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# A reafferent model of song syntax generation in the Bengalese finch

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The Bengalese finch produces a set of ordered sequences of syllables. After deafening this song syntax is disrupted, i.e. within days the sequence become randomized and unstable [1]. Interestingly, the normal song syntax is recovered when hearing is restored [2]. Studies have shown that the vocal motor control system of the Bengalese finch rely on real time auditory feedback [3] and that activity in the high vocal center (HVC) is affected by feedback perturbations [4]. This suggests a reafferent model [3] of song syntax generation in which the perception of the bird's own song (BOS) cues the motor system.

Here, we present a functional network model of the song syntax generation based on realistic spiking neurons. Neurons are connected in feed-forward structures (synfire chains, SFCs) that can reproduce the neural activity observed in the HVC of the songbird [5]. Individual syllables are represented by the activity propagation throughout distinct SFCs. The auditory perception of the syllables is modeled by activity changes in an auditory network which in turn primes specific subsets of the HVC neurons to obtain the desired song syntax. If the auditory feedback is suppressed random syllable sequences are generated due to the 'winner takes all' competition of individual syllables [6].

## Conclusion

Our model can reproduce the experimentally observed song syntax of the Bengalese finch and its disruption when auditory feedback is interrupted. It provides a framework for theoretical investigations of HVC activity and changes in the song syntax in response to specific feedback disturbances. Additionally, the model predicts priming of HVC neurons at the transition between individual syllables that could be tested in further experimental studies.

From a theoretical point of view the individual syllables can be regarded as primitives of the song which are combined following a given syntax. Hence, our reafferent model demonstrates how compositionality of a system can be realized given neurobiologically realistic assumptions.

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