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The Origin of Time in the Songbird Motor Pathway[1]

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Many complex behaviors, like speech or music, have a hierarchical organization with structure on many timescales. How does the brain control the timing and ordering of behavioral sequences? Do different circuits control different timescales of the behavior? To begin answering these questions, we use temperature to manipulate the biophysical dynamics in different regions of the songbird forebrain involved in song production. We found that cooling premotor nucleus HVC (high vocal center) uniformly slows song speed by up to 40% while only slightly altering the acoustic structure, whereas cooling downstream motor nucleus RA (robust nucleus of the arcopallium) has no observable effect on song timing, despite a marked affect of RA spiking activity. To better understand the circuit mechanisms of precise premotor timing, we perform intracellular recordings in RA-projecting HVC neurons during singing. Our observations suggest highly ordered dynamics within HVC which are consistent with a synfire-like neuronal architecture.

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