# Comparison of trainee cognitive load during robotic and laparoscopic tasks using objective metrics

**Wendy S. Li, MD**, Nicholas E. Anton MS, Dimitrios Stefanidis MD, PhD
Department of Surgery, Indiana University School of Medicine, Indianapolis, IN, USA

INDIANA UNIVERSITY
SCHOOL OF MEDICINE

## INTRODUCTION

- Elevated cognitive load (CL) can significantly impede surgical performance with implications for learning and patient safety
- Novices display significantly higher cognitive load than experienced surgeons suggesting that CL decreases with experience and the development of expertise

**Aim:** to explore the impact of task difficulty and surgical modality (robotic vs. laparoscopic) on the cognitive load of novices

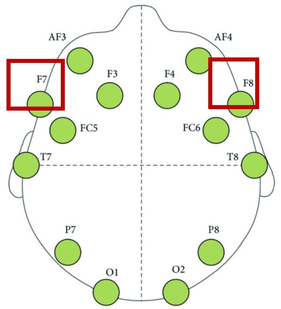
**Hypothesis:** CL will increase with task difficulty and be lower during robotic tasks compared to laparoscopy

## METHODS

- Crossover Design: participants perform the same tasks using laparoscopic and robotic surgery
- Tasks used: peg transfer (basic) and tension suturing (advanced)
- Concurrent performance of secondary task to measure spare attention capacity
- EEG and heart rate (HR) measurements obtained monitor and compared with baseline

## RESULTS

Six Novice Participants
Median Age 30 [28-32]
Right Hand Dominant
MS4 – PGY2



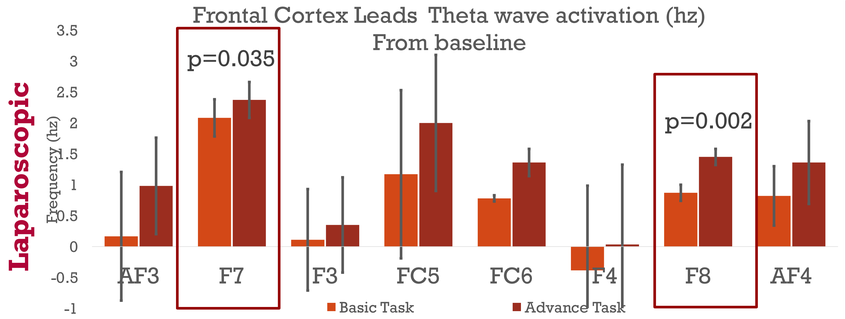

**Electroencephalogram (EEG)**

**Theta Wave (hz) Frontal Cortex** = **Cognitive Load**

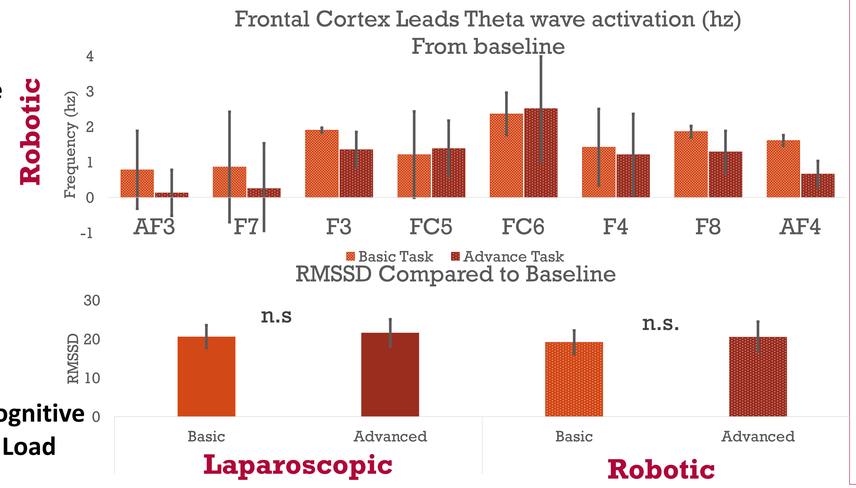



**Heart Rate Variability (HRV)**

**Root mean square of successive differences** = **Cognitive Load**




Reduced activation in Leads AF3, F7, FC5, F8 and AF4 was seen in advanced robotic task compared to advanced laparoscopy task. Although difference was not statistically significant.




## CORRELATION

| Performance Correlation | Spare Attention Capacity |
|---|---|
| • F8 Activation was negatively correlated with performance during lap tasks<br>• Higher activation, suggesting higher CL related to lower performance score<br>• R=-0.604, p=0.038 | • F8 activation also negatively correlated with spare attention capacity<br>• Higher F8 activation is associated with worse hit rate for secondary tasks that suggest lower spare attention capacity<br>• R=-0.689, p=0.013 |

## CONCLUSION

Higher CL in advanced laparoscopy tasks corroborates the hypothesis that CL escalates with task complexity

Reduced activation during advanced robotic tasks implies a lower cognitive load, however further research is needed for validation

Negative correlation between CL and performance holds promise for use of CL as a metric for assessing training effectiveness

@md_wendyli
@IU_surgery
lishiw@iu.edu