Uncertainty in estimating time-to-passage revealed by reaction times

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Introduction

In everyday tasks we do not solely interact with inanimate objects but also with people. During these interactions it is important to estimate the time it takes an object to reach or to pass us. Rigid (RM) and non-rigid (biological, inverted and complex non-biological) motion conditions were compared in a time-to-passage (TTP) judgment. Due to relative and opponent movements of body parts, non-rigid patterns conveyed a noisier looming pattern. Here we explore the uncertainty levels of TTP judgments of point-light-walker displays. Analysis relating reaction time (RT) and accuracy can provide information on this uncertainty.

Method

We presented large-size stimuli (1.75m) consisting on expanding Point-Light Walker (PLW) animated with:

- rigid motion (RM),
- biological motion (BM),
- inverted motion (IM),
- complex non-biological motion (COM-NBIO).

In a TTP task with independent blocks for each motion condition, subjects had to decide whether the PLW passed them before or after a reference time (1s) signaled by a tone.
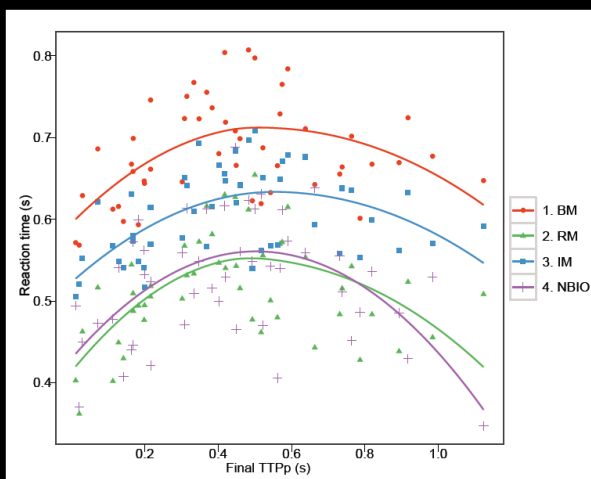
X-axis coordinates as a function of time (frame)
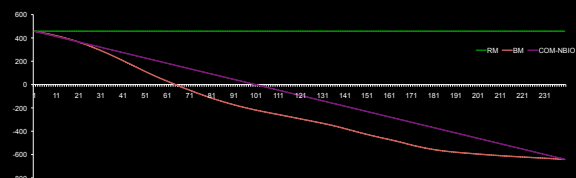
Trajectory of a PL (left knee) on the translation axis, when the translational component is removed for each motion type (example for stimuli illustration only).
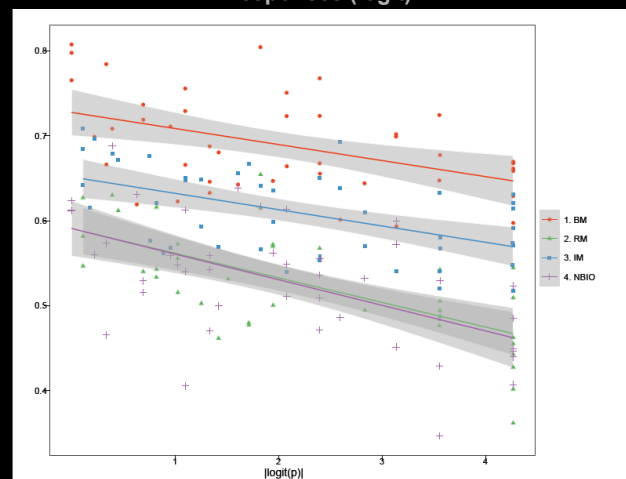
Results

Reaction time as a function of TTP

Data points are averaged across all 6 subjects. The four functions give Gaussian smoothing version of the data for each motion condition.

Reaction time as a function of proportion of "later" responses (logit)

Proportion of trials on which the object is judged to have passed later were transformed in logit units. Reaction time was plotted as function of logit units.

Discussion

1. In general, RT decreased with the decrease of uncertainty of the task, i.e. when the probability to have a correct judgment is higher.

2. Non-rigid biological stimuli required higher RT for the same level of uncertainty .

3. RT results suggest that the differences obtained between motion conditions are due to the effect of an additive mechanism in the processing of BM on top of that of RM, but not a different channel with different motion sensitivity.