DECODING OF VIBRISSAL TEMPORAL CUES BY THALAMOCORTICAL LOOPS.

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Vibrissal information is encoded by both spatial and temporal cues. Our data from anesthetized rats indicate that these types of information are decoded in parallel by two thalamocortical systems: the lemniscal and paralemniscal, respectively. The temporal processing is associated with the emergence of two types of internal representations of the input temporal frequency: spike-count and latency. To asses which of the two can be reliably used for downstream computations, we examined the constancy of these codes while modifying the stimulus pulse-width. Reducing the pulse-width from 50 to 20 ms resulted in a significant reduction in latency coding but almost no change in spike-count coding. For comparison, lemniscal spike-count coding was significantly reduced with 20 ms pulse-widths. This result suggests that the spike-count coding is actively maintained by the paralemniscal system, on the expense of the latency code. This coding constancy can be explained by our working model - the thalamocortical phase-locked loop (PLL). However, if the paralemniscal loops function as PLLs, they should function outside their stability range to allow the wide working ranges observed. Such unstable loops should produce unreliable coding. Indeed, while reliable coding was generated by pools of neurons, single neurons reliability was poor. Our data, together with computer simulations, suggest that coding reliability within wide working ranges is achieved by pooling together tens of unstable PLLs. Overall, these data suggest that pools of thalamocortical loops transform temporal vibrissal cues to rate-coded population signals in the barrel cortex.

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