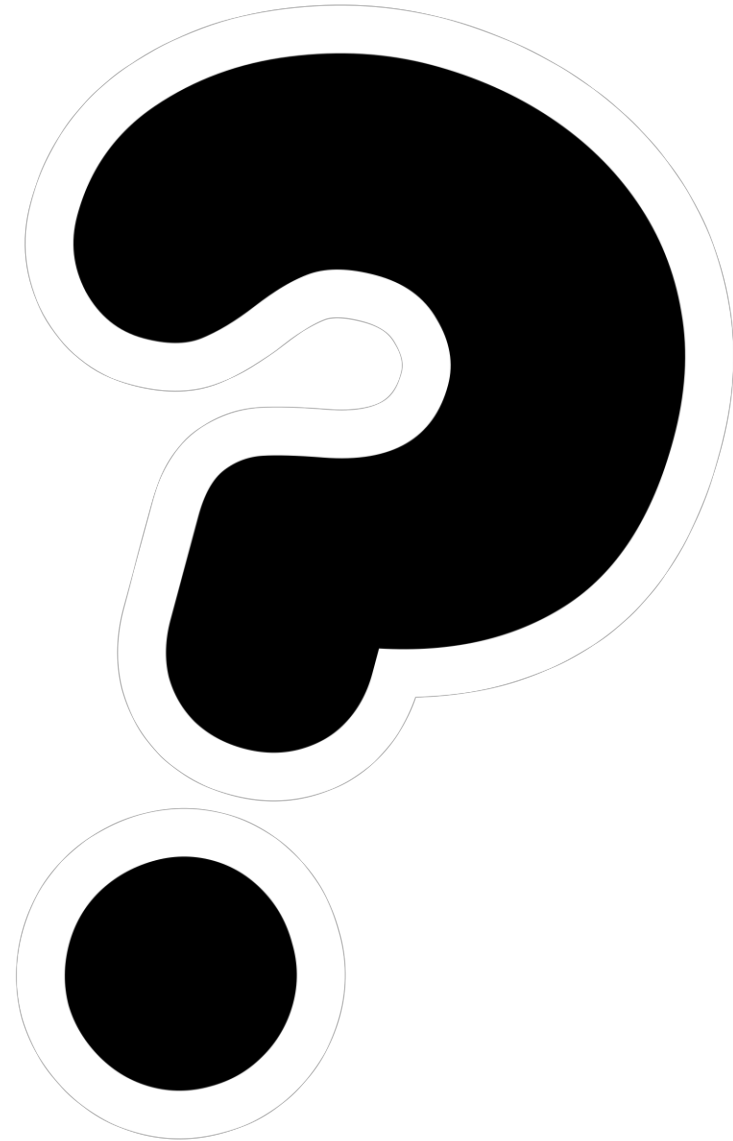


Intraoperative Teaching and Learning

Thoughts from the surgical education research residents

"I would love to see all of you guys being given more autonomy in the OR, because you guys have so much less than even when I was a resident"

Faculty Perspective



Roadmap

- Contrast intraoperative teaching and learning
- Discuss perspectives and evidence on four topics
- Highlight strategies to increase learning/autonomy
 - What trainees can do
 - What faculty can do



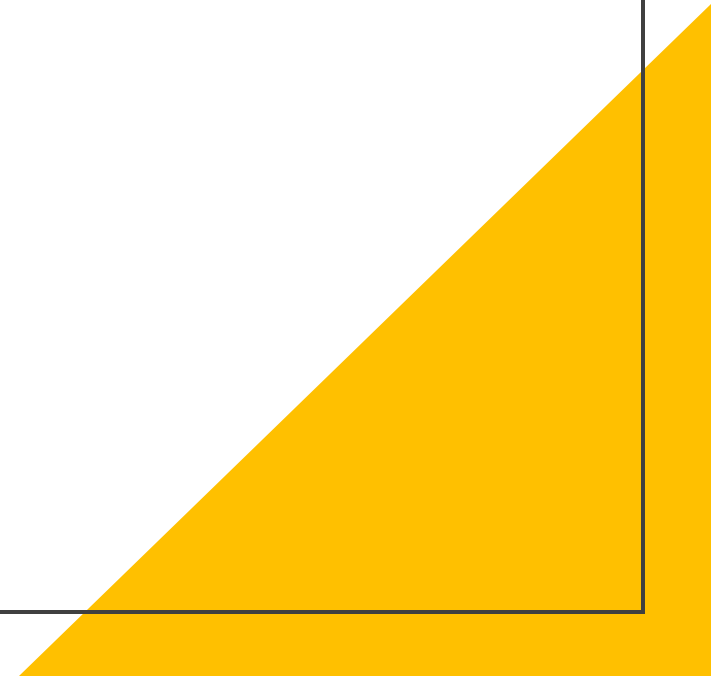



Teaching

Learning

Topic #1

Preparation and Experience






"Oftentimes, the exposure that people rely on is in the operating room, when it doesn't necessarily need to be... a lot of the basic stuff could be done outside the operating room"

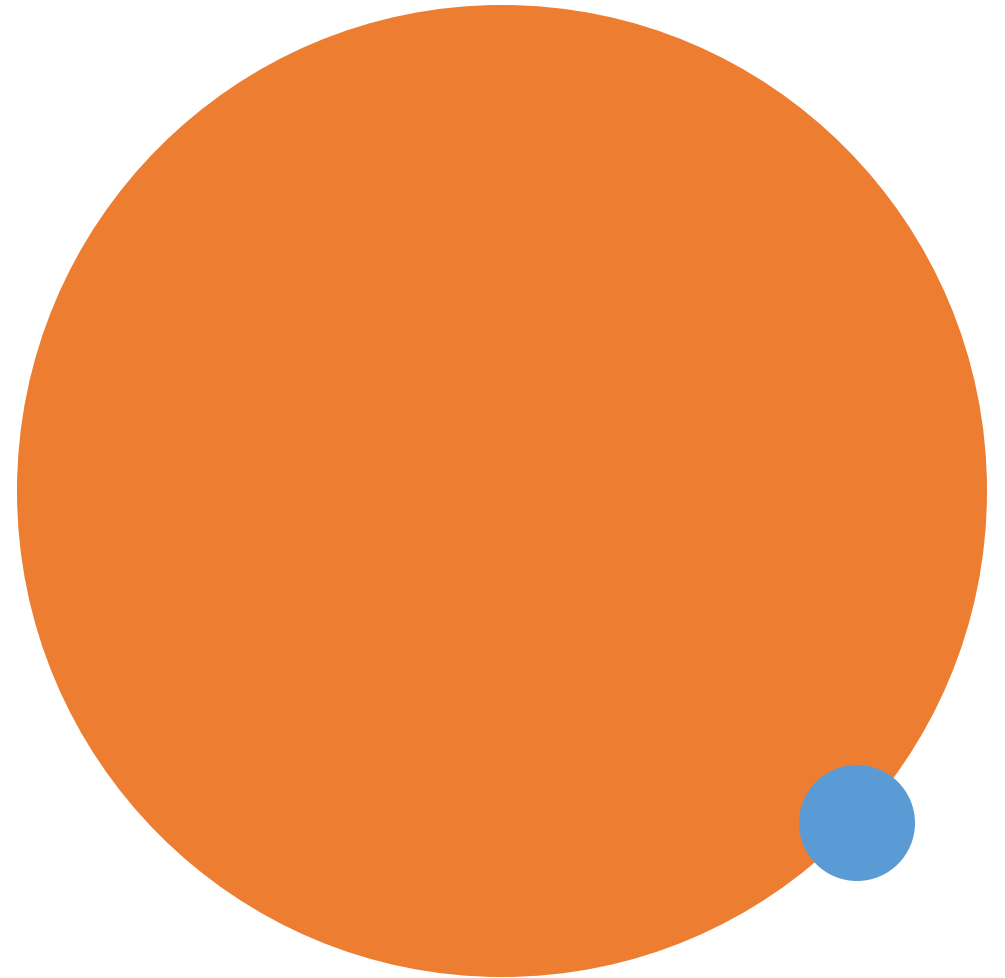
Faculty Perspective





"The less familiar I am with the case, the more consistent ongoing feedback I want. And the more familiar I am with the case, I like it when they let me just struggle a little bit"

Resident Perspective



Evidence: Preparation and Experience

- Surgical simulation improves performance in the OR
- Many basic and advanced skills readily learned by simulation

Comparative Study > [Surg Endosc.](#) 2017 Jan;31(1):135-141. doi: 10.1007/s00464-016-4942-6.

Epub 2016 May 2.

Simulation-trained junior residents perform better than general surgeons on advanced laparoscopic cases

[Camilo Boza](#)¹, [Felipe León](#)¹, [Erwin Buckel](#)¹, [Arnoldo Riquelme](#)², [Fernando Crovari](#)¹,
[Jorge Martínez](#)¹, [Rajesh Aggarwal](#)^{3 4}, [Teodor Grantcharov](#)⁵, [Nicolás Jarufe](#)¹, [Julián Varas](#)⁶

Affiliations + expand

PMID: 27139703 DOI: [10.1007/s00464-016-4942-6](#)

Early exposure should be through simulation

Evidence: Preparation and Experience

- Preparation goes beyond technical skills
 - What is the surgical indication?
 - What prior treatment has the patient had?
 - What prior surgery has the patient had?
 - What is the patient's anatomy?
 - What did the imaging show?
- Take understanding of case to identify goals
- Practice with mental rehearsal

"A motor task is rehearsed in the mind without actual physical movement"



Evidence: Preparation and Experience

- Studies have randomized trainees to mental rehearsal or not
- Improvements in multiple technical areas following mental rehearsal
 - Global rating scores, OSATS, and others

RANDOMIZED CONTROLLED TRIAL

Mental Training in Surgical Education

A Randomized Controlled Trial

Immenroth, Marc PhD^{*}; Bürger, Thomas[‡]; Brenner, Jürgen MD[‡]; Nagelschmidt, Manfred PhD[§]; Eberspächer, Hans PhD[†]; Troidl, Hans MD[§]

[Author Information](#) 

Annals of Surgery 245(3):p 385-391, March 2007. | DOI: 10.1097/01.sla.0000251575.95171.b3

Evidence: Cognitive Load

- Even with preparation: must reduce extraneous cognitive load

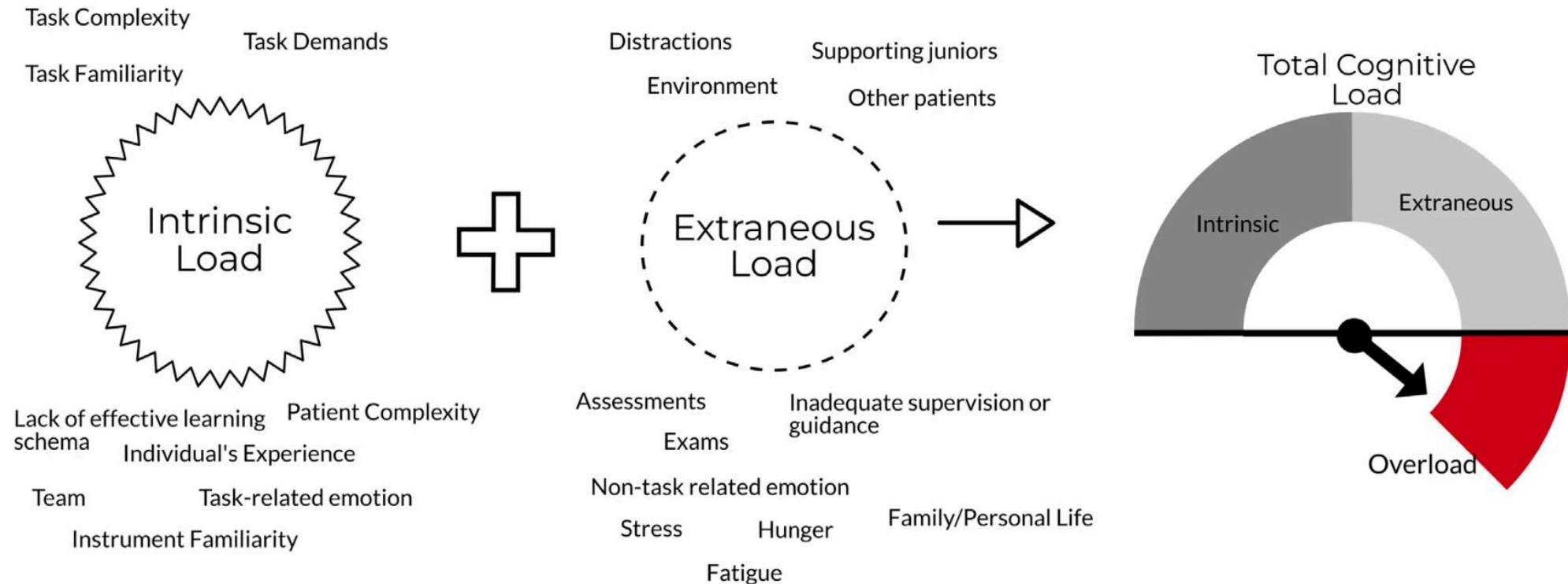


FIGURE 2. Contributing factors to cognitive load in surgery.

Evidence: Cognitive Load

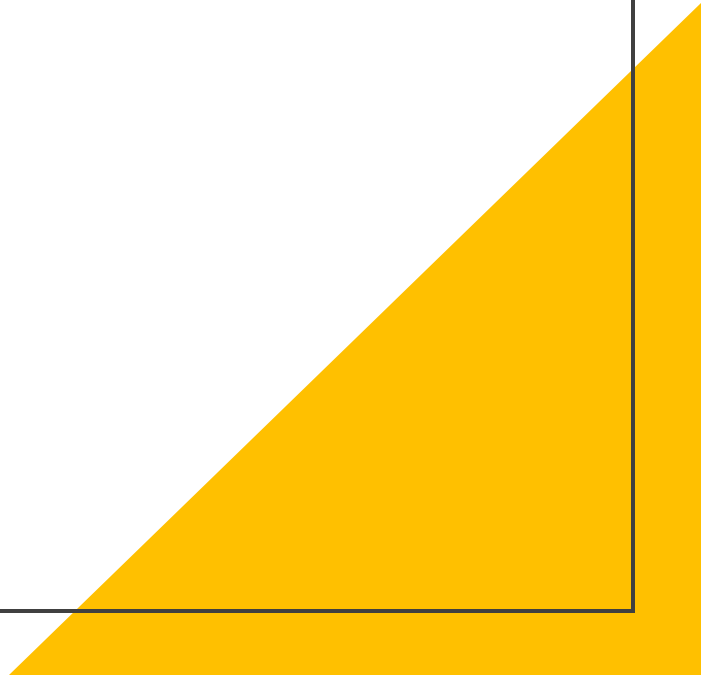
- Too little *or* too much instruction increases cognitive load
 - Too little instruction creates uncertainty: am I doing the right thing?
 - Too much instruction creates distraction: why can't I focus?
 - This will change based on prior experience
- Not providing rationale increases cognitive load
 - Why are we doing this?
- Cognitive overload prevents learning and decreases performance


Suggestions / Strategies

- Trainees can practice relevant skills prior to cases
 - Mentally rehearse steps of the operation
 - Physically practice - example: practice laparoscopic knot tying prior to a Nissen
- Faculty can reduce extraneous cognitive load
 - Ask trainees about their experience with cases
 - Avoid excess instruction or prolonged silence
 - Provide rationale when possible

Topic #2

Learning/teaching through challenges





"They just couldn't see the planes... I had to kind of take over"

Faculty Perspective



"That's very frustrating... If then the teaching also stops at that point too, because they take over and there's not much interaction"

Resident Perspective

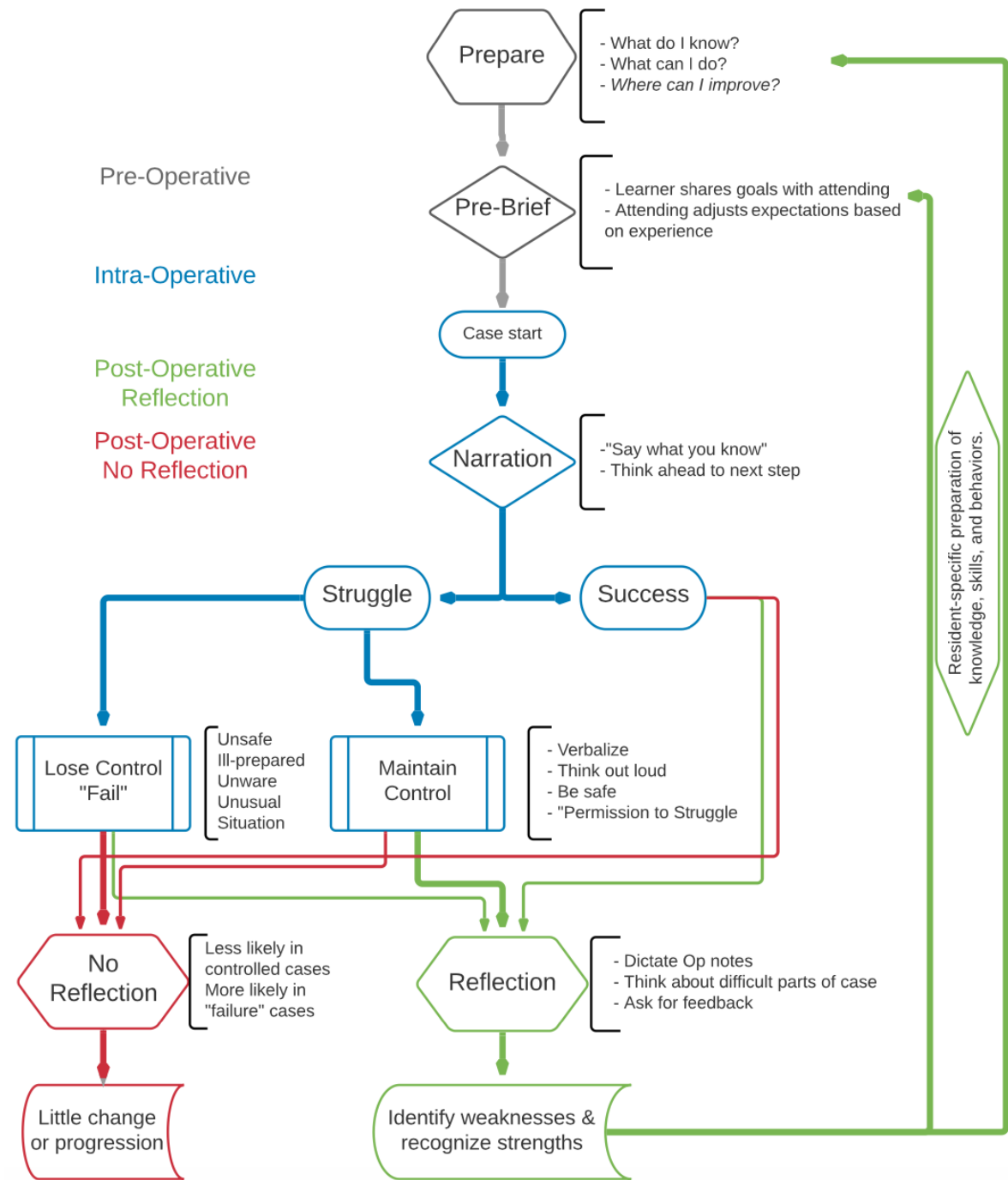


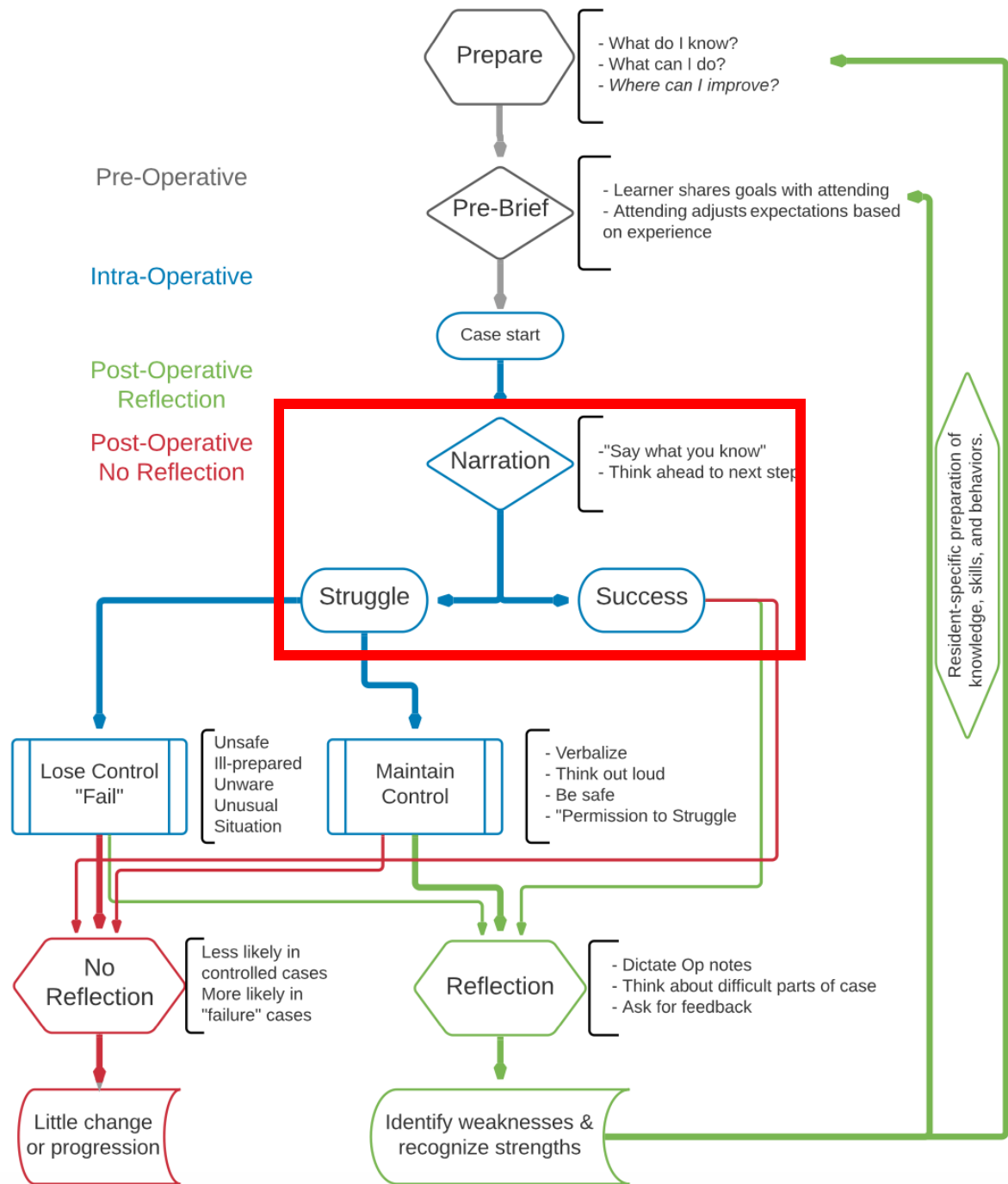
Evidence: Learning/Teaching Through Challenges

- Taking over is common
 - Sometimes it is necessary for patient safety
 - Sometimes it is unnecessary: "I don't like the way it looks"
- Many qualitative studies have addressed take over
 - Trainees understand take over may be necessary

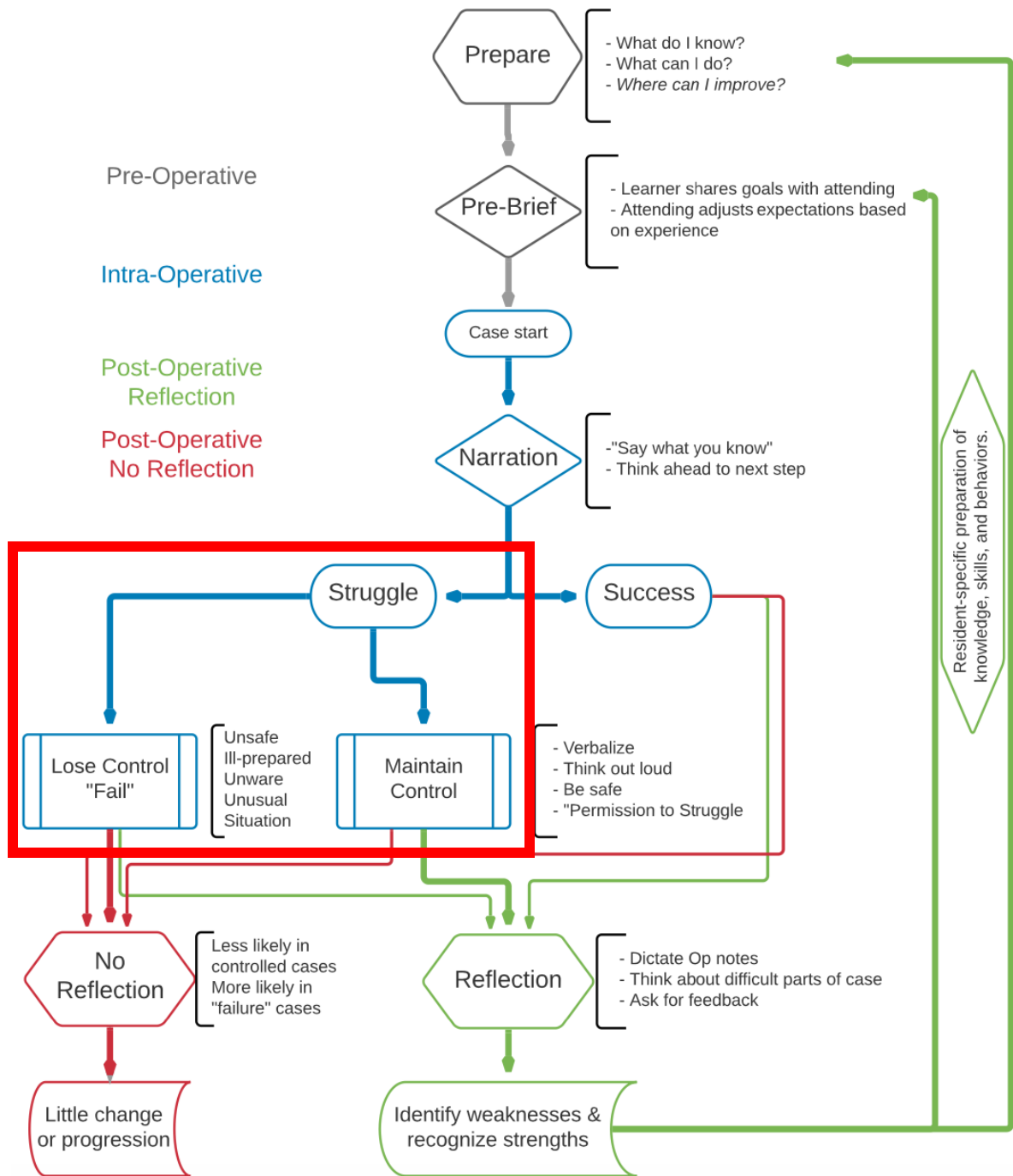
Evidence: Learning/Teaching Through Challenges

- Several things can happen with take over

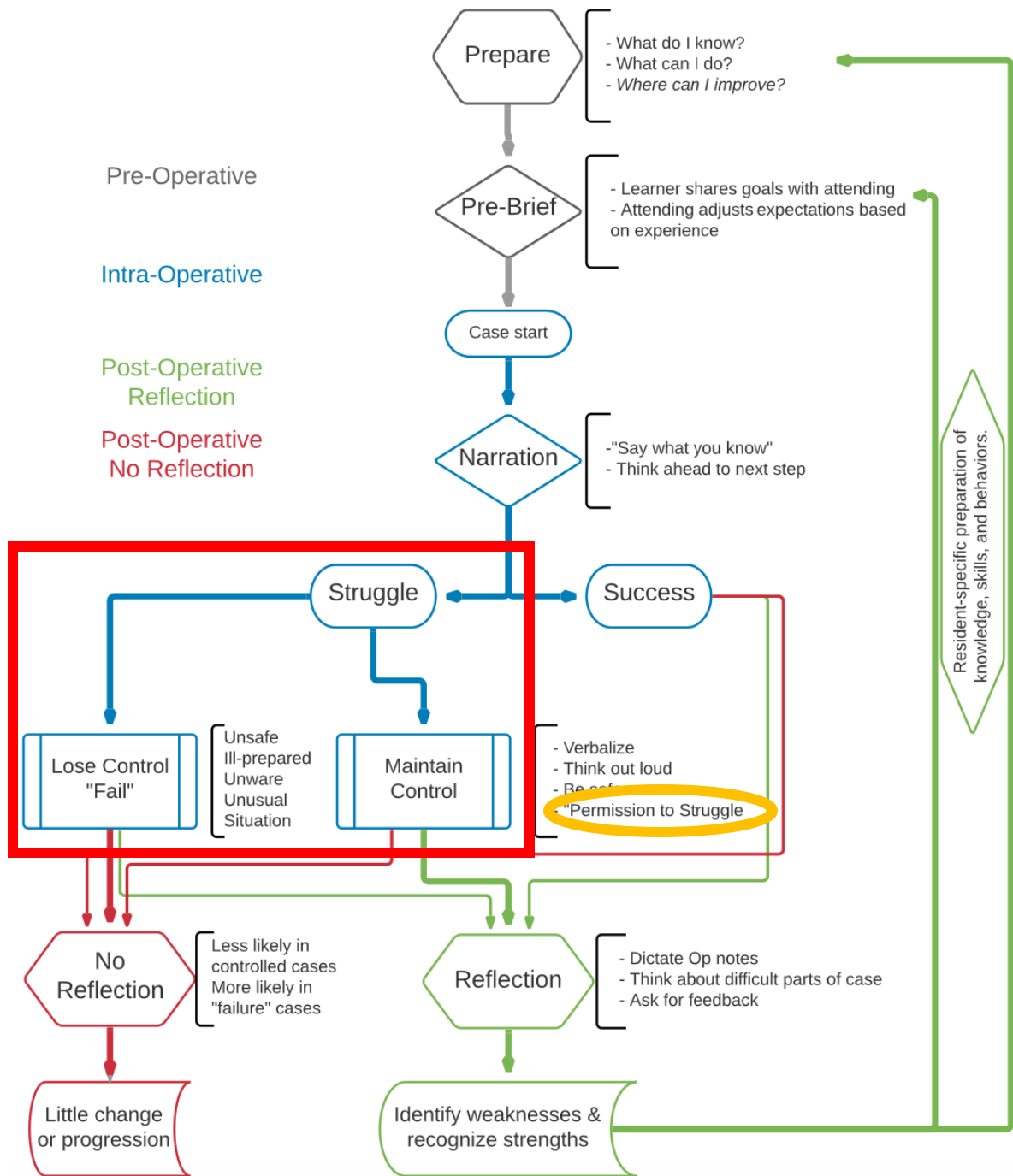




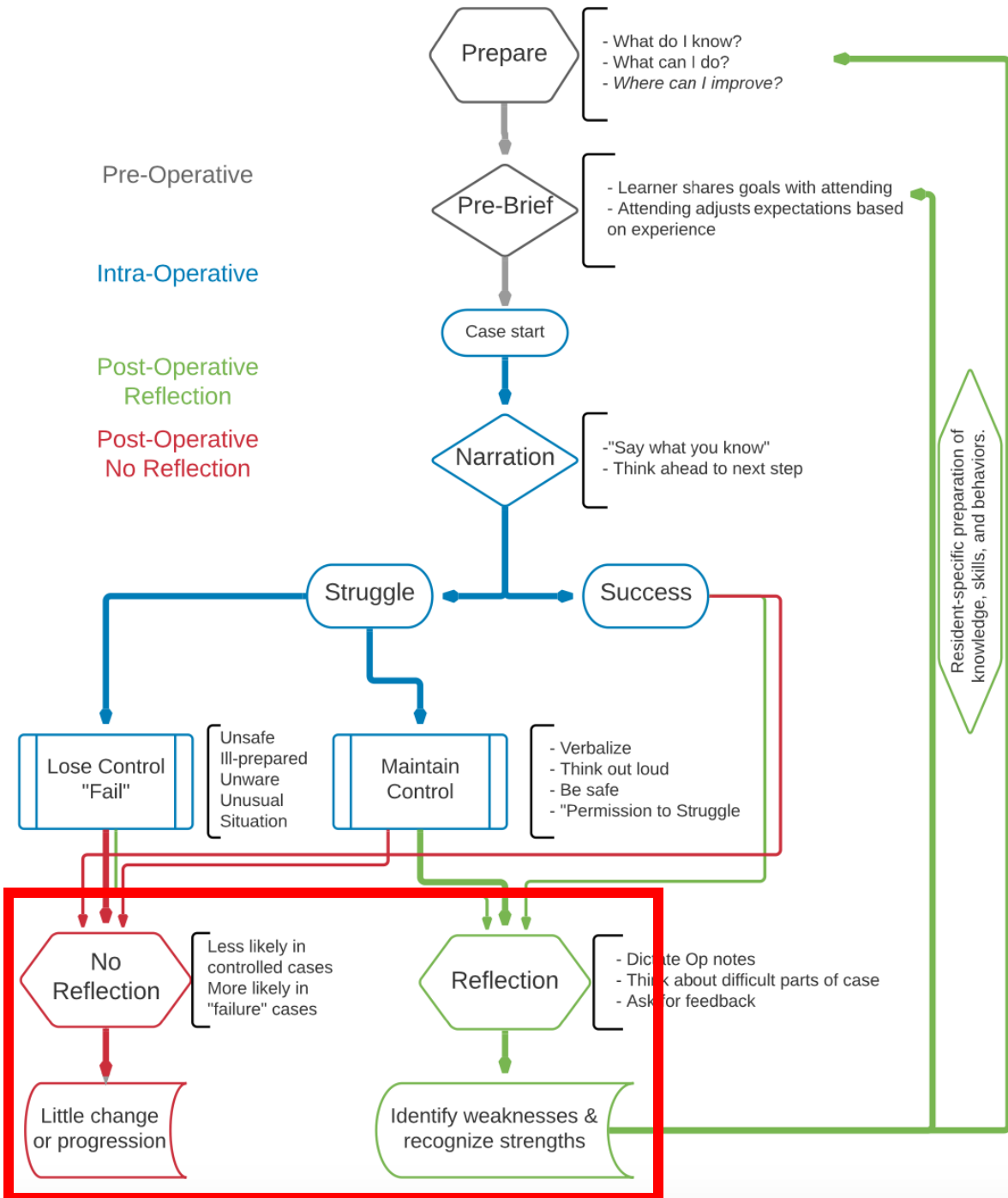
Take over may start with a struggle



Struggle results in losing control or maintaining control



Struggle results in losing control or maintaining control



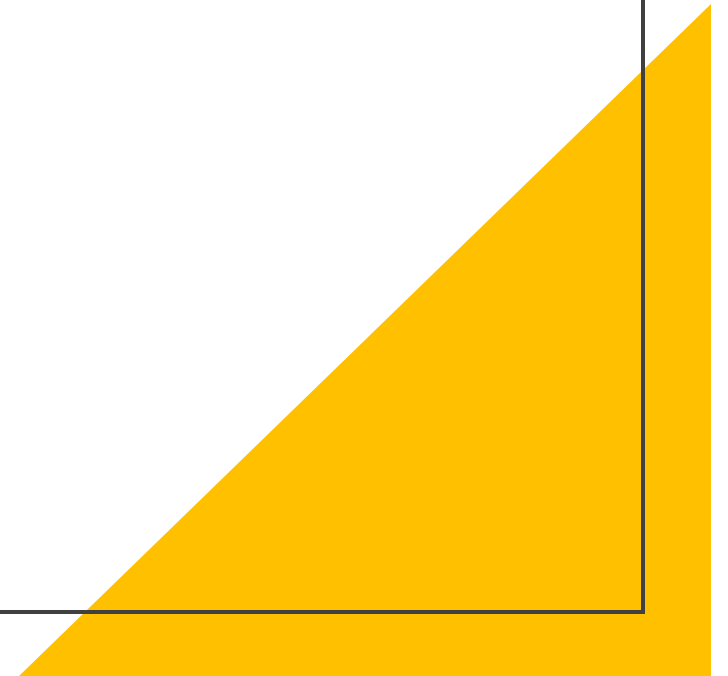
After losing control, there can be reflection or no reflection

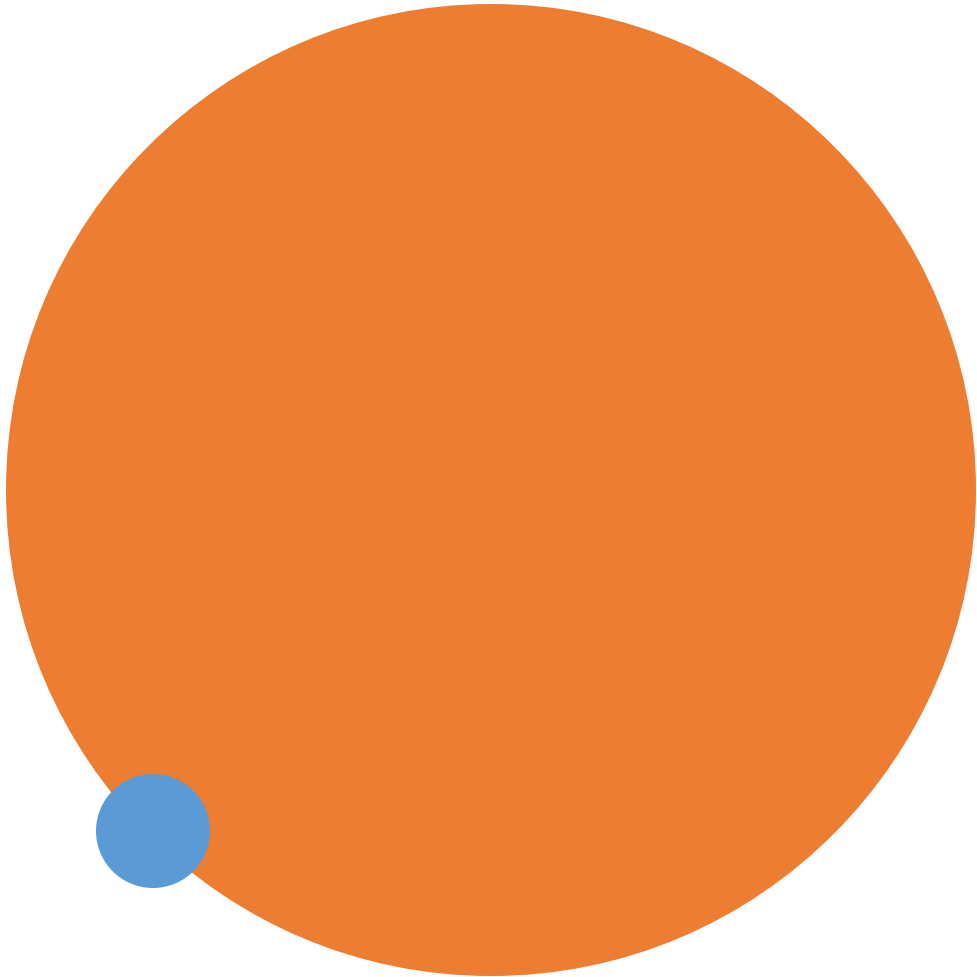
Suggestions / Strategies

- Trainees can stay engaged during take over
 - Continue to assist
 - Keep asking questions and reflect
- Faculty can optimize take over
 - Provide rationale for take over
 - Continue describing anatomy, thought processes, and operative steps after take over
 - Reinvolve trainees when safe

Topic #3

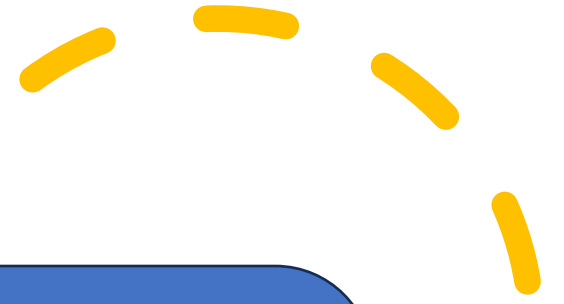
Reinforcing and corrective feedback

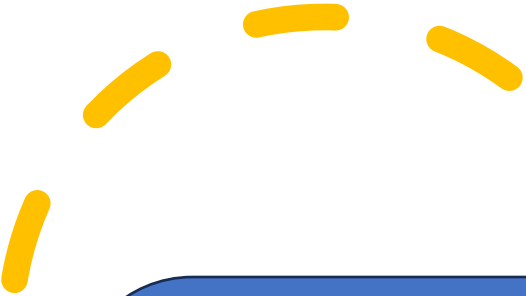




"I think it's important to have
as much positive feedback as
negative"

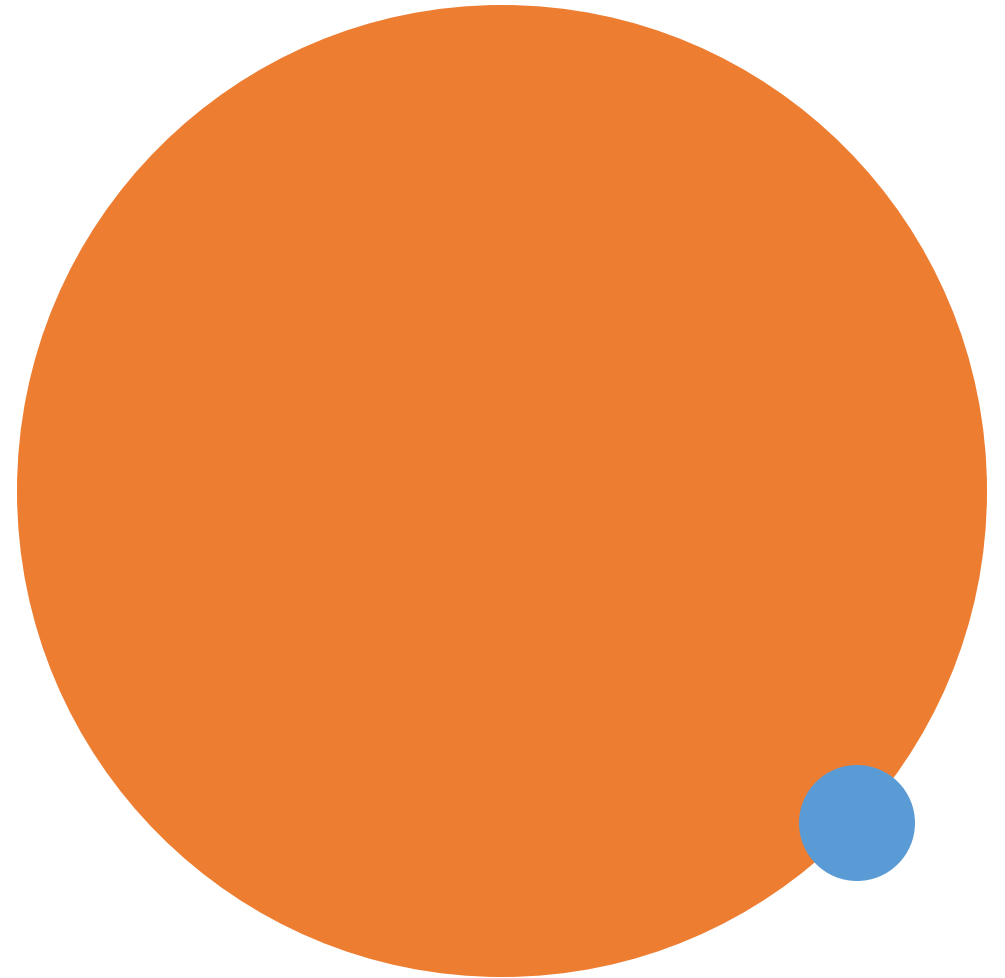
Resident Perspective





"Certain professions do require a little bit of tough love, you know? Tough love is still a type of love"

Faculty Perspective



Evidence: Reinforcing and Corrective Feedback

- Feedback receptivity relates to mindset
- Belief in ability to improve -> more growth from feedback



Evidence: Reinforcing and Corrective Feedback

- Studies of feedback valence and laparoscopic performance
 - Two RCTs assigned students (n=65) to (+) or (-) feedback
 - Bottom line: include both (+) and (-)



Kannappan A, Yip DT, Lodhia NA, Morton J, Lau JN. The Effect of Positive and Negative Verbal Feedback on Surgical Skills Performance and Motivation. *Journal of Surgical Education*. 2012;69(6):798-801. doi:[10.1016/j.jsurg.2012.05.012](https://doi.org/10.1016/j.jsurg.2012.05.012)

Flinn JT, Miller A, Pyatka N, Brewer J, Schneider T, Cao CGL. The effect of stress on learning in surgical skill acquisition. *Medical Teacher*. 2016;38(9):897-903. doi:[10.3109/0142159X.2015.1114597](https://doi.org/10.3109/0142159X.2015.1114597)

Evidence: Reinforcing and Corrective Feedback

- Be specific about both (+) and (-)



Actionable feedback is one of the most important considerations by trainees

Evidence: Reinforcing and Corrective Feedback

- Be specific about both (+) and (-)
 - "Good job" <<< "Good job promoting case progression by asking for instruments right when we needed them"



Evidence: Reinforcing and Corrective Feedback

- Be specific about both (+) and (-)
 - "Good job" <<< "Good job promoting case progression by asking for instruments right when we needed them"
 - "Keep practicing" <<< "You struggled getting needle angles with the anastomosis. Practice suturing at depth and see how angles change"

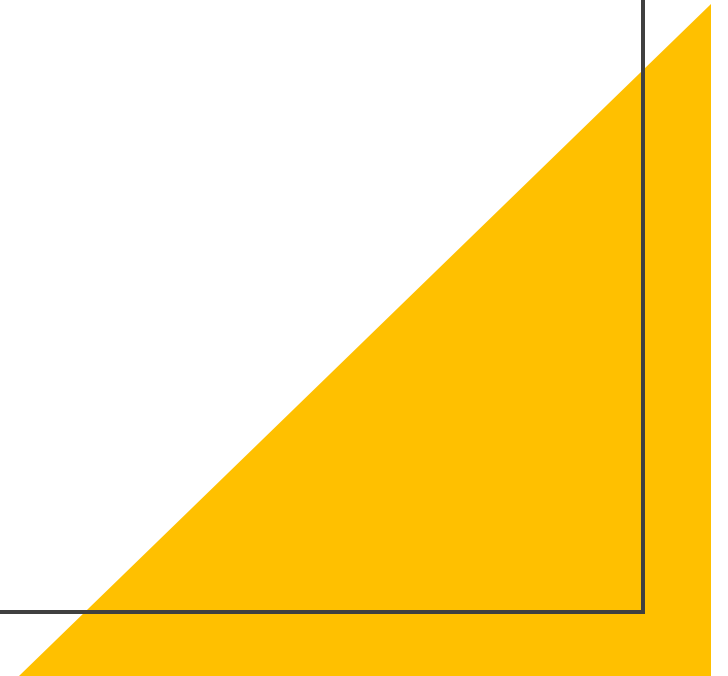



Suggestions / Strategies

- Trainees can approach feedback with a growth mindset
 - Collate feedback and work on deficient areas
- Faculty can balance types of feedback
 - Reinforce good practices
 - Correct suboptimal practices
 - Be specific with both reinforcing and corrective feedback

Topic #4

Understanding the other side





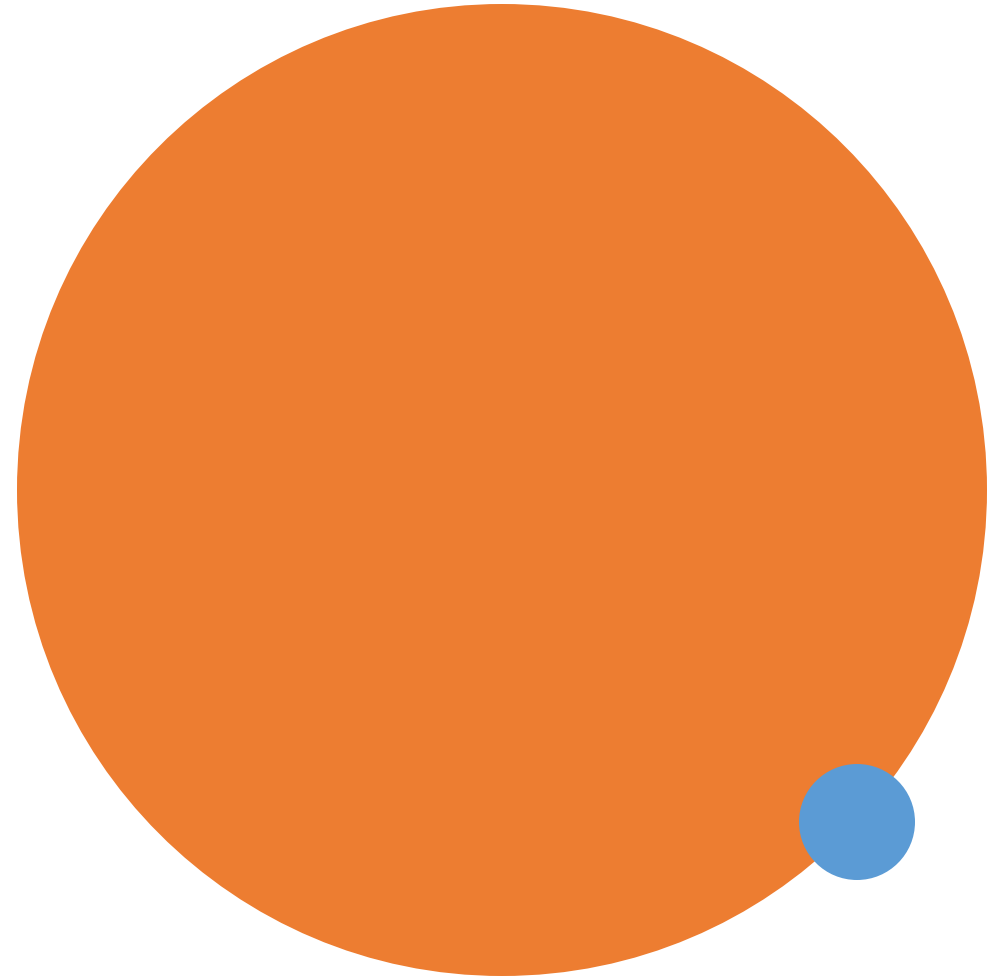
"It's actually very stressful to do a... case with someone who doesn't 100% know what they're doing"

Faculty Perspective



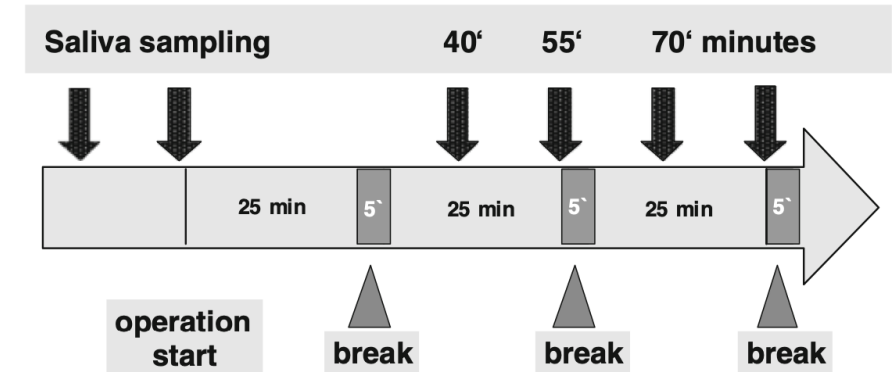
"At the end of the day you don't really feel like you learn that much"

Resident Perspective



Evidence: Understanding The Other Side

- Operating can be stressful
 - Some studies have measured subjective stress during surgery
 - Multiple other studies have objectively measured surgeon stress
 - Acute stress markers:
 - Heart rate analysis
 - Electrodermal activity/ skin conductance
 - Salivary biomarkers (e.g., cortisol, alpha amylase)



Salivary sampling protocol

Engelmann, C., Schneider, M., Kirschbaum, C. *et al.* Effects of intraoperative breaks on mental and somatic operator fatigue: a randomized clinical trial. *Surg Endosc* 25, 1245–1250 (2011).

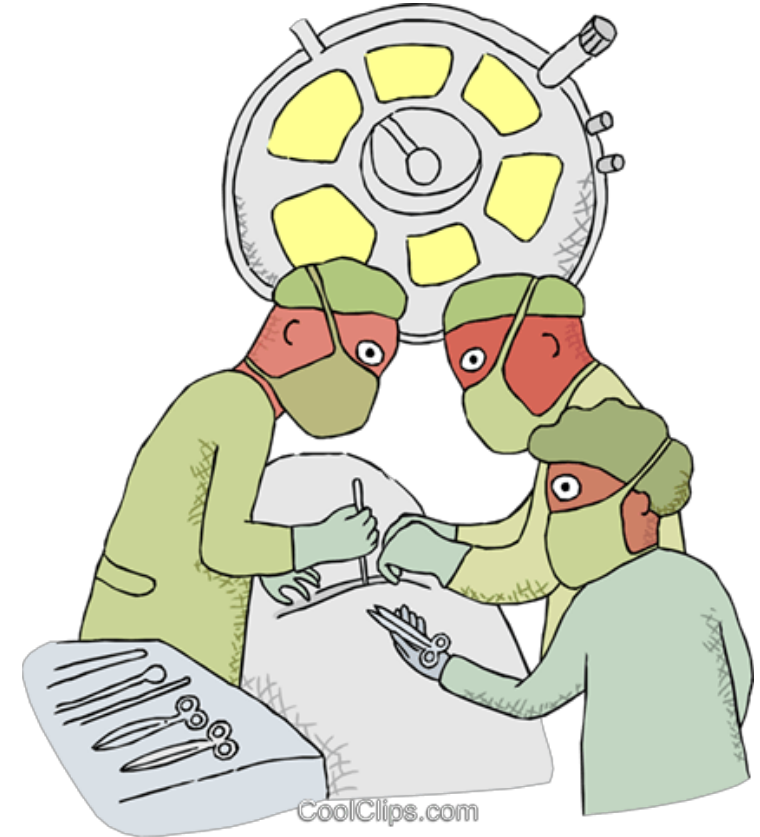
<https://doi.org/10.1007/s00464-010-1350-1>

Georgiou K, Larentzakis A, Papavassiliou AG. Surgeons' and surgical trainees' acute stress in real operations or simulation: A systematic review. *The Surgeon*. 2017;15(6):355-365.

doi:[10.1016/j.surge.2017.06.003](https://doi.org/10.1016/j.surge.2017.06.003)

Evidence: Understanding The Other Side

- Teaching can be **more** stressful
 - Heart rate analysis -> more stress when teaching compared to operating



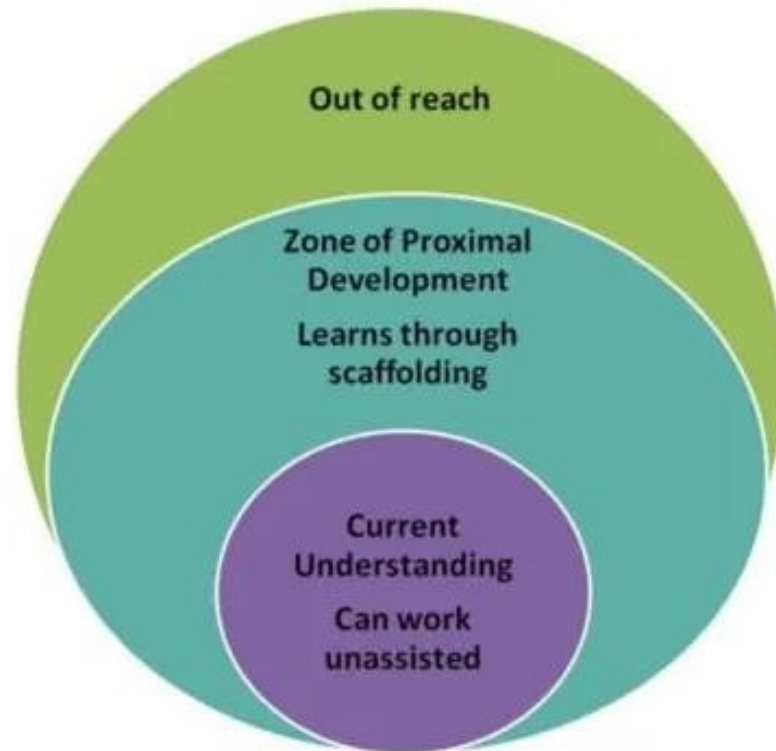
Evidence: Understanding The Other Side

- Qualitative work: trainees can reduce attendings' stress
 - Frankly explain prior experience
 - Describe goals for the case
 - Be "very honest"
 - Ask questions
 - Talk out loud (describe thought process)
 - Particularly important when struggling

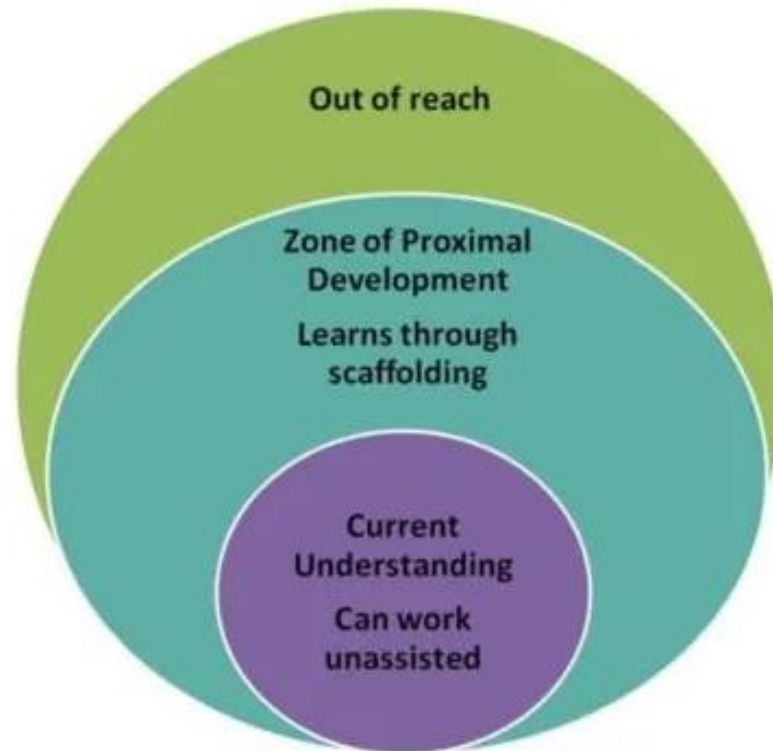


Trainees also get stressed in the OR

Evidence: Understanding the Other Side

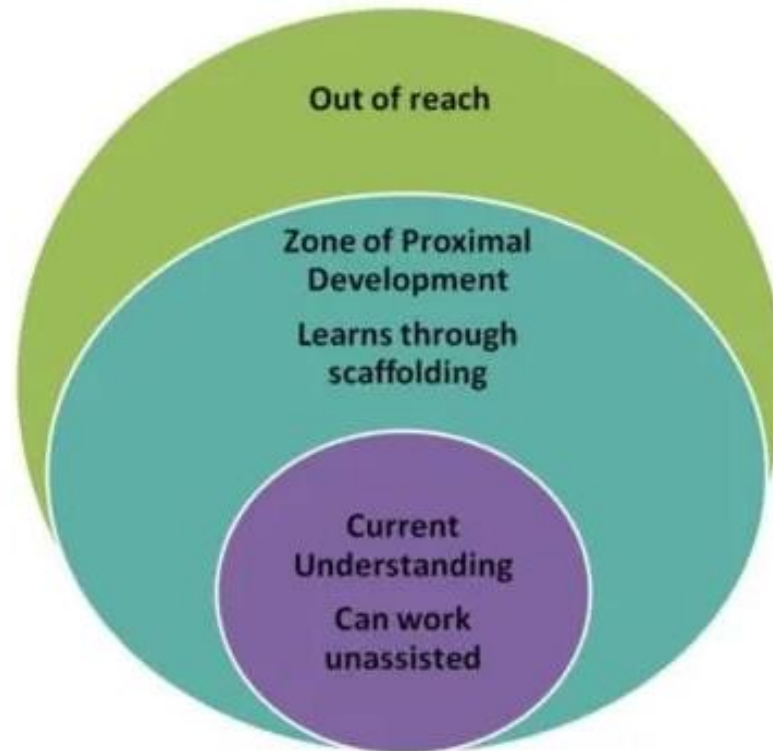


Evidence: Understanding the Other Side



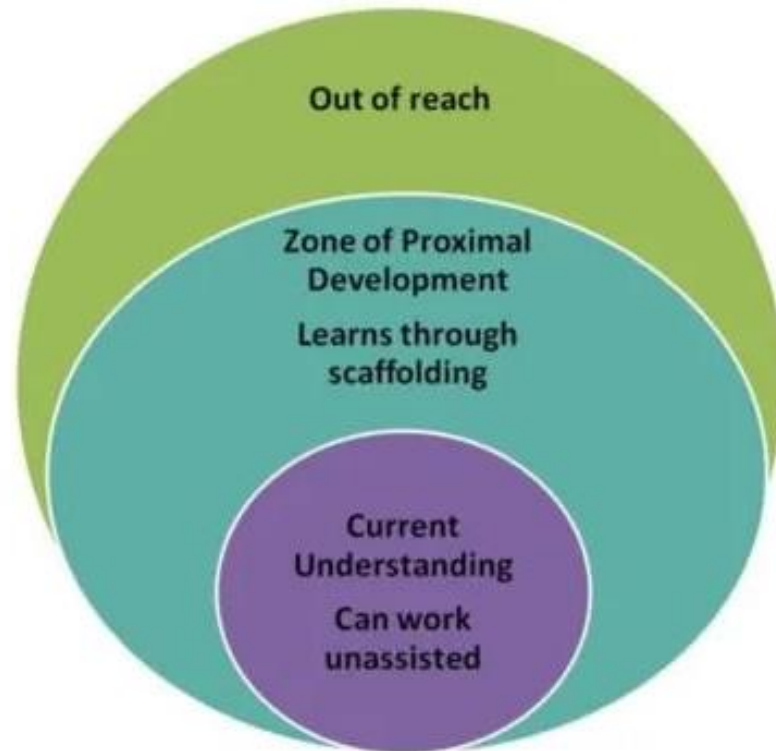
Stress occurs in the
out of reach zone

Evidence: Understanding the Other Side



Learning occurs in the zone of proximal development

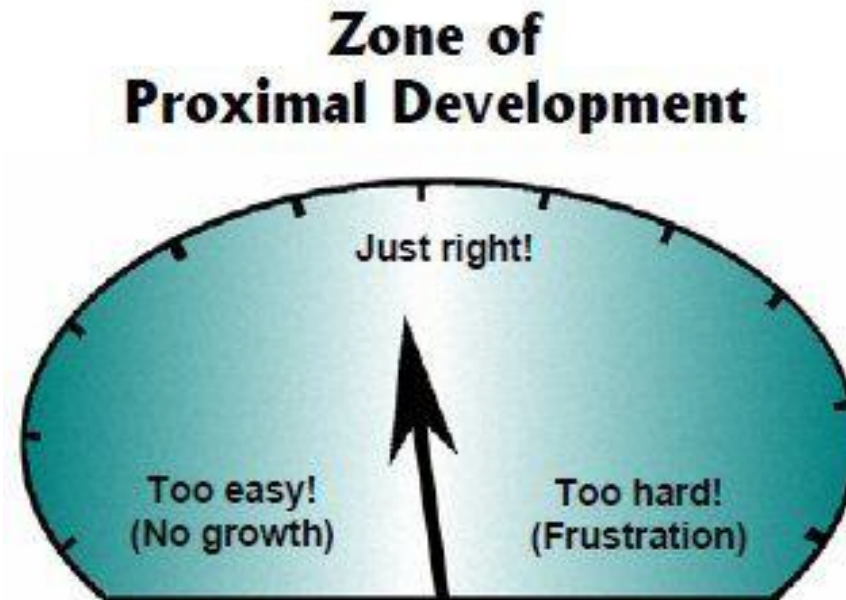
Evidence: Understanding the Other Side



Stagnation occurs in the zone of current understanding

Evidence: Understanding the Other Side

- Find the zone of proximal development
 - Ask about prior experience
 - Don't anchor entirely on PGY level
 - Integrate prior skills from simulation, skills lab rotation, etc.



Suggestions / Strategies

- Trainees can reduce attending stress
 - Verbalize thoughts, struggles, and plan
 - Stop if unsure and ask
- Faculty can welcome new training developments
 - Tailor instruction to trainees' skill level, not PGY level

"I love teaching. I love giving feedback... I enjoy it. I enjoy seeing you guys improve"

"The program is doing wonderful things"

*[Faculty member]
"is extremely dedicated"*

"I feel very lucky"

"I've learned a lot from him"