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Rapid intermittent deep brain stimulation biases behavior in financial decision-making task

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We report single-unit responses recorded from the human subthalamic nucleus (STN) in patients undergoing deep brain stimulation while engaged in a financial decision-making task. The task is modeled as a simplified version of the classic card game "war". The subject is dealt a card and asked to make a high or low wager ($5 or $20). Immediately following their choice they are shown their opponent's card-the player with the highest card wins. We recorded 20 individual neurons from 5 patients. We found that during the go-cue period, neuronal activity in the STN predicted whether the subject would ultimately bet high or low on trials where the probability of a positive or negative outcome were equal (6-card trials, two-tailed t-test, p=0.03). To explore this further, we used intermittent electrical stimulation to assess changes in financial decision-making. Using modified stimulator, we applied one of three stimulation conditions during 6-card trials: no stimulation, 1 sec of stimulation at the fixation, or 1 sec of stimulation at the go-cue epoch. We found that intermittent stimulation at the go-cue epoch-the same period STN neurons encode the upcoming decision-biases subject to make a low wager (binomial proportion, 95% c.i.). Fixation and no stimulation categories had no effect on decision-making. In this study, we demonstrated that neuronal activity in the dorsal STN predicts financial decisions. We then showed that we could apply intermittent electrical stimulation through the implanted electrode to bias the decision signal and ultimately alter the subject's behavior.

Biography

Shaun R Patel has completed his PhD from Boston University School of Medicine and is currently undergoing postdoctoral studies at the Massachusetts General Hospital/Harvard Medical School. He is primarily interested in understanding neural computations underlying higher order cognitive functions, such as: decision-making, learning and memory, and reward processing. To explore these questions, he primarily uses techniques in awake-and-behaving neurophysiology and applied mathematics. He has been the recipient of numerous awards and his work has been published in numerous journals of high repute.

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