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Area-specific excitation of hippocampal parvalbumin expressing basket cells

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Parvalbumin expressing basket cells (PVBCs) provide powerful inhibition to principal cells of all hippocampal regions and play pivotal roles in feedback inhibitory mechanisms. The key component in feedback inhibition is the excitation of the inhibitory cells by local principal cells. However, it is less understood whether local excitatory inputs to PVBCs show any hippocampal region-specificity that could underly the region-specific mechanisms of feedback inhibition. To address this question we analysed the synaptic connections between local excitatory cells and identified PVBCs in the CA1, CA3 and dentate gyrus (DG). The initial failure rate, effective amplitude and potency of unitary EPSCs were similar in PVBCs from all three regions. However, in contrast to CA1 and DG, EPSCs in CA3 PVBCs showed a significant facilitation due to a drop in the failure rate. Furthermore, the resting membrane potential of PVBCs in the CA3 were more depolarized enabling them to be more actively involved in feedback inhibition compared to CA1 and DG. In addition to this region specificity, detailed analyses suggested that failure rates depended on the relative distance between presynaptic principal and postsynaptic PVBCs. Namely, in average the connections between more proximal CA3 cells (<100 μm) were less reliable compared to distal pairs. Altogether, these results suggest that beyond the types of the connected cells location of the cells is also important in fine-tuning of synaptic networks.