Title (103/**1200** characters with space):

A generative model to assess the behavior of humans and monkeys in a virtual balancing task.

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Disclosures

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Abstract (2000/**2300** characters without spaces)

A large body of behavioral and neurophysiological studies on primates have attempted to address the computations needed for the control of voluntary movements. Despite numerous insights, these studies mostly relied on simple reaching movements that tended to be short and stereotypic in their kinematic profiles. Much remains unknown about the control mechanisms that govern movements involving continuous interactions with the world. An example of such interactions is balancing a beam, which requires integration of continuous feedback and leads to unique behavior at each attempt. To explore such interactive control, we introduced the Critical Stability Task (CST), where monkeys were trained to balance a linear unstable system in the virtual environment, akin to balancing a beam.

Previous analysis of CST behavioral data revealed that despite large trial-by-trial variations, monkeys exhibited consistent features in behavior. For example, as task demands became more difficult, the success rate dropped, and the control response showed shorter lag and lower feedback gains. However, these observations alone could not fully capture the behavioral richness of the task to provide insight into the monkeys' control strategies. To gain more understanding, this study adopted a normative approach and developed a generative model based on stochastic optimal control theory. This model produced strikingly similar behavior to the monkeys, both at the aggregate and at the single-trial level of behavior. On average, the model

successfully captured how success rate, lag of control response, and magnitude of feedback gains changed as a function of task difficulty. In addition, analysis of single trials provided further insight into different control strategies that the monkey employed for different task demands. Specifically, the model suggested that the behavior in easier trials resembled that of position-based control, while the behavior in more difficult trials exhibited features of a velocity-based control strategy. The proposed model also makes new predictions about the role of different sensory information in task success, which can be later tested in behavioral experiments with both humans and monkeys. Importantly, with available neural recordings from monkeys, this model may inform the analysis of neural data and hence add to the understanding of the neural basis of sensorimotor integration during continuous interactive behavior.