Effects of Visual Field Size and Speed on Acceleration and Deceleration Perception

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Introduction

Smooth pursuit affects speed perception[1], but it is unclear how it affects acceleration and deceleration perception.

Studies disagree on whether we perceive acceleration and deceleration similarly[2 3 4], but several used different speed ranges for each by holding initial or final speed constant.

Research questions

1. Do we detect acceleration and deceleration similarly?
2. Does smooth pursuit affect detection?
3. Does speed range affect detection?

We hoped to manipulate smooth pursuit by changing the horizontal extent of the visual field, assuming that small fields restrict smooth pursuit while large fields encourage it.

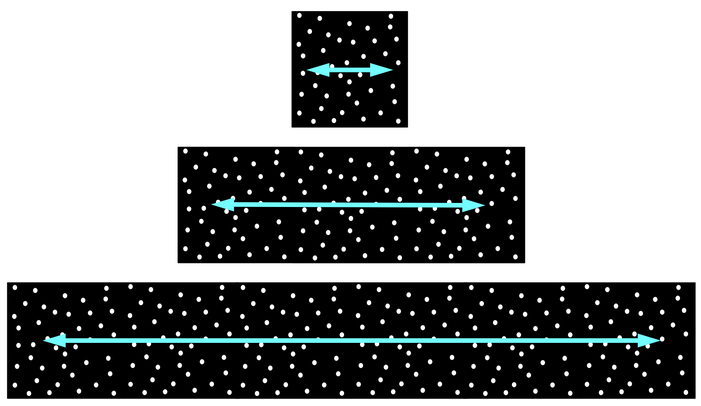
Method

Participants

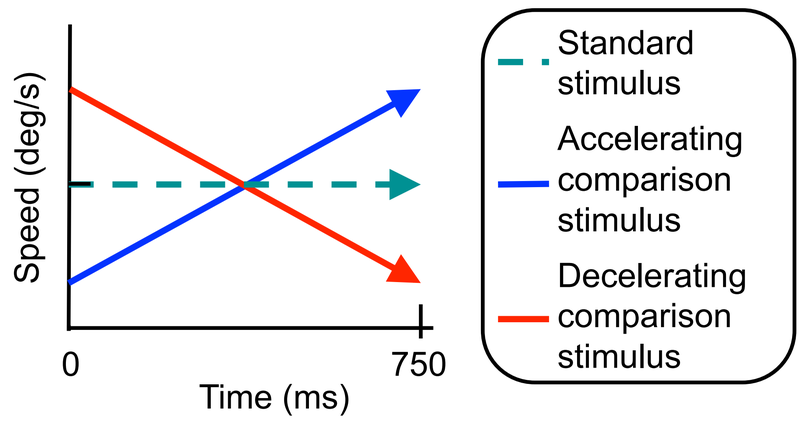
N = 9 (including ASM), *M* age = 25 years (*SD* = 2.35).

Horizontal motion stimuli

Three fields: small (1.02°), medium (14.28°), large (27.54°).

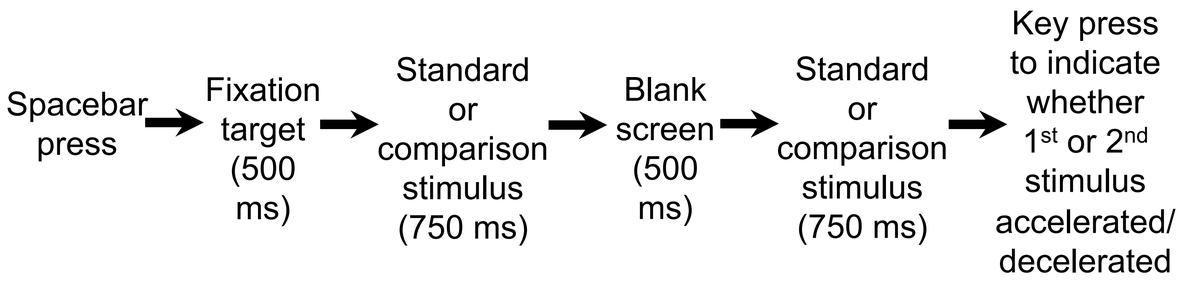


Two speed ranges defined by middle speed: slow (2.04 deg/s) and fast (10.20 deg/s). Schematic examples of stimuli within a speed range:



Procedure

2I2AFC task using method of constant stimuli:

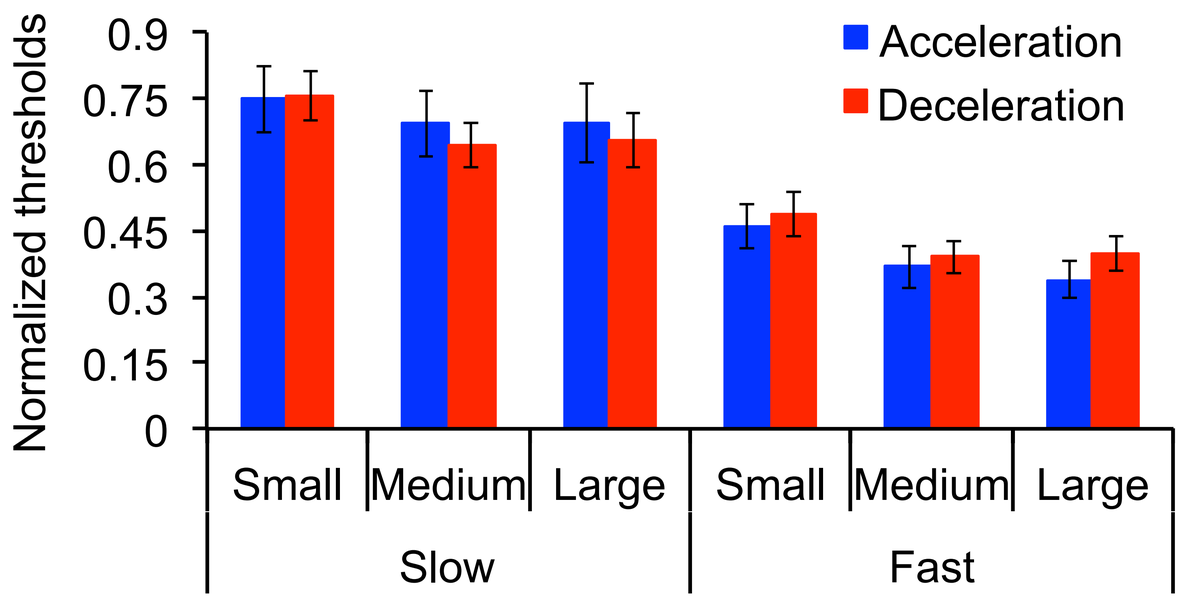


Dependent measures: acceleration and deceleration detection accuracy.

Results (** $p < .01$, *** $p < .001$)

75% correct thresholds were analyzed as Weber fractions with respect to average speed (i.e., normalized thresholds):

$$\frac{\left(v_{max} - v_{min}\right)}{\left(\frac{v_{max} + v_{min}}{2}\right)}$$



1. Acceleration = deceleration.
2. Normalized thresholds ↓ as field size ↑***: small > medium** and large**, medium = large.
3. Normalized thresholds ↓ as speed ↑***.

Discussion

1. Acceleration and deceleration within the same speed range were detected similarly.
   - Mechanisms that process changes in velocity appear to behave similarly for positive and negative changes.
   - ∴ Reports of an acceleration/deceleration asymmetry may stem from differences in speed range.
2. Effect of visual field size suggests that performance becomes relatively consistent when fields are large enough to encourage smooth pursuit.
3. The task was more difficult (with higher normalized thresholds) at slow speeds than at fast speeds.

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References

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