Fast and tight control of motor vigor by accumulated decision evidence

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Acting in the natural world involves not only identifying the most favorable action but also converting decisions into motor commands. The relationship between the dynamics of decision formation and the kinematics of response movement remains poorly understood. Here we investigate how the accumulation of decision evidence shapes response trajectories in a task where freely-moving rats combine prior expectations and acoustic information to select between two possible responses. We extracted rats' trajectories using automatic video analysis and found that the vigor of rats' movements are initially modulated by the prior, and typically incorporate the stimulus information after movement onset by speeding their response if the stimulus supports their choice, slowing it otherwise. The delay between stimulus onset and its measurable impact on trajectories could be as small as 60 ms. When the stimulus is strongly incongruent with the initial choice, rats reversed their initial trajectories and headed to the alternative port. A remarkably similar behavior was found in humans performing an analogous task under time pressure. We encapsulated this behavior in a computational model that describes the mapping between the dynamics of evidence accumulation and the full orienting response trajectory. The model was fitted to individual rat decisions and movement times by using a recently developed method that allows approximating its likelihood using artificial networks. The model replicates the rat choices, orienting trajectories and explains the conditions yielding trajectory reversals. Together, our results show the tight and graded relationship between the evidence accumulated during perceptual decisions and the kinematics of the response trajectories described by rats and humans to execute their choices.