

# Eye-Tracking Analysis from a Flight-Director-Use and Pilot-Monitoring Study

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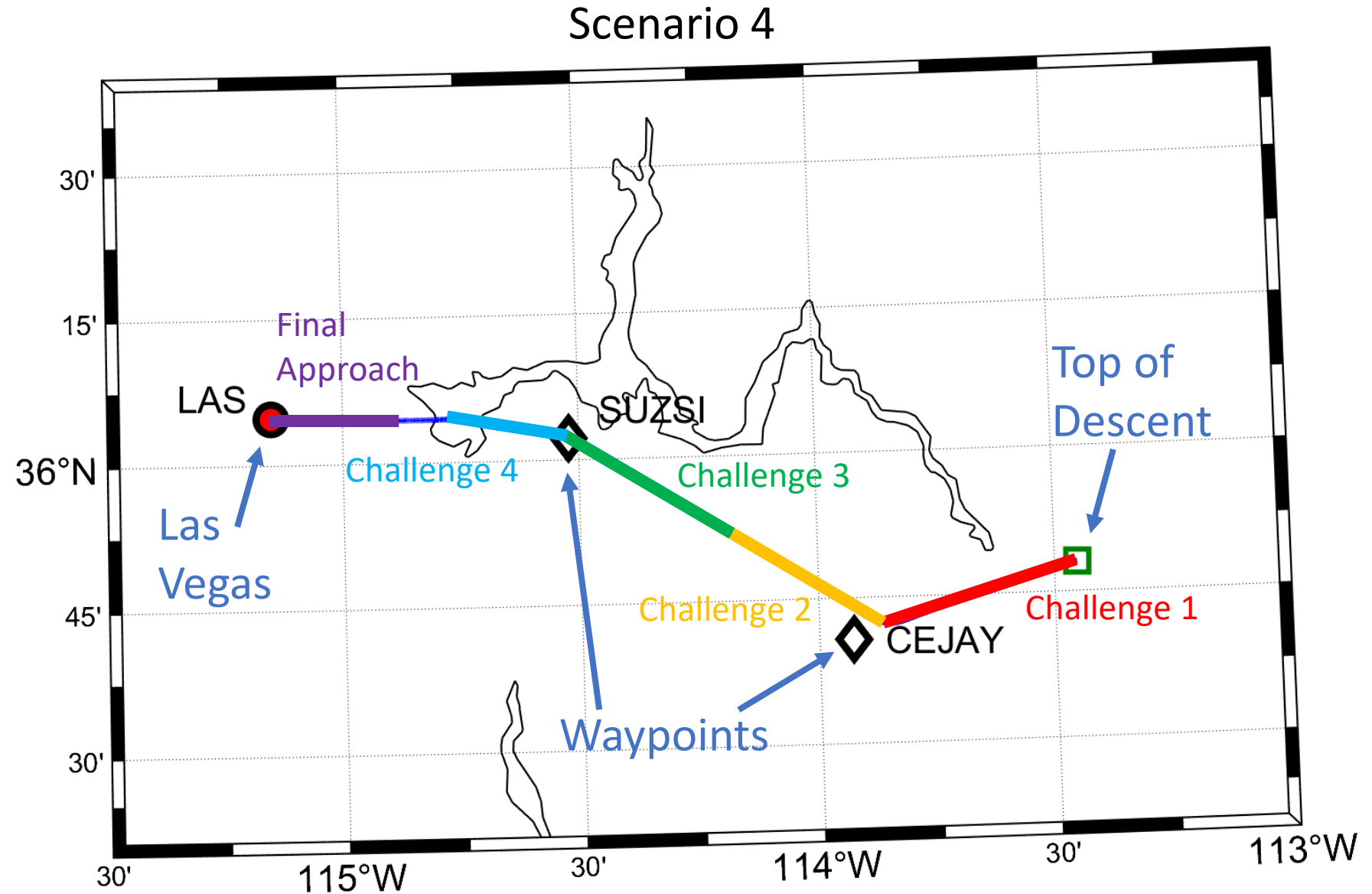
# Eye-Tracking Objectives

- A simulator study assessed pilots' flight path monitoring skills before and after training on sensemaking cycle approach to monitoring.
- Eye tracking served two underlying objectives:
  1. Test the hypothesis that having the flight director engaged on the pilot monitoring side in the final approach will result in pilots focusing more on the primary flight display.
  2. Explore if eye tracking measures are different between successful and unsuccessful pilots in monitoring challenges.



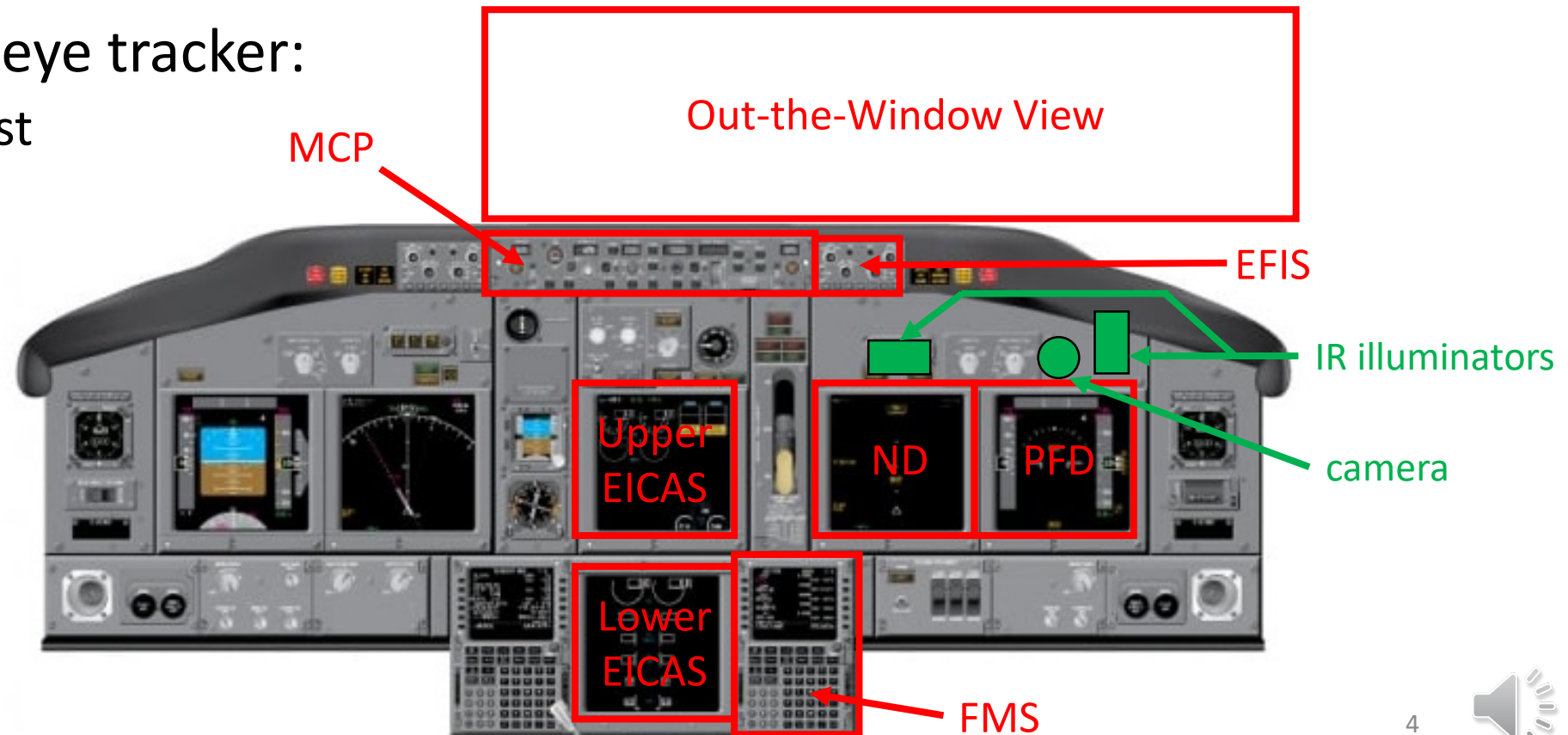
# Scenarios

- Four scenarios each included:
  - 3-4 monitoring challenges
  - Final approach segment



# Method

- B737-700 Full Flight Simulator
  - 231 variables
- Seeing Machines eye tracker:
  - 8 areas of interest
  - 15 variables
- Video/audio data



# Method

Order 1	Order 2	Order 3	Order 4
Scenario 1/ FD on	Scenario 1/ FD off	Scenario 3/ FD on	Scenario 3/ FD off
Scenario 2/ FD off	Scenario 2/ FD on	Scenario 4/ FD off	Scenario 4/ FD on
Training	Training	Training	Training
Scenario 3/ FD on	Scenario 3/ FD off	Scenario 1/ FD on	Scenario 1/ FD off
Scenario 4/ FD off	Scenario 4/ FD on	Scenario 2/ FD off	Scenario 2/ FD on

- Hypothesis: with the flight director engaged on the primary flight display of the pilot monitoring, the Proportion Dwell Time would be higher than when the flight director was not engaged.



# Flight Director Status Results

- Proportion Dwell Time is trending higher with flight director off ( $\chi^2(1)=3.65, p=0.056$ )
- The effect of scenario is significant ( $\chi^2(1)=5.73, p=0.018$ )

		Proportion Dwell Time, s Mean (Standard Deviation)		
		Scenario 2	Scenario 4	Mean by FD Status
FD Off	higher	0.51 (0.08)	0.47 (0.11)	0.49 (0.10)
FD On	lower	0.44 (0.10)	0.38 (0.13)	0.41 (0.12)
Mean by Scenario		0.48 (0.10)	0.43 (0.13)	0.45 (0.11)

higher

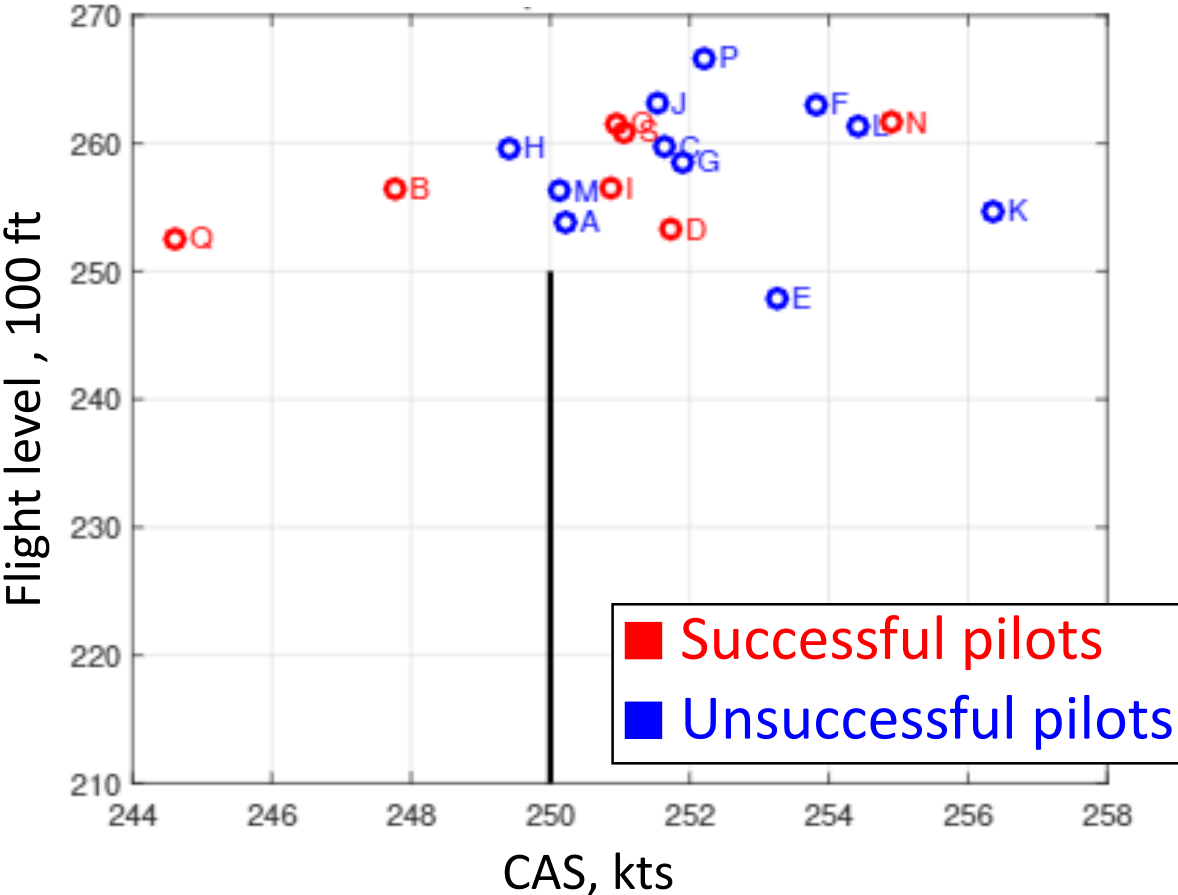
lower



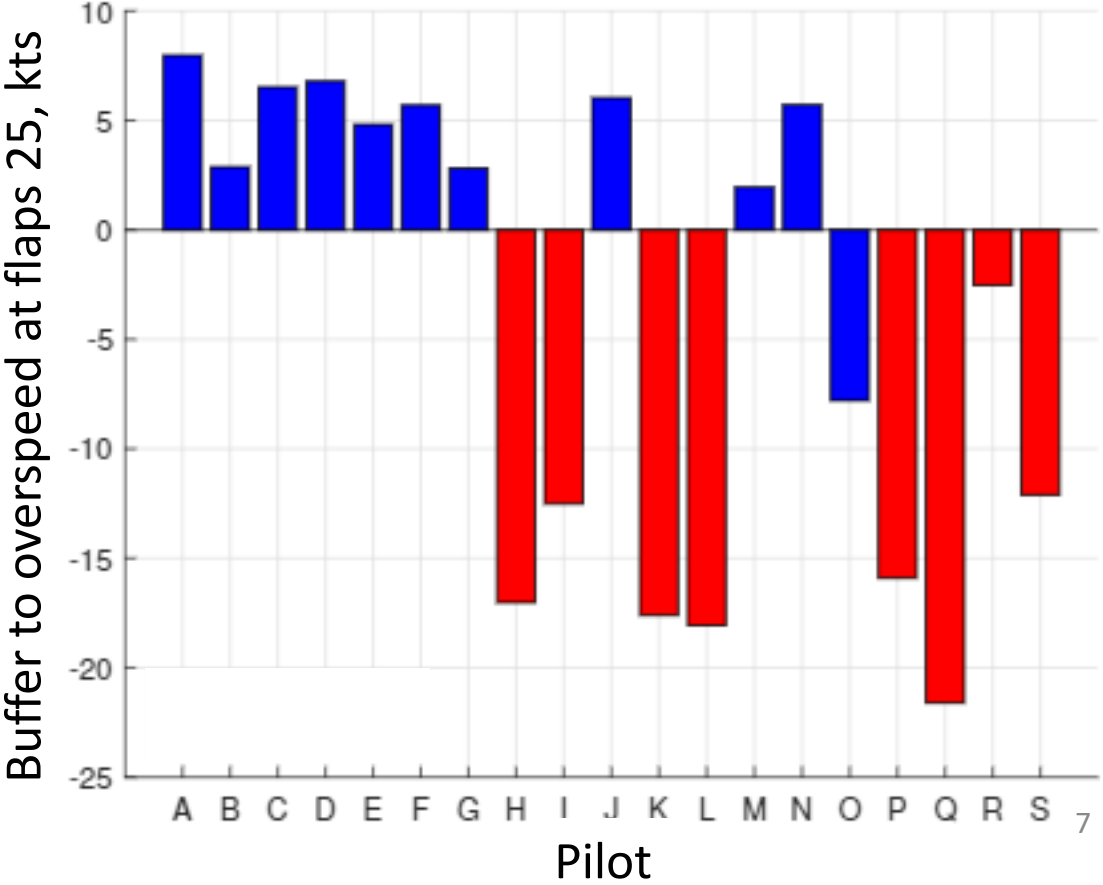
# Monitoring Challenges

- Two challenges with waypoint restrictions

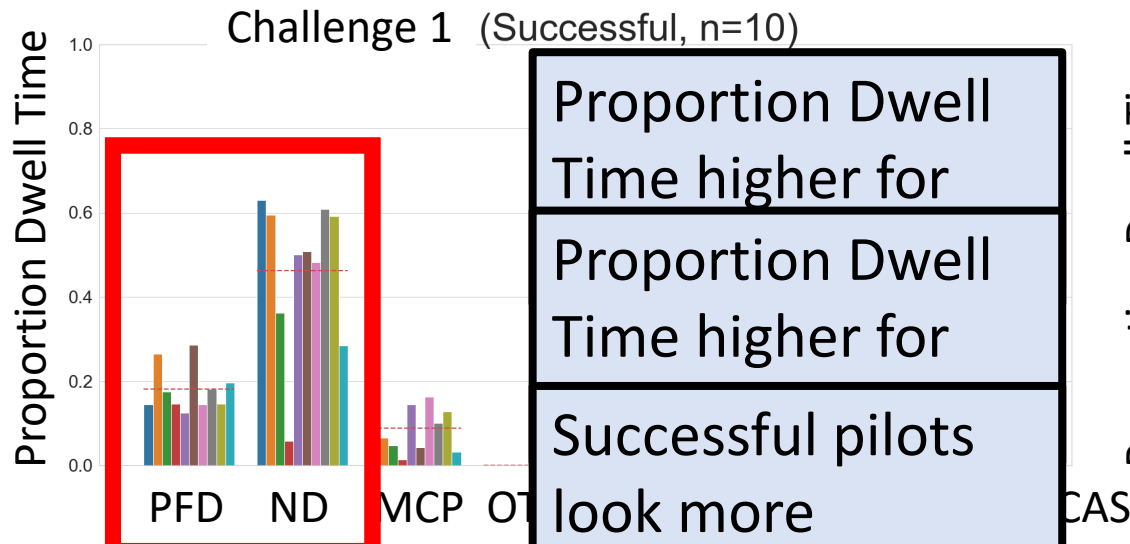
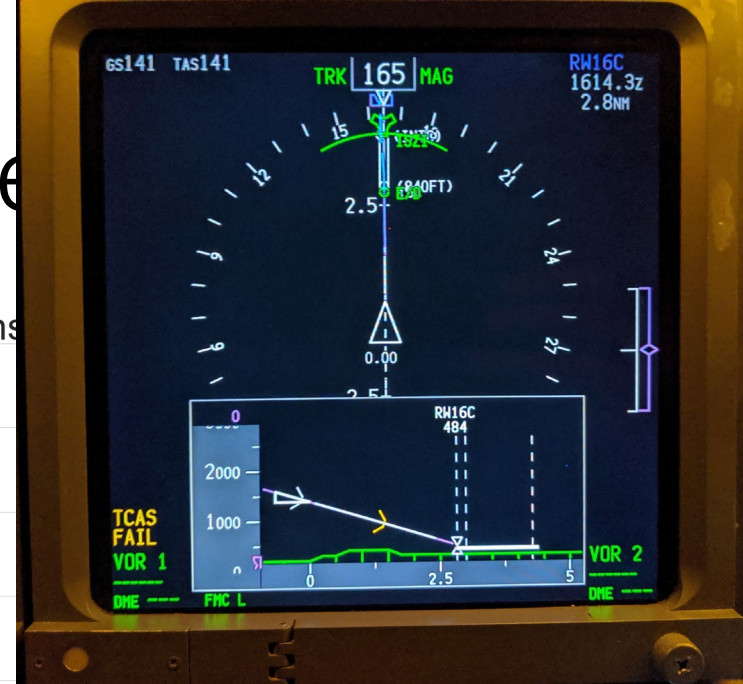
Altitude and Speed Restrictions at JIMVE



- Two challenges with flap extensions

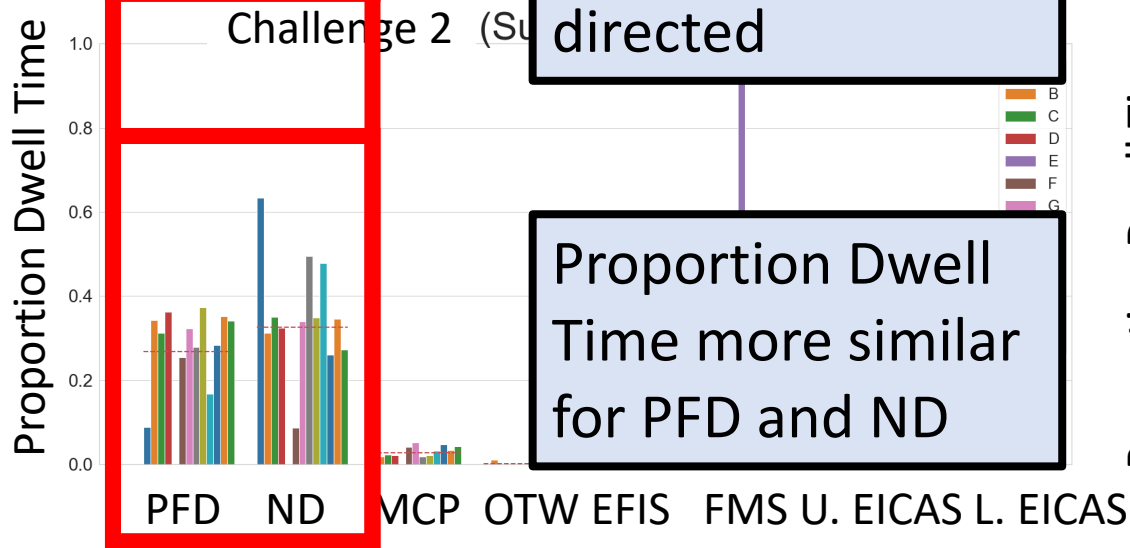


# Waypoint Restrictions Challenge Results

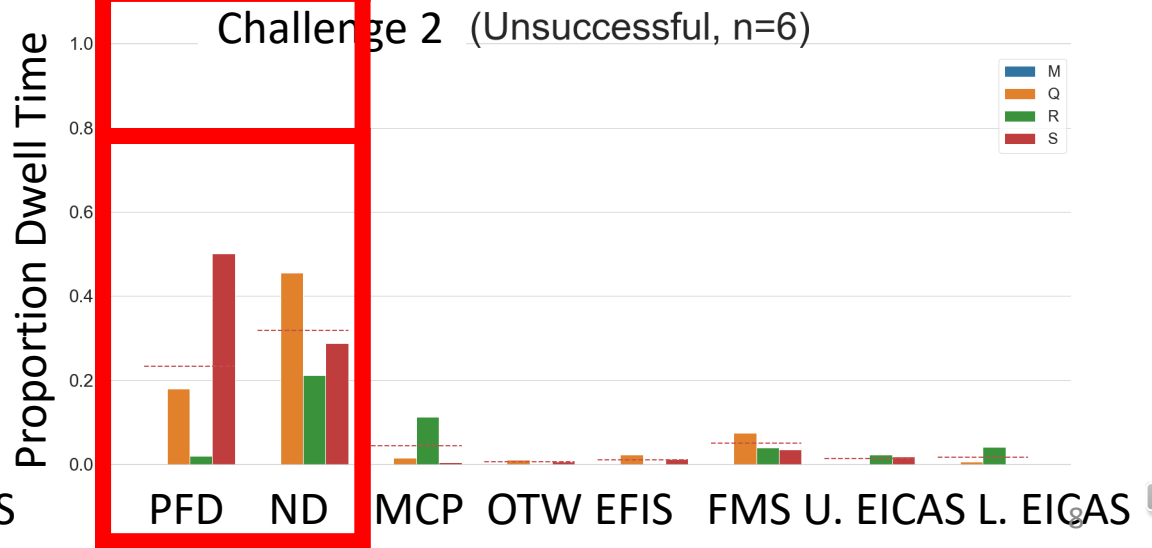
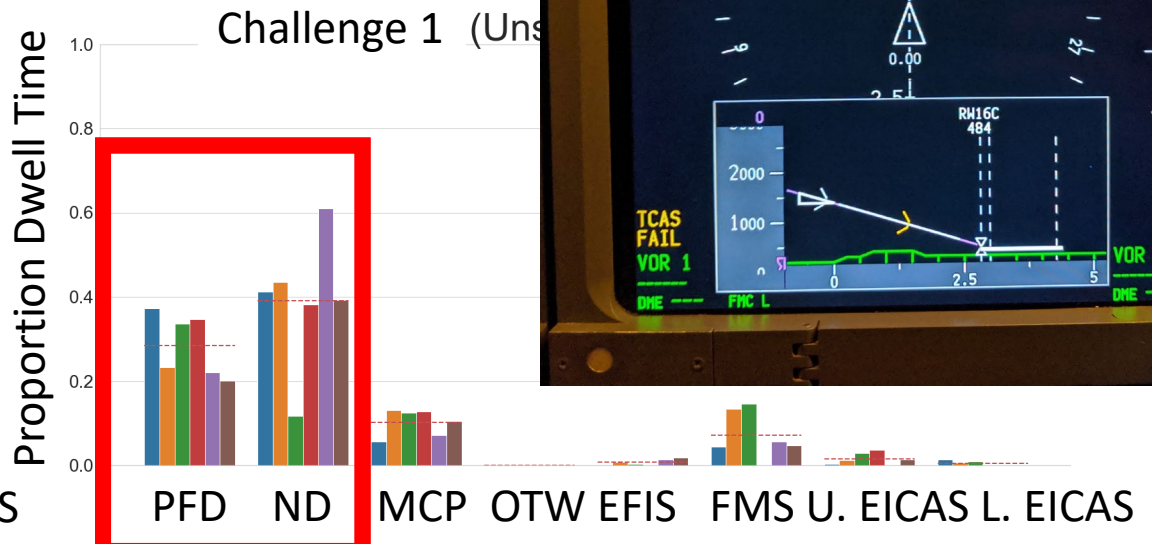


Proportion Dwell Time higher for PFD and ND

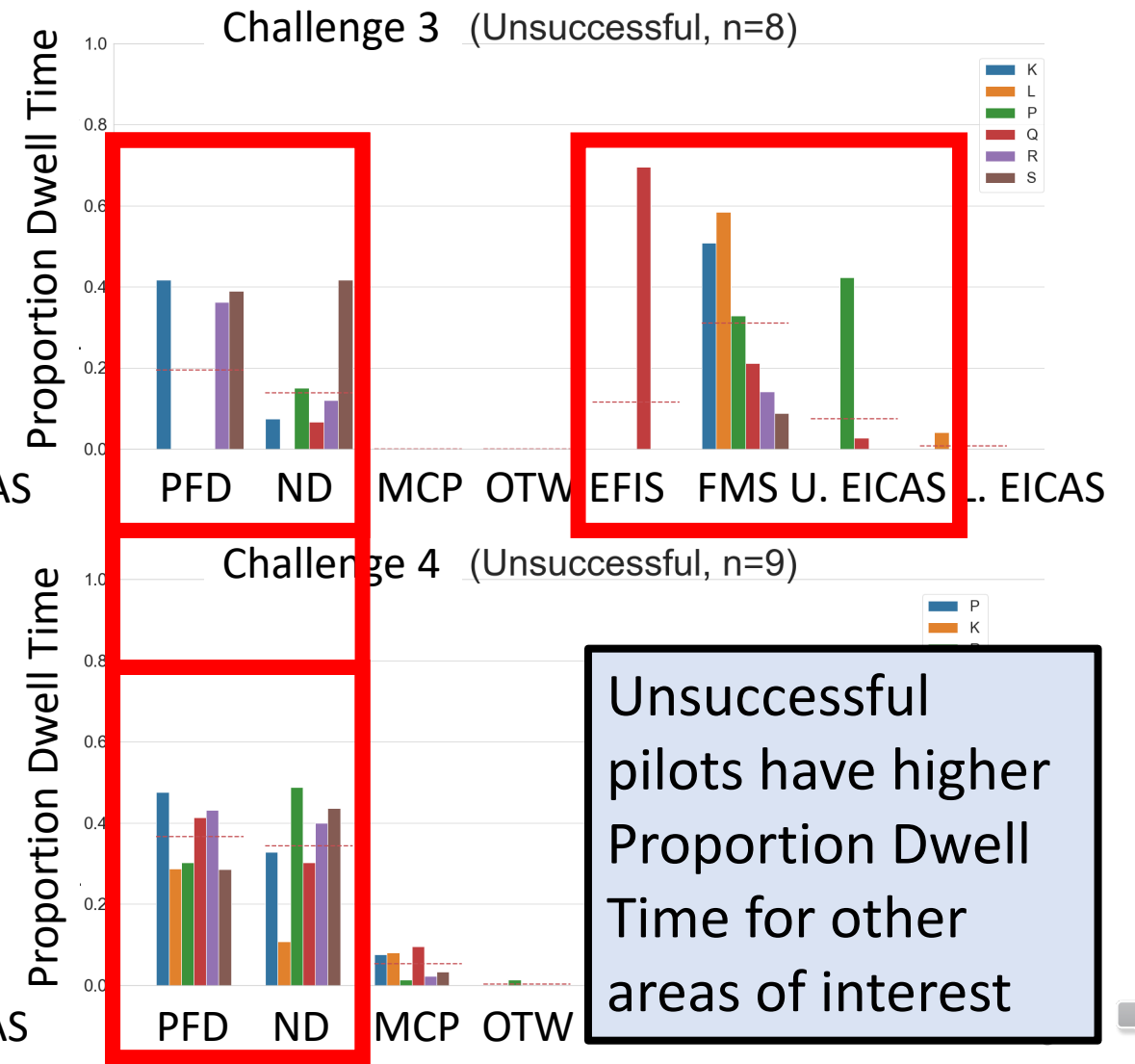
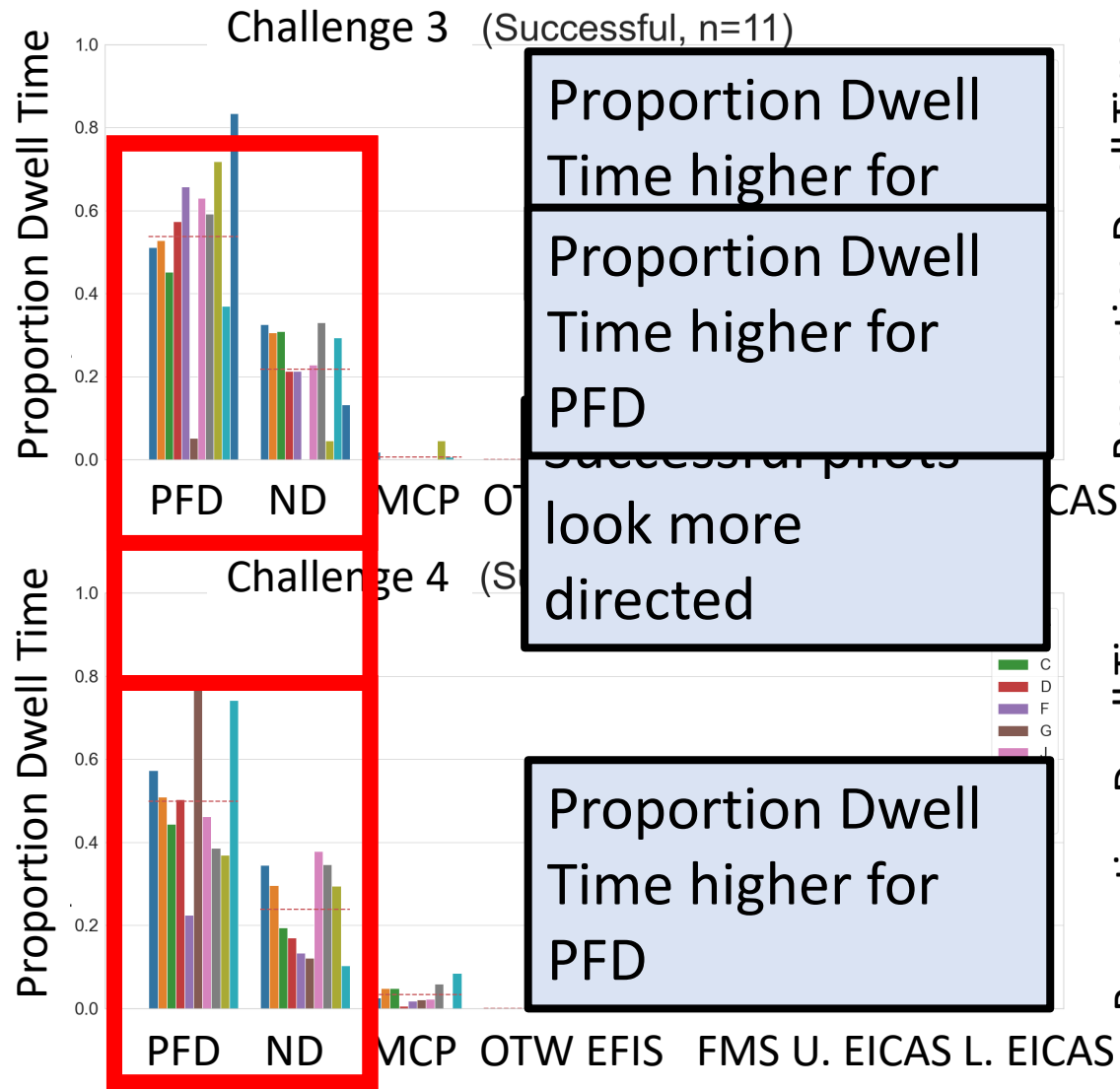
Successful pilots look more directed



Proportion Dwell Time more similar for PFD and ND



# Flap Extension Challenge Results



# Conclusions

- During two final approach segments, pilots monitoring tended to focus less on the primary flight display with the flight director on, not off as hypothesized.
- Pilots that successfully completed the monitoring challenges:
  - Focused more on the areas of interest that contained the most relevant information to successfully complete the challenge.
  - Adapt their monitoring strategy more to the challenge at hand.

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