

Where do expectations bias choices: in the decision or in the movement?

Dendauw E, Logan GD, Schall JD, Gajdos Preuss T*, Servant M* (2026). Separating decision and motor contributions to behavioral biases induced by manipulating stimulus probability. *Cognitive Psychology* 165: 101818.
<https://doi.org/10.1016/j.cogpsych.2026.101818>

* Equal contribution.

When one stimulus is more likely than another, people choose it more often and respond to it faster. We asked where this bias arises along the chain from decision to muscle. Twenty-four participants judged the direction of moving dots while we recorded the electrical activity of their response muscles (electromyography). We varied stimulus probability and stimulus discriminability. Stimulus probability strongly changed the time from stimulus onset to muscle activation, but had little effect on the time from muscle activation to the button press. It also changed subthreshold muscle activations. We explained these data with the gated cascade diffusion model (GCDM), which links evidence accumulation, motor preparation and muscle activation (Fig. 1). The best model combined a bias in the rate of evidence accumulation favouring the expected stimulus and an urgency signal at the motor preparation level, engaged earlier for the response linked to the expected stimulus. The classic account, a shift in the starting point of evidence accumulation, received little support (Figs. 2 and 3).

Use of the D²S²C cluster. The cluster was used to fit GCDM. The model has no closed-form likelihood, so each fit relies on simulation. For each of the 24 participants and each of the 8 model variants, parameters were estimated by differential evolution, with 20,000 simulated trials per condition (24 conditions) at each evaluation. The fit of each model was then re-estimated with 500,000 simulated trials per condition. A parallel set of standard diffusion model fits was also run.

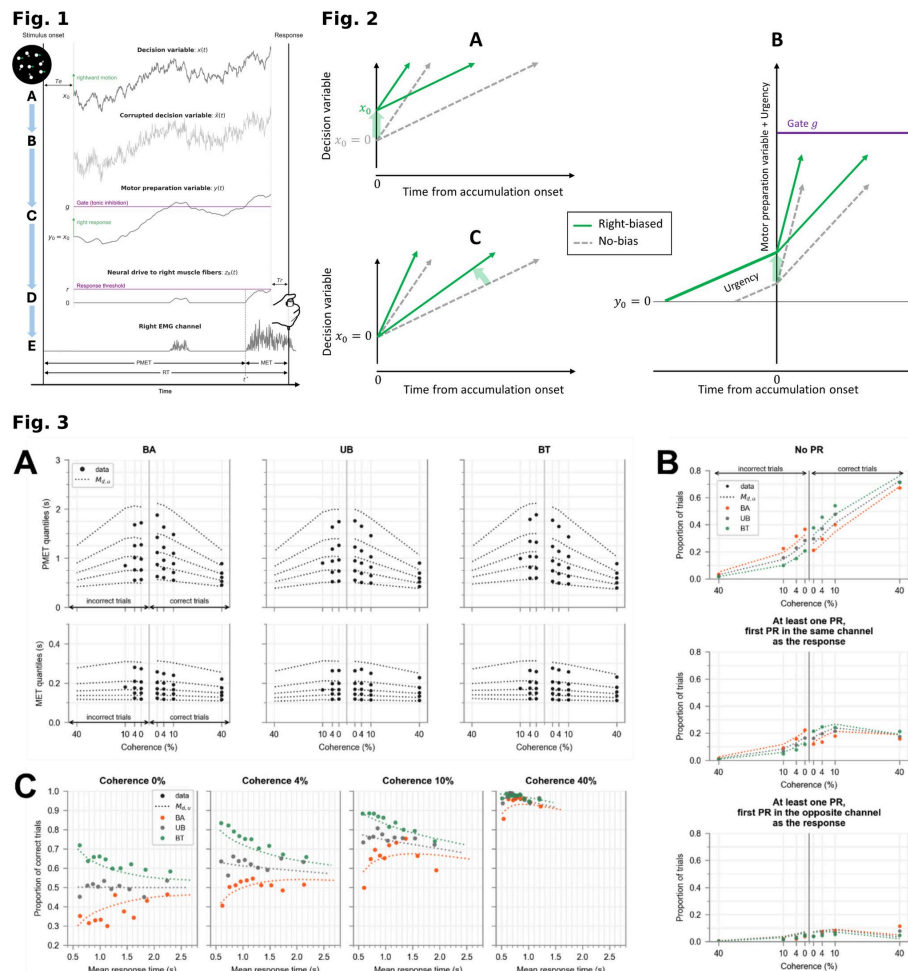


Fig. 1. Architecture of the gated cascade diffusion model (GCDM). Trial of the motion task with a rightward stimulus. (A) After an encoding latency T_e , the decision variable $x(t)$ accumulates evidence from starting point x_0 . (B) It is transmitted to motor preparation areas and corrupted by noise. (C) The motor preparation variable $y(t)$ filters this noise (approximate Kalman-Bucy filter) and is subject to gating inhibition g . (D) Above the gate, $y(t)$ sets the neural drive to the muscle; the response occurs after a latency T_r once the drive reaches threshold r ; a drive that returns to zero first gives a partial response. (E) The rectified EMG is a noisy proxy of the neural drive; muscle onset t^* splits the response time (RT) into pre-motor execution time (PMET) and motor execution time (MET).

Fig. 2. Hypothesized loci of stimulus probability effects. Rightward stimulus; green: right-biased condition, grey dashed: unbiased condition; each pair of arrows shows high and low discriminability. (A) Starting point bias: x_0 is shifted toward the expected category. (B) Urgency in motor preparation: an evidence-independent linear signal starts before evidence accumulation and adds to $y(t)$; purple line: gate g . (C) Drift bias: a constant is added to the rate of evidence accumulation.

Fig. 3. Fit of the best model (drift bias + urgency, $M_{0,u}$). Data (points) and model predictions (dotted lines), averaged across participants. BA: bias against the presented stimulus; UB: unbiased; BT: bias toward the presented stimulus. (A) 0.1, 0.3, 0.5, 0.7 and 0.9 quantiles of PMET (top) and MET (bottom), for incorrect and correct trials, as a function of motion coherence. (B) Proportions of trials without partial response (PR), and with a first PR in the same or the opposite channel as the response. (C) Accuracy as a function of response time (conditional accuracy functions), per coherence level. Figures reproduced from Dendauw et al. (2026), Figs. 1-3 (CC BY 4.0).