



Examination of individual differences in eye movement dynamics during mouse-and gaze-foraging

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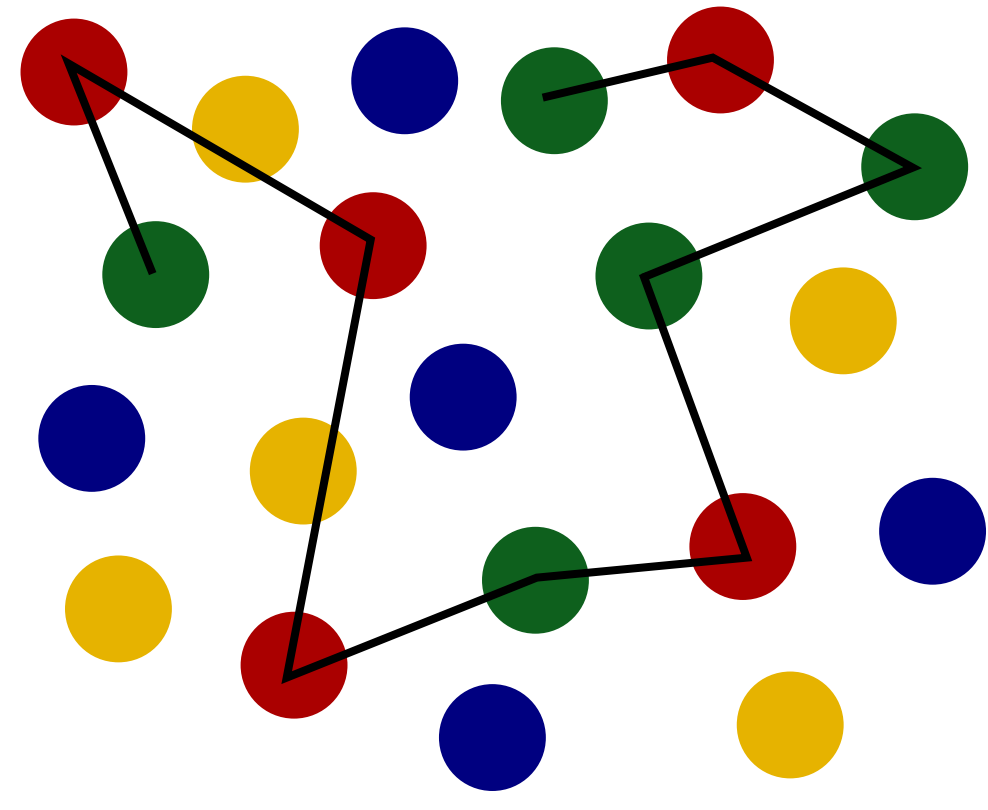
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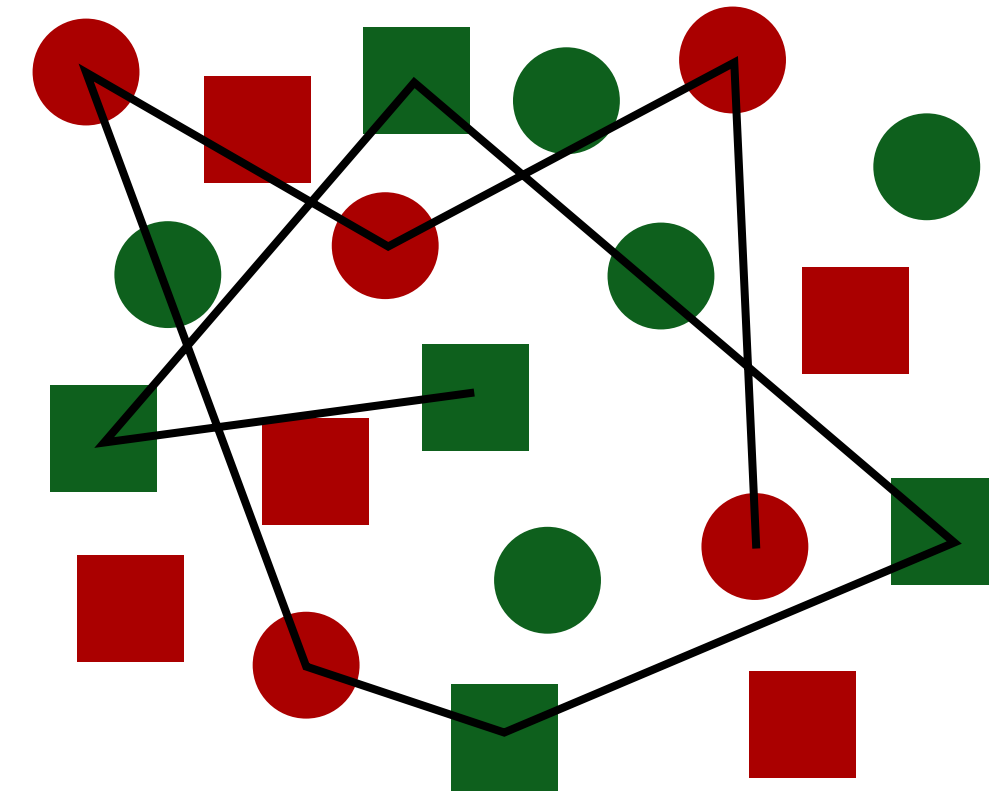
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INTRODUCTION

During multi-target visual foraging, most observers change their strategy when target crypticity is increased (Kristjánsson et al., 2014):



7 runs: GRRRGRGGRG



2 runs: GGGGRRRRR

Although this behavior is observed for most individuals, some of them - so called "super foragers" - continue to frequently switch between target types during conjunction foraging.

Two modes of visual exploration can be distinguished:

Ambient mode:

Short fixation durations
Large saccade amplitudes

Focal mode:

Long fixation durations
Small saccade amplitudes

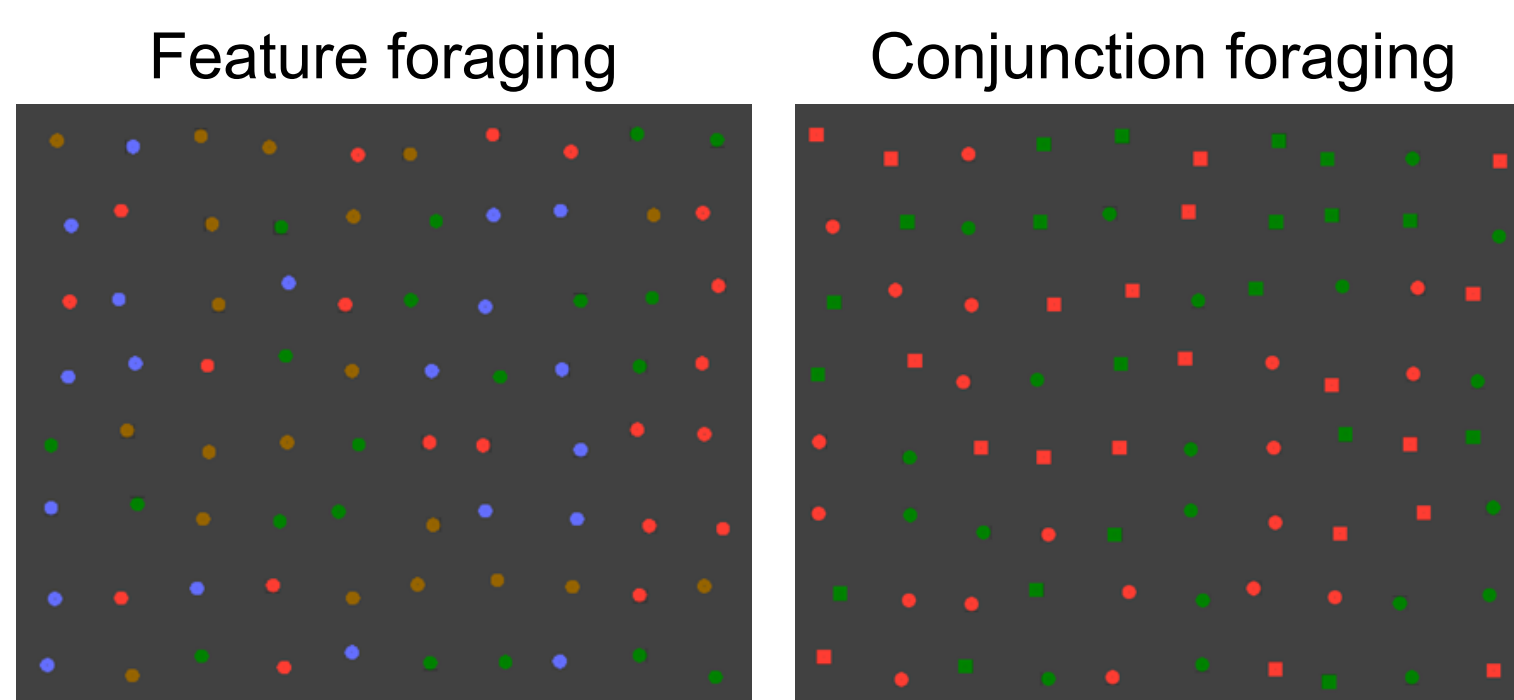
The exploration mode is assessed by calculating the K-coefficient (Krejtz et al., 2016) based on the z-scores of a given fixation duration (d_i) and of the subsequent saccade amplitude (a_{i+1}):

$$K = \frac{1}{n} \sum_n K_i \quad \text{with} \quad K_i = \frac{d_i - \mu_d}{\sigma_d} - \frac{a_{i+1} - \mu_a}{\sigma_a}$$

- Are the different foraging strategies associated with different eye movement dynamics?
- Do observers modify their strategy when foraging with eye gaze?
- Are individual differences in foraging reflected in oculomotor behavior?

METHODS AND RESULTS

"Select all the targets in the display as fast as possible, without selecting any distractor"



Target types: ●● (Feature) & ●● (Conjunction)

Two tasks: Mouse foraging & Gaze foraging

80 stimuli on screen (40 targets, 40 distractors)

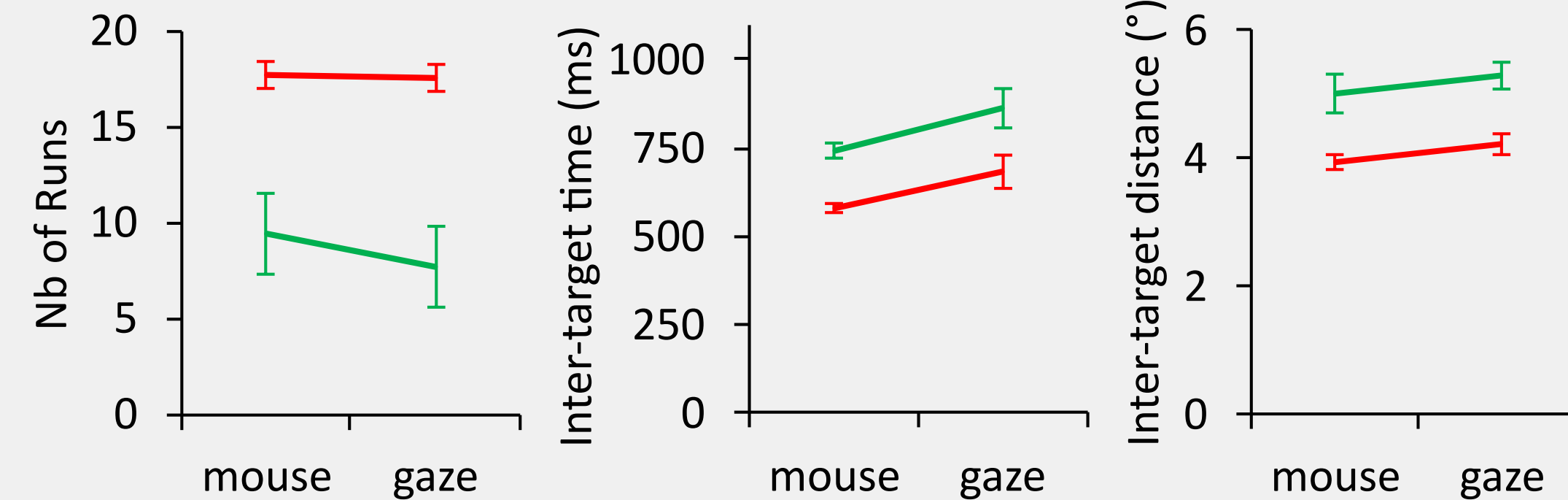
Selected targets disappeared. Distractor selection led to an error-message and renewal of the trial.

Stimuli equalized in size (0.5° diameter) and luminance (7 cd/m²).

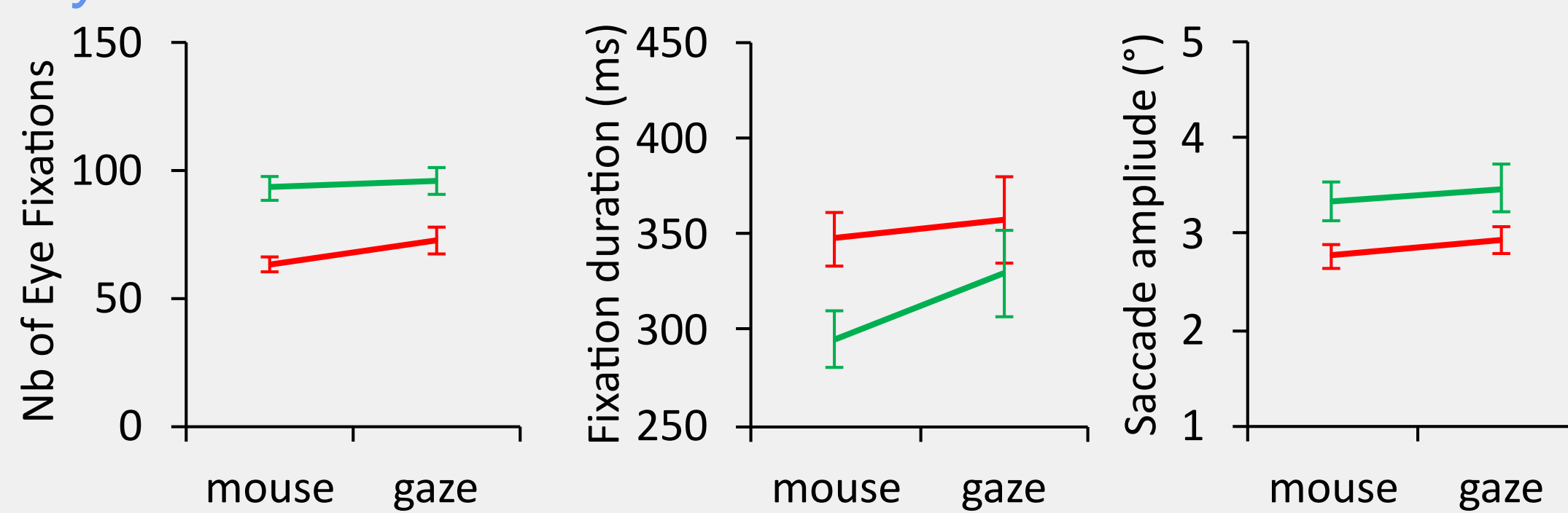
Eye movement recordings during all tasks (EyeLink 1000 Plus, SR Research).

Average results (24 observers)

Behavioral data



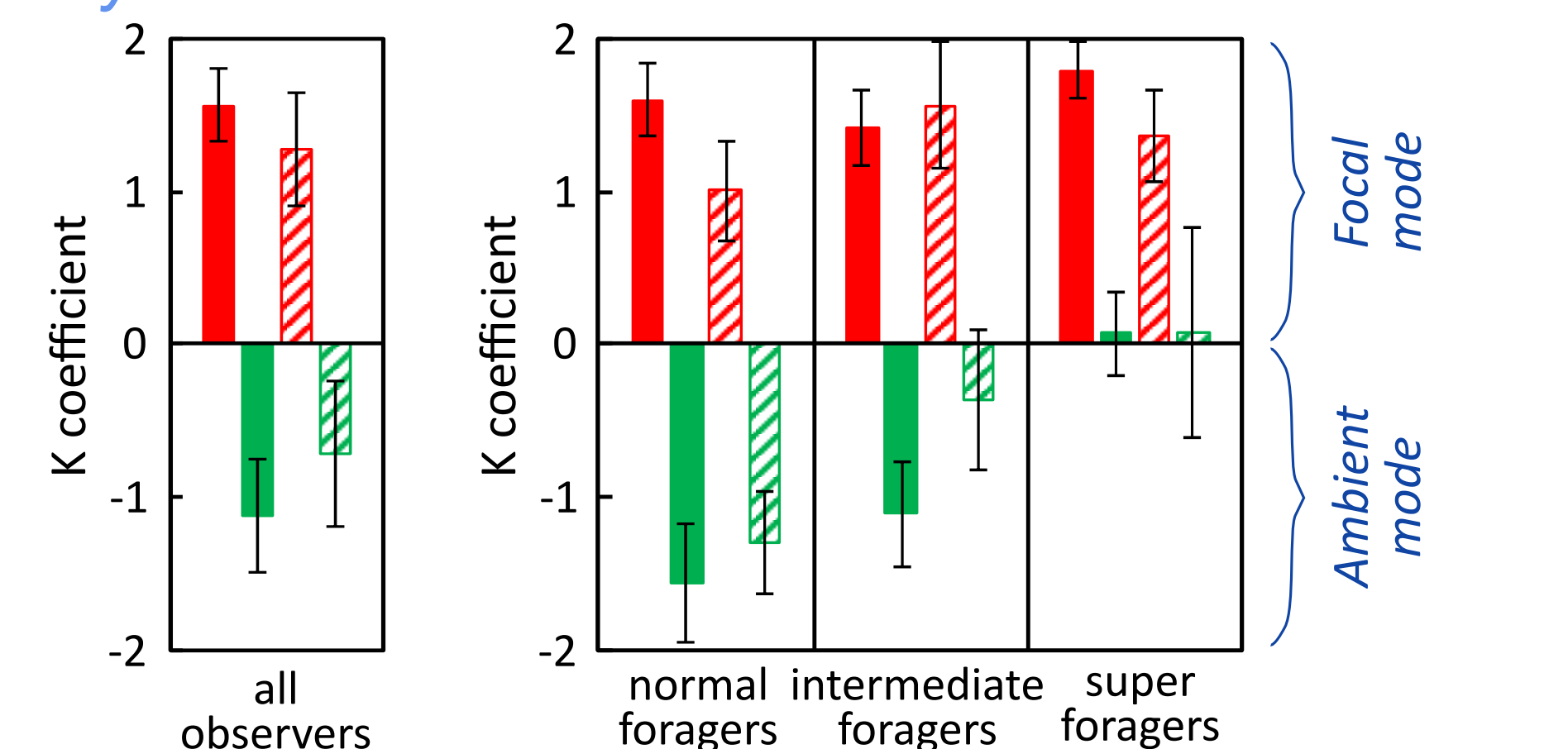
Eye movement data



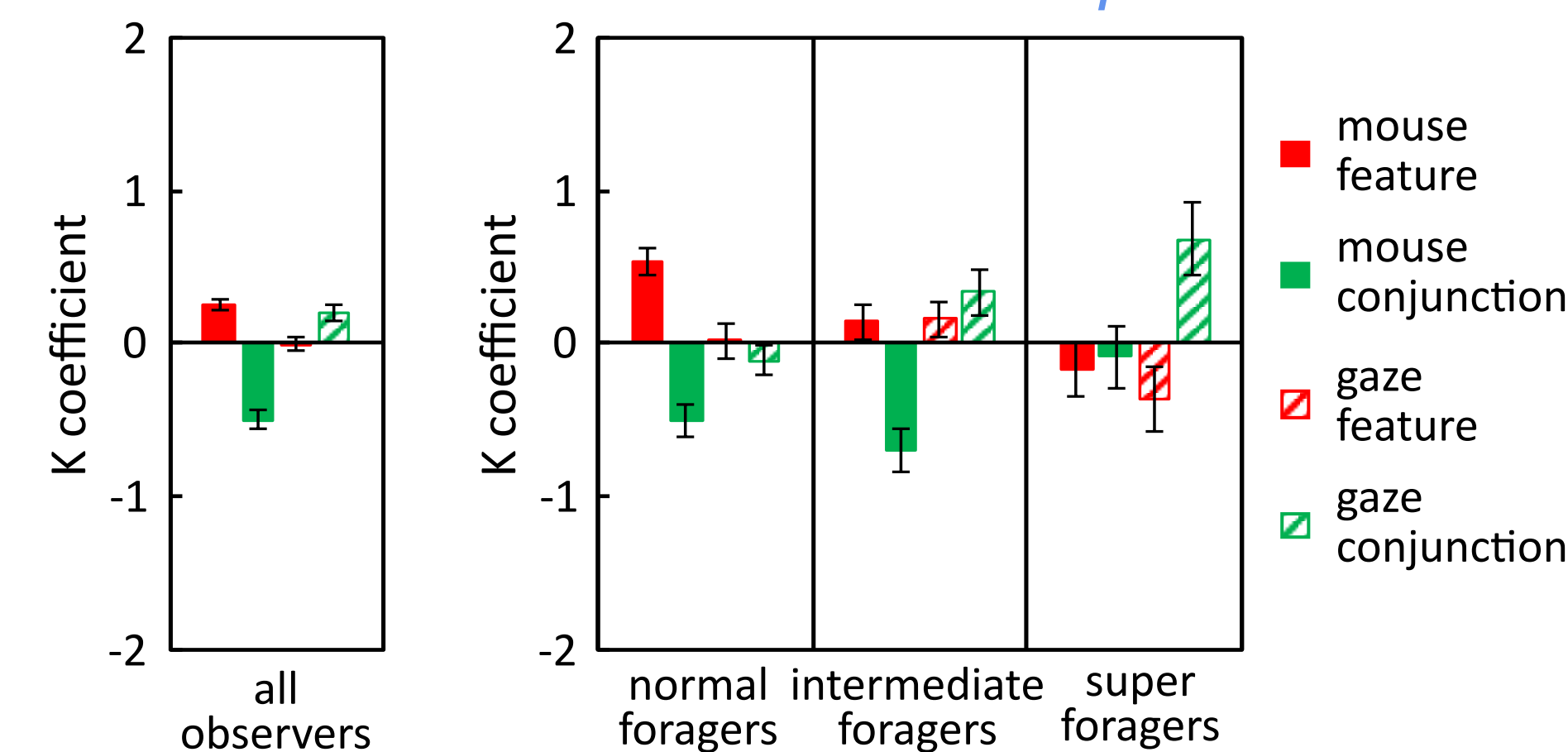
— feature foraging — conjunction foraging
± 95% Confidence Intervals

Organization of the visual exploration

All eye fixations and saccades

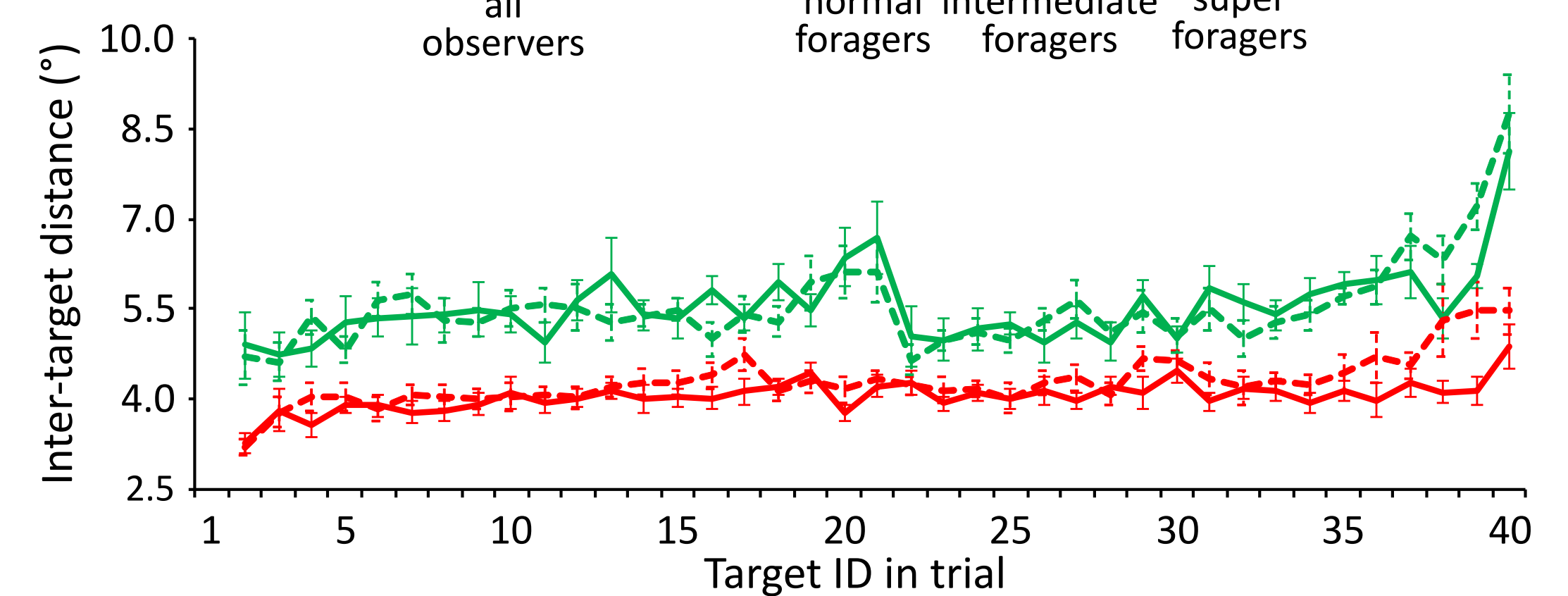
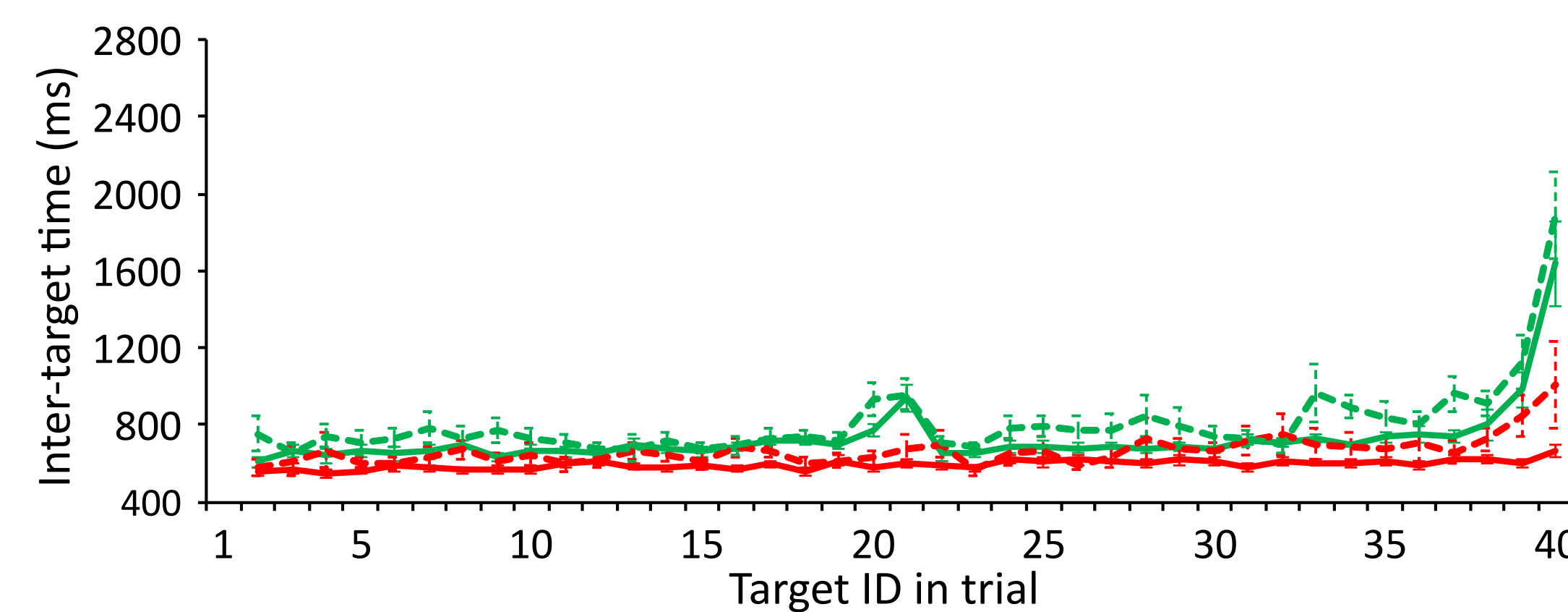
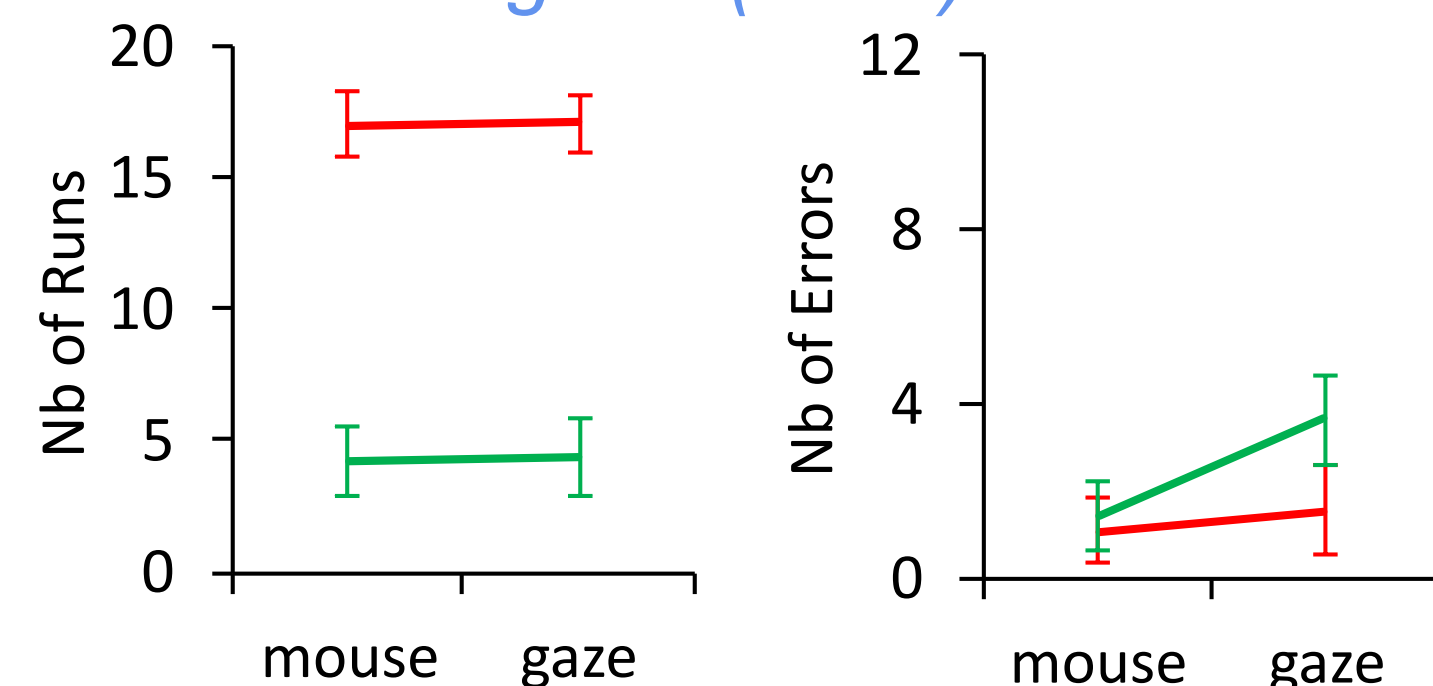


The 40 "critical" fixations and subsequent saccades

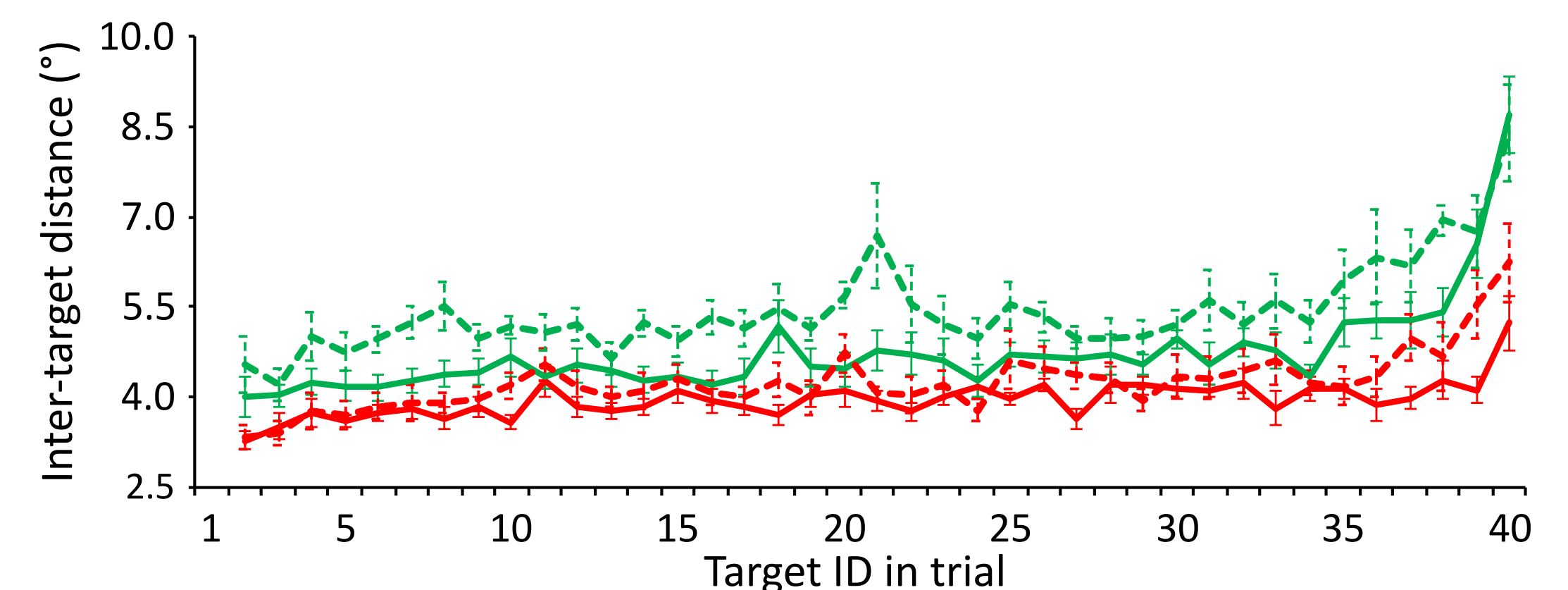
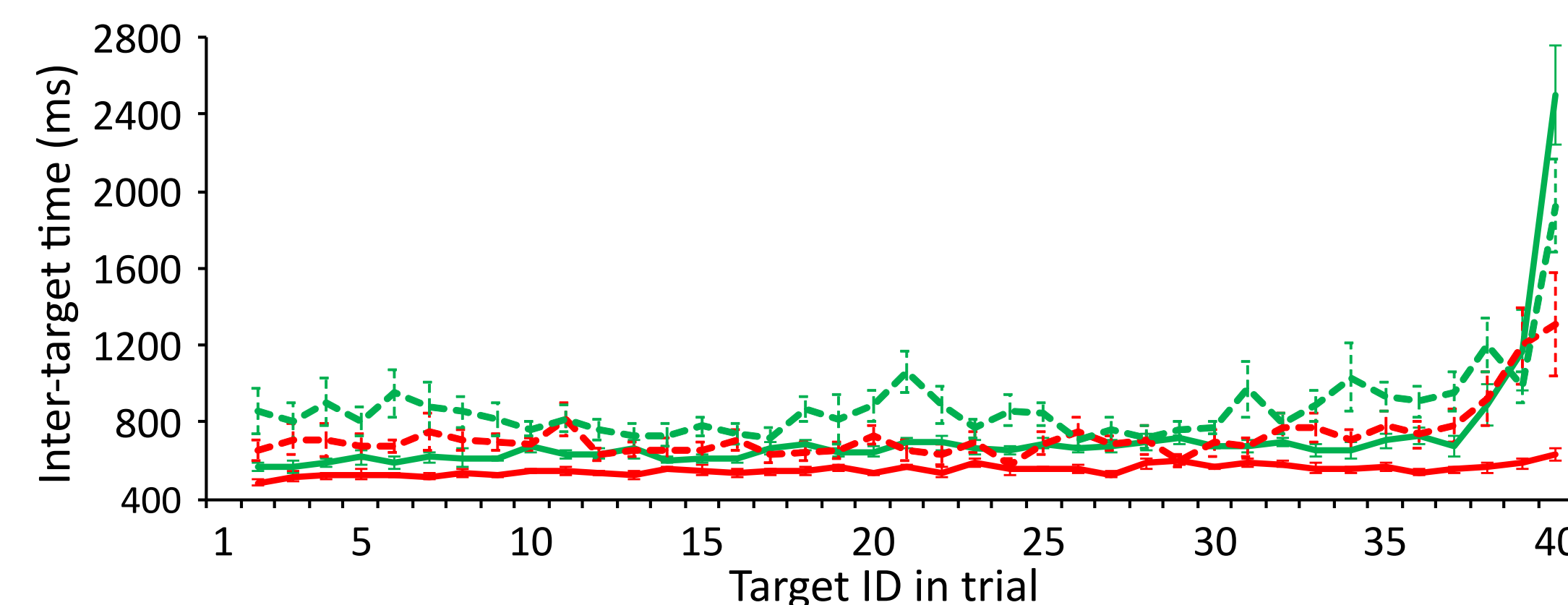
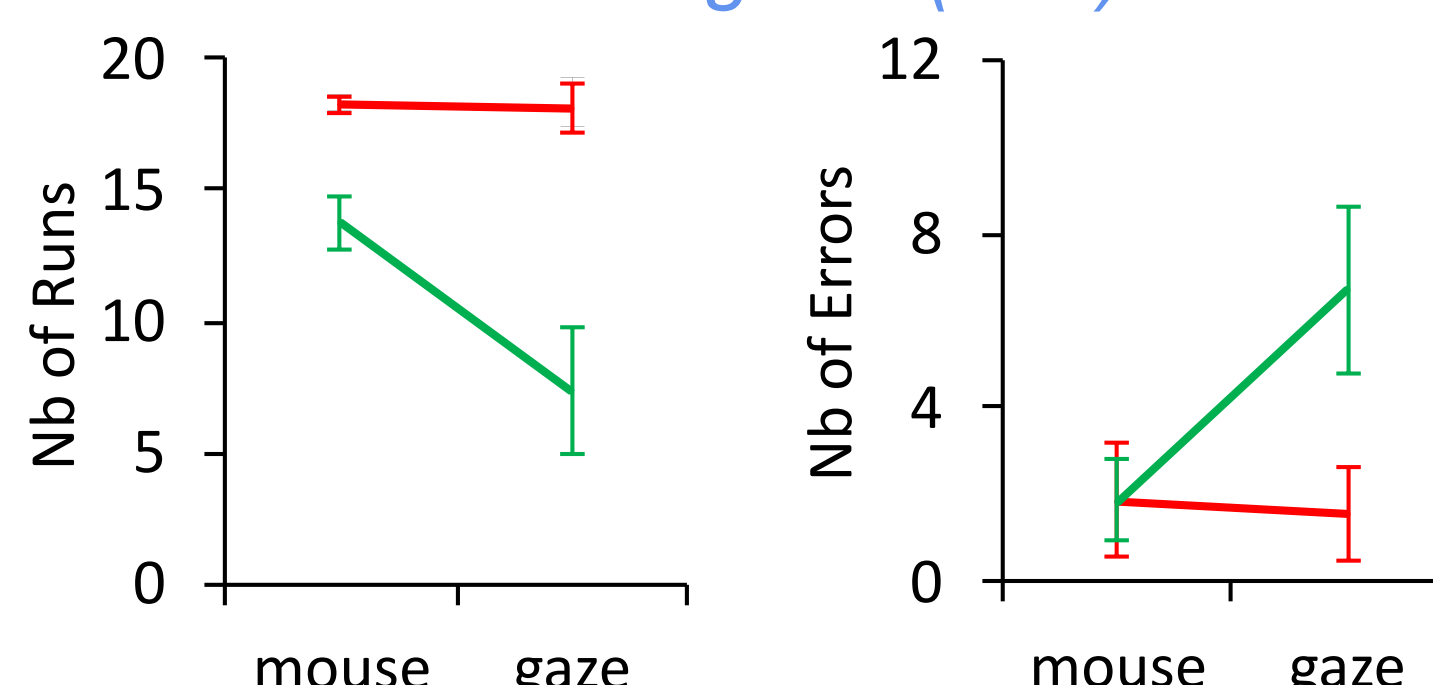


Number of Runs: 3 behaviors

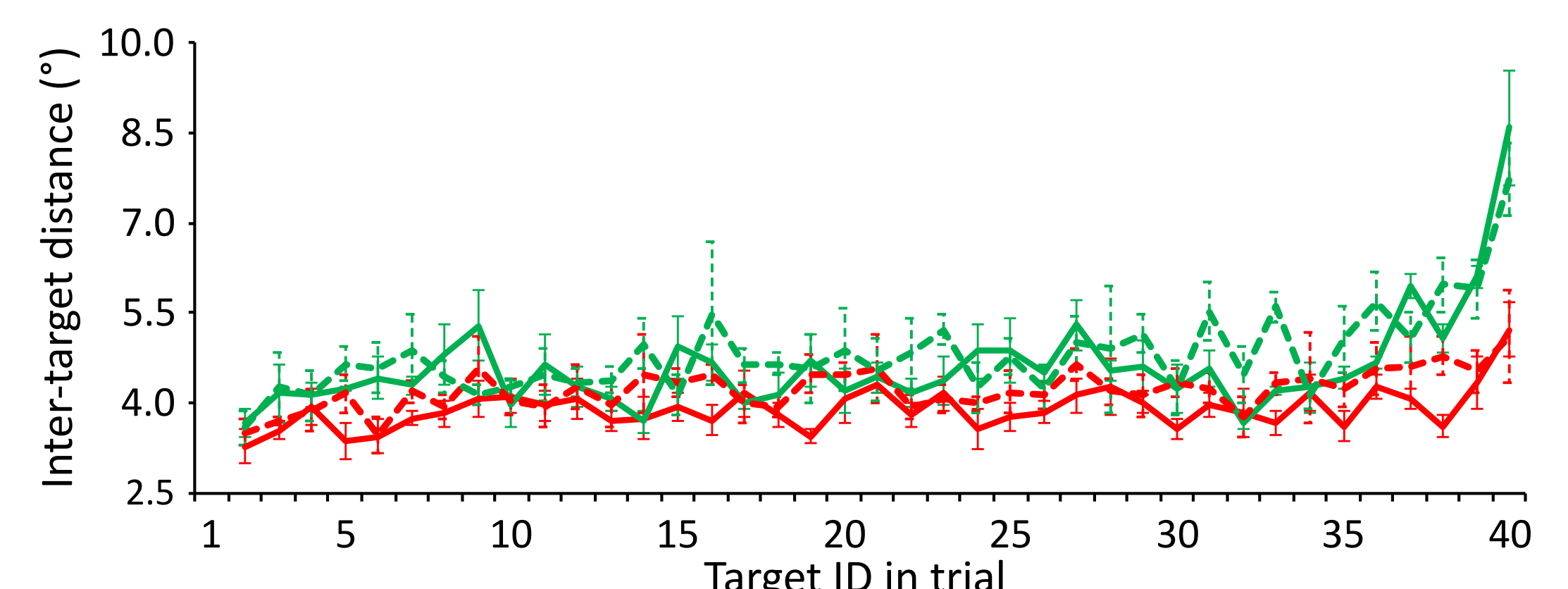
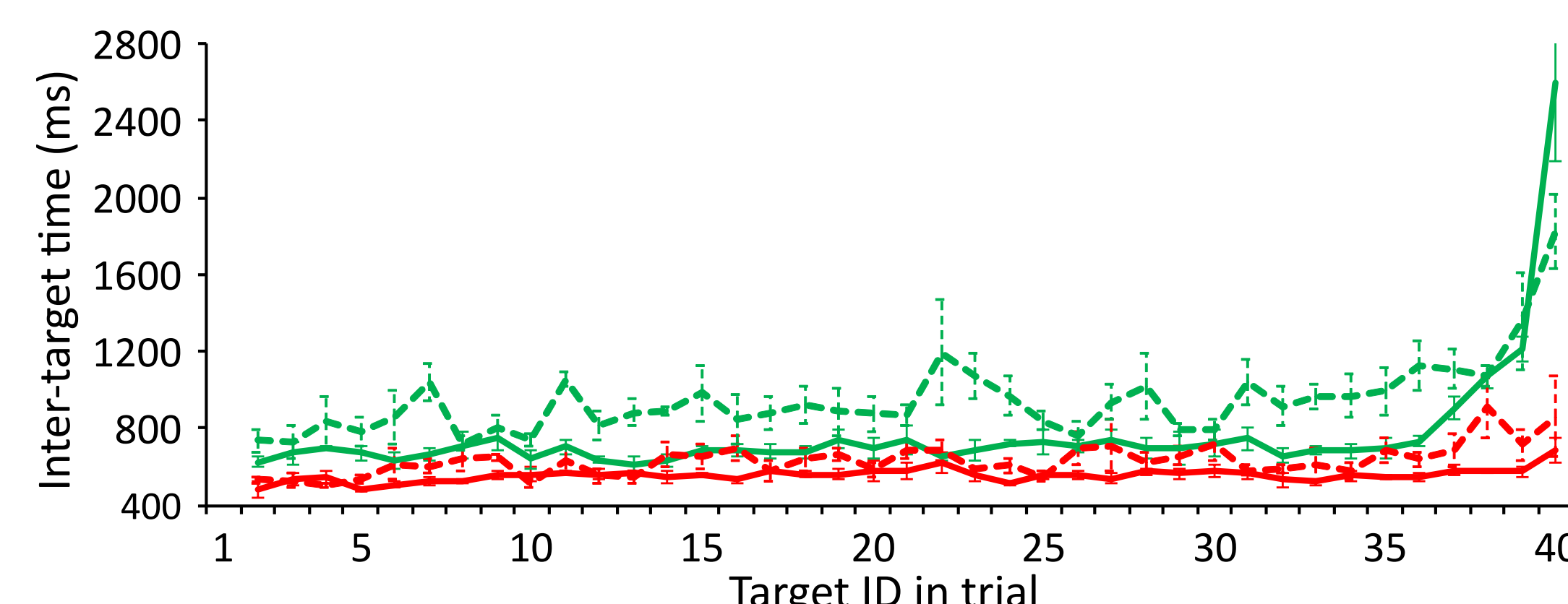
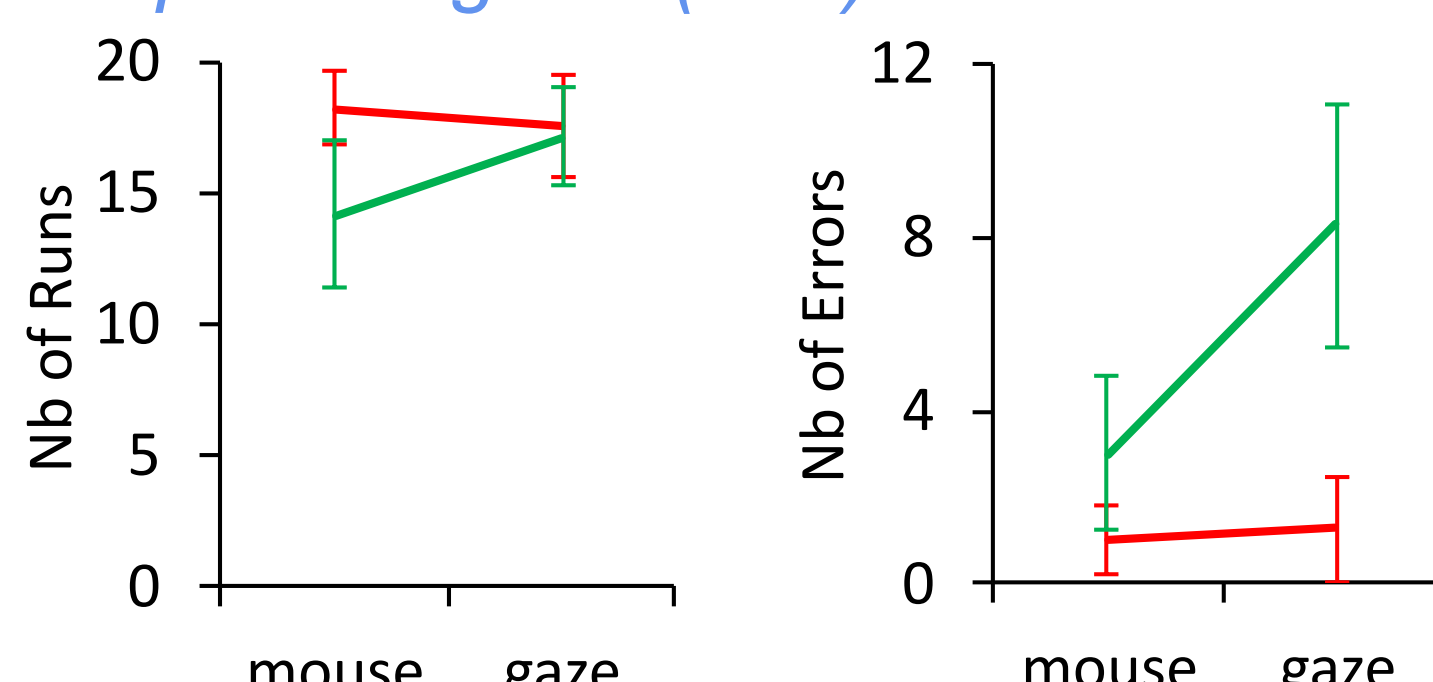
"Normal foragers" (n=11)



"Intermediate foragers" (n=9)



"Super foragers" (n=4)



— feature foraging — conjunction foraging
± 95% Confidence Intervals

— Mouse Feature — Mouse Conjunction --- Gaze Feature --- Gaze Conjunction

CONCLUSIONS

- Humans adapt their foraging to target crypticity, both when foraging with a computer mouse and with eye gaze.
- Gaze foraging seems to be more demanding than mouse foraging (e.g., higher nb of errors, higher inter-target times).

- "Super foragers" may actually be "suboptimal foragers"
- Within-trial analyses during foraging tasks accurately capture the foraging strategy; analysis that cannot be performed in traditional single-target visual search tasks.