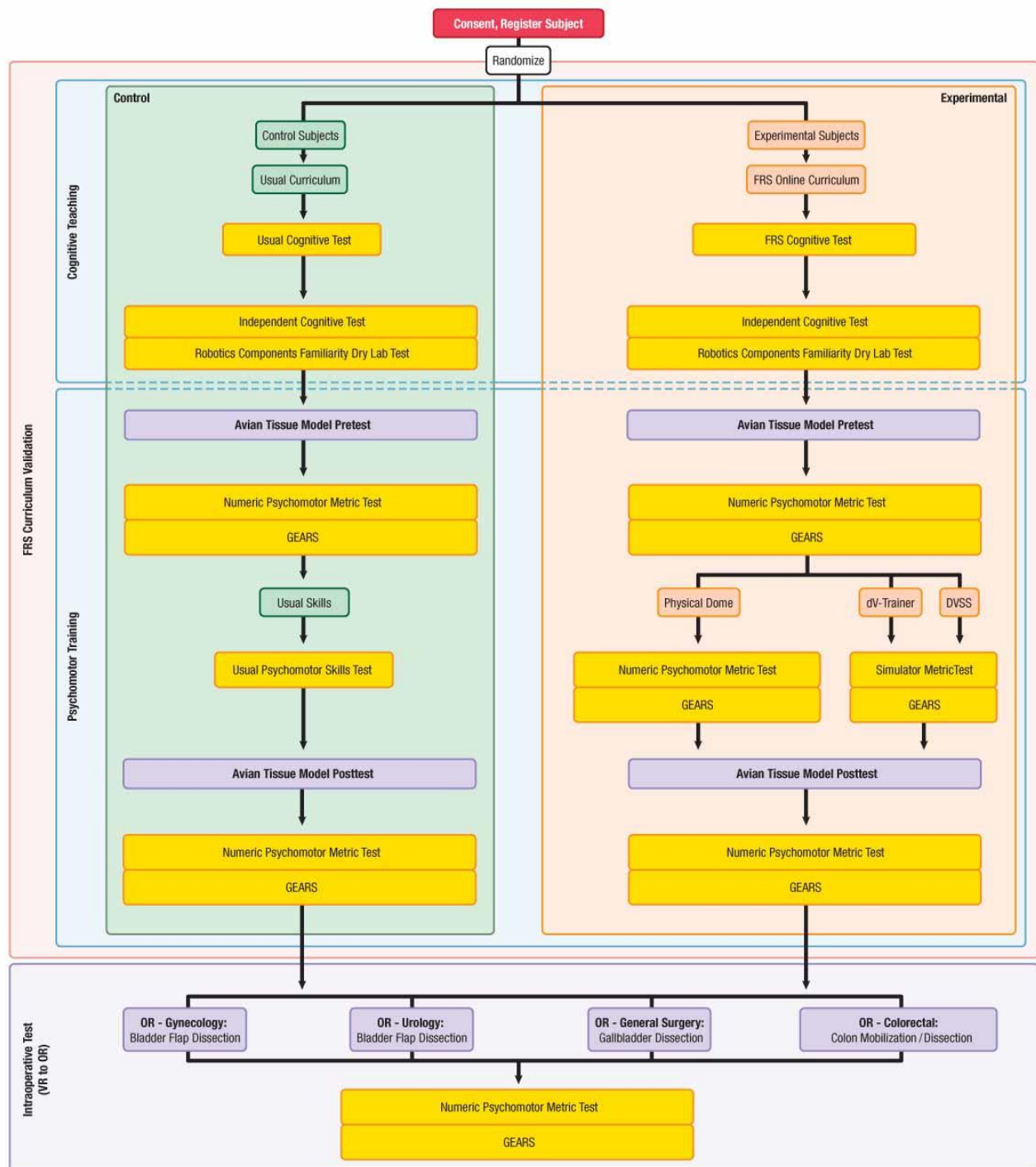


Puzzle Piece Dissection



Vessel Dissection/Division

FRS Validation Trial Outline



Other Factors Affecting Performance



Relationship Between Technical and Nontechnical Skills

- “A skillfully performed operation is about 75% decision making and 25% dexterity”

Frank Spencer, MD 1978

- Failures in nontechnical skills (especially in situational awareness among surgeons) are associated with a higher rate of technical errors

Hull L et al 2012 JACS

- Strong positive correlation between teamwork disruptions and surgical errors

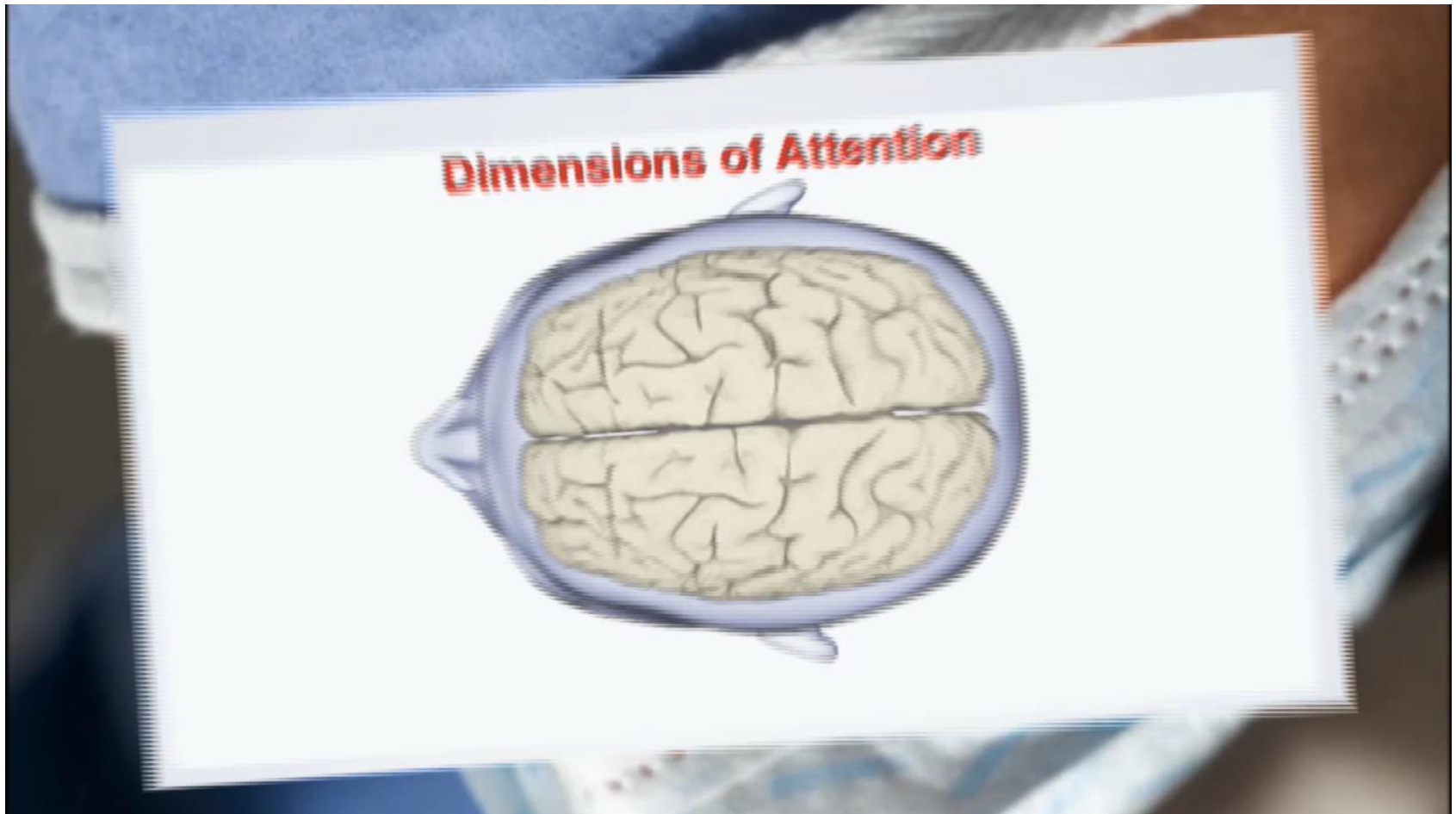
Wiegmann DA et al 2007 Surgery



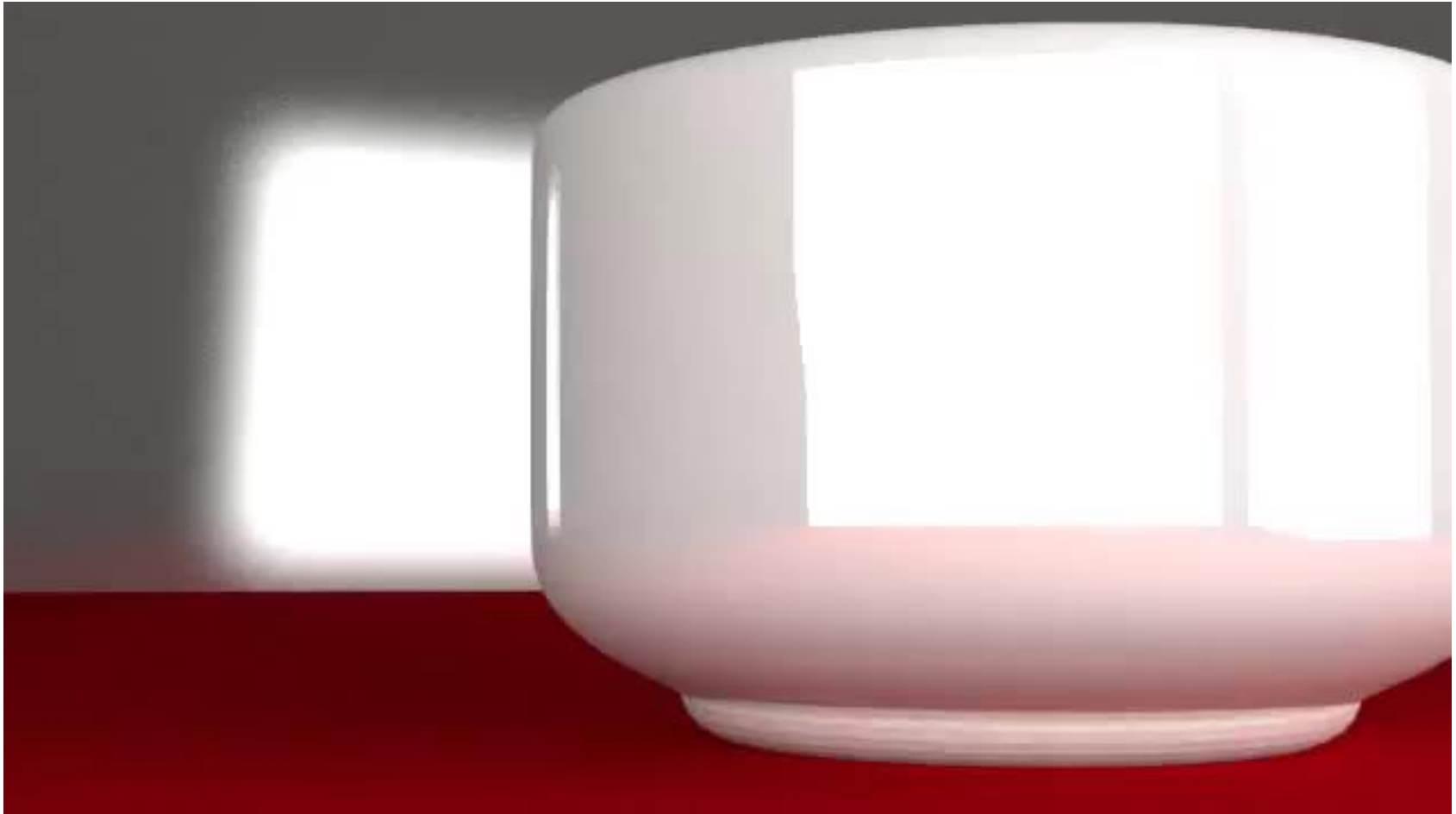
Attention to Your ...Attention!



Attention and Performance

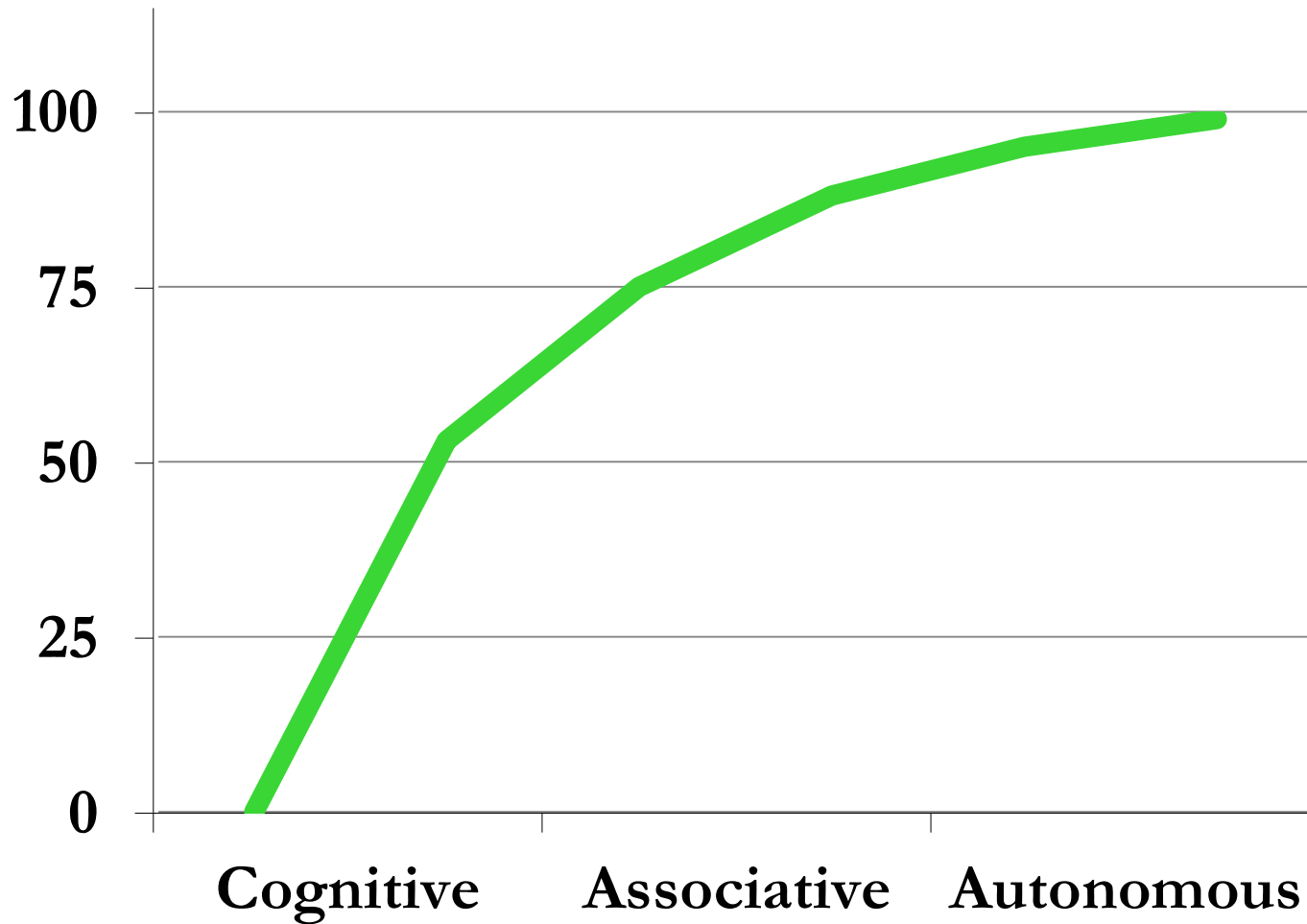


Our Attentional Capacity is Limited

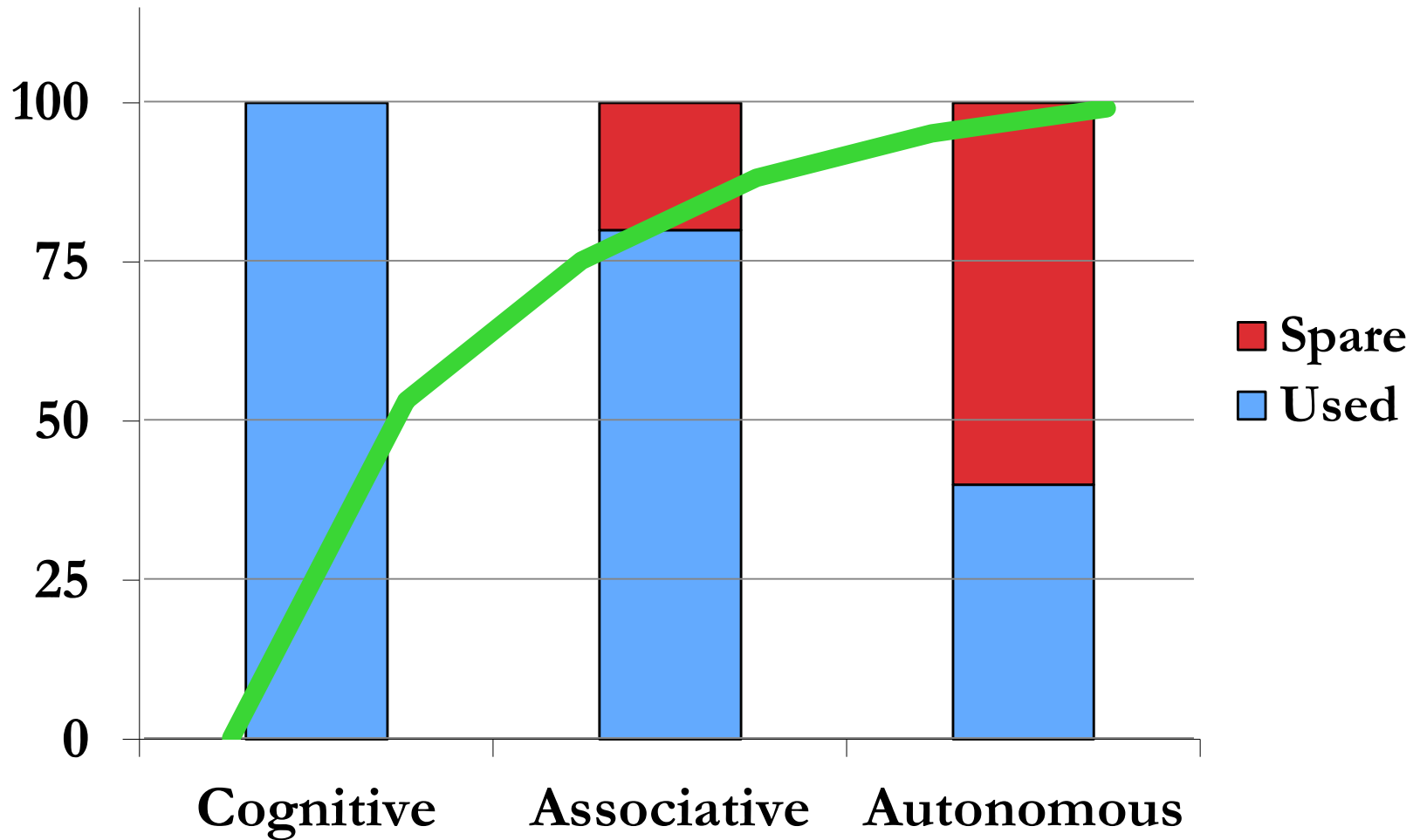


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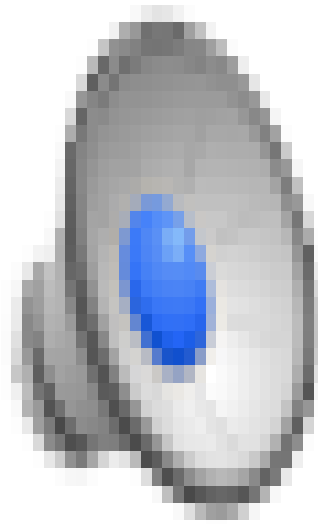
Performance & Attentional Capacity



Performance & Attentional Capacity



Can Spare Attentional Capacity Be Measured?



Is Training to Automaticity Superior?

ANNALS OF **SURGERY**
A Monthly Review of Surgical Science Since 1885

RANDOMIZED CLINICAL TRIAL

Simulator Training to Automaticity Leads to Improved Skill Transfer Compared With Traditional Proficiency-Based Training

A Randomized Controlled Trial

Dimitrios Stefanidis, MD, PhD,† Mark W. Scerbo, PhD,‡ Paul N. Montero, MD,†
Christina E. Acker, BA,* and Warren D. Smith, PhD§*

- Using secondary task performance goals led to more robust skill acquisition and skill transfer



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Noise and Distraction

- Noise and distractions generally impair attention
- They also have been shown to decrease performance in a variety of settings
- In contrast white noise has been shown to improve attention in ADHD children
- Techniques that focus on noise and distraction elimination can be useful for performance enhancement as attention focus is easier to maintain
- Sterile cockpit concept



Intraoperative Teaching Model

1

- **STOP** – prompt trainee to pause

2

- **IDENTIFY** – ask trainee what the problem is

3

- **EXPLAIN** – inform trainee what the problem is

4

- **INSTRUCT** – inform what needs to be done to proceed

5

- **CHECK** – verify trainee's understanding of next steps

6

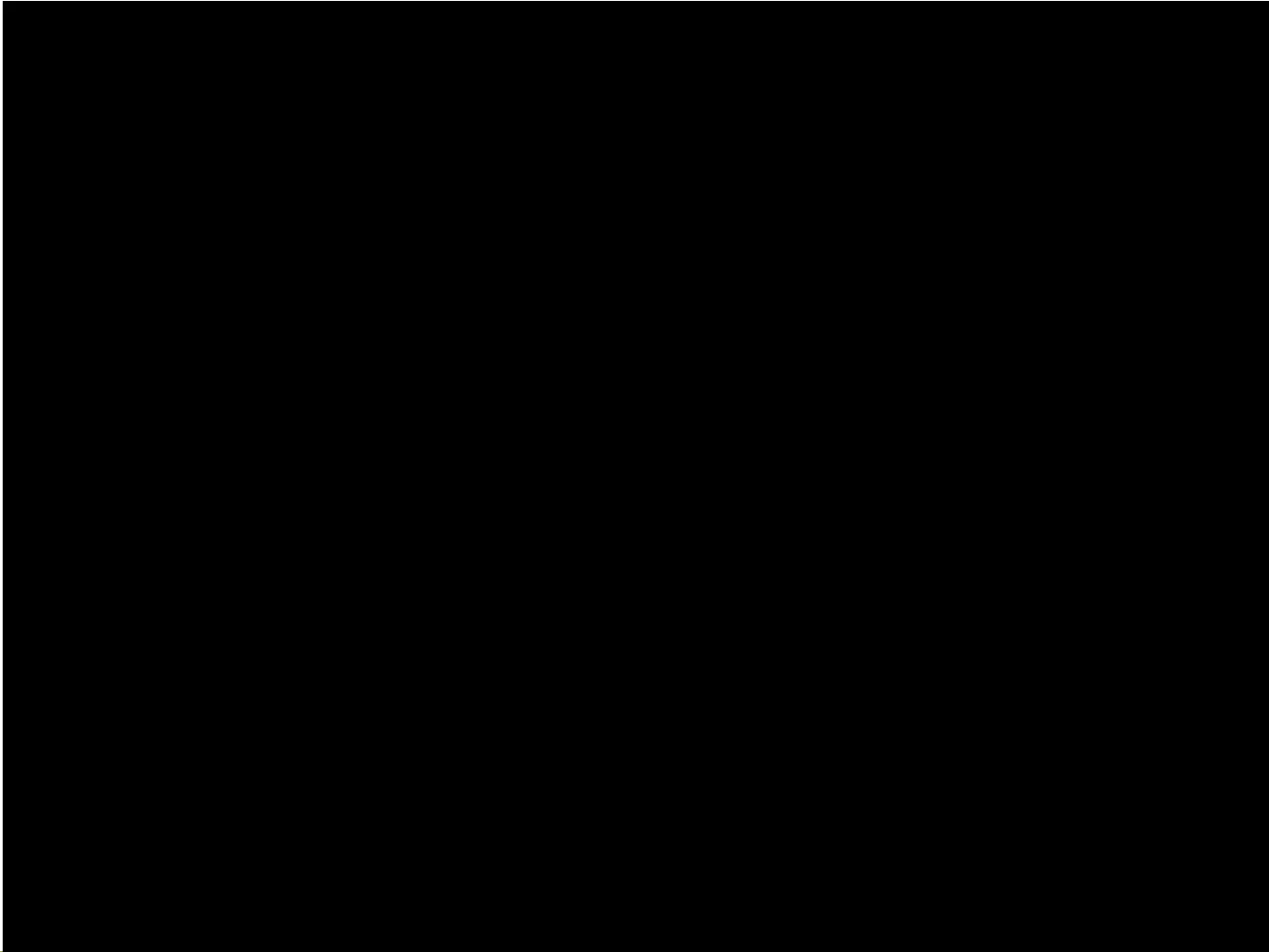
- **JUDGE** – assess trainee's capability to proceed

Coleman et al 2011 Colorec Dis



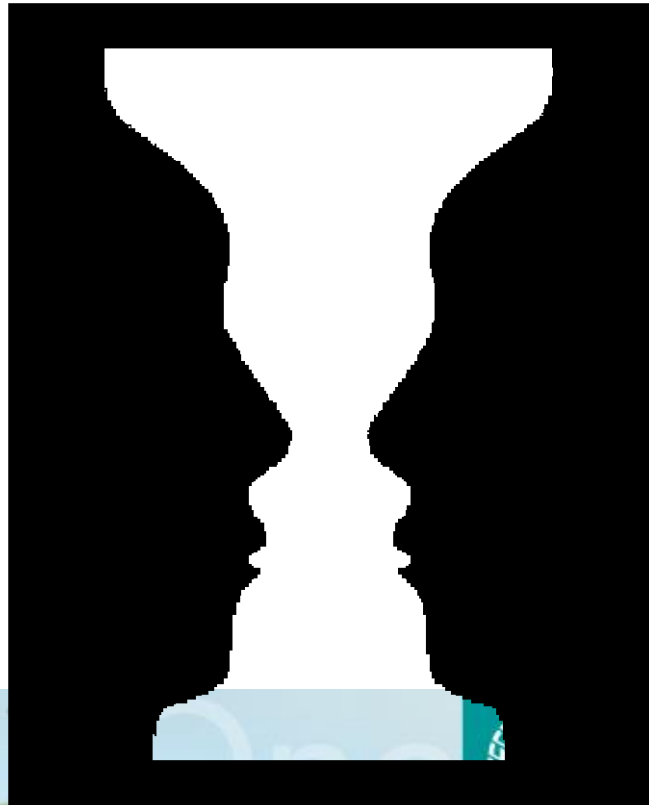
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Our Attention is Selective

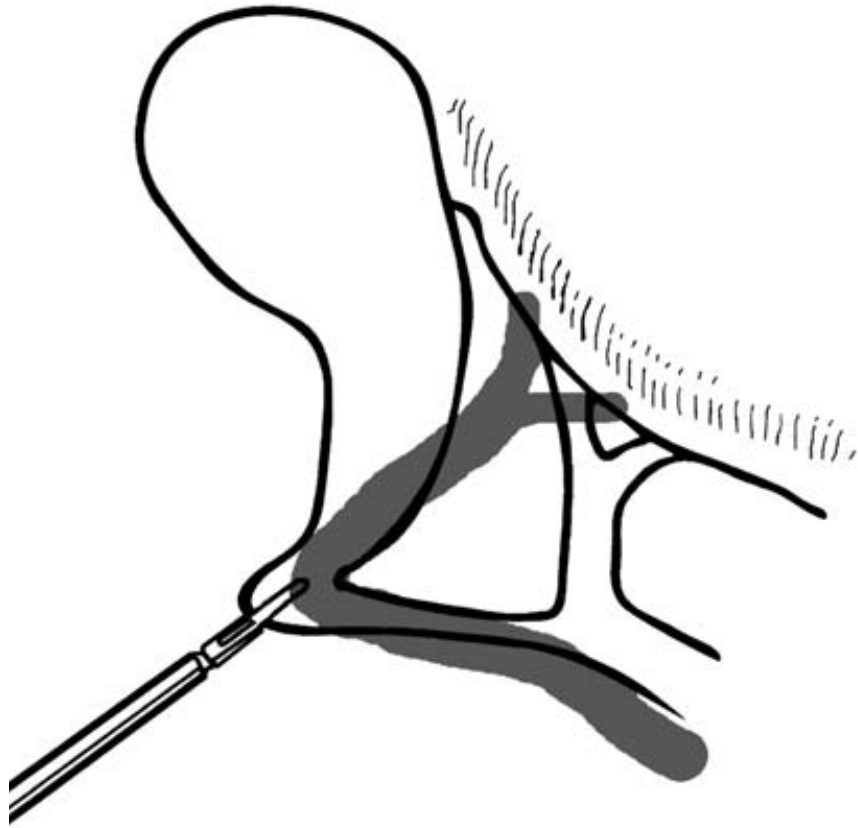


Heuristics: Psychology of Visual Perception and Decision Making

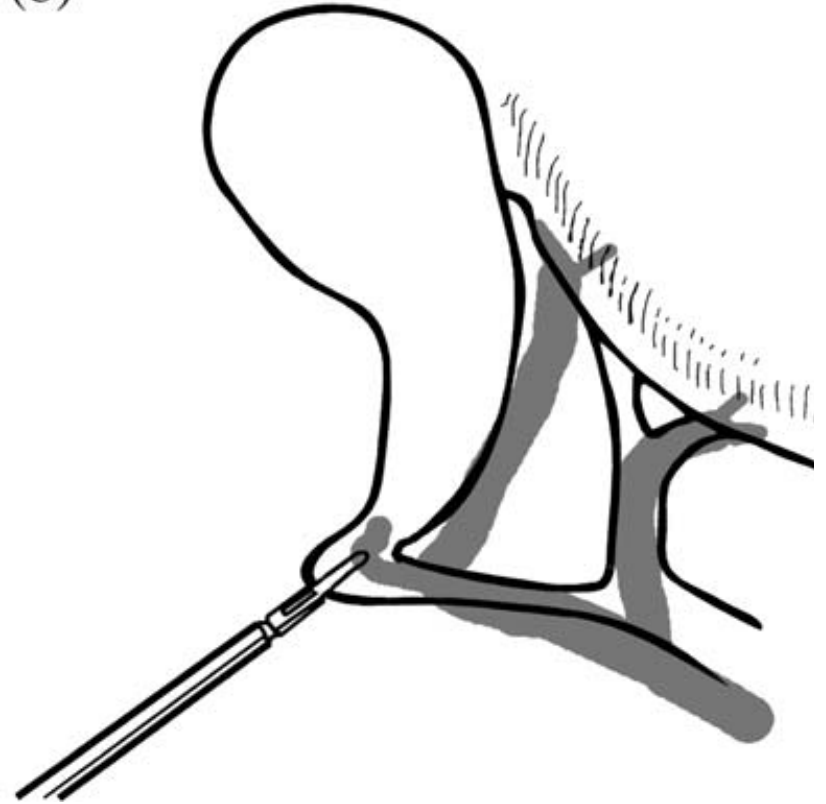
Heuristic is any approach to problem solving, learning, or discovery that employs a practical methodology not guaranteed to be optimal or perfect, but sufficient and expedient for the immediate goals



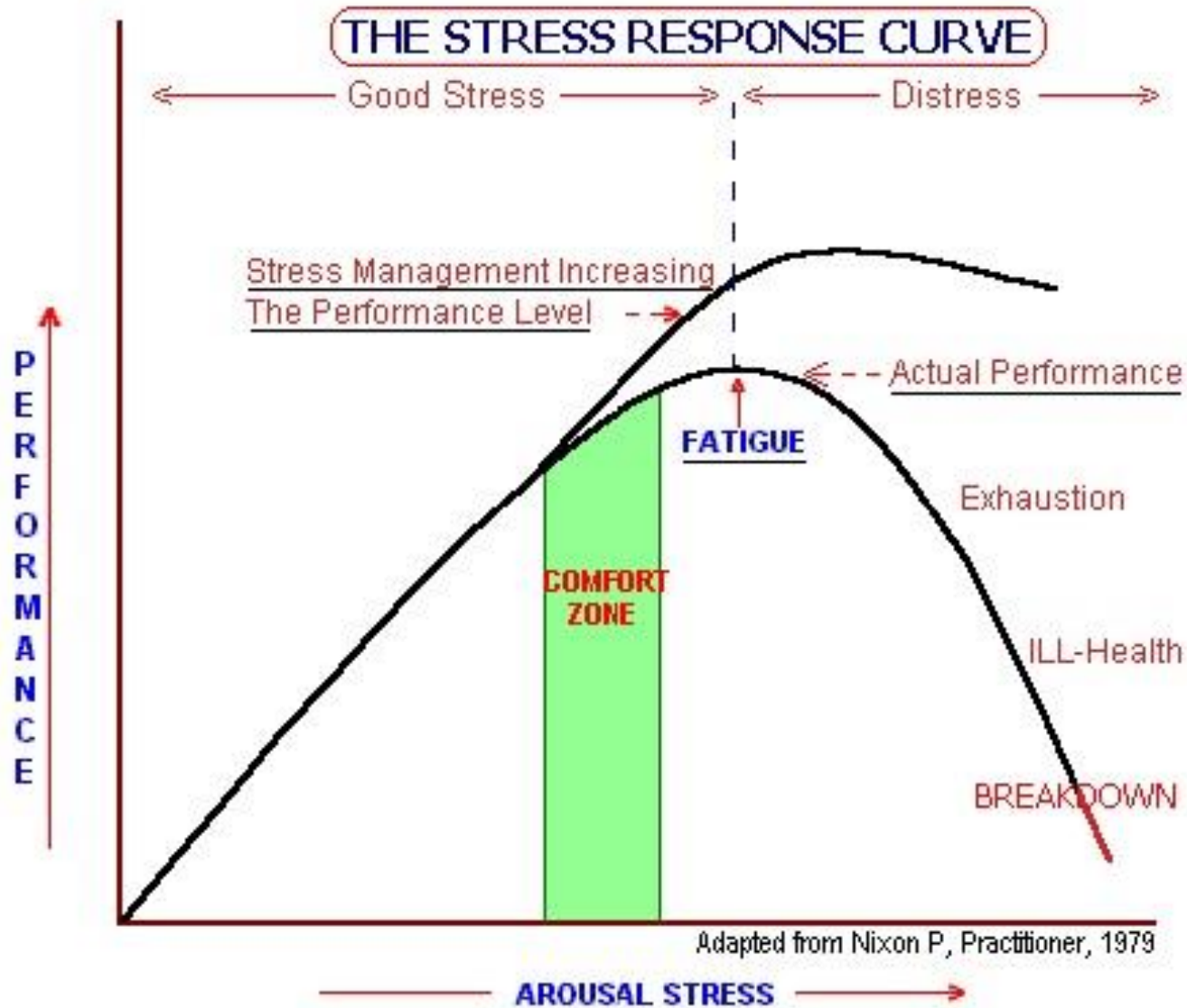
Heuristics during LC



(b)



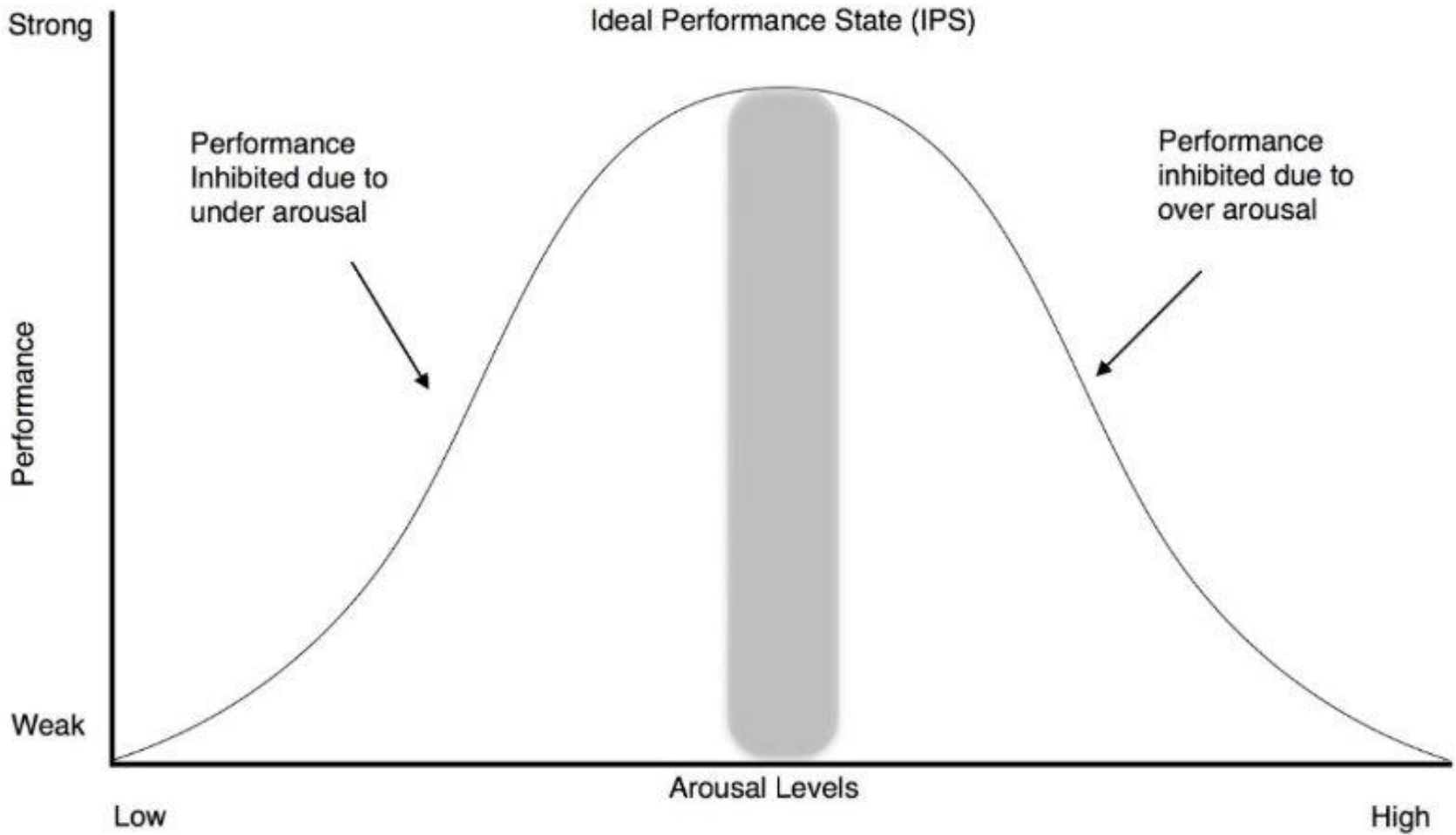
Stress and Performance



Fatigue



Ideal Performance State



Mental Training Definition

- Mental skills training aims at self-mastery, generated through self-knowledge, to enhance the psychological state of the individual
- The ability of the individual to control mental and emotional elements assists task performance as well as creating a psychological foundation for confidence and well-being¹
- When the individual feels as though they possess a degree of self-mastery in relation to psycho-somatic function, this serves to motivate continued efforts in attempting to increase performance²

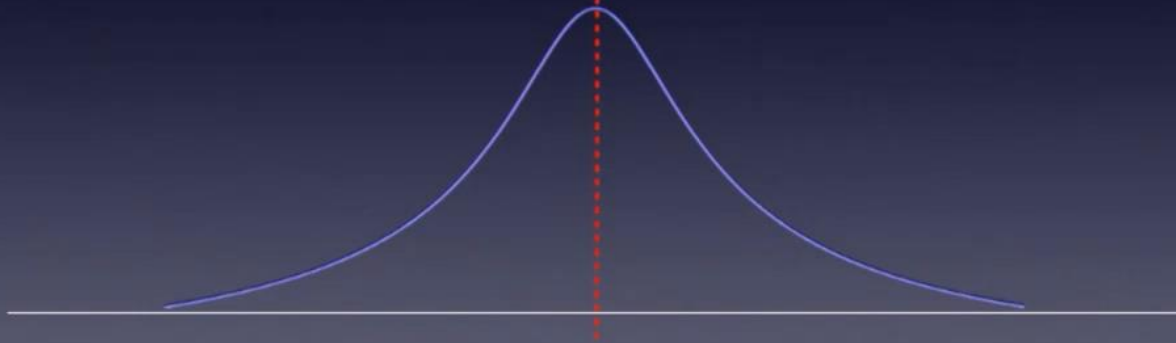


About Mental Skills Training

Making Average Excellent

Probability Distribution

Average



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Elements of Mental Training

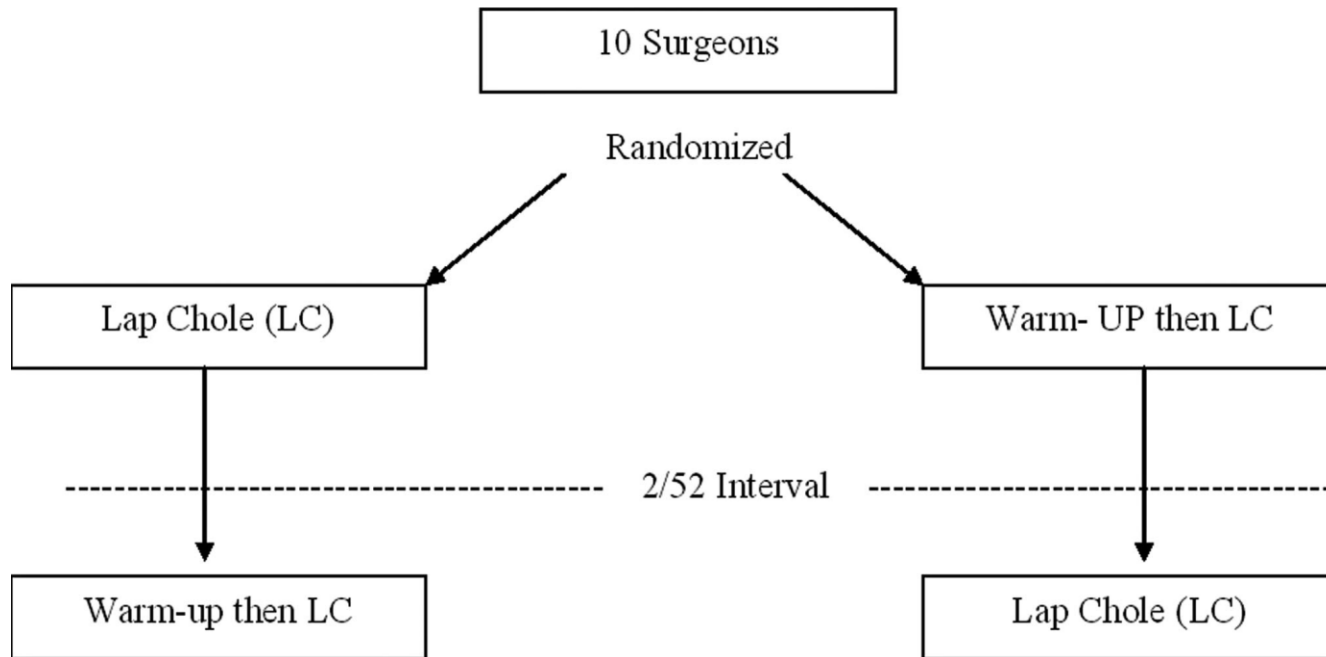
Mental skills training focuses upon core skills to develop mental toughness and mental strength such as

- Concentration
- Anxiety control
- Goal setting
- Motivation
- Relaxation techniques
- Imagery
- Self confidence

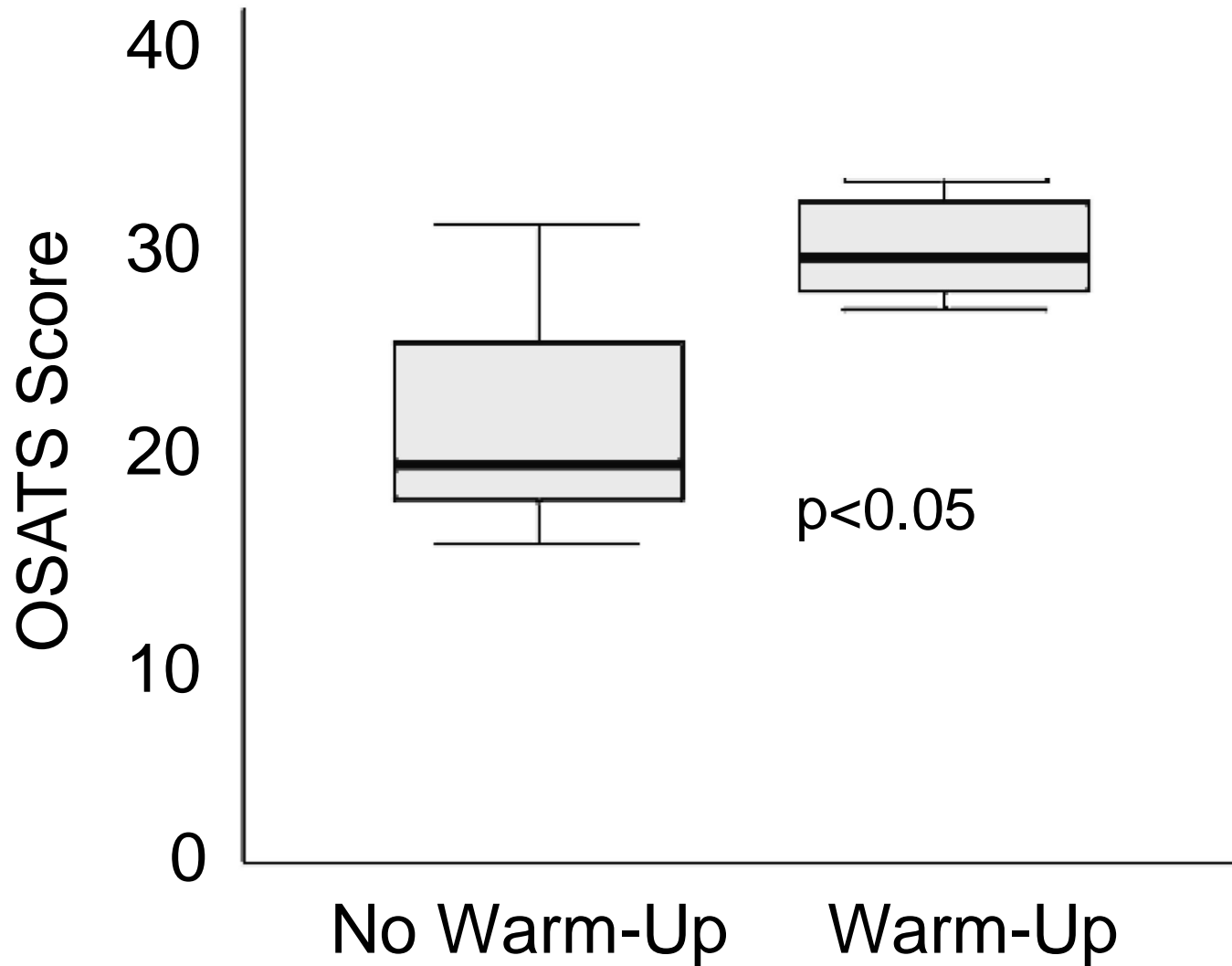


Effect of Warm-up on Performance

- 10 surgeons enrolled in a cross-over RCT
- 15 minutes warm-up on 3 VR tasks (Lap Sim)
- Video taped OR performance assessed (OSATS)



OR Performance



Take Home Points

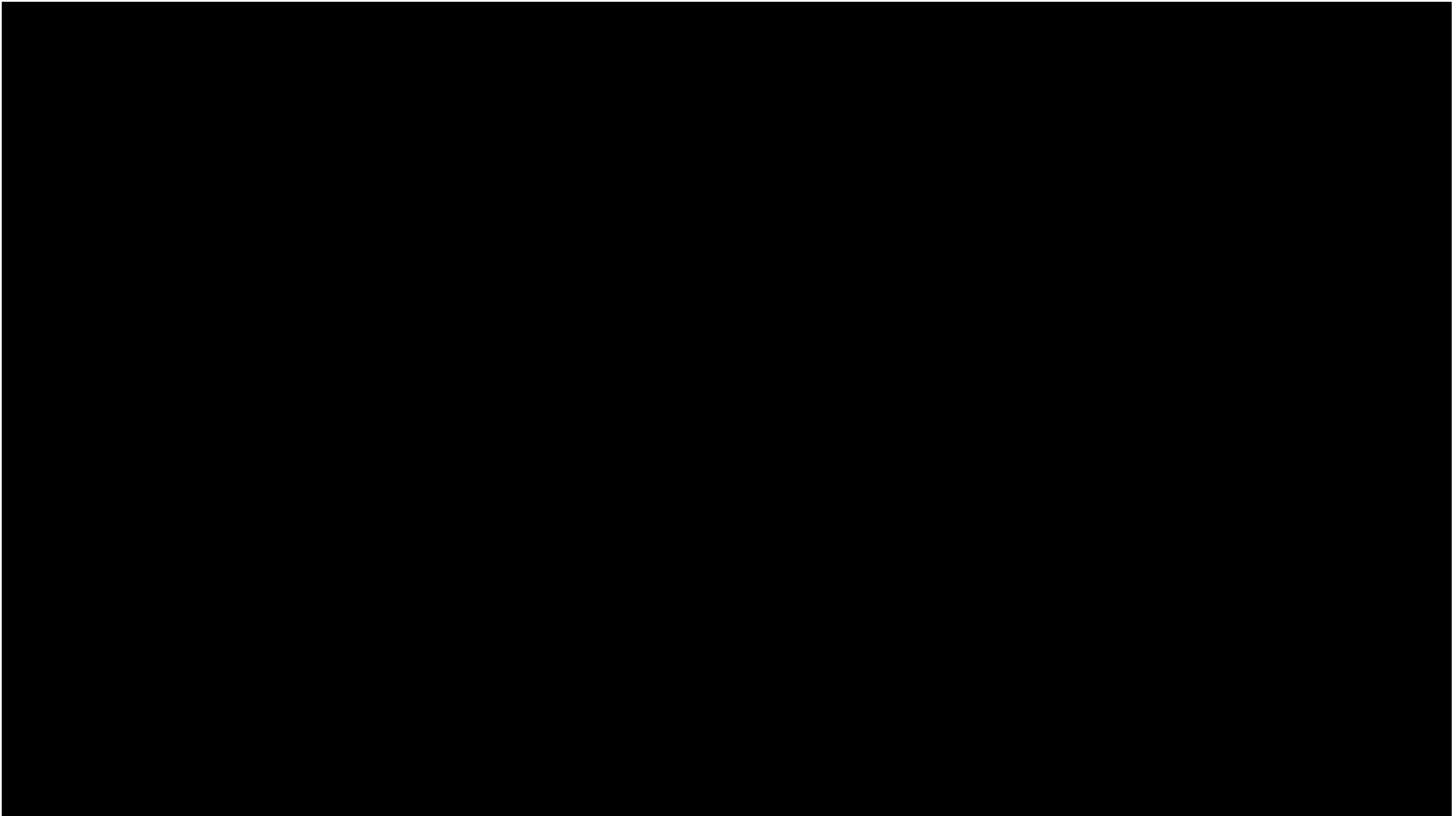
- Deliberate practice essential to improve skills
- Coaching significantly impacts performance
- Goal oriented (proficiency) training superior
- Performance affected by many factors such as stress
- Mental skills training can help optimize performance
- Understanding what the limitations of our attention are may help us become safer surgeons



Questions?



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Sources of Bias & Errors in Ratings

- **Halo effect** - one particular positive aspect is overemphasised and enhances the ratings for other patterns of behaviour
- **Horns effect** - one particular negative aspect is overemphasised and diminishes the ratings for other patterns of behaviour
- **Leniency** - tendency to give favourable (higher) ratings
- **Severity** - tendency to give unfavourable (lower) ratings
- **Primacy** - remembering better/over-weighting behaviours that were observed first
- **Recency** - remembering better/over-weighting behaviours that were observed last

Applications of simulation

- Importance of performance monitoring- mention how our residents progress in their skills over the years
- Team training? Videos?
- Resident feedback



Goal Setting

- Role of clear, effective goals in achieving performance excellence and building confidence; importance of clarifying both the tasks and processes essential for success in a procedure; includes
 - Technical (e.g., nodal points; clear performance plan)
 - Process (e.g., slow and steady; breath to remain calm)



Activation Management

- Skills to relax physically and mentally, as well as techniques for raising energy level when fatigued

Attention Management

- Techniques for maintaining attention on what is essential and ignoring distractions
 - Thought stopping
 - Self-talk
 - Re-directing attention



Imagery

- Techniques for mental rehearsal of both technical aspects and non-technical skills (e.g., managing emotions; successfully dealing with stressful events)

Refocusing Strategies

- Techniques and principles for handling various events that can be stress inducing or disruptive; learning how to develop specific, individualized strategies for coping; plans address both technical and non-technical aspects of situation



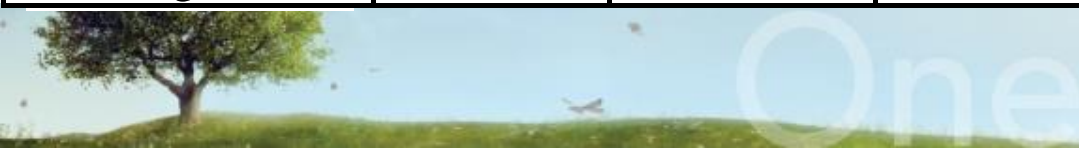
Upcoming Projects

- Mental Skills Training
- Fundamentals of Endoscopic Surgery
- Fundamentals of Robotic Surgery



Performance Benchmarks

	PGY 1 n=80	PGY 2 n=21	PGY 3 n=20	PGY 4 n=15	PGY 5 n=11	p-value (ANOVA)
2 handed knot tying	27±17	36±11	41±12	39±13	43±6	<0.001
1 handed knot tying	30±16	46±7	47±7	50±4	51±3	<0.001
Knot tying under tension	22±16	38±12	36±15	39±14	43±11	<0.001
Difficult knot tying	18±15	23±15	25±19	35±18	31±19	0.003
Interrupted Suturing	74±22	85±18	84±17	92±12	90±11	0.002
FLS Peg Transfer	133±75	200±52	223±46	240±24	239±14	<0.001
FLS Pattern Cut	57±65	105±83	124±77	182±65	180±24	<0.001
FLS intracorp. suturing	130±147	268±173	343±173	361±170	376±154	<0.001



COACHING MODEL

