Does the brain perform arithmetical computations with neurally embedded kinematic parameters?

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Accuracy and precision of saccades

No spatial lead either in untrained monkeys

Comparable errors between saccades toward a static versus moving target

NO SPATIAL LEAD of endpoints for interceptive saccades

Constant speed = 20°/s
Contrary to the claim that interceptive saccades "would assure a spatial lead of the gaze at the saccade end instead of a precise capture of the target," our observations indicate that interceptive saccades either precisely capture the target, where it is when it is there, or they undershoot the target (lag).

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Dual-drive hypothesis (version complicated)

**ASSUMPTIONS:**

1. Snapshot of Eye Position Error (EPE)
2. Snapshot of Retinal Slip (RS)
3. Calculation of \( \text{TXE} = \frac{\text{EPE}}{\text{RS}} \) (eye crossing time)
4. Sum: \( \text{EPE} + (\text{TXE} \times \text{TV}_{\text{est}}) =\) AMP

Temporal bounding: at best here-and-now
Behavioral performance

Stationary target

Neural commands

in the SC

Saccade

Stationary target

Behavioral performance

Stationary target

Neural commands

in the SC

Saccade

Stationary target
Behavioral performance

Neural commands

in the SC

Stationary target

Target moving downward

Saccade

Behavioral performance

Neural commands

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Stationary target

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Behavioral performance

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Target moving downward

Saccade

Behavioral performance

Neural commands

in the SC

Stationary target

Target moving downward

Saccade
Behavioral performance

Neural commands in the SC

Stationary target

Saccade

Target moving downward

Firing rate

Direction (°)

Behavioral performance

Neural commands in the SC

Stationary target

Saccade

Target moving downward

Firing rate

Direction (°)

Behavioral performance

Neural commands in the SC

Stationary target

Saccade

Target moving downward

Firing rate

Direction (°)

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Stationary target

Saccade

Target moving downward

Firing rate

Direction (°)

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Stationary target

Saccade

Target moving downward

Firing rate

Direction (°)
Dual drive hypothesis

Bounded remapping hypothesis

Goffart et al. JNP 2017

Temporal bounding: at best here-and-now

Eye Position

Error

TD

Saccade Amplitude

starting eye position

starting eye position

U

L

R

D

Temporal bounding: at best here-and-now

Eye Position

Error

Temporal bounding: at best here-and-now

Observations consistent with predictions of “fastigial weighing” hypothesis

Hor. error increases with target velocity

YES

Hor. error increases with target velocity

YES

Hor. error increases with target velocity

YES

Fastigial weighing of collicular drive

Fastigial weighing of collicular drive

Same streak of collicular activity but different spread dynamics (as a result of different target speed) → different saccade endpoints

Fastigial weighing of collicular drive
Observations consistent with predictions of "fastigial weighing" hypothesis, but not completely.

1. CFN is primarily involved in the adjustment of the horizontal component of saccades (Goffart et al. 2003; 2004)

2. SC is a gaze-related structure (eye+head) whereas the CFN is oculomotor (Quinet & Goffart 2005; 2007; 2009; Fuchs et al. 2010)
Fastigial + Interpositus (?) weighing hypothesis

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