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

Dimitrios Stefanidis, MD, PhD, FACS, FASMBS
Associate Professor of Surgery, CHS
Surgical & Research Director, Carolinas 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
Surgeon’s Competencies

- **Technical Expertise**
  - Recognising conditions for which surgery may be necessary
  - Maintaining dexterity & technical skills
  - Defining scope of practice

- **Professionalism**
  - Having awareness & insight
  - Observing ethics & probity
  - Maintaining health & well-being

- **Judgement & Decision-Making**
  - Considering options
  - Planning ahead
  - Implementing & reviewing decisions

- **Medical Expertise**
  - Demonstrating medical skills & expertise
  - Monitoring & evaluating care
  - Managing safety & risk

- **Scholarship & Teaching**
  - Showing commitment to lifelong learning
  - Teaching, supervision & assessment
  - Improving surgical practice

- **Management & Leadership**
  - Setting & maintaining standards
  - Leading that inspires others
  - Supporting others

- **Collaboration & Teamwork**
  - Documenting & exchanging information
  - Establishing a shared understanding
  - Playing an active role in clinical teams

- **Health Advocacy**
  - Caring with compassion & respect for patient rights
  - Meeting patient, carer & family needs
  - Responding to cultural & community needs

- **Communication**
  - Gathering & understanding information
  - Discussing & communicating options
  - Communicating effectively

(R.A.C.S.)

Collins et al 2007 ANZ J Surg
<table>
<thead>
<tr>
<th>Responsibility extends to others and the environment.</th>
<th>“Dreyfus Model of Skill Acquisition”</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sense of responsibility increases with experience.</td>
<td>Proficient</td>
<td></td>
</tr>
<tr>
<td>Sense of responsibility arises from actively making decisions.</td>
<td>Competent</td>
<td></td>
</tr>
<tr>
<td>Still does not experience personal responsibility.</td>
<td>Advanced Beginner</td>
<td></td>
</tr>
<tr>
<td>Only feels responsible to follow the rules.</td>
<td>Novice</td>
<td></td>
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<thead>
<tr>
<th>Practice</th>
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<tr>
<td>Fellowship</td>
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<td>Residency</td>
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### 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. | “Intuition aids in identifying the situation; the actions are governed by the principals.” | “Just does what works.” |
| “Only capable of following the rules” | “Rules have nuance and became conditional in nature” | “Higher order rules shape contexts and conditions” | | | | |
How We Acquire Psychomotor Skills

Fitts and Posner (1967)

COGNITIVE STAGE
Development of basic movement pattern

ASSOCIATIVE STAGE
Refinement of movement pattern

AUTONOMOUS STAGE
Performance of movement virtually automatic
Performance Changes During Skill Acquisition

- Cognitive
- Associative
- Autonomous
Acquisition of Skills by Individuals
Why Case Numbers Don’t Work

# Training Events/ Cases
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
The graph illustrates the estimated accumulated practice (in hours) of violinists at different levels: Best, Good, Teachers, and Professionals, as a function of their age. The data shows a clear upward trend, indicating that the more experienced violinists (Professional and Teachers) have accumulated more practice hours than the less experienced ones (Best and Good). The best violinists reach the highest number of practice hours, followed by good violinists, then teachers, and finally professionals with the least amount of practice hours. This suggests that extensive practice is a significant factor in achieving high skill levels in violin playing.
Frequent Popular Science Writing Topic
Deliberate Practice Important BUT…

- 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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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
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?


- 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
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

- Assess Skills Through Video
- Identify Areas for Growth
- Deliberate Practice with Coaching
- Group and Individual Coaching Sessions
- Monitor Patient Outcomes
Prerequisites for Optimal Skill Acquisition

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Goal Oriented Training: Proficiency-based
Going Beyond Proficiency: Effect of Overlearning on Performance

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

[Graph showing score changes over time for Control Group and Ongoing Training Group]
Simulation allows all these principles to be put in action

Learning Curve of New Skills
Optimal Skills Curriculum Design
The Value of Simulation

Baseline Assessment → Distributed Training Sessions → Training Goal → Overlearning → Maintenance Training

Demonstration Video Tutorials → Feedback/Coaching

Post Training Assessment

Adjusted to level of Trainee

= Training session

Stefanidis Arch Surg 2009

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

Module 1: Introduction to Robotic Surgical Systems

Module 2: Didactic Instructions

Module 3: Psychomotor Skills Curriculum

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
Performance & Attentional Capacity

Cognitive | Associative | Autonomous

0 | 25 | 50 | 75 | 100
Performance & Attentional Capacity

Cognitive  Associative  Autonomous

Spare  Used
Can Spare Attentional Capacity Be Measured?
Is Training to Automaticity Superior?

Using secondary task performance goals led to more robust skill acquisition and skill transfer.
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
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
Stress and Performance

**THE STRESS RESPONSE CURVE**

- Good Stress
- Distress

Stress Management Increasing
The Performance Level

- Actual Performance
- Fatigue
- Comfort Zone
- Breakdown
- Ill-Health
- Exhaustion

Adapted from Nixon P, Practitioner, 1979

**AROUSAL STRESS**
Fatigue
Ideal Performance State

Performance

Strong

Weak

Performance Inhibited due to under arousal

Ideal Performance State (IPS)

Performance inhibited due to over arousal

Arousal Levels

Low

High
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-being\(^1\).

• 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 performance\(^2\).

\(^1\) Boyd & Zenong 1999
\(^2\) Wuff & Toole 1999
About Mental Skills Training

Making Average Excellent

Probability Distribution

Average
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

OSATS Score

No Warm-Up

Warm-Up

p<0.05
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?
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.

Flin et al, 2009
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

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

Develop Relationship

Building Trust

G
Goals – What do you need to achieve?

R
Reality – What is happening now?

O
Options – What could you do?

W
Will – What will you do?

T
Tactics – How and when will you do it?

H
Habits – How will you sustain success?

Results

Celebrate results!