ACS 2022 Surgeons and Engineers: A Dialogue on Surgical Simulation Meeting

Research In-Progress

Using Digital Biomarkers to Measure Fluctuations in Instructors' Cognitive Load Between High-Fidelity Simulations and Debriefing Sessions

Egide Abahuje, MD, MMED, MsHPEd; Steven Yule, PhD, FRCSEd; Christian Miccile; Robert Riviello, MD, MPH; Charles N. Pozner, MD; and Roger Dias, MD, MBA, PhD

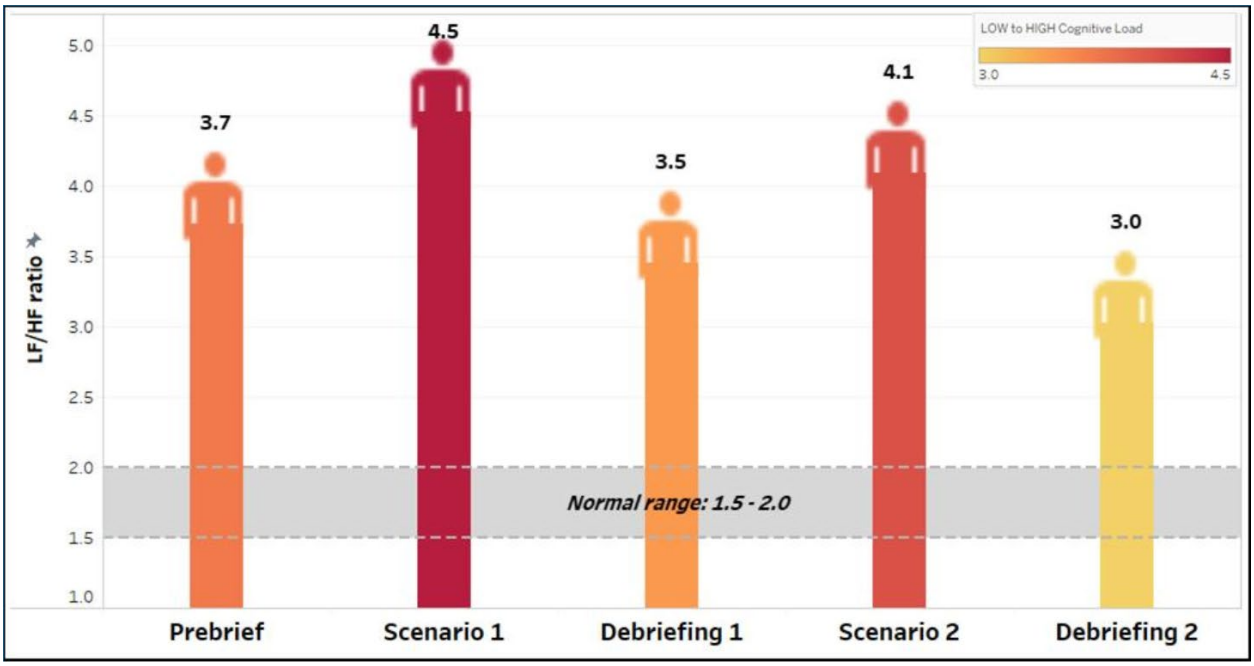
Northwestern University, Chicago, IL; University of Edinburgh, Edinburgh, United Kingdom; Brigham and Women's Hospital, Boston, MA

Introduction: Facilitating simulation training requires instructors to perform multiple tasks throughout the session. These activities generate a substantial cognitive load to instructors. If the mental demand exceeds an instructor's cognitive capacity, it may negatively affect performance. The aim of this study was to analyze cognitive load fluctuations among simulation instructors during high-fidelity Interprofessional training sessions.

Methods: Data were collected from instructors (simulation fellows). Each session was composed of 5 phases: prebrief, scenario 1, debriefing 1, scenario 2, and debriefing 2. Participants wore a chest strap that collected Heart Rate Variability (HRV). Low frequency/ high frequency (LF/HF) ratio was used as a proxy for the cognitive load. LF/HF ratio was calculated using a 1-minute time window. Friedman's two-way analysis of variance was performed.

Preliminary Results: Five fellows debriefed 15 sessions. Eleven had 1 debriefer and 4 had 2 debriefers (co-debriefing), totaling 19 measures over the 5 phases of the session. The median of the LF/HF ratio in each phase were: prebrief = 3.7 (2.8-6.1); scenario 1 = 4.5 (2.8-6.1); debriefing 1 = 3.5 (2.6-4.9); scenario 2 = 4.1 (3.4-5.2); debriefing 2 = 3.0 (2.2-4.4). There was a statistically significant relationship between the simulation phase and LF/HF ratio ($p = 0.001$). Post-hoc pairwise comparisons showed that debriefing 2 posed the lowest LF/HF ratio compared to scenario 1 ($p = 0.001$) and scenario 2 ($p = 0.048$). Grouped analysis for *prebrief vs scenario vs debriefing* showed that instructors presented the lowest LF/HF ratio during the debriefing phase: 3.1 (2.6-4.9), compared to prebrief: 3.7 (2.8-6.1); $p=0.028$ and scenario: 4.3 (3.0-5.5), $p=0.017$.

Next Steps: The cognitive load during all phases was higher than the normal range (i.e LF/HF ratio: 1.5-2.0). The use of co-debriefers or cognitive aids can be used to avoid cognitive overload and potential negative impact on performance. The next step consists of assessing the relationship between cognitive load and instructors' debriefing performance.


LOW to HIGH Cognitive Load
3.0
4.5
LF/HF ratio
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
3.7
4.5
3.5
4.1
3.0
Normal range: 1.5 - 2.0
Prebrief
Scenario 1
Debriefing 1
Scenario 2
Debriefing 2