



Interference Between Camera Conditions in Laparoscopic Surgery Simulation

Noah J Wheeler and Martina I Klein
Texas Tech University

Houston - 5/3/123



Laparoscopic surgery

- Long thin graspers inserted through incisions
- Surgical field viewed via camera and monitor
- Poses perceptual-motor challenges

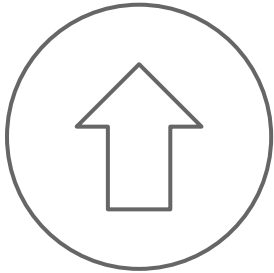




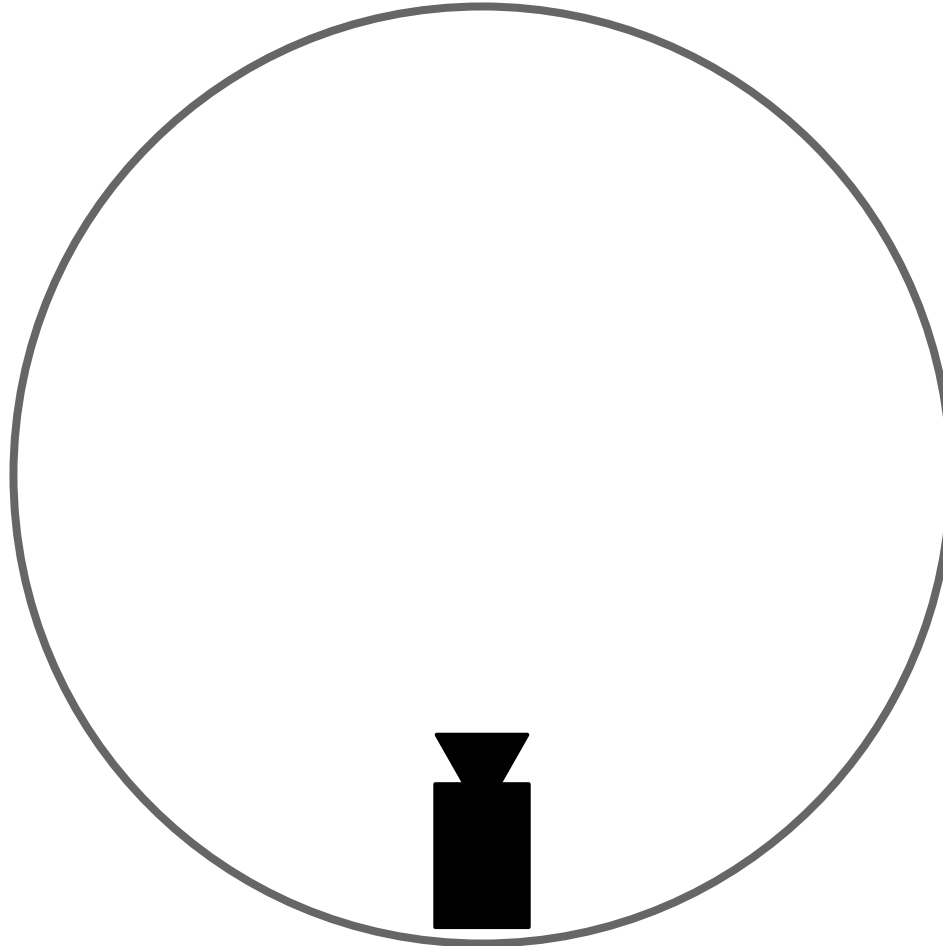
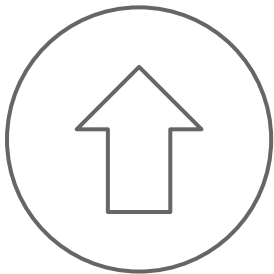
Camera placements

0 Degrees

Movement on Monitor



Grasper Movement



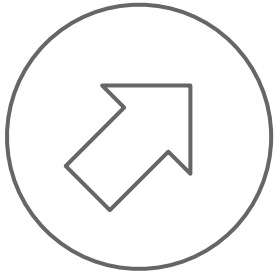
Surgeon



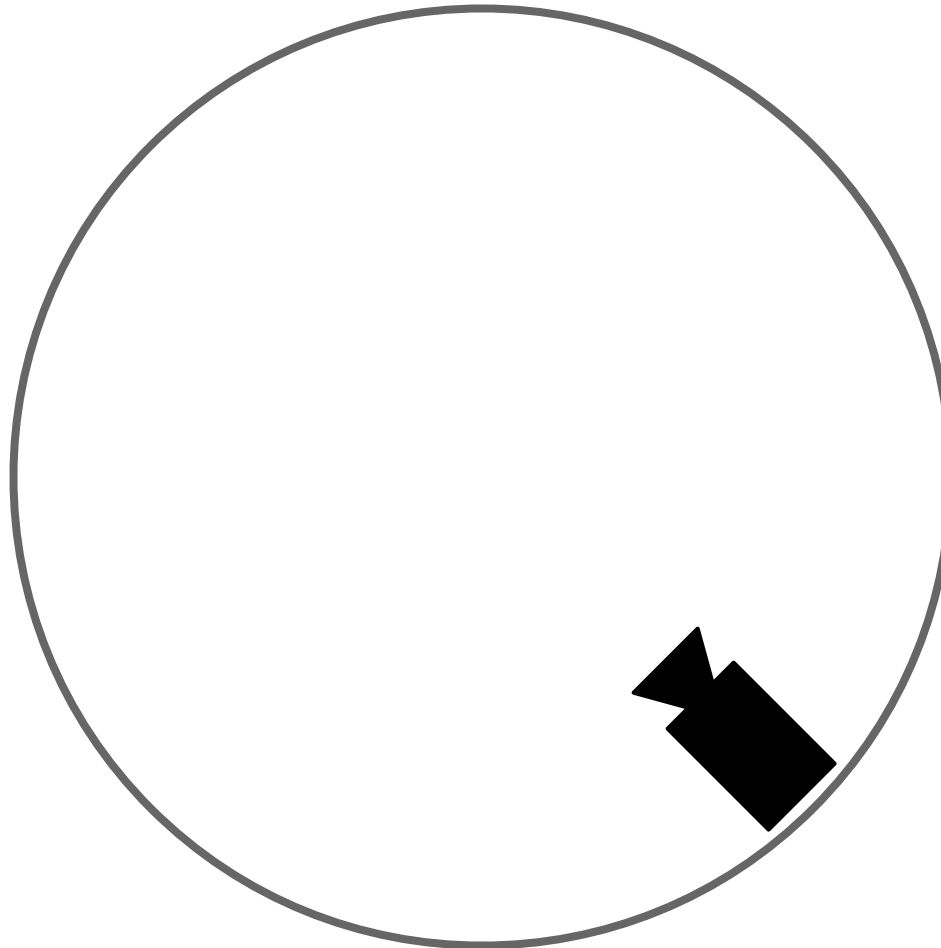
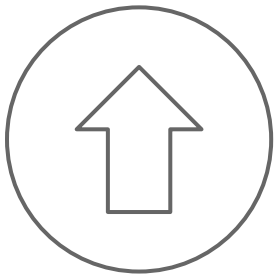
Camera placements

45 Degrees

Movement on Monitor



Grasper Movement



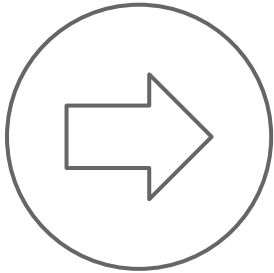
Surgeon



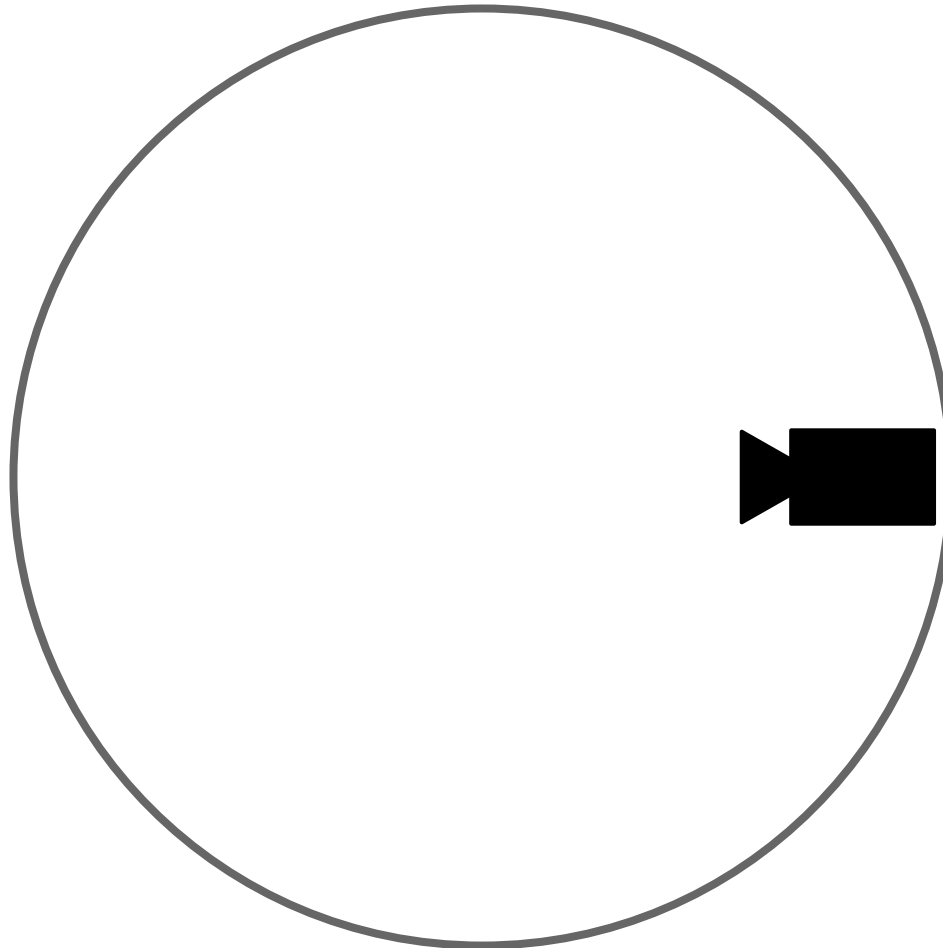
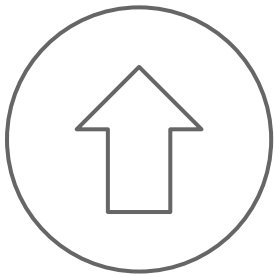
Camera placements

90 Degrees

Movement on Monitor



Grasper Movement



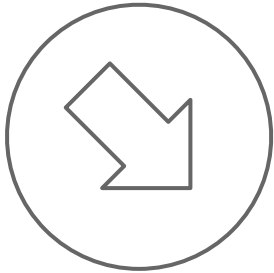
Surgeon



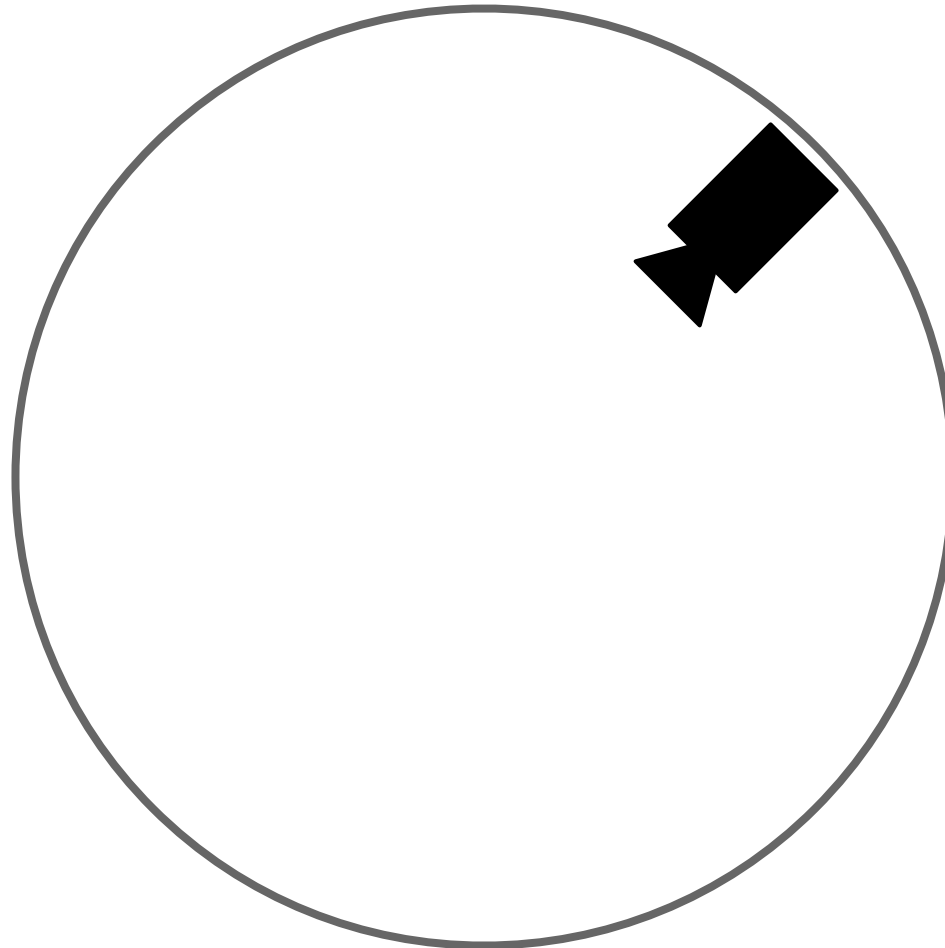
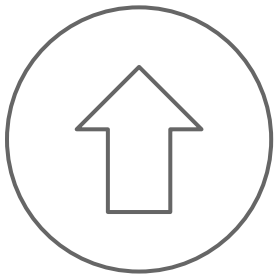
Camera placements

135 Degrees

Movement on Monitor



Grasper Movement



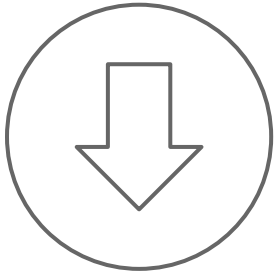
Surgeon



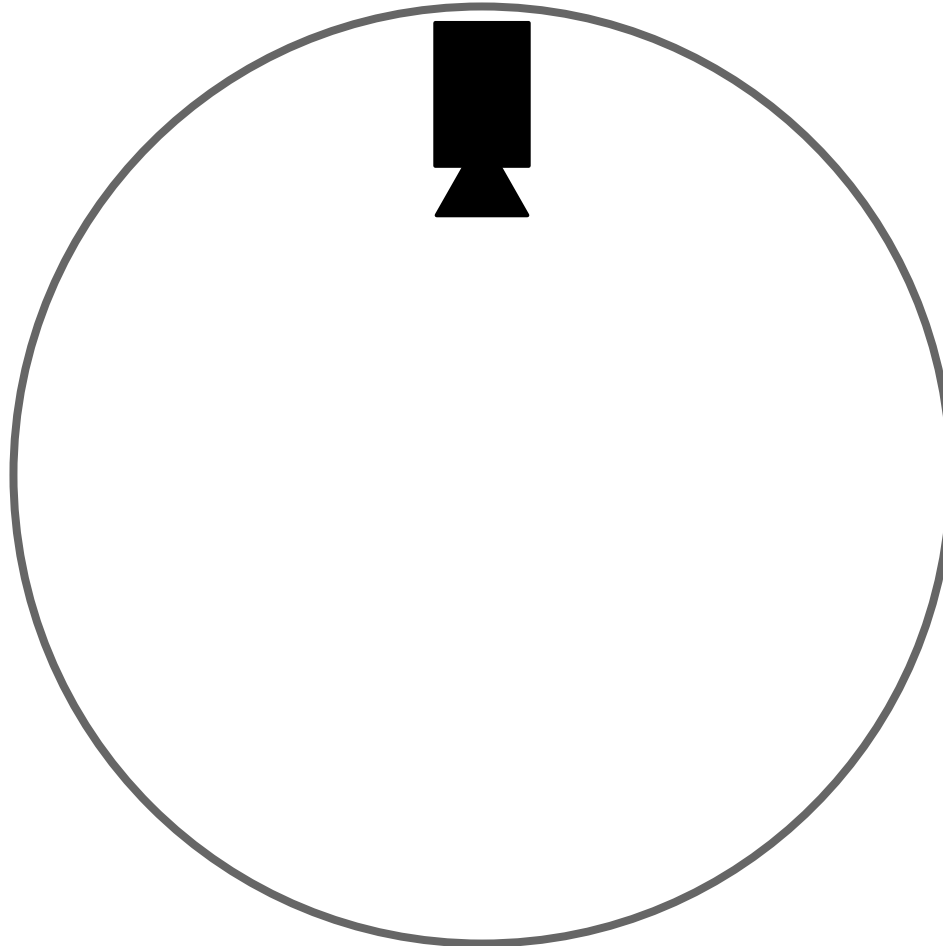
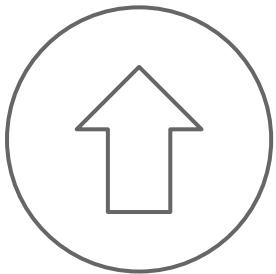
Camera placements

180 Degrees

Movement on Monitor



Grasper Movement



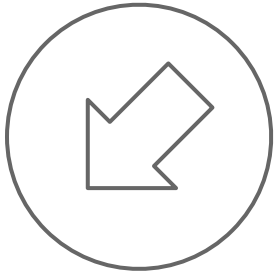
Surgeon



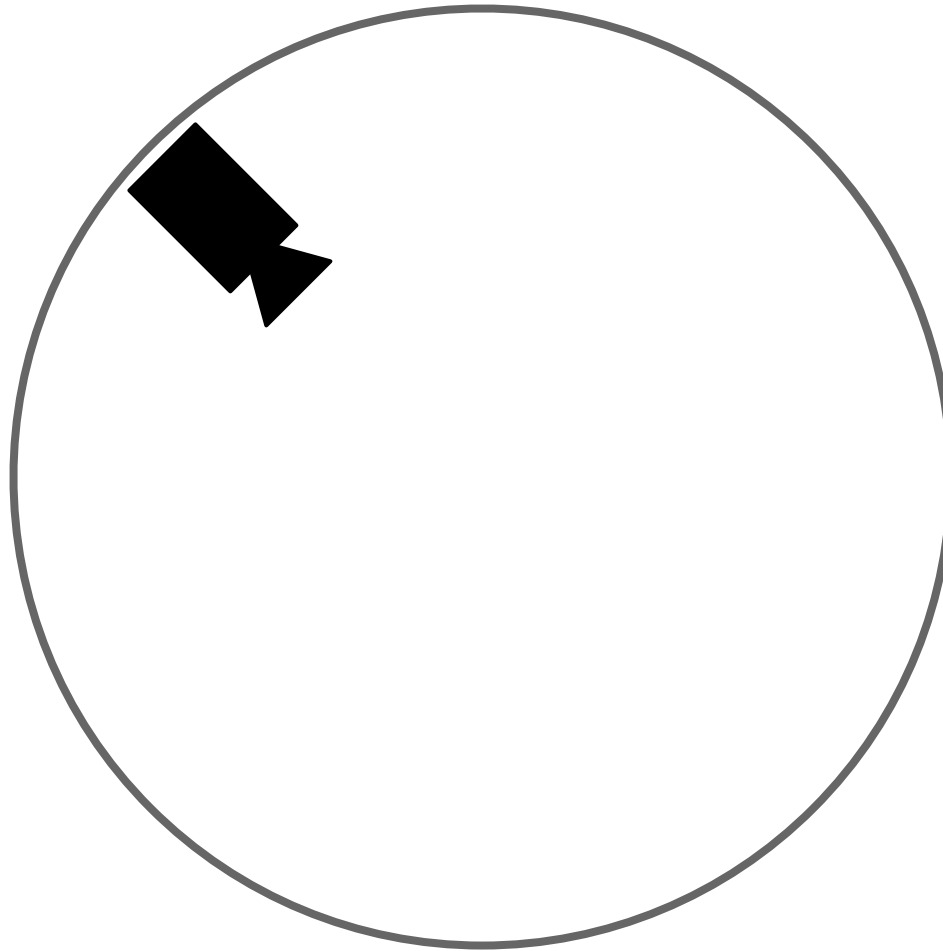
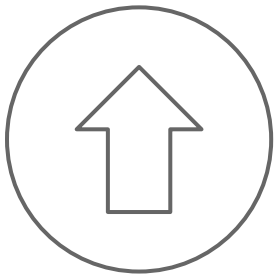
Camera placements

225 Degrees

Movement on Monitor



Grasper Movement

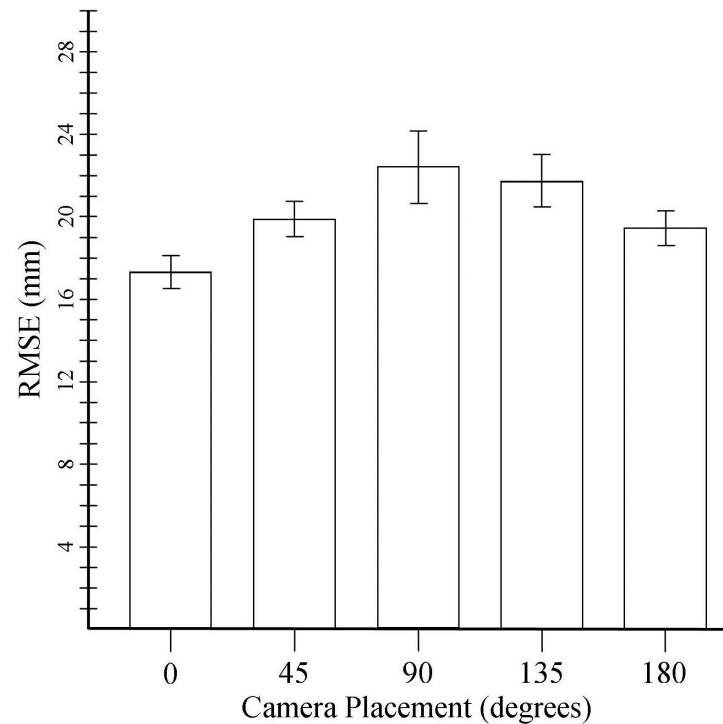


Surgeon



Work we have done

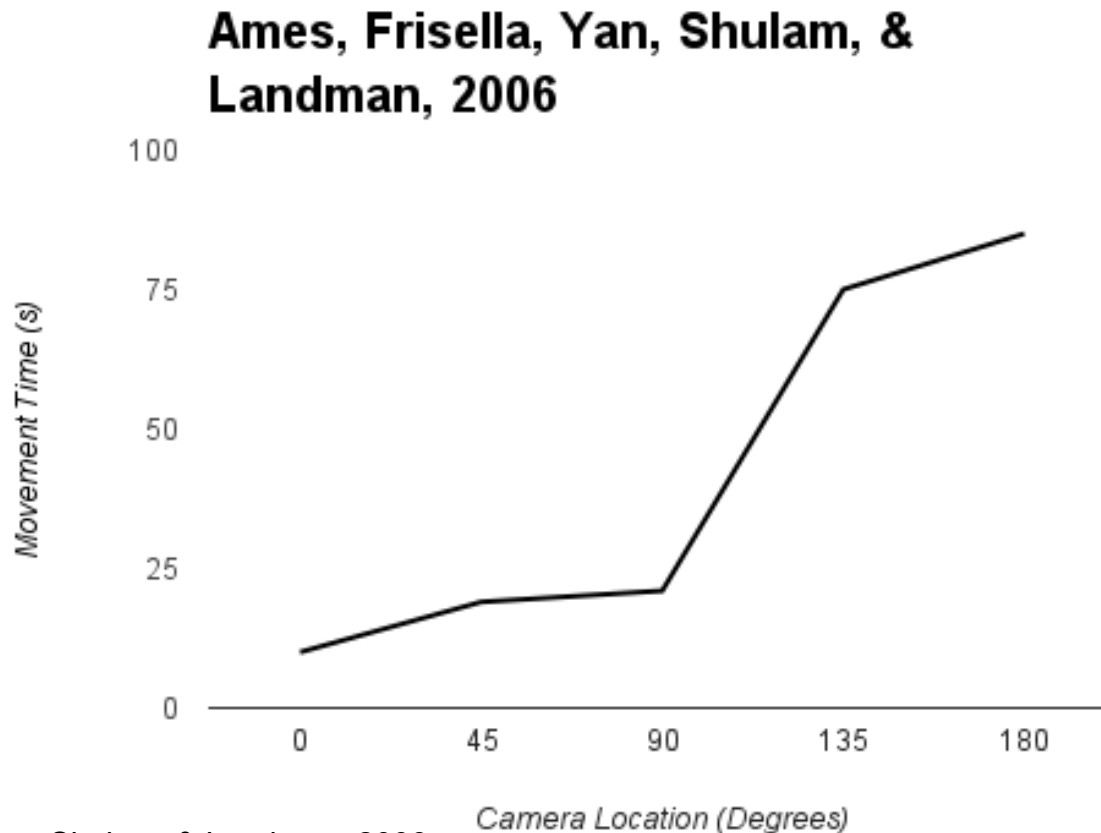
- The results of our previous research
 - Peak error lies between 90 and 135 degrees (1)





Previous related work

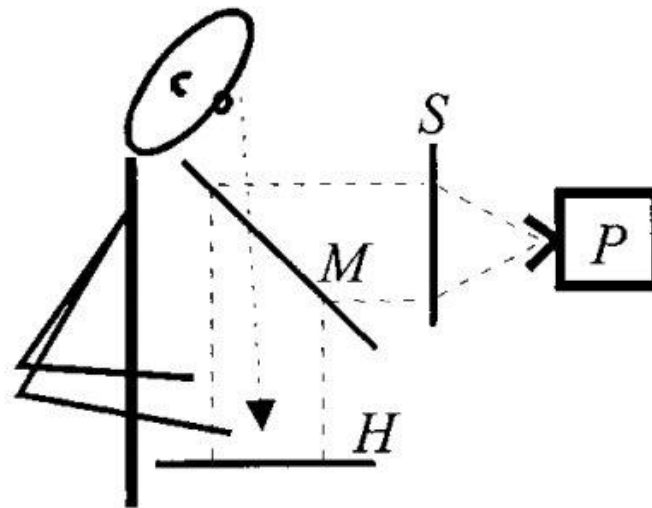
- Other laparoscopic research
 - Experts' peak error lies closer to 180 degrees (1)





Otmar Bock

- Rotated visual feedback (1)
 - Participants used different processes
 - Less than 113 degrees
 - Greater than 113 degrees
 - These two types of processes interfered with each other
- Used a 2D task





Objectives

- Long-term goal
 - To improve surgical performance
- Objective of this study
 - To see if interference occurs between camera conditions
- Central hypothesis
 - Experience with camera rotations less than 113 degrees will interfere with performance in camera conditions greater than 113 degrees



- Provide the basis for research that improves flexibility
 - Ensure equivalent performance in all camera locations
 - Surgeons sometimes have to switch multiple times between camera port placements (1)
- Development of training programs
 - Support camera switching
 - Decrease movement error



This work will be . . .

- **Innovative**
 - Applies basic movement research to the laparoscopic training environment
- **Beneficial**
 - Provide possible explanation of variance in surgeons' performance
 - Set the stage for the development of training programs
 - Decrease injury due to surgical lacerations
 - Decrease operation times
 - Improve patient outcomes



Methods

Participants:

- 19 males 23 females
- Normal or corrected to normal vision
- Ages 18 to 23

Task:

Target pointing task in a laparoscopic simulator using a model surgical grasper.

Data collection:

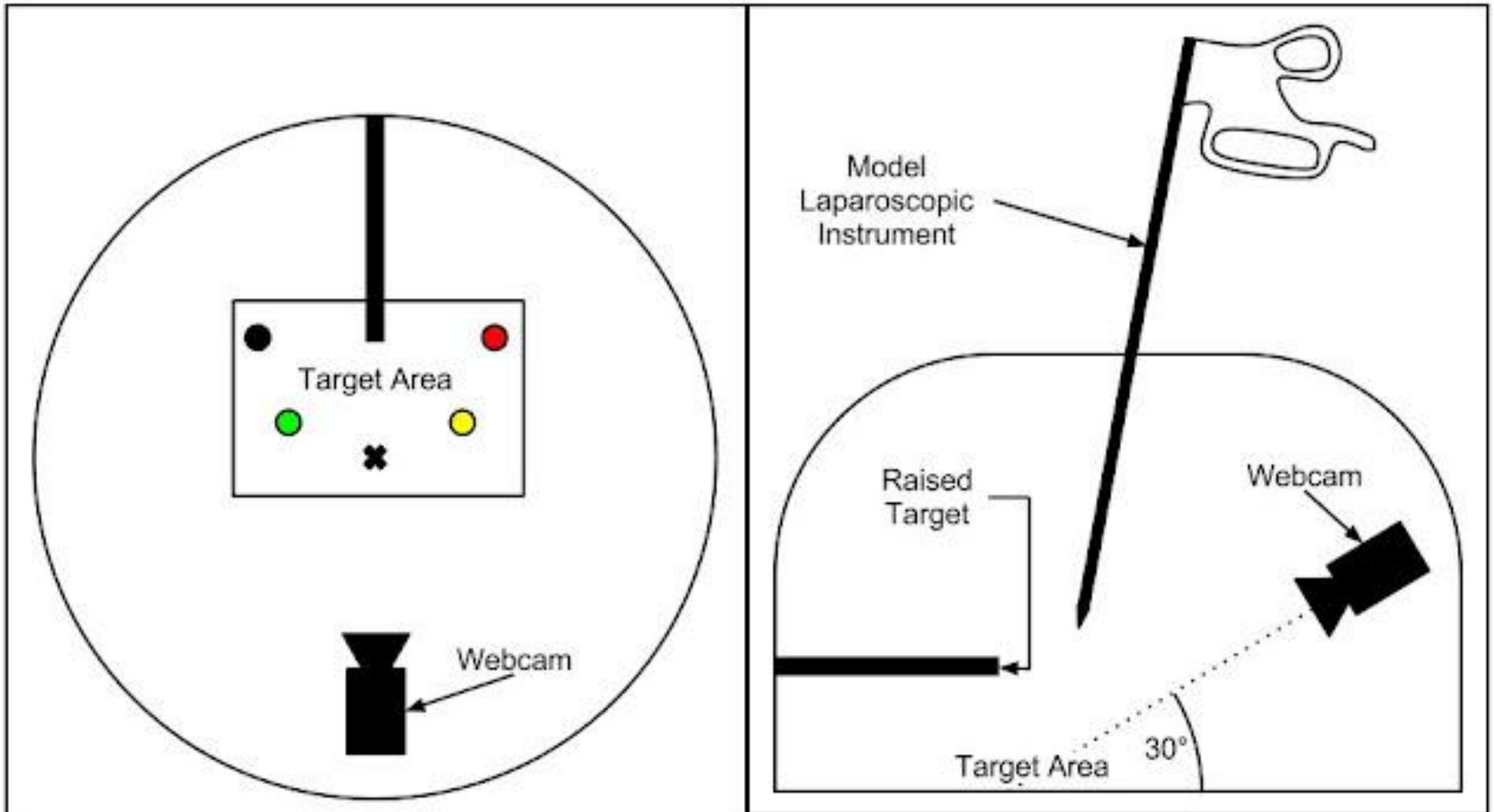
Electromagnetic motion tracker recorded tip of model grasper at 240 Hz.

Procedure:

- 2 familiarization blocks
- 14 practice blocks
- 1 experimental block



Methods - Apparatus



Design

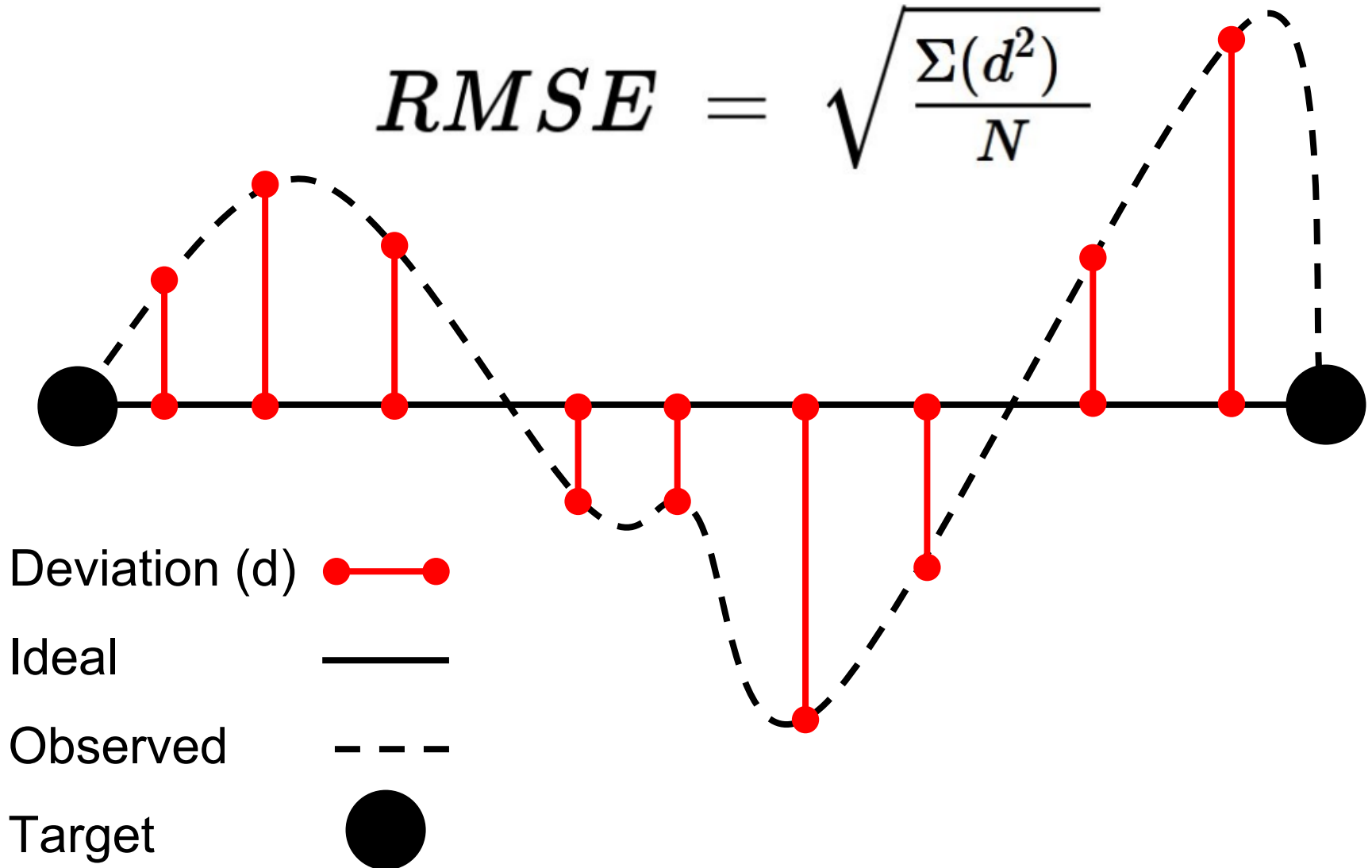


Familiarization Blocks (2)	Practice Blocks (14)	Experimental Block (1)
Direct view of task	45 degrees	135 degrees
		180 degrees
		225 degrees
	Direct task view	135 degrees
		180 degrees
		225 degrees



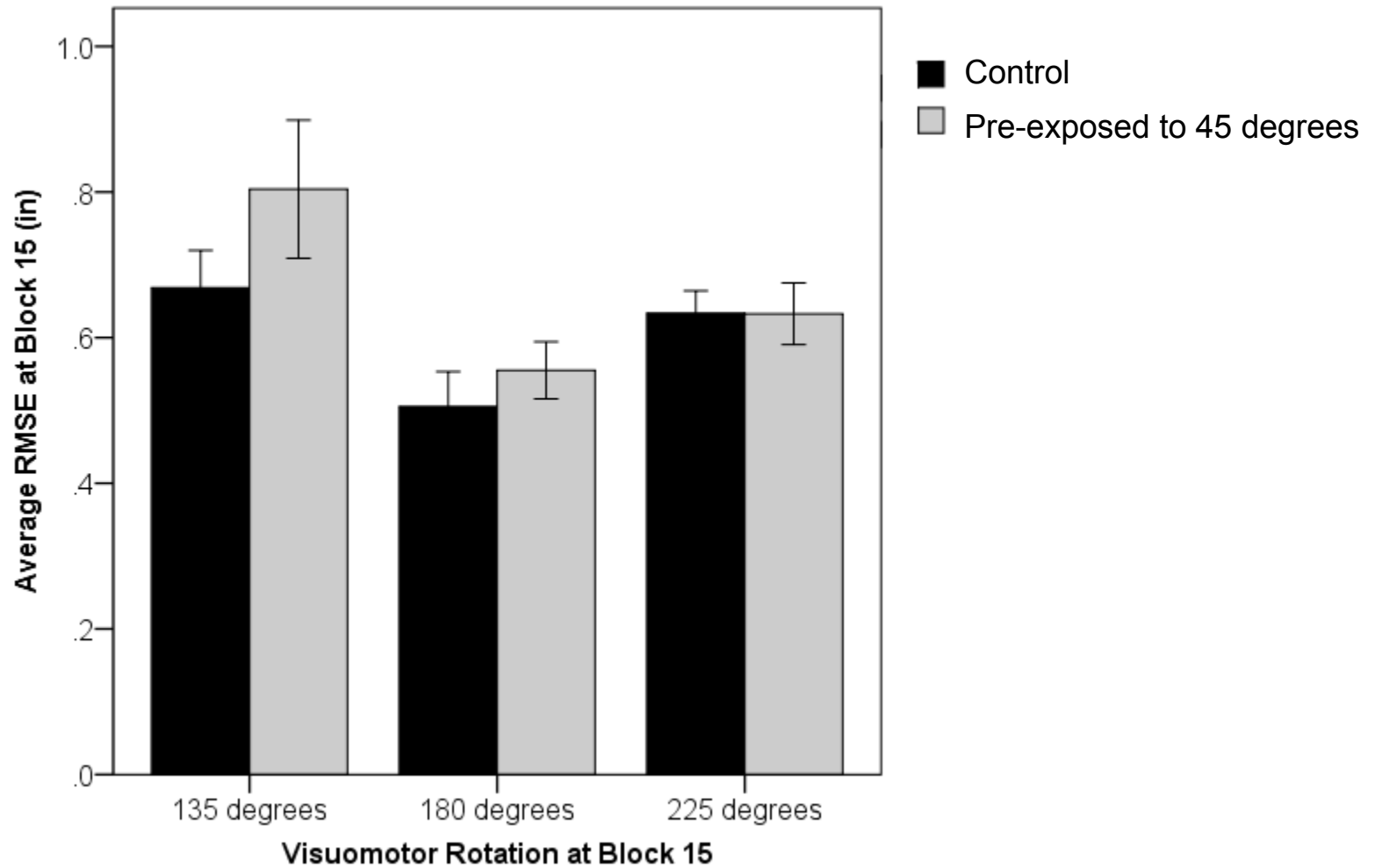
Measurement

$$RMSE = \sqrt{\frac{\Sigma(d^2)}{N}}$$



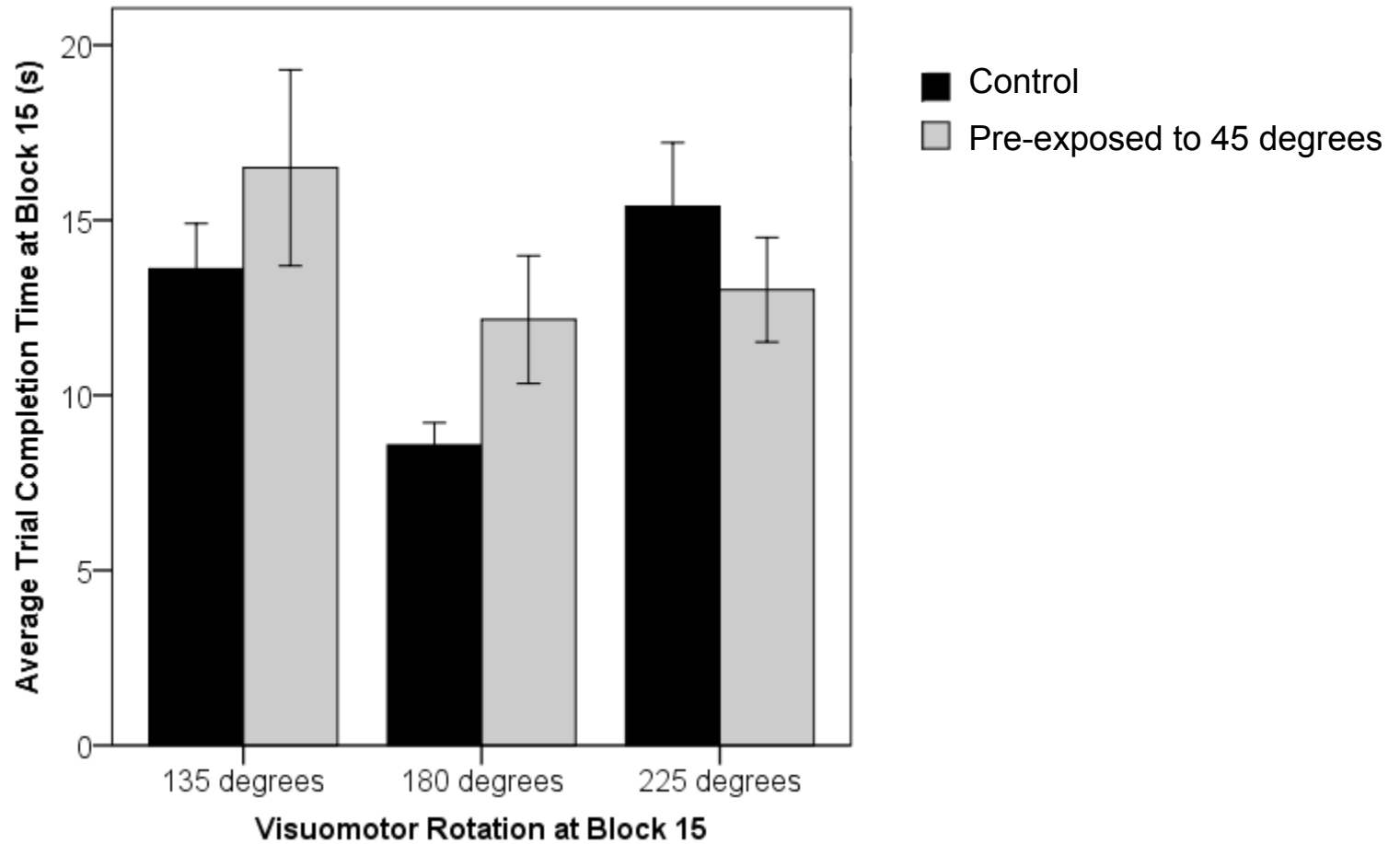


Results - RMSE





Results - Time





Conclusions

Theoretical implications:

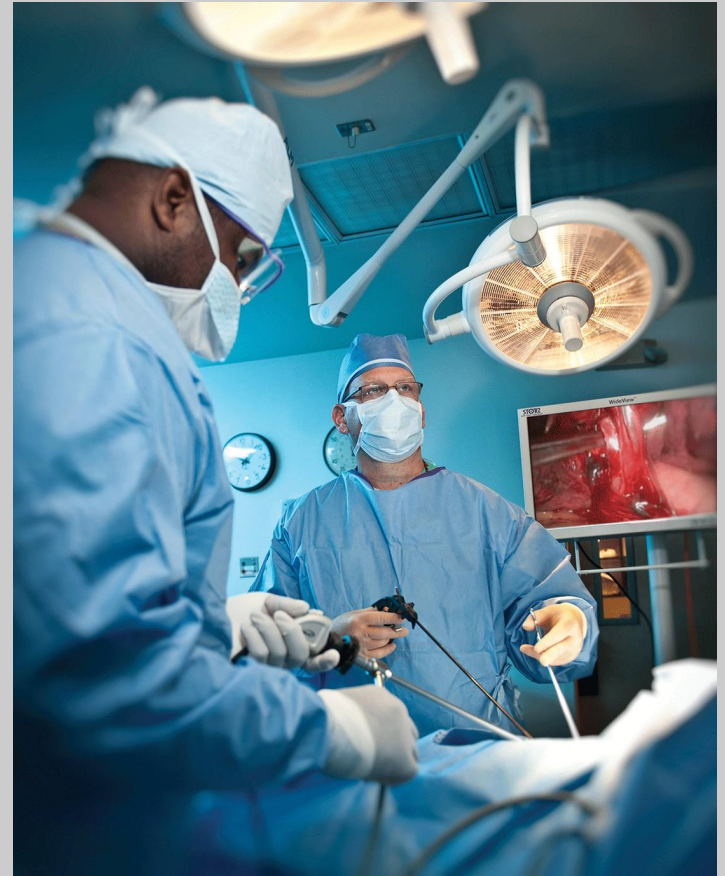
- Previous experience with visuomotor distortions alters the relationship between visuomotor rotations and performance

Practical implications:

- Training programs for surgeons

Future directions:

- See if experts exhibit similar patterns





Questions?



References

Ames, C., Frisella, A. J., Yan, Y., Shulam, P., & Landman, J. (2006). Evaluation of laparoscopic performance with alteration in angle of vision. *Journal of Endourology*, *20*, 281-284. Retrieved from EBSCOhost.

Bock, O., Abeele, S., & Eversheim, U. (2003). Human adaptation to rotated vision: Interplay of a continuous and a discrete process. *Experimental Brain Research*, *152*, 528-532.

Ferzli, G., & Fingerhut, A. (2004). Trocar placement for laparoscopic abdominal procedures: a simple standardized method. *Journal Of The American College Of Surgeons*, *198*(1), 163-173. Retrieved from EBSCOhost.

Wheeler, N. J., Klein, M. I., & Craig, C. (2012). Camera placement in simulated laparoscopic surgery influences performance. *Proceedings of the Annual Meeting of the Human Factors & Ergonomics Society*, *56*, 1346-1350.