

Smooth pursuit eye movements and motion prediction in patients with schizophrenia and untrained healthy controls

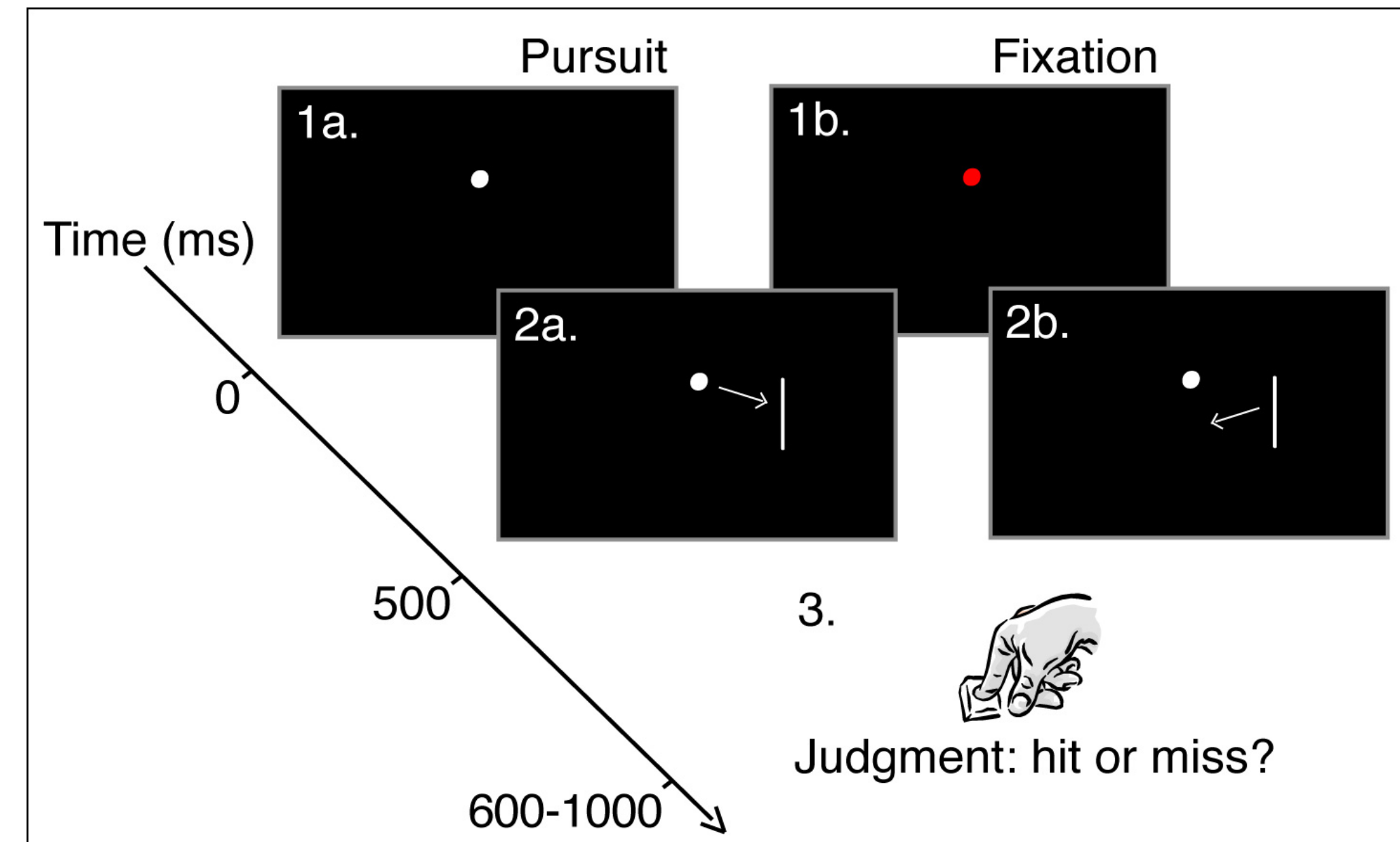
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Background

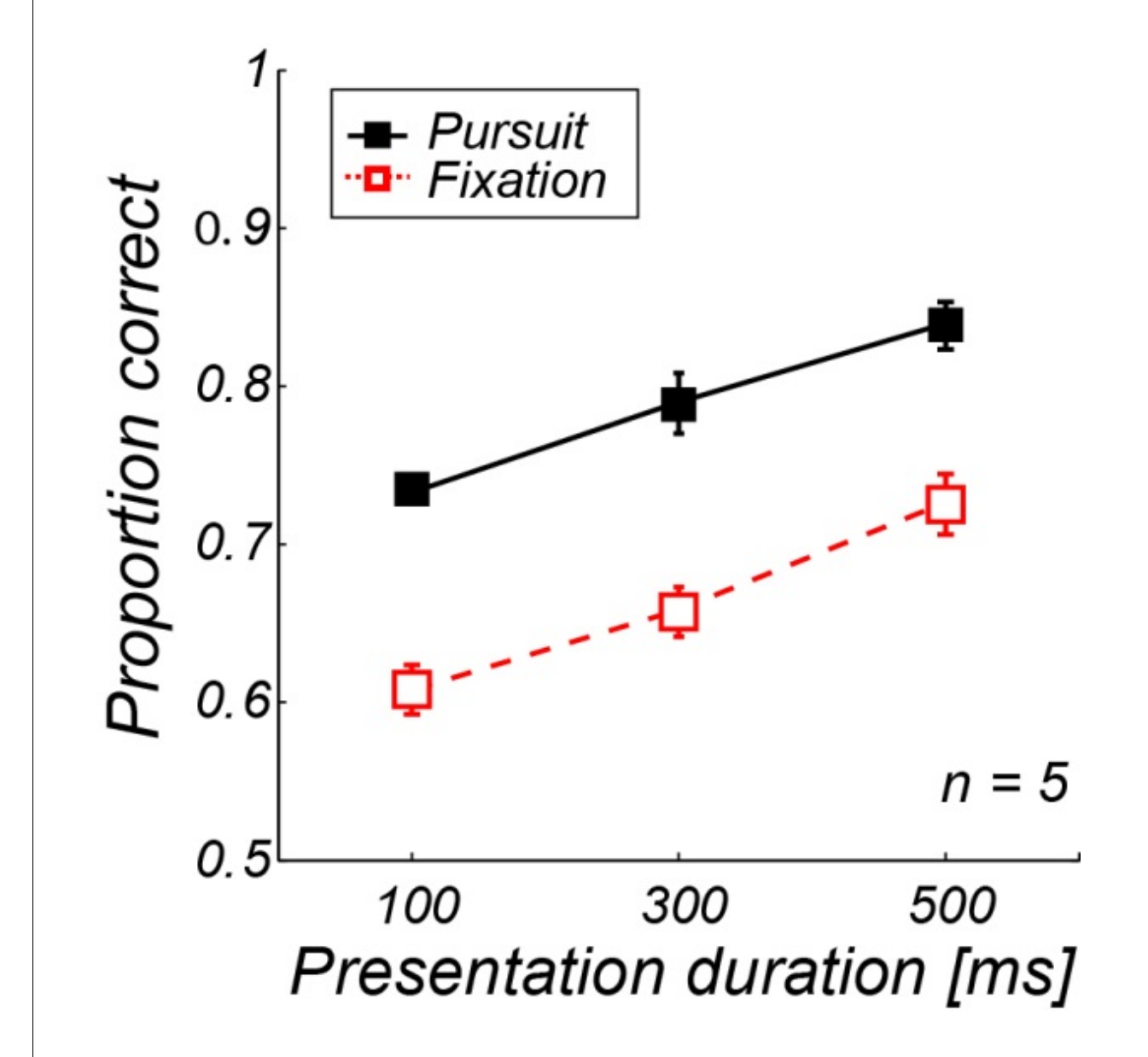
Smooth pursuit eye movements can help improve motion prediction: healthy adults performed better in a motion prediction task during pursuit than during fixation

Eye soccer: did the ball hit or miss the goal?



Spring, Schütz, Braun & Gegenfurtner, J. Neurophysiol. 2011

Pursuit > Fixation



How is the ability to predict visual motion affected by impairments in smooth pursuit eye movements?

Patients with schizophrenia and clinically unaffected first-degree relatives show deficits in:

- Pursuit (e.g., velocity gain, saccade rate, predictive tracking) *Holzman et al., 1974; O'Driscoll & Callahan, 2008*
- Motion perception (e.g., higher direction detection thresholds) *Butler & Javitt, 2005; Chen et al., 1999; 2003*

Methods

Procedure

- Visual target ("ball") moved towards "goal" at 10°/s; ball and goal disappear before hit/miss
- Pursuit condition: track ball; fixation condition: fixate goal
- Judgment: button press for ball "hit" or "miss" relative to goal.

Patients

- 15 patients who met DSM-IV (SCID-defined) criteria for schizophrenia
- Age: 40.9 yrs (SD 8.6); 14 male
- IQ (quick test): 97.2
- SES (Hollingshead Scale): 22.7
- All patients receiving typical/atypical antipsychotic medication
- Duration of illness: 19.1 yrs

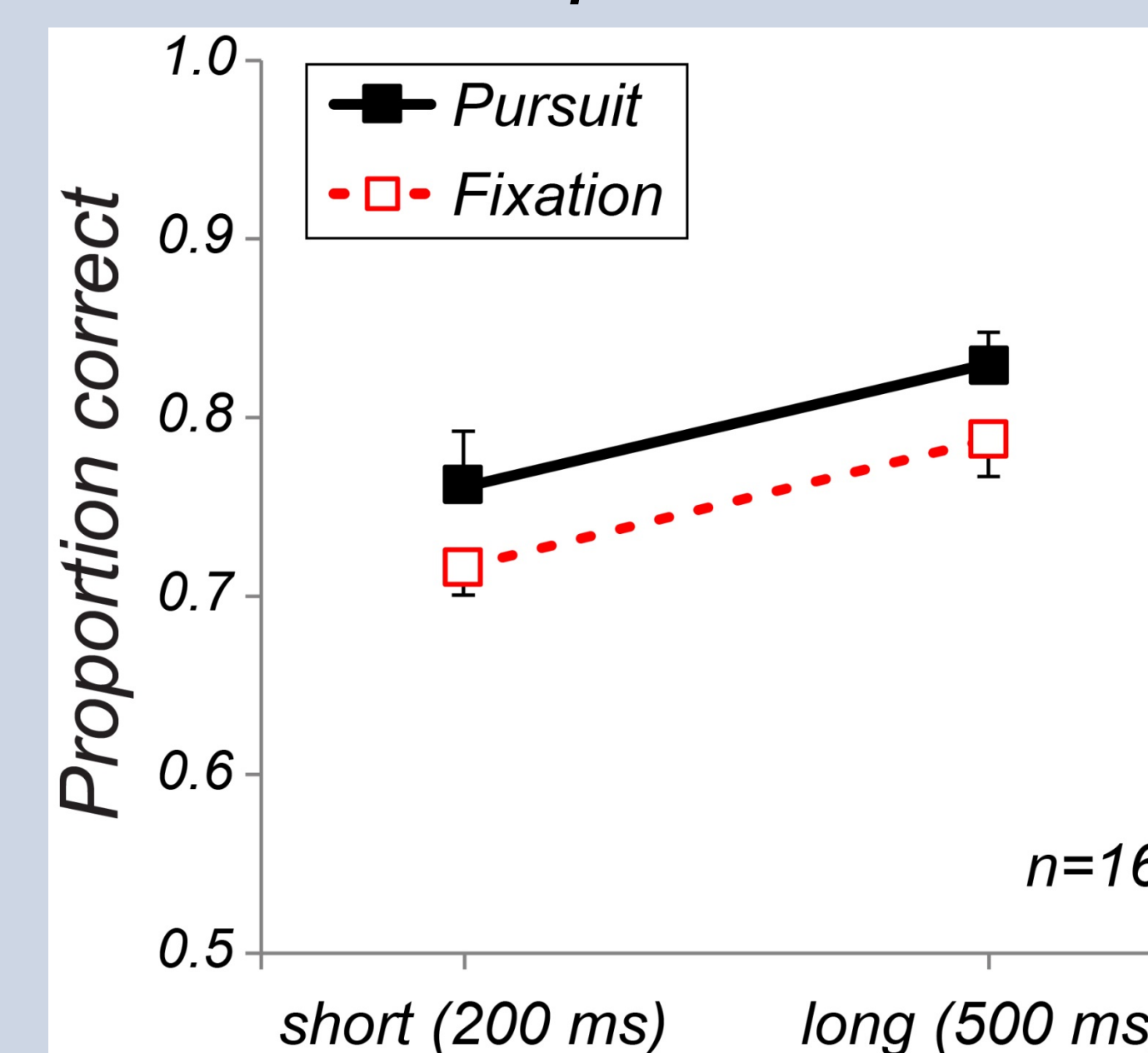
Controls

- 16 adults with no history of SCID-defined Axis I psychiatric disorder
- Age: 31.9 yrs (SD 7.7); 11 male
- IQ (quick test): 101.3
- SES: 42.2

Results

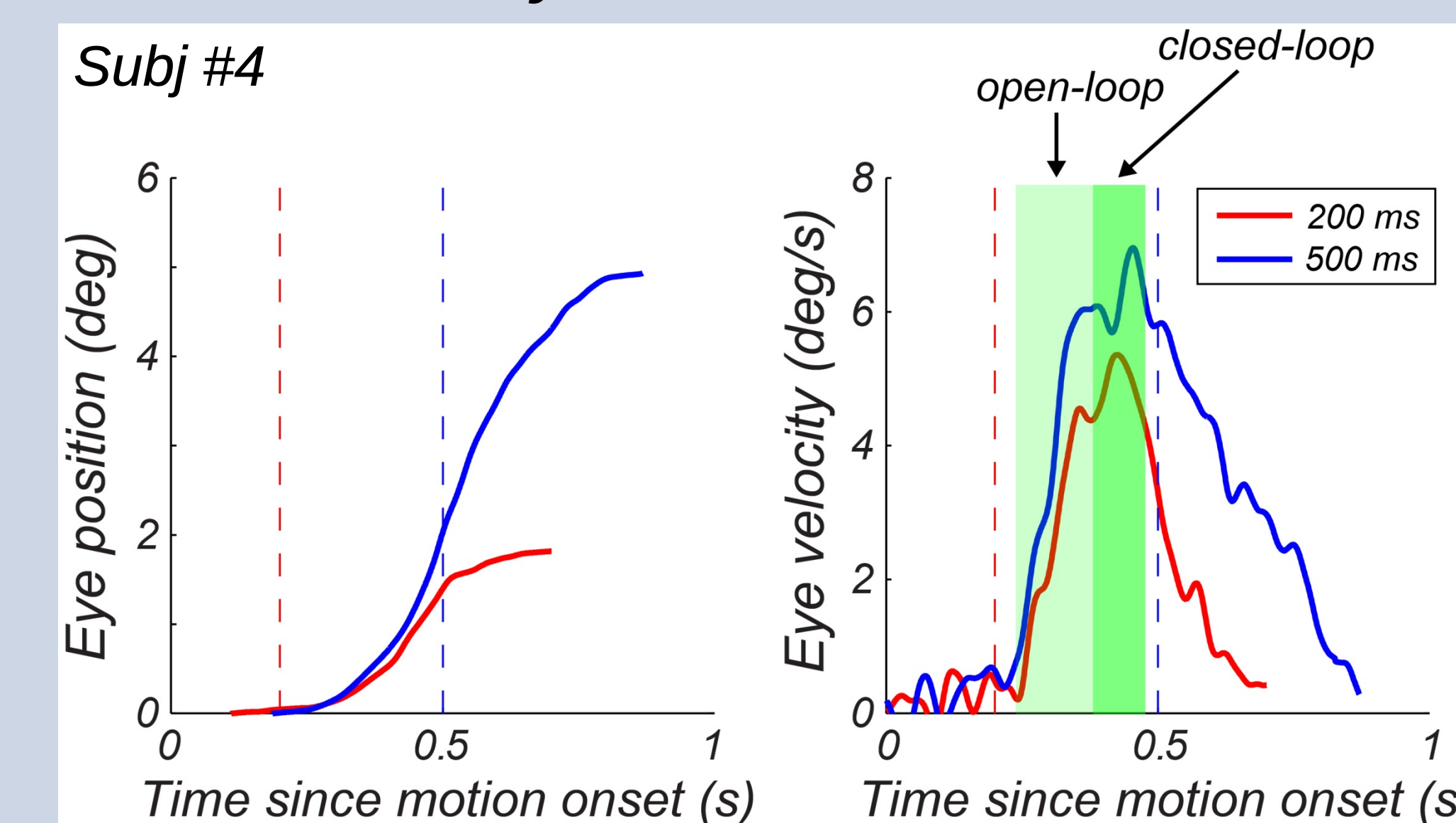
Controls

Motion prediction

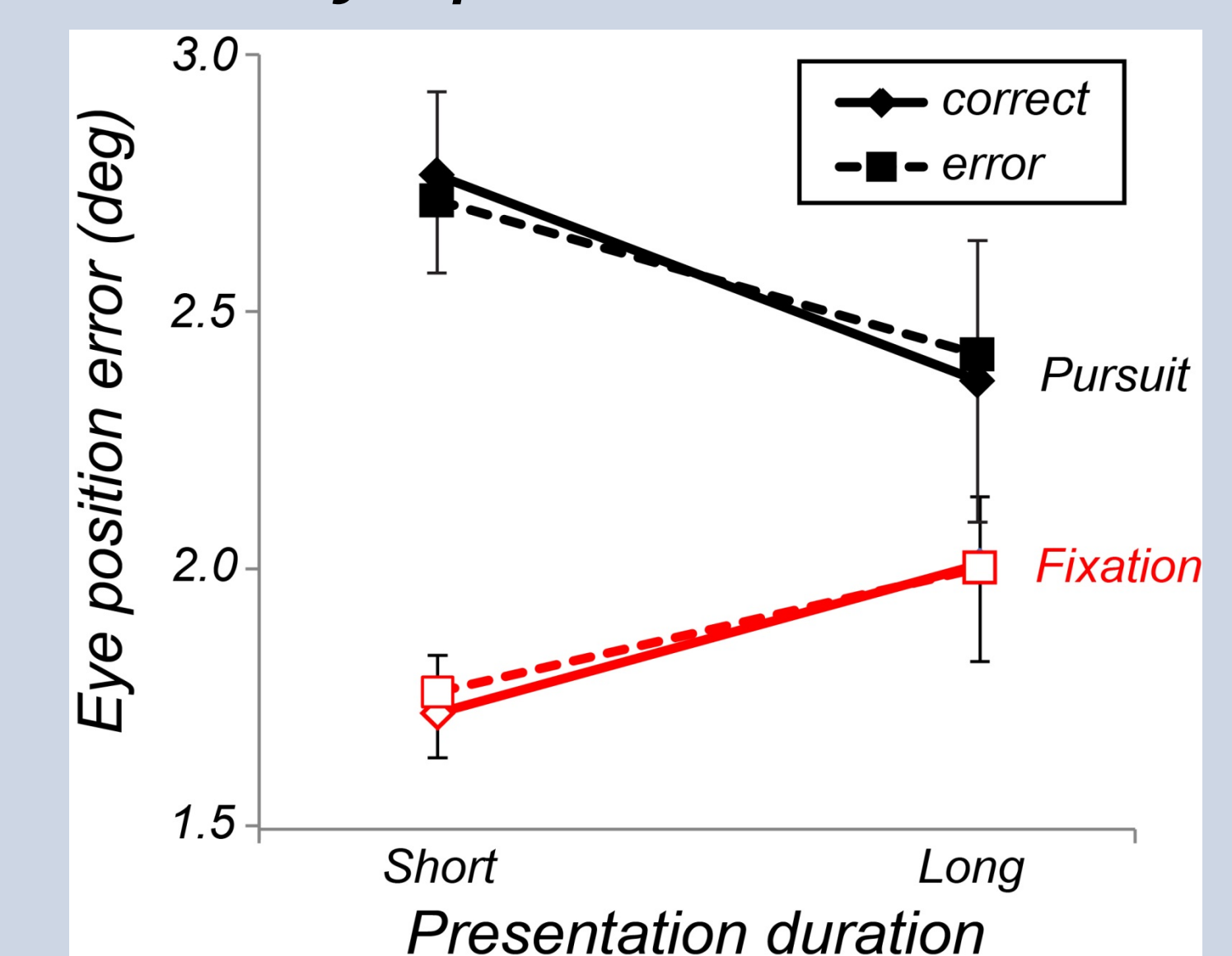


- Motion prediction pursuit > fixation ($F = 5.61, p = .03$)
- Performance increase with presentation duration ($F = 13.23, p = .002$)
- Valid pursuit trials: 28.7% of total pursuit trials

Mean eye movement traces

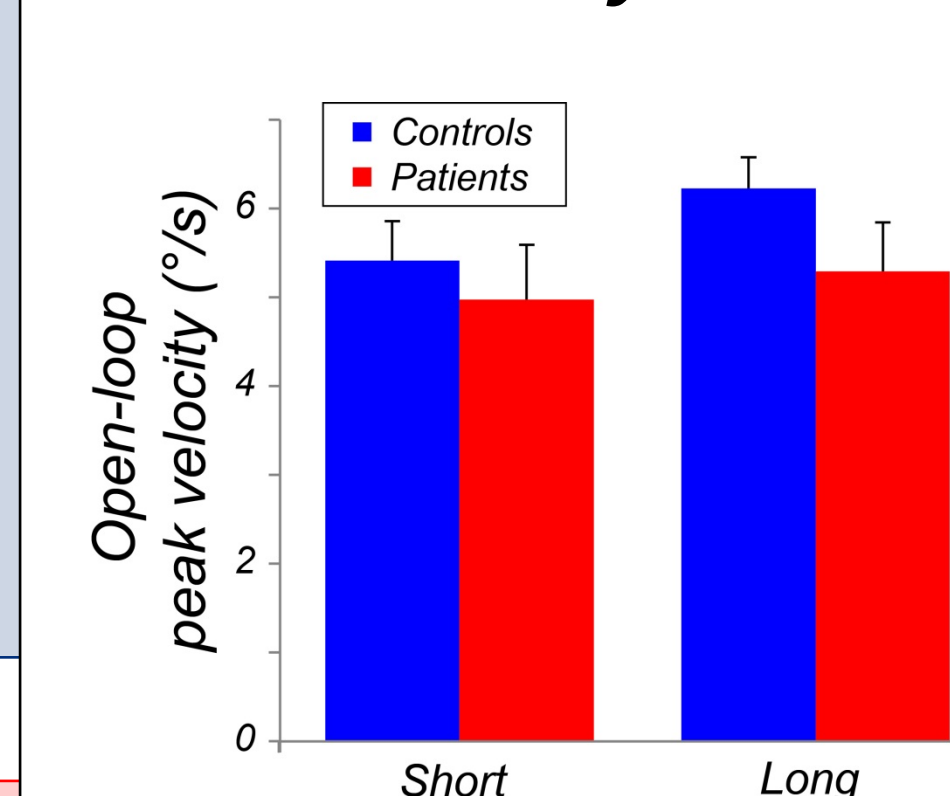


Eye position error

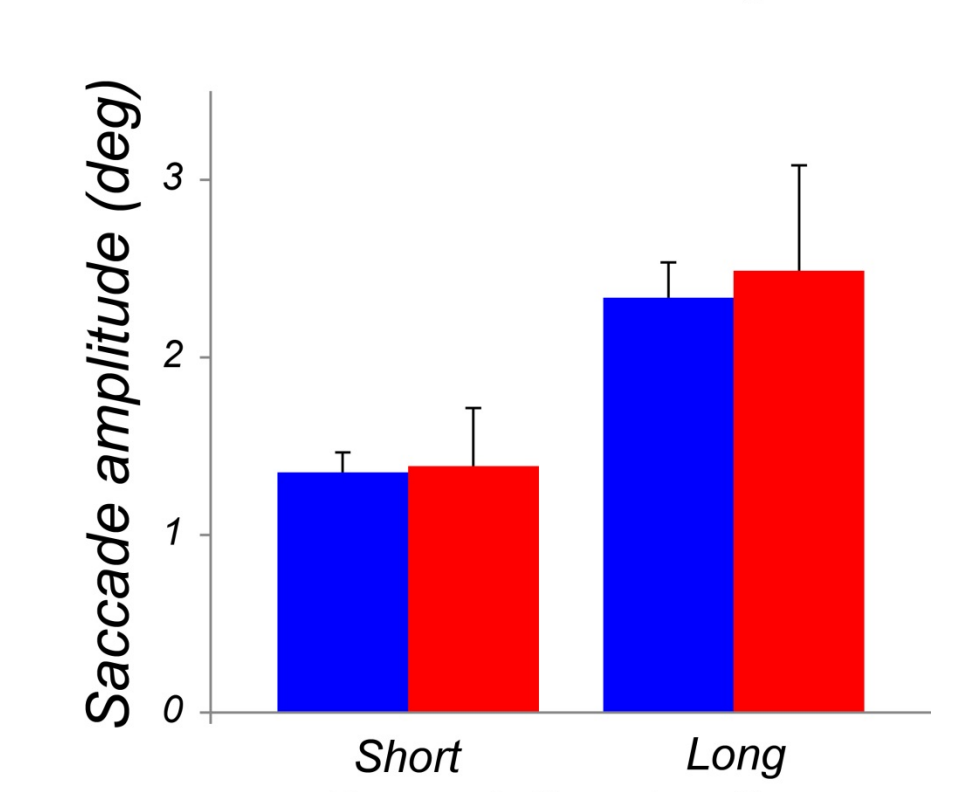
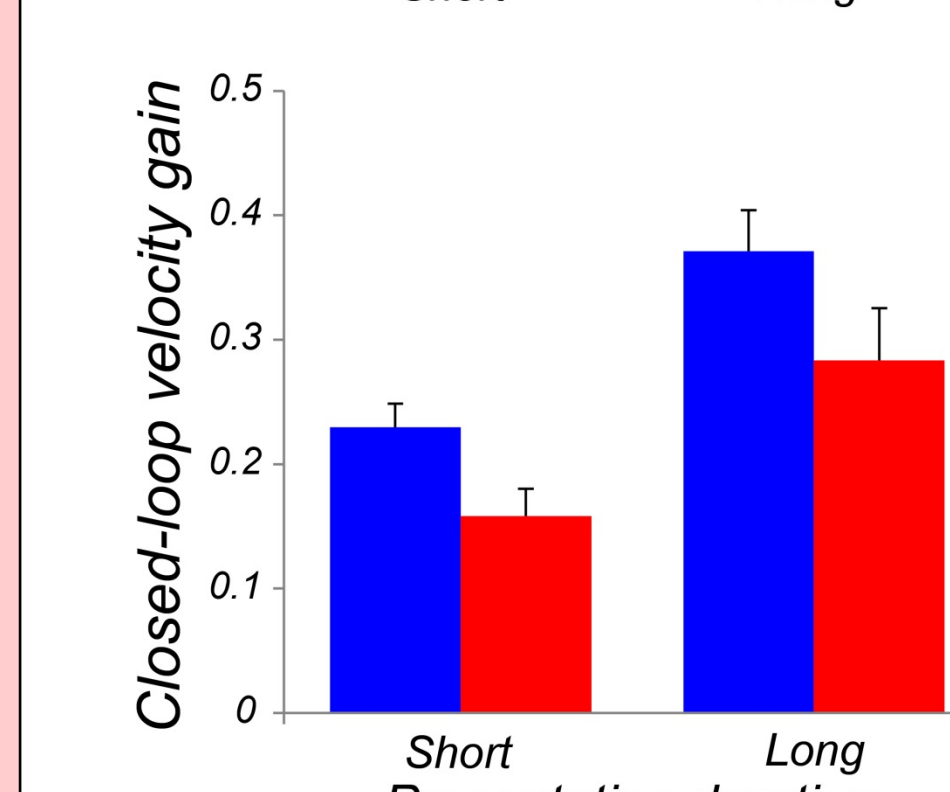
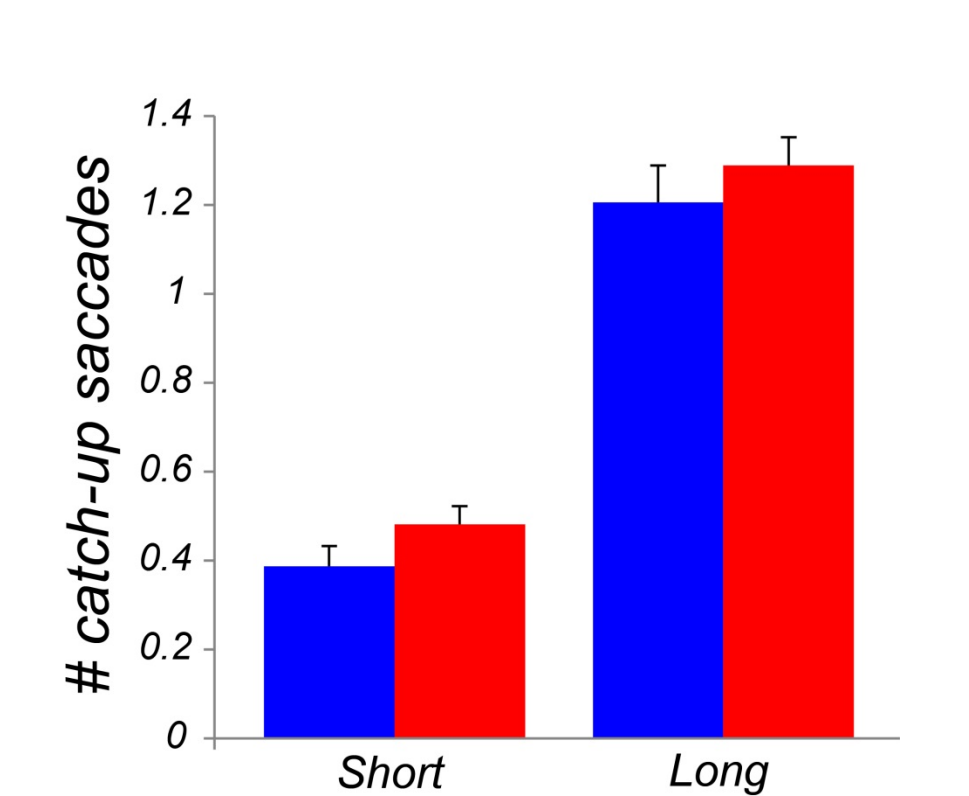


- Eye position error across all trials including at least one saccade to the goal (pursuit trials without pursuit onset) or away from the goal (fixation)
- Position error correct = incorrect trials ($F < 1$)

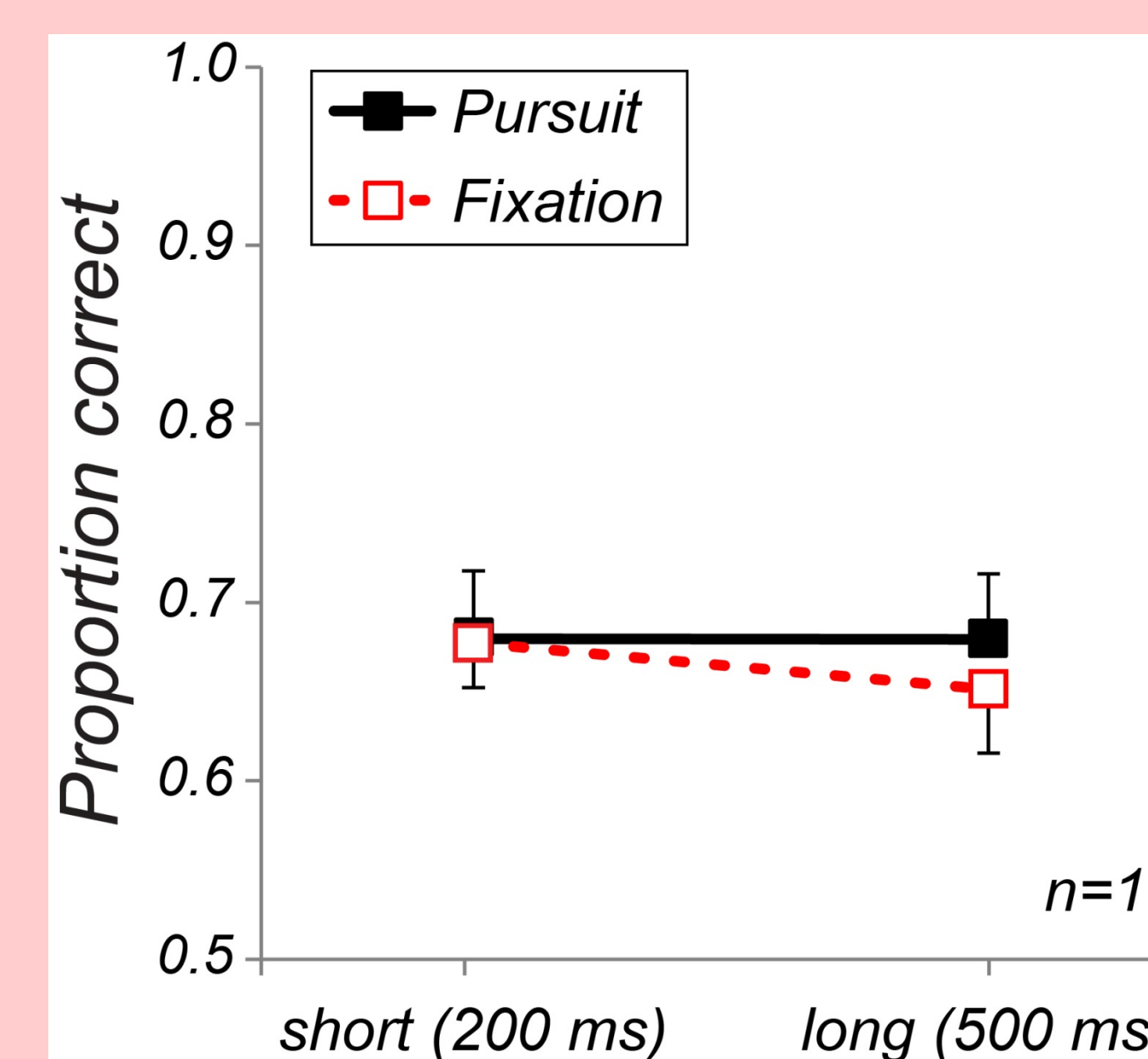
Smooth eye velocity



Saccades

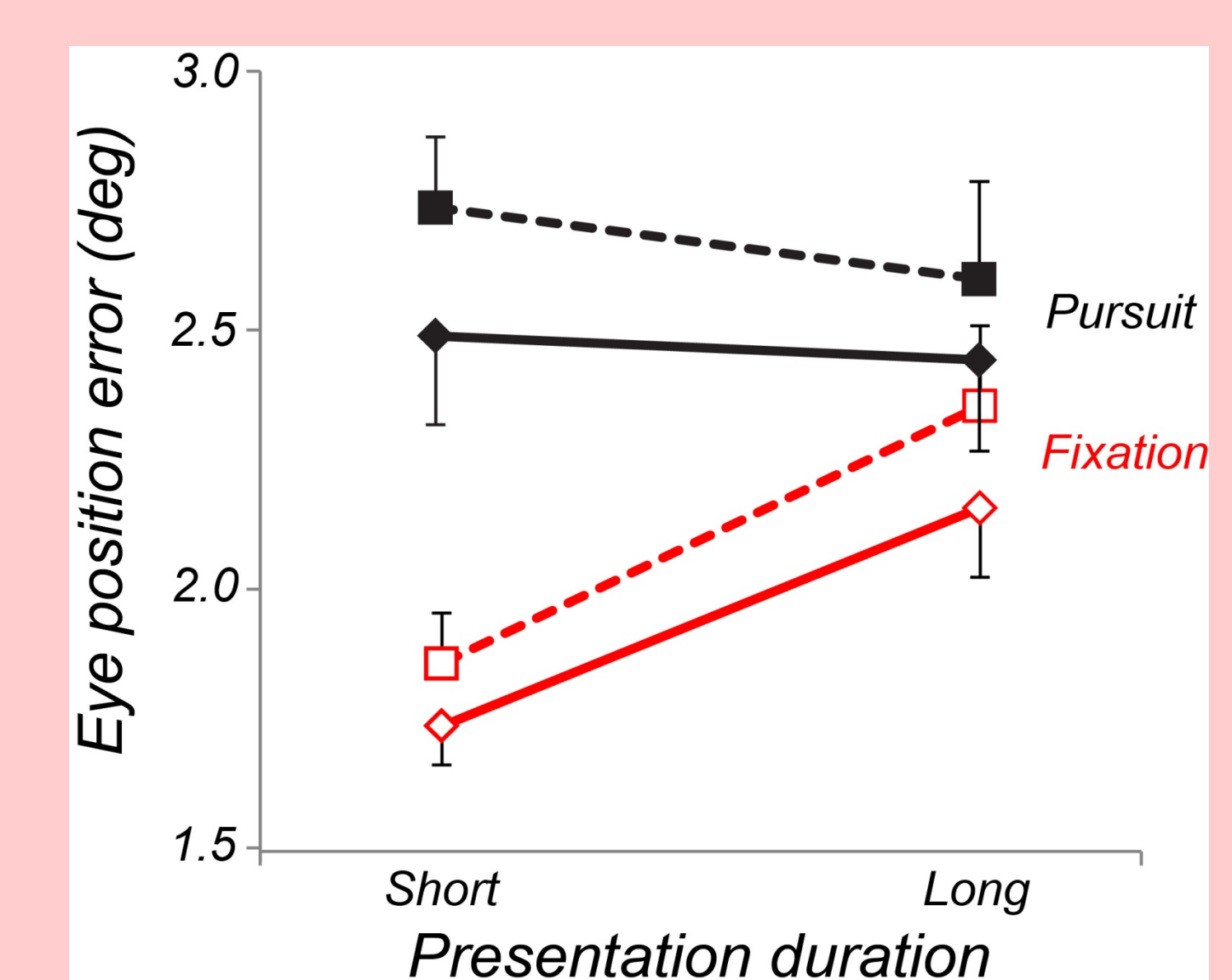
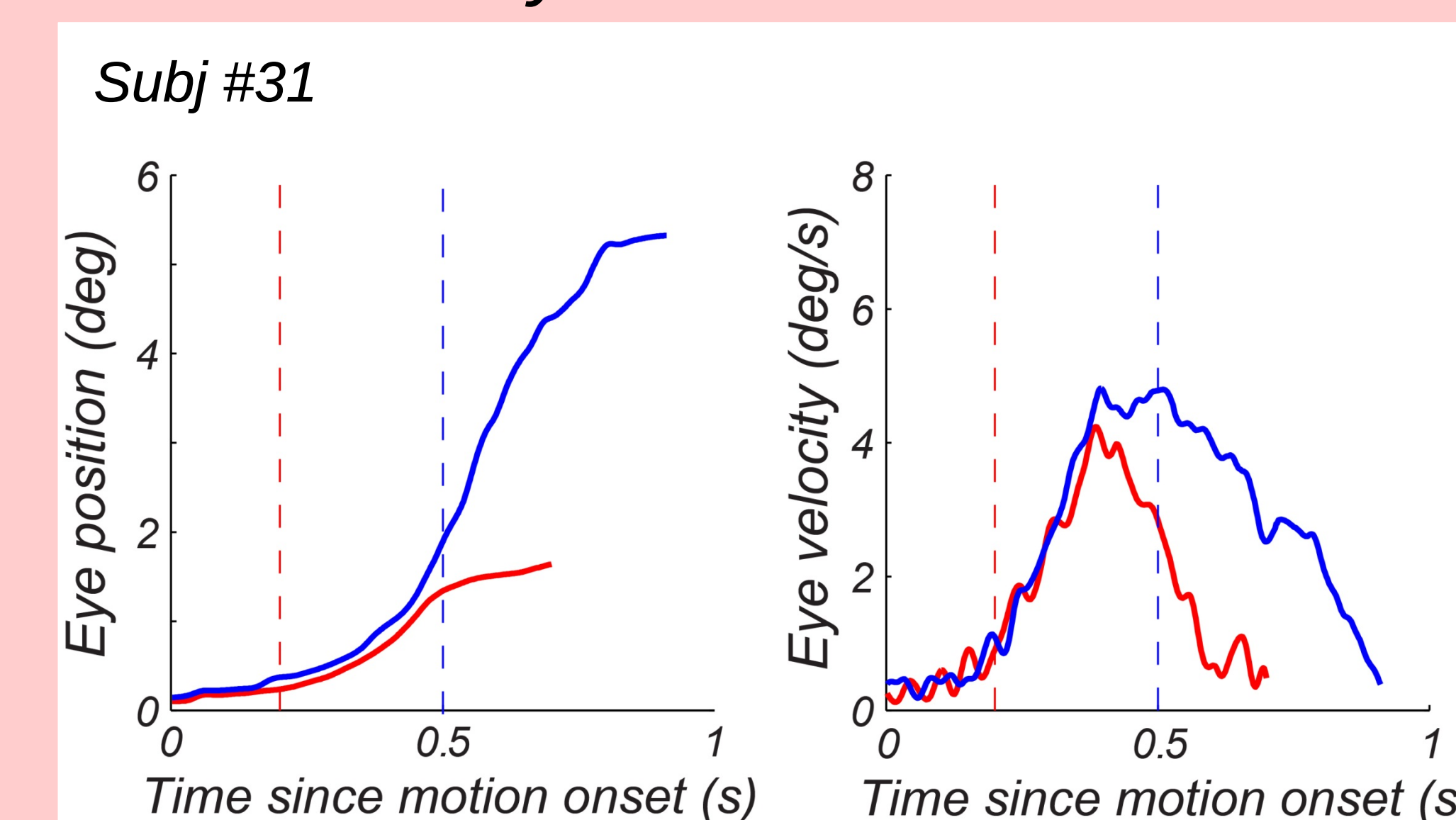


Patients



- Motion prediction pursuit = fixation ($F < 1$)
- No performance increase with presentation duration ($F < 1$)
- Valid pursuit trials: 11.8% of total
- Worse overall performance than controls (short: $p = .04$, long: $p = .0005$)

Mean eye movement traces



- Position error incorrect > correct trials ($F = 15.65, p = .001$)

Conclusions

- Schizophrenia patients show lower pursuit gain than controls and no perceptual performance advantage during pursuit; consistent with impaired motion processing and reduced MT activity *Butler & Javitt, 2005; Kim et al., 2005; 2006*
- Impaired sensory input to frontal pursuit areas (FEF/SEF) could explain deficits in using extraretinal motion information
- Patients have higher eye position errors in trials with perceptual error, indicating an inability to compensate for sensory consequences of eye movements *Lindner et al., 2005*

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