Exploring gaze markers to differentiate expertise based on navigation status during colonoscopy

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Background

- Endoscopy skill training has been traditionally focused on an individual's deliberate practice.
- With the evolution of technologies, virtual reality (VR) simulation training is now a reality for general surgery residents.
- In practicing endoscopic skills, it is important to monitor residents' skill levels with psychomotor evidences.
- Previous studies showed the moment of navigation lost (MNL) can be good behavioral markers for endoscopic expertise.
- In this study, we further explored gaze markers to differentiate experts and novices in a simulated colonoscopy procedure.

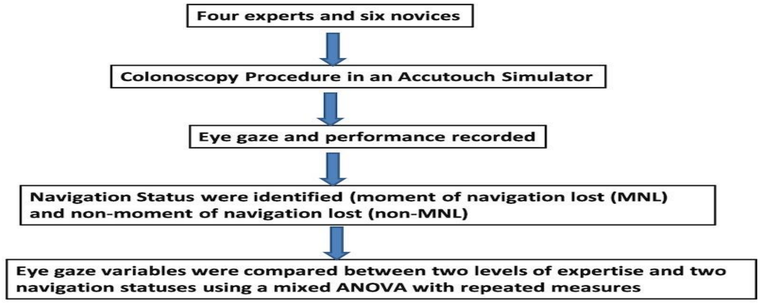
Methods

Figure 1. Experimental Setup



A subject is working under AccuTouch® Endoscopy Simulation System

Figure 2. Flow of Data Collection and Analysis



Results

- The mixed ANOVA revealed significant differences between navigation status on four dependent variables: saccade amplitude ($p = 0.007$), fixation traveling distance [0, 50] (pixels) ($p < 0.001$), fixation traveling distance [0, 75] (pixels) ($p < 0.001$), and fixation traveling distance [0, 100] (pixels) ($p < 0.001$).
- Specifically, subjects in MNL had larger saccade amplitude (2.36 vs. 1.51) (degree) than in normal performance (non-MNL).
- Upon entering MNL, subjects have reduced amounts of long fixation compared to normal performance; measured by accumulated fixation travel distance longer than 50, 75, and 100 pixels.
- Adjusted Pupil Size (APS) showed a significant difference between navigation status (60.5 ± 1.95 vs. 4.24 ± 1.06, $p = 0.033$) in non-MNL.
- Significant differences were found on between expertise on three pupil variables: APS in trial ($p = 0.006$), APS in saccade ($p = 0.004$), and APS in fixation ($p = 0.005$).
- Specifically, subjects in MNL had a small APS in the trial (0.46 vs. 0.63), saccade (0.45 vs. 0.62), and fixation phase (0.46 vs. 0.63), compared to normal performance (non-MNL).
- No significant interaction was found between expertise and viewing conditions.

Figure 3. A) Fixation traveling distance in MNL.

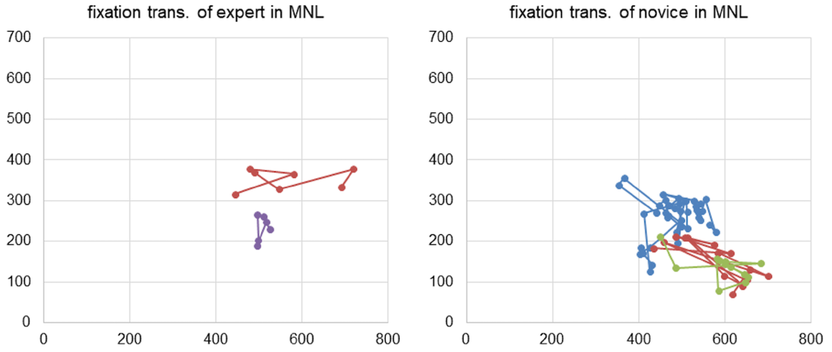
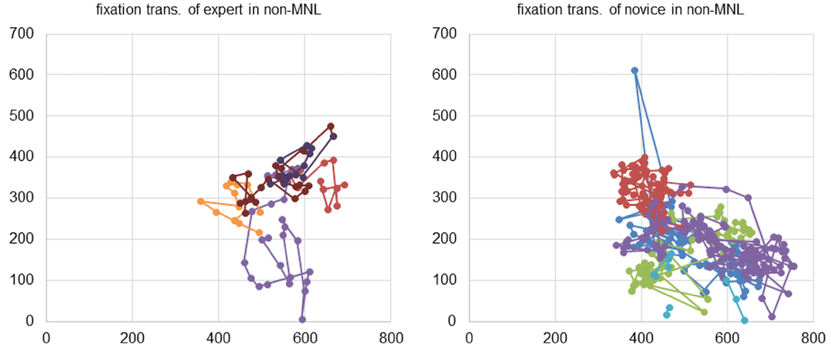


Figure 3. B) Fixation traveling distance in non-MNL.



Conclusion

- Significant gaze differences were found in MNL and non-MNL.
- More behavior markers need to be explored on how experts transitioned from MNL to non-MNL.
- The gaze markers identified from this study could be used for skill training and assessment of novices in the future.

Acknowledgments

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