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Saccadic adaptation alters object size perception

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Introduction

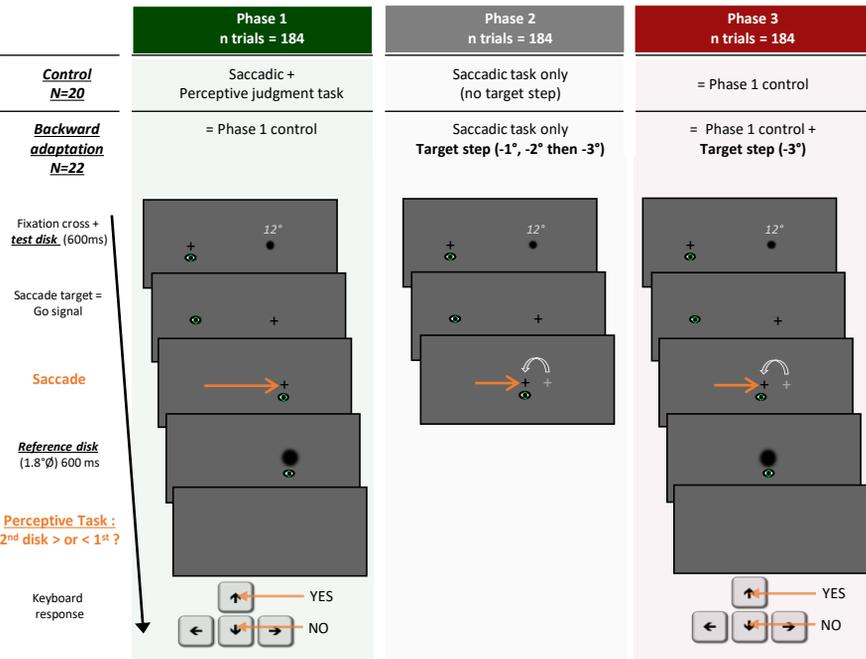
► In the **ATOM model**, do action parameters share the common system of magnitude?

Walsh (2003) proposed **A Theory of Magnitude (ATOM)** model that posits a generalized magnitude system shared by perceptual magnitudes (such as time, number and space). This model is mainly focused on sensorimotor consequences of magnitude processing. **Indeed, perception and action are tightly linked**, but what about possible influences of action magnitude on perception? Interestingly, some studies show that oculomotor changes modify visual perception, e.g. perceived object location (Collins et al., 2007; Zimmerman & Lappe, 2010) and size (Bosco et al., 2015). In the later study, saccadic amplitude was adapted following a systematic change of object size during saccades. It remains unclear however whether perceived size modifications were due to the change of object size (inducing the adaptive motor change), or to the motor change itself.

We investigated whether the modification of saccadic amplitude (induced by saccadic adaptation) affects object size perception.

References:
Bosco, Lappe & Fattori (2015). *J. of Neuroscience*
Collins & Doré-Mazars (2009), *Année Psychologique*
Walsh (2003), *Trends in cognitive sciences*
Zimmerman & Lappe (2010), *J. of Vision*

Methods and Results



► Pre-requisites for our study

	Backward adaptation		Control	
	1 st Phase	3 rd Phase	1 st Phase	3 rd Phase
Gain	0.99 ± 0.05 ***	0.80 ± 0.05	0.97 ± 0.05 *	0.99 ± 0.05
Latency	235 ± 97 ***	205 ± 40	259 ± 74 ***	218 ± 44
JND ¹	0.11 ± 0.1 ns	0.10 ± 0.04	0.11 ± 0.1 ns	0.10 ± 0.04
PSE ²	0.942 ± 0.1 **	0.981 ± 0.1	0.987 ± 0.1 ns	0.996 ± 0.1

Paired t-test: * p<.05, ** p<.005, *** p<.001
ns p>0.5

¹JND: just noticeable difference
²PSE: Point of Subjective Equivalence

- Phase 1 similar to Phase 3 for control group
Saccadic parameters and difficulty of the task are stable in the control group.

- For Phase 1, both groups are comparable.

► Saccadic adaptation

The adaptation rate was calculated with the following formula :

$$\text{Adaptation rate (\%)} = \frac{\text{Gain}_{\text{First}} - \text{Gain}_{\text{Third}}}{\text{Gain}_{\text{First}}} * 100$$

Mean = 18.49 % ; range [10.14 ; 23.82]

All participants were adapted.

▼ Saccadic adaptation and perceived size

The rate of change in perceived size was calculated with the following formula :

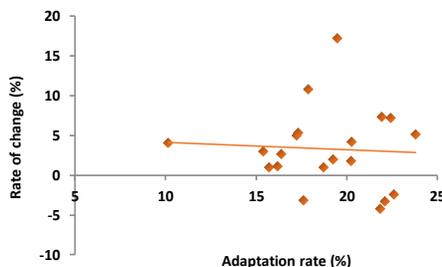
$$\text{Rate of change (\%)} = \frac{\text{PSE}_{\text{First}} - \text{PSE}_{\text{Third}}}{\text{PSE}_{\text{First}}} * 100$$

Mean = 4.41 % ; range [-4.17 ; 17.24]

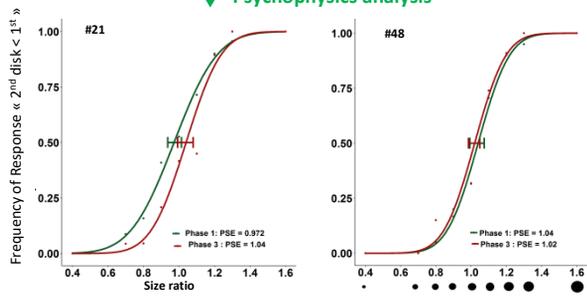
We investigated whether adaptation rate correlated with the rate of change in perception.

Two participants were excluded from this analysis (rate of change > mean+2*sd).

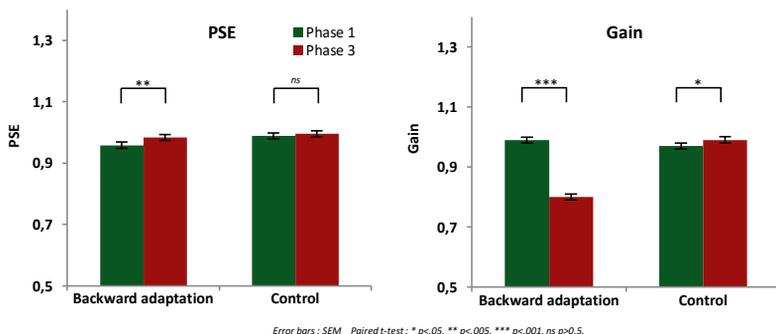
No correlation was found (r = -0.06, p > .05).



▼ Psychophysics analysis



Psychometric functions for #21 from Backward adaptation group (left) and for #48 from Control group (right). Error bars represents confidence interval at 95%. We observed a shift of the PSE to the right for #21 and an overlap of the PSEs for #48



Overall, PSE slightly increases when saccadic amplitude decreases.

An increase in PSE indicated that the size of the comparison disk in the third phase has to be larger to become perceptually equal to the standard, compared to the first phase.

Discussion

Following backward saccadic adaptation, an increase in mean PSE was observed.

This pattern of results was not found without saccadic adaptation.

► The perceived size is modified by saccadic adaptation, which is in line with Bosco et al. (2015).

This finding supports the view of a critical role of motor change in size perception.

► Our study confirms the hypothesis according to which saccadic parameters share common coordinates with perceptual domains.

An ongoing study investigates whether this change in perceived size is reversed (shift of the PSE in the opposite direction) following an increase in saccadic amplitude.



Adapted from Walsh (2003)