ASSESSING THE RELATIONSHIPS BETWEEN SPATIAL REASONING, VR MOTOR MIMICRY, AND ROBOTIC SURGERY SIMULATION PERFORMANCE

Brandon M. White[1,2], Sourav K. Bose[1], Kevin B. Hayes[1], Rohan Palanki[1,2], Rosa Hwang[1], Apeksha Dave[1], Shiva Teerdhala[1], William H. Peranteau[1] and Pablo Laje[1]

[1] Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA; [2] Children's Hospital of Philadelphia, Philadelphia, PA

BACKGROUND

In this pilot study, we sought to evaluate whether a priori spatial reasoning skills correlate with robotic simulation performance and if visual-spatial rehearsal can improve task performance. Specifically, we aimed to:

(1) assess the relationship between baseline spatial reasoning skills and robotic surgery simulation performance

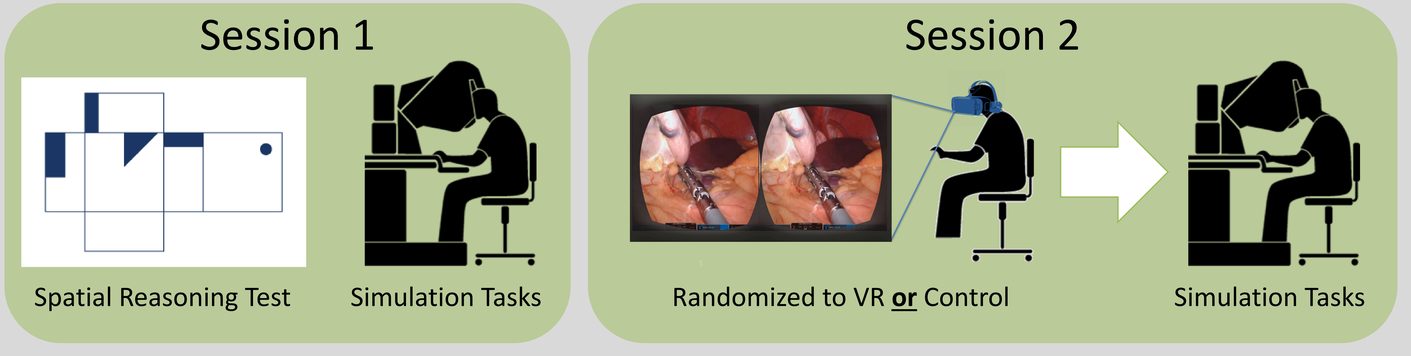
(2) evaluate the potentiating effect of VR motor mimicry on performance

METHODS

Procedure: An IRB exempt, single-blinded randomized control study was conducted with 10 novice trainees. Subjects completed a 20 minute validated spatial assessment (PSVT:R) and then participated in two days of simulation activities. During session 1, subjects completed 4 simulations using a DaVinci Si Console. During session 2, subjects were randomized to control (n=5) or virtual reality (VR) (n=5) groups. Using a VR headset, the intervention group observed a 5 minute VR clip of a robotic surgical case and mimicked the hand motions seen in the console view. All subjects then completed two additional robotic simulation tasks.

Analysis: Statistical evaluations were performed in JMP15.0. Explanatory variables included spatial reasoning score and session 1 (baseline) task performance. Outcome variables included session 2 task completion time, economy of motion, and performance. After univariate analysis, multivariate stepwise linear regressions to predict each outcome were generated to account for covariation between explanatory variables. Each model contained no more than two explanatory variables given the limited number of study participants.

RESULTS



- Control and VR groups had similar baseline spatial reasoning scores and simulation performance
- In multivariate regression, session 2 task performance was associated with increased spatial reasoning scores (R^2 =0.81; p=0.0168) and demonstrated non-significant improvement with VR intervention (p=0.093)
- Similarly, session 2 task completion time (R^2 = 0.54; P=0.058) and economy of motion (R^2 = 0.75; P=0.0116) were highly associated with spatial scores

CONCLUSIONS

Despite limited pilot study sample size, these data suggest that among novice trainees, baseline spatial reasoning scores predict overall robotic simulation performance and that there is a potential benefit to VR motor mimicry to enhance performance. Additional study participants will be recruited to determine if the benefit of intervention is due to chance, enhanced learning among those with higher spatial reasoning skills, or the intervention itself. Ultimately, the potential to predict a surgical trainee's facility with minimally invasive surgical skills may allow for customized or targeted training.

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