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POSTER PRESENTATION

Pattern separation is not affected by granule cell threshold independent of its effect on sparseness

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Mounting evidence indicates that the dentate gyrus functions as the computational locus of pattern separation [1-5], a phenomenon thought to be crucial for associative memory functions in area CA3 [6-11]. Pattern separation enables the decorrelation of highly overlapped input patterns arising from the perforant path via the formation of sparse, uncorrelated outputs [4,5]. Several anatomical and physiological properties of the dentate have been proposed to mediate pattern separation, including input expansion [11]. A series of simple models consisting perforant path (PP) inputs and granule cells (GCs) were employed to investigate whether granule cell threshold contributes to pattern separation independent of its effect on the sparseness of GC activity. Input connections were binary and chosen independently for each possible PP-GC pairing. Simulations included eight input patterns, each consisting of seven active PP elements, where input patterns 1 and 2 are highly overlapped and patterns 1 and 8 have no overlap. The percent overlap was defined as the ratio of co-active elements across pattern pairs relative to the total number of active elements in each pattern. Pattern separation was defined as a reduction in percent overlap for the output relative to the input. In accord with previously published models using k-winner take all dynamics [1], our results reveal that increasing GC threshold increased pattern separaration, but increasing the size of the granule cell population did not. However, if an increase in GC threshold was accompanied by an increase in connection probability in such a way to maintain the probability of GC activation, the percent overlap in the GC output remained unchanged. Therefore, changing a fixed granule cell threshold does not affect pattern separation independent of its effect on the sparseness of GC activity. The effective threshold of granule cells may be regulated by a number of mechanisms, including synaptic scaling and metaplasticity. We are currently investigating how such changes, which introduce dependencies between connection strength and patterned activity, might contribute to pattern separation across a series of afferent inputs.

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