Modelling response times in multi-alternative categorization with TVA

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Background

In TVA\cite{1}, it is assumed that encoding in VSTM is a race between competing categorizations. Previously\cite{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.

Multi-alternative random walk model

\[ p_A = \frac{v_A}{v_A + v_B} \]

\[ p_B = \frac{v_B}{v_A + v_B} \]

\[ p_C = \frac{v_C}{v_A + v_B + v_C} \]

\[ p_D = \frac{v_D}{v_A + v_B + v_C + v_D} \]

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.

Experiment

Fixation

Stimulus

Response

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

Results

Individual fits

<table>
<thead>
<tr>
<th>Difficulty</th>
<th>Correct</th>
<th>+90 deg err</th>
<th>-90 deg err</th>
<th>180 deg err</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy</td>
<td>0.9</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Intermediate</td>
<td>0.8</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Hard</td>
<td>0.7</td>
<td>0.5</td>
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Group results

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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


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