Supplementary Data

Pattern separation and completion of distinct axonal inputs transmitted via micro-tunnels between co-cultured hippocampal dentate, CA3, CA1 and entorhinal cortex networks

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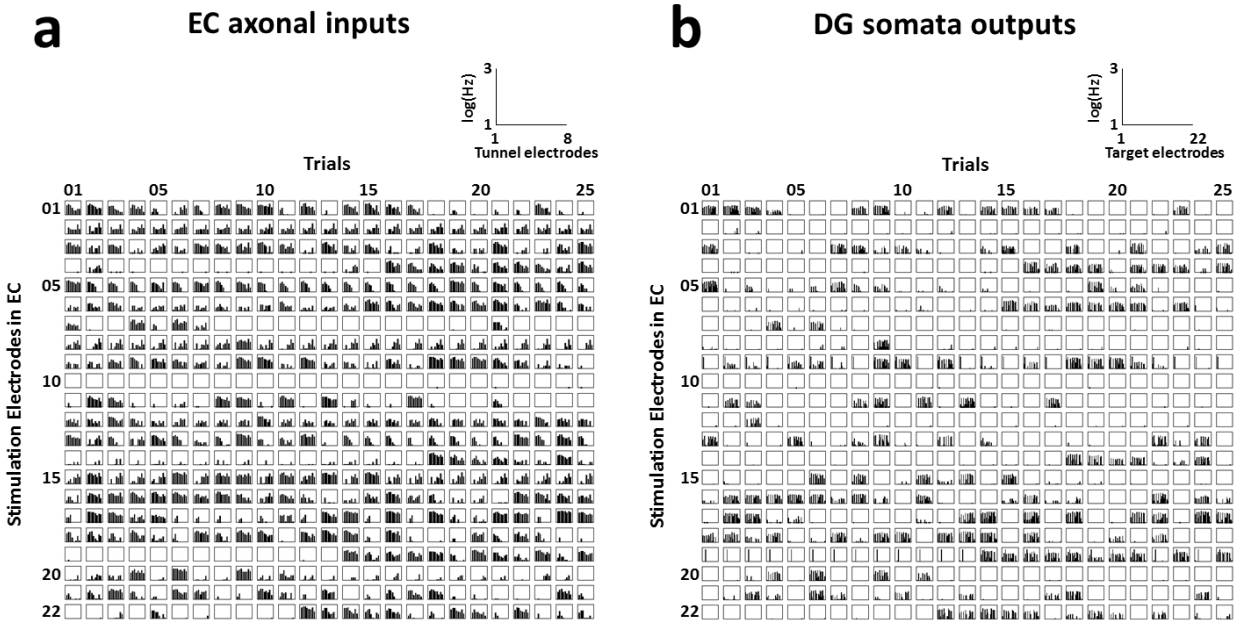

Figure S1. Rate patterns of EC axonal inputs and DG somata outputs evoked by 25 stimulation trials applied at each of 22 EC electrodes. **(a)** Log spike rates evoked at each tunnel electrode (n=8) by 25 paired-pulse stimulation trials (columns) applied at each of 22 EC electrodes (rows). **(b)** Log spike rates evoked at each DG target electrode (n=22) by 25 repetitions of paired-pulse stimulation (columns) applied at each EC site (rows). Bars in each sub-plot represent spike rates in log scale at each tunnel (a) or target (b) electrode of one array example. We observed evidence of transmission failures during specific EC stimulation trials and off/on network states for different stimulation sites, e.g. 04, 14, 19 and 22. Off/on states were transmitted from EC to DG, increasing the activity failures and highlighting site-specific responses to each stimulus.

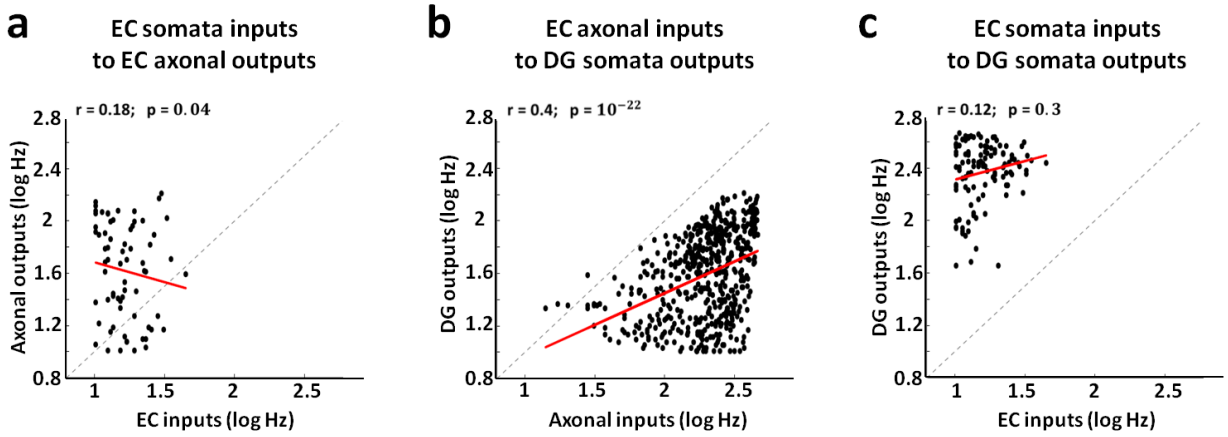

Figure S2. Considering all trials separately, axonal inputs and DG somata outputs correlated better than EC somata inputs with axonal outputs, or EC somata inputs with DG somata outputs. **(a)** Weak correlation between EC somata inputs and axonal outputs in the tunnels (r=0.18, p=0.04). **(b)** Better correlation than (a) between axonal inputs and DG somata outputs (r=0.4, p=10^{-22}). **(c)** Weak correlation between EC somata inputs and DG somata outputs (r=0.12, p=0.3). All points represent the spike rates > 12.5 Hz evoked by each EC stimulation trial for 4 arrays. The truncations in x and y axes are a consequence of this minimum spike rate of 1/80 ms and the maximum rate limited by 40/80 ms.

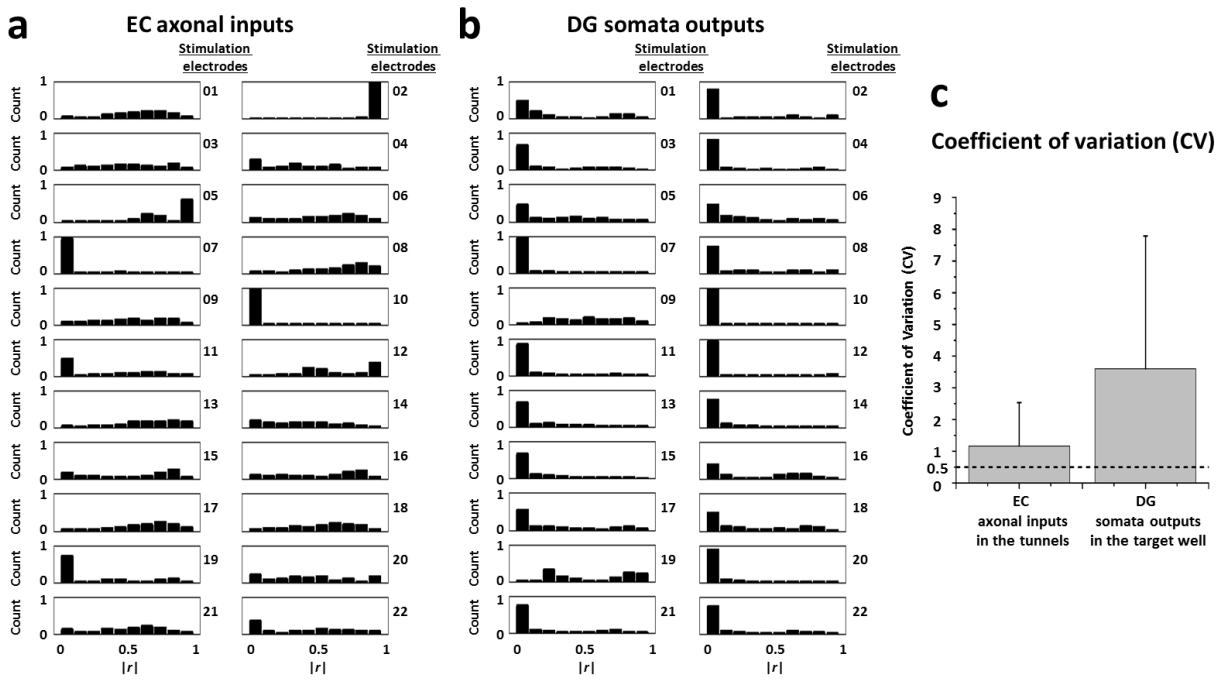

Figure S3. Poor reproducibility of the correlation values of the axonal and somata rate patterns evoked by 25 stimulation trials applied at each of 22 source electrodes. Correlations of axonal inputs transmitted through the tunnels from EC **(a)** and somata outputs in the DG target well **(b)** consistently fail to distribute around a fixed Pearson coefficient. **(c)** High variability of the coefficients of variation of the input and output correlations (average and standard deviation from 22 EC stimulation sites in 4 arrays).

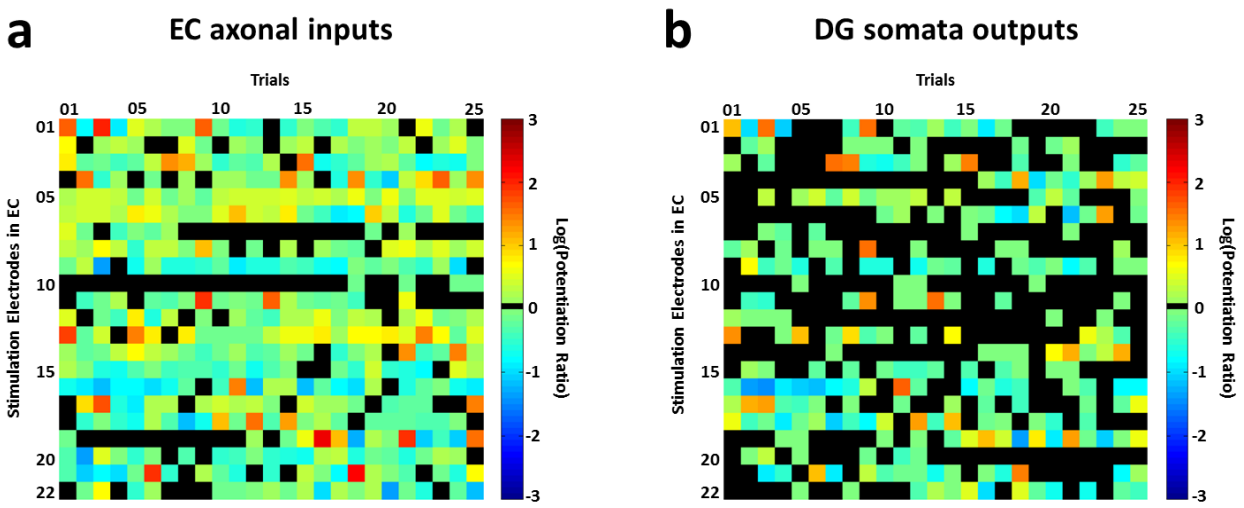

Figure S4. Paired-pulse stimulation trials at each EC site evoked transitions from potentiation (red-yellows) to inhibition (blues) network activity for the same stimulus. The potentiation ratio was defined as the ratio of the spike rate after the second pulse to the spike rate after the first pulse (log scale). Axonal potentiation ratios in the tunnels **(a)** and somata potentiation ratios in the DG target well **(b)** for each stimulation trial (columns) applied at each of 22 EC sites (rows) for one array example.

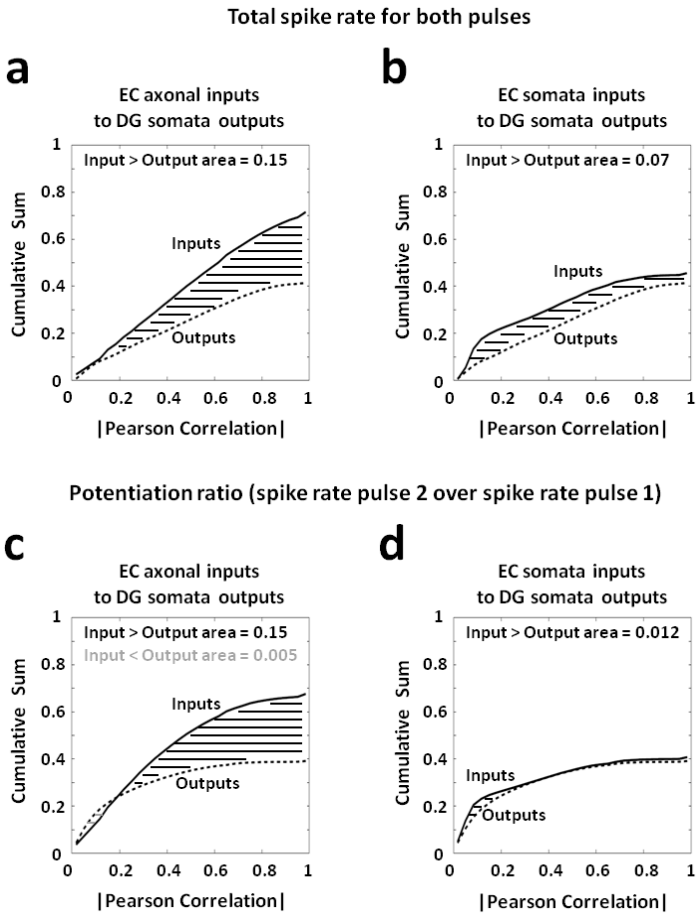

Figure S5. Axonal inputs are more frequently correlated than DG target outputs for both overall spike rate and potentiation ratio measures. **(a)** The axonal inputs expressed as spike rates and transmitted through the tunnels from EC are more separated into DG (Input – Output area = 0.15; black shading) than **(b)** the somata rate patterns evoked in the EC source well (Input – Output area = 0.07). Similarly, **(c)** the axonal inputs expressed as potentiation ratios and transmitted through the tunnels from EC are more separated into DG (Input – Output area = 0.15; black shading) than **(d)** the somata outputs in the EC source well (Input – Output area = 0.012). A weak level of pattern completion (gray shading) was observed in (c) (Output – Input area = 0.005).