

Do neurons play dice? And does the answer matter for free will?

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Consider two trials of an experiment where a subject is asked to volitionally decide whether to raise the right hand or the left hand. Let us assume that every single external and internal condition is identical in both cases (history, current environment conditions, degree of tiredness, spatiotemporal concentration of ions and proteins in neurons, everything). Would the subject demonstrate behavioral variability or always choose the same course of action? It is difficult to empirically test such conditions. Under the conjecture that subjects would still be somehow able to trigger different behaviors in these conditions, it seems that there would be a need for internal mechanisms that have random components. I will provide an overview of experiments recording neuronal activity in cortex showing that neurons can respond in a largely deterministic fashion. When external conditions are approximately matched across trials, neurons can show minimal levels of noise in their firing patterns. While these experiments do not negate the possibility of randomness, they do quantitatively constrain the role of chance in neuronal activity. Contrary to common belief, neurophysiological recordings suggest that neurons can be very reliable and that behavioral variation may be largely ascribed to different external and internal conditions across trials.