

Robot as the Great Equalizer: Rethinking Psychomotor Barriers in Surgical Training

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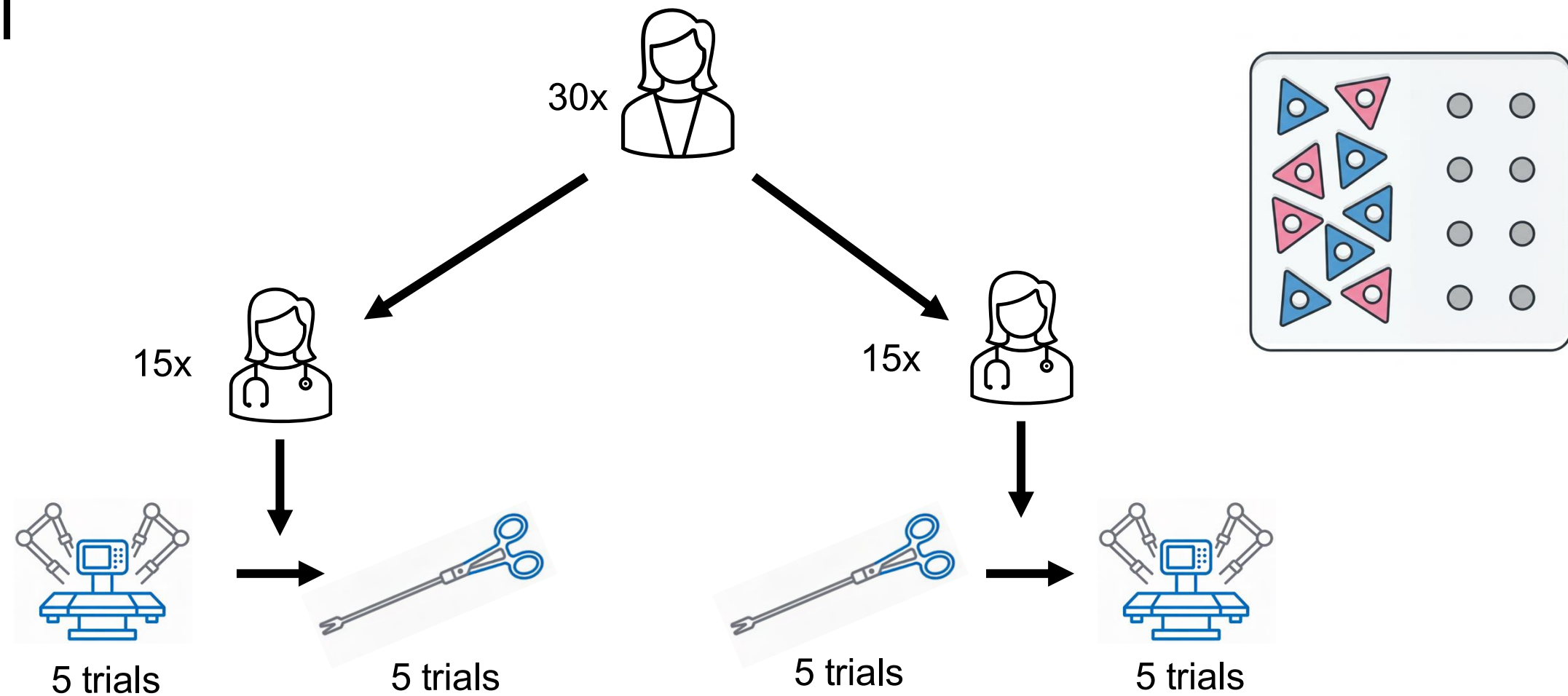


- Background:
- Proficiency in surgical skills has been traditionally described as the product of psychomotor aptitude and practice
 - Psychomotor ability is often considered an innate trait
 - Growing adoption of robotic platforms in surgical training relative to laparoscopy

Study Objective: Evaluate if the interface of robotic platforms compensates for variation in psychomotor ability observed in traditional laparoscopy

- Methods:
- Design:** Randomized 2x2 crossover study with repeated measures

Population: 30 medical students with no prior surgical experience performing a peg-transfer drill



Primary Outcomes: Task completion time and number of peg drop errors

- Data Analysis:
- Means compared with Welch’s t-test
 - Variability evaluated with standard deviation (SD), interquartile range (IQR), and coefficients of variation (CV)
 - Platform performance predictability assessed with Pearson correlation and Linear regression
 - Heatmap analysis of performance tiers

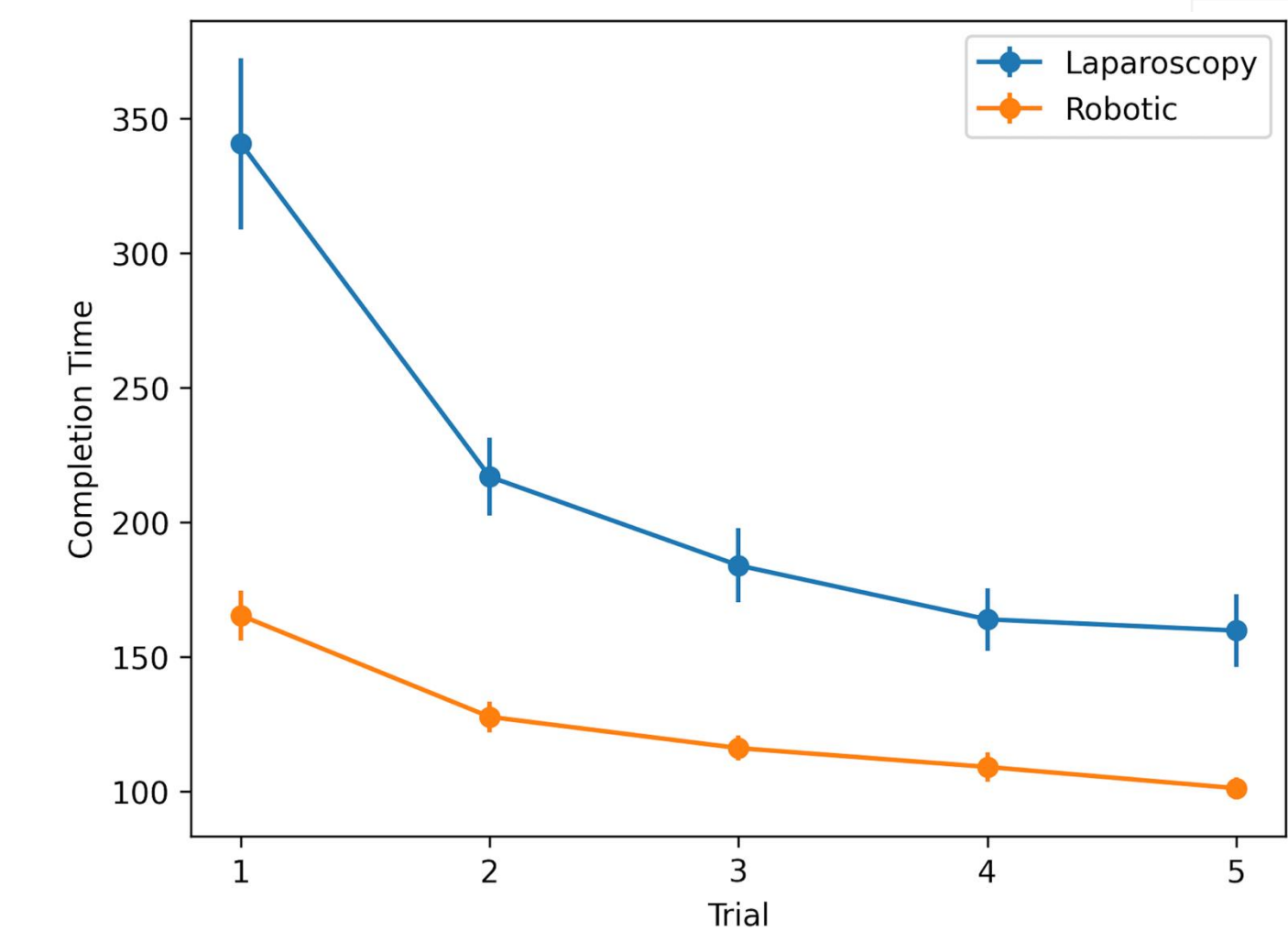
Results:

Overall Platform Evaluation and Variability Analysis:

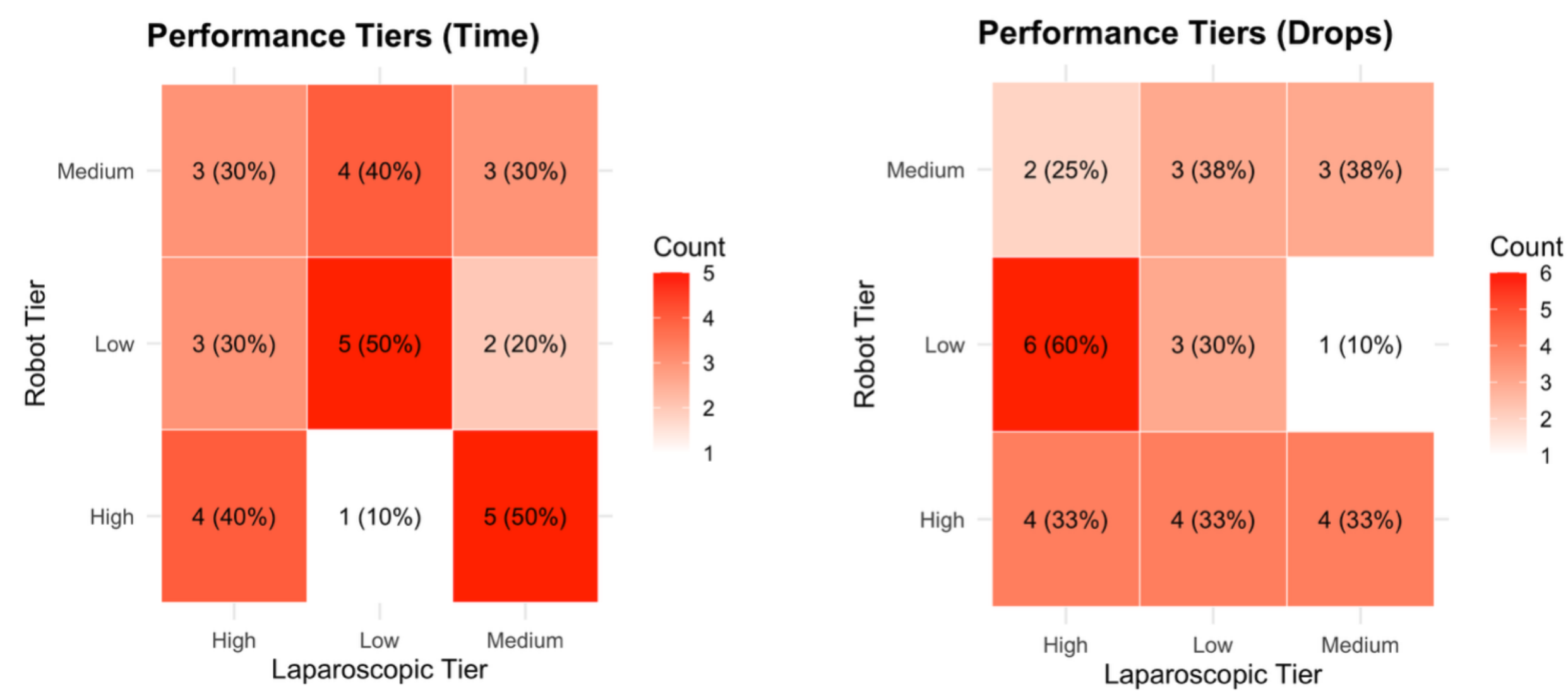
- All 30 medical students completed the protocol

	Robotic platform	Laparoscopic platform	P-Value
Mean completion time (s)	124	213	<0.001
Mean drop errors (count)	0.37	2.49	<0.001
SD – time (s)	26.6	75.0	
IQR – time (s)	37.9	121.9	
CV – time (%)	21	35	
SD – drops	0.45	1.83	
IQR – drops	0.6	3.0	
CV – drops (%)	121	73	

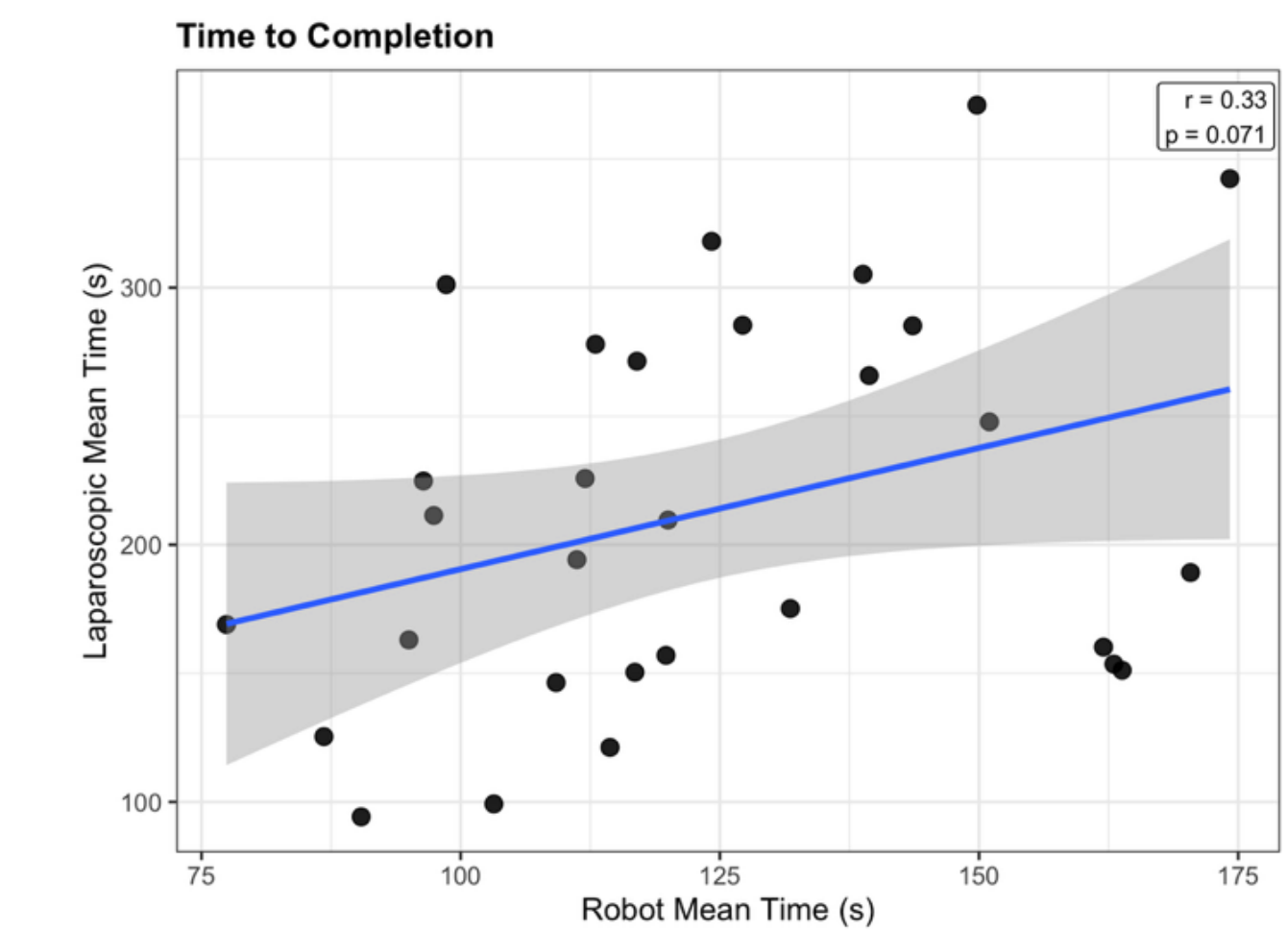
- Average completion time decreased with medical students consistently demonstrating improved time on the robot compared to laparoscopy for all 5 trials



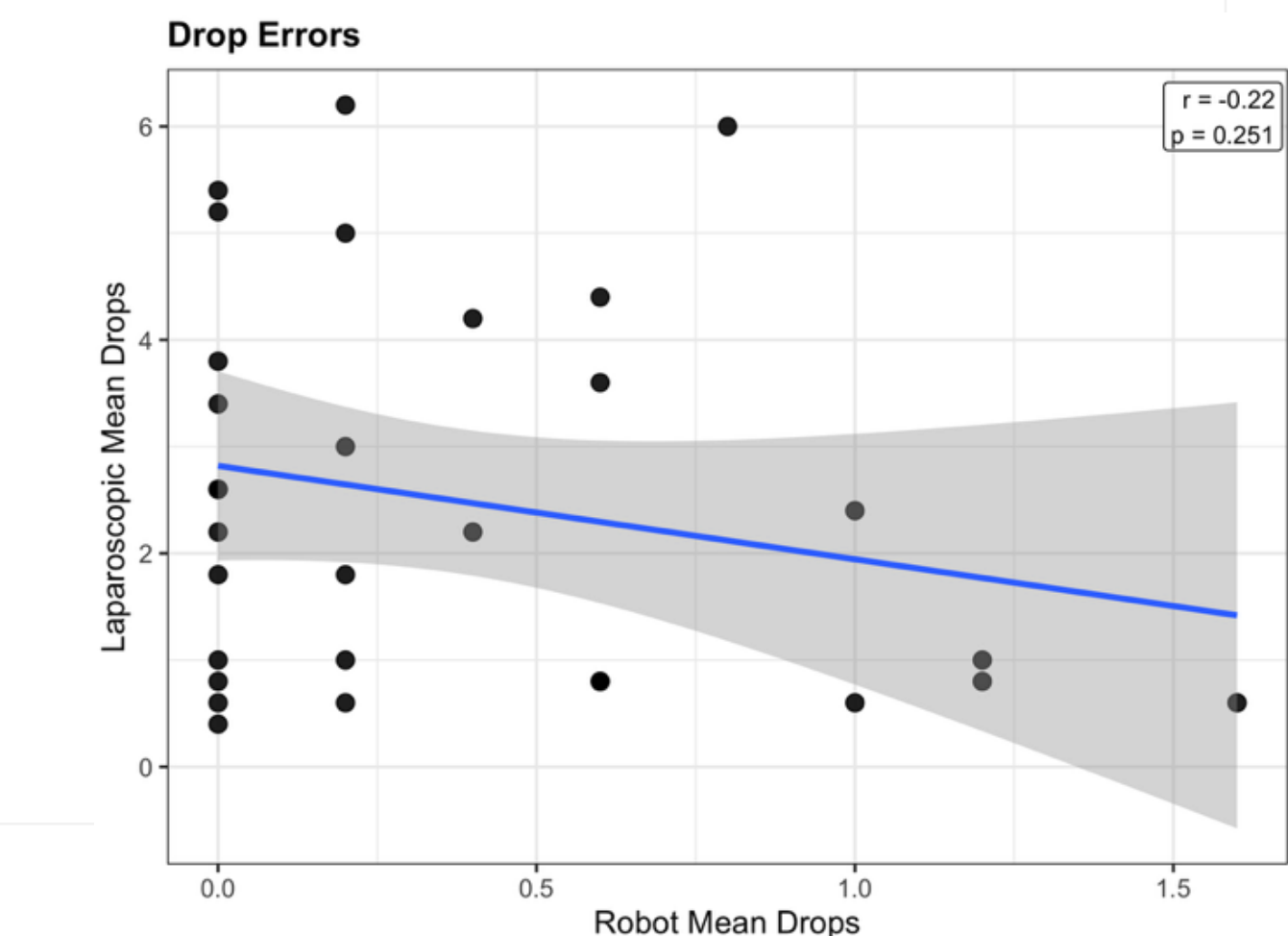
- Cross-Tier Performance Analysis:
- Many with low-performance on laparoscopy (both completion time and drop errors) achieved medium- or high-performance on the robot



- Correlation Analysis:
- Weak, non-statistically significant relationships identified
 - Performance on one platform did not reliably predict performance on the other with respect to completion time



- Performance on one platform did not reliably predict performance on the other with respect to drop errors



- Conclusions:
- The robotic platform appears to reduce performance variability among novice learners regardless of their innate psychomotor ability
 - The weak correlations between robotic and laparoscopic platforms suggest distinct learning curves
 - Cross-tier analysis revealed that while some subjects performed consistently across modalities, others showed marked divergence—particularly those with low laparoscopic performance but high robotic efficiency
 - By reducing variability, the robot may function as a “great equalizer” in surgical skill acquisition