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## On the robustness of the measurement of eye dominance strength based on saccadic parameters

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# On the robustness of the measurement of eye dominance strength based on saccadic parameters

## Introduction

The saccadic system presents multiple asymmetries. Notably, saccadic peak velocities are higher for temporal saccades, for centripetal saccades and for the abducting eye (Collewijn, Erkelens & Steinman, 1988).

However, some of these asymmetries could be influenced by sighting eye dominance strength, the dominant eye being the one chosen when performing a monocular task (Vergilino-Perez et al., 2012).

Indeed, in situations involving centrifugal saccades initiated from the center of the screen, we have shown that:

- **Participants with weak eye dominance exhibit the classical naso-temporal asymmetry** (higher saccadic peak velocities toward the left visual field with the left eye and toward the right visual field with the right eye, *Robinson, 1964*).
- **Participants with strong eye dominance exhibit higher saccadic peak velocities for a given saccade direction whichever the recorded eye.**

## The current study

tests the robustness of this classification by varying eye departure position, involving centrifugal and centripetal saccades, and by comparing saccades made by the abducting eye and the adducting eye.

This will permit us to investigate the influence of this classification of eye dominance strength on all the asymmetries of the saccadic system (naso-temporal, abducting-adducting and centripetal-centrifugal asymmetries).

## Methods

### Participants:

28 participants (20 ♀, 26.4±6 y.o.) divided into 8 groups according to their:

**Handedness** (RH vs. LH, Humphrey laterality questionnaire modified by *Hécaen & de Ajuriaguerra, 1963*),

**Eye dominance** (RE vs. LE, « Hole-in-Card-Test », *Miles, 1930*),

**Eye dominance strength** (Strong ED vs. Weak ED, *Vergilino-Perez et al., 2012*):

	RH-RE	RH-LE	LH-RE	LH-LE
Weak ED	4	6	3	4
Strong ED	5	1	3	2

### Procedure:

• 2 blocks of 400 trials:

- 1 block containing step trials involving reflexive saccades,
  - 1 block containing overlap trials involving voluntary saccades.
- All participants performed the step before the overlap trials.

• Each trial began by the presentation of the initial fixation cross randomly displayed during 400 or 800 ms at -10°, -5°, 0, 5° or 10° of eccentricity on the horizontal axis. The saccade target appeared at 5° on the left or on the right of the fixation cross. The participants had to make a saccade toward the target when the fixation cross disappeared.

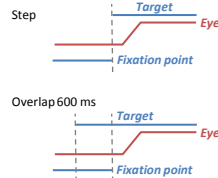
### Instruments:

Binocular recording of eye movements with an EyeLink 1000 system, SR Research®, sampled at 500 Hz. Stimuli were displayed on a Iiyama HM240DT monitor (170 Hz refresh rate, 800 x 600 pixels resolution).

Systematic investigation of **Saccadic Peak velocity**.

### Stimuli:

- Fixation and Saccade target: 0.5 x 0.5° white cross, 35 cd/m<sup>2</sup>
- Medium gray background, luminance of 4.5 cd/m<sup>2</sup>.



## Results

### The classical asymmetries on saccadic peak velocities:

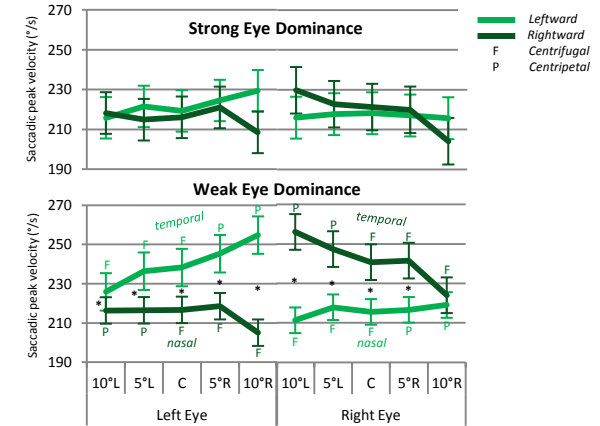
• There is **no effect of handedness** (RH vs. LH) and of **Eye dominance** (RE vs. LE) on the saccadic peak velocity, all  $F < 1$

• We have an **effect of the Paradigm** (Step vs. Overlap), with higher peak velocities in Step trials than in Overlap trials ( $F[1,26] = 11.3, p < 0.005$ ).

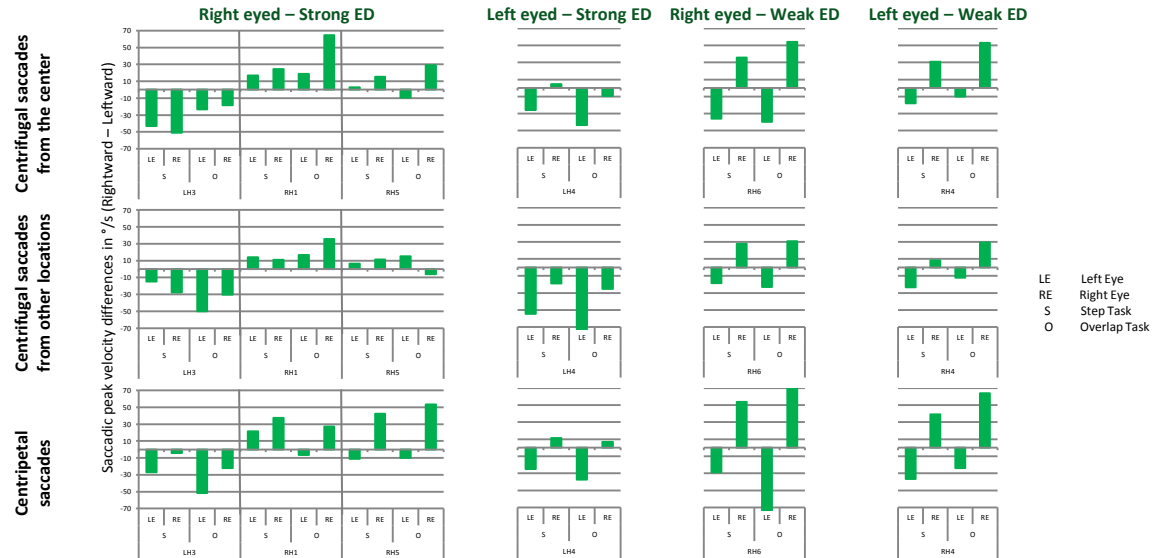
• The interaction between eye dominance strength, the recorded eye and saccade direction ( $F[1,26] = 18.0, p < 0.001$ ) indicates **Naso-Temporal** (leftward vs. rightward saccades) and **Abducting-Adducting** (left vs. right eyes) asymmetries in participants with weak eye dominance but **not in participants with strong eye dominance**.

• On average, we have a strong **centripetal-centrifugal asymmetry**, with higher peak velocities for centripetal than for centrifugal saccades ( $F[4,104] = 34.4, p < 0.0001$ ). Interestingly, this asymmetry tends to be present **only for participants with weak eye dominance** ( $F[4,104] = 2.3, p < 0.07$ ).

• The **interaction between eye dominance strength, the recorded eye, saccade direction and departure position** is significant for weak eye dominance ( $F[4,64] = 3.83, p < 0.01$ ) but not for strong eye dominance ( $F[4,40] = 1.2, p > 0.30$ ) (see figure on the right)



### Influence of the centripetal-centrifugal asymmetry on individual rightward-leftward differences in saccadic peak velocities:



## Conclusions

### Validation of the measurement of eye dominance strength with saccadic parameters:

Eye dominance strength influences the naso-temporal asymmetry, which is present only for participants with weak eye dominance (same results as in *Vergilino-Perez et al., 2012*).

Furthermore, current data indicate that **eye dominance strength also modulates the centripetal-centrifugal asymmetry**, which again is present only in participants with weak eye dominance.

### Toward a more precise measure of eye dominance strength:

We show that the naso-temporal asymmetry is stronger on centripetal saccades.

Moreover, **peak velocities of some participants with strong eye dominance can change to a naso-temporal asymmetry (i.e., indicator of weak eye dominance) when the saccade is centripetal**.

By involving centripetal and centrifugal saccades, we can now distinguish participants with very strong eye dominance from participants who exhibit strong eye dominance only on centrifugal saccades.

This can lead to an accurate test of sighting eye dominance strength.