Modelling response times in multi-alternative categorization with TVA

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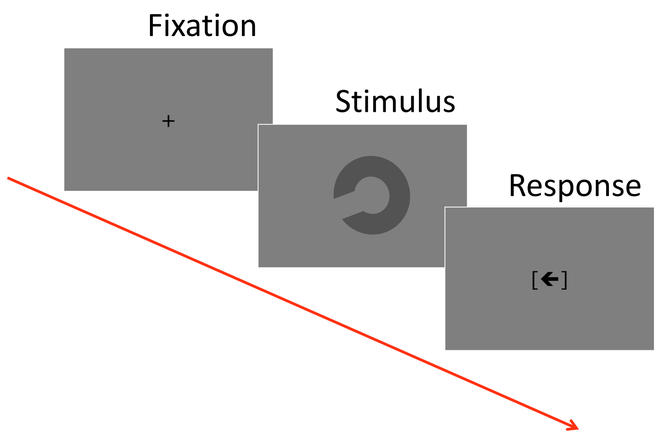
Background

In TVA[1] it is assumed that encoding in VSTM is a race between competing categorizations.

Previously[2], we presented a Poisson Counter model of visual identification of mutually confusable stimuli in pure accuracy tasks.

Here we propose and test a multi-dimensional Poisson Random Walk model to explain response time distributions in four alternatives.

Experiment



Speeded response time task

Respond *as quickly and accurately as possible* (4-AFC).

Task:

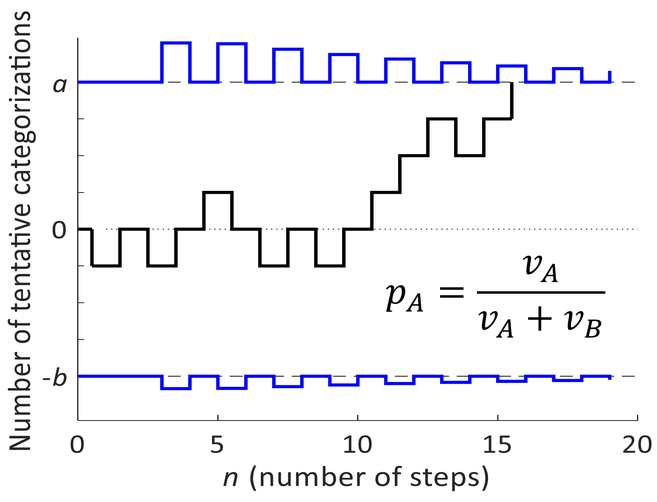
Judge the orientation of a Landolt C-ring

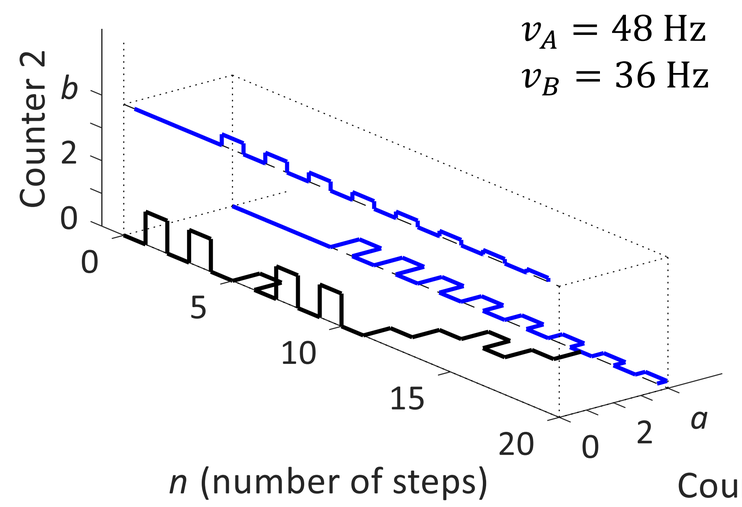
Varying difficulty:

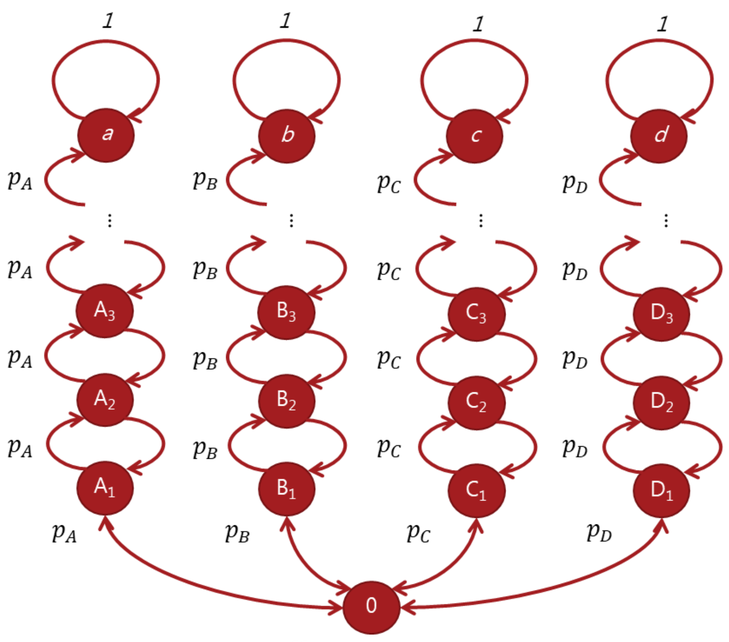
±33 deg, ±39 deg, and ±42 deg

Three participants were tested in 4800 trials

Multi-alternative random walk model





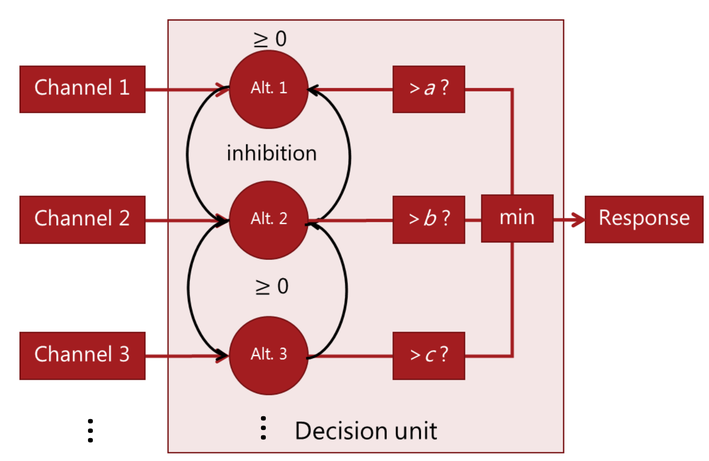


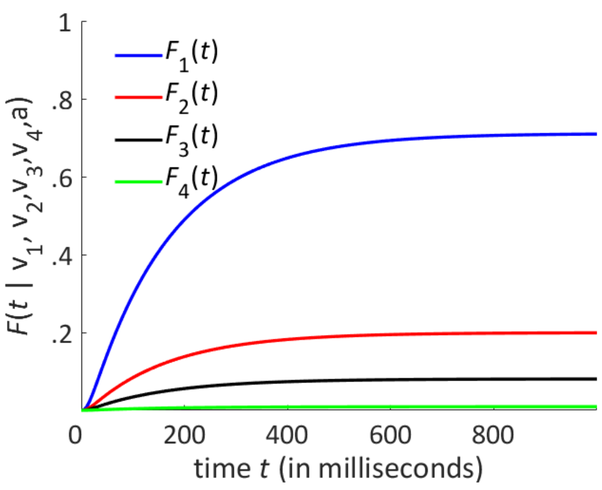
$$p_A = \frac{v_A}{v_A + v_B + v_C + v_D}$$

$$p_B = \frac{v_B}{v_A + v_B + v_C + v_D}$$

$$p_C = \frac{v_C}{v_A + v_B + v_C + v_D}$$

$$p_D = \frac{v_D}{v_A + v_B + v_C + v_D}$$



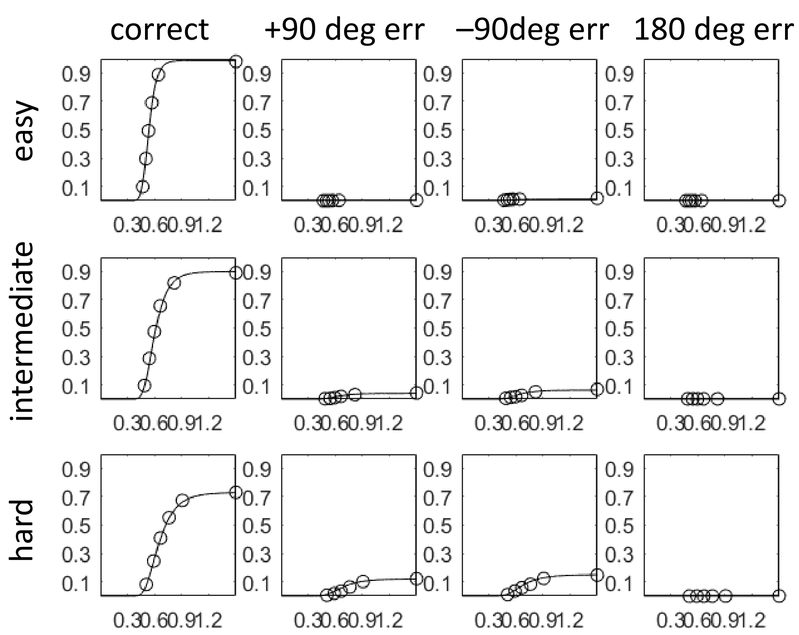


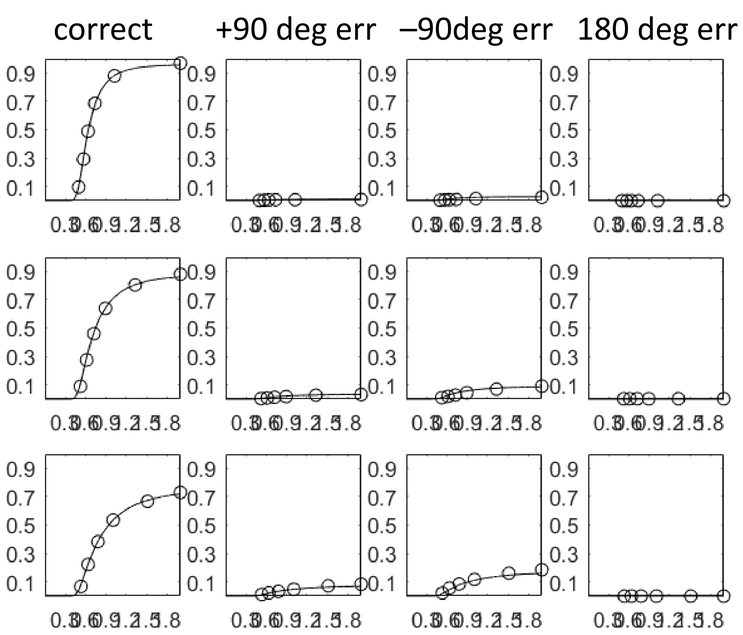
$v_A = 48$ Hz
$v_B = 36$ Hz
$v_C = 24$ Hz
$v_D = 12$ Hz
$a = 3$

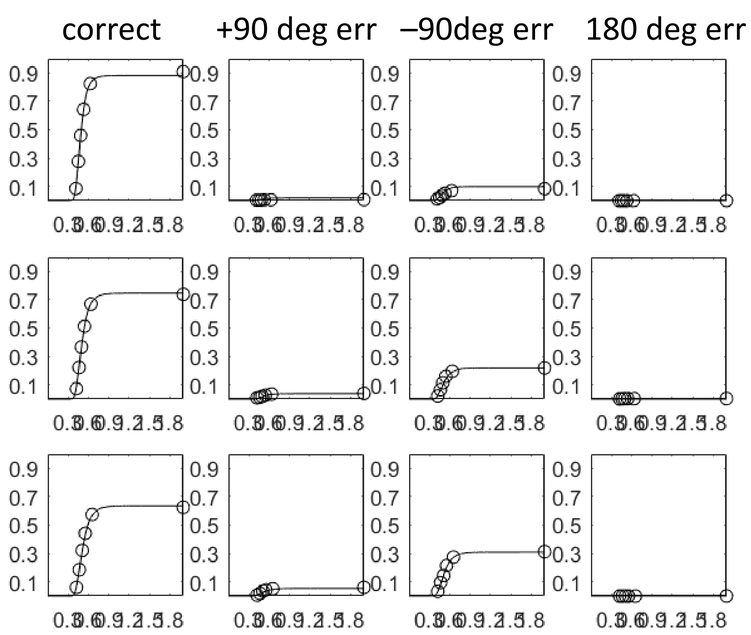
Competitive Poisson accumulator model: Evidence for one alternative counts as evidence against all other alternatives. Inhibition can never lead to negative activation. For two alternatives, the model is equivalent to the standard random walk.

Results

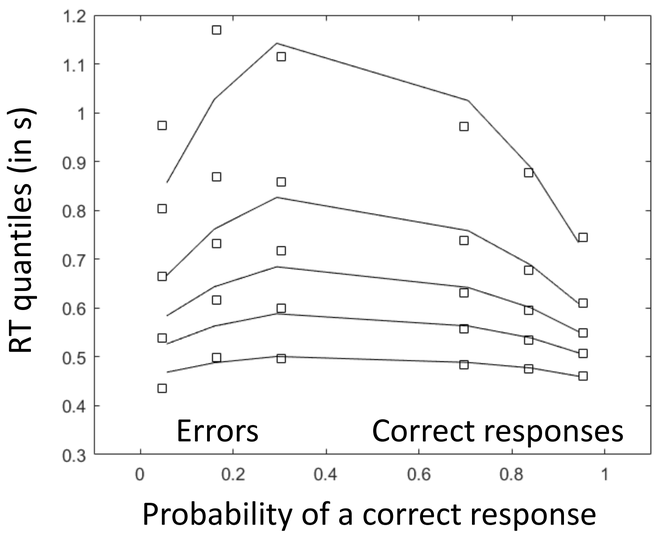
Individual fits







Group results



Conclusions

The assumption of a relative response rule with exponential processing leads to a simple Poisson random walk model that can easily be generalized to multiple alternatives.

The Poisson Random Walk model accounts well for observed performance in a speeded response time task with multiple alternatives.

References

1) Bundesen, C. (1990). A Theory of Visual Attention. *Psych Rev*.
2) Kyllingsbæk, S., Markussen, B., & Bundesen C. (2012). Testing a Poisson counter model for visual identification of briefly presented, mutually confusable single stimuli in pure accuracy tasks. *JEP:HPP.*

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