**Supplemental Material**

# Selectivity of pyramidal cells and interneurons in the Human Medial Temporal Lobe

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## Autocorrelograms for putative pyramidal cells and interneurons in the MTL

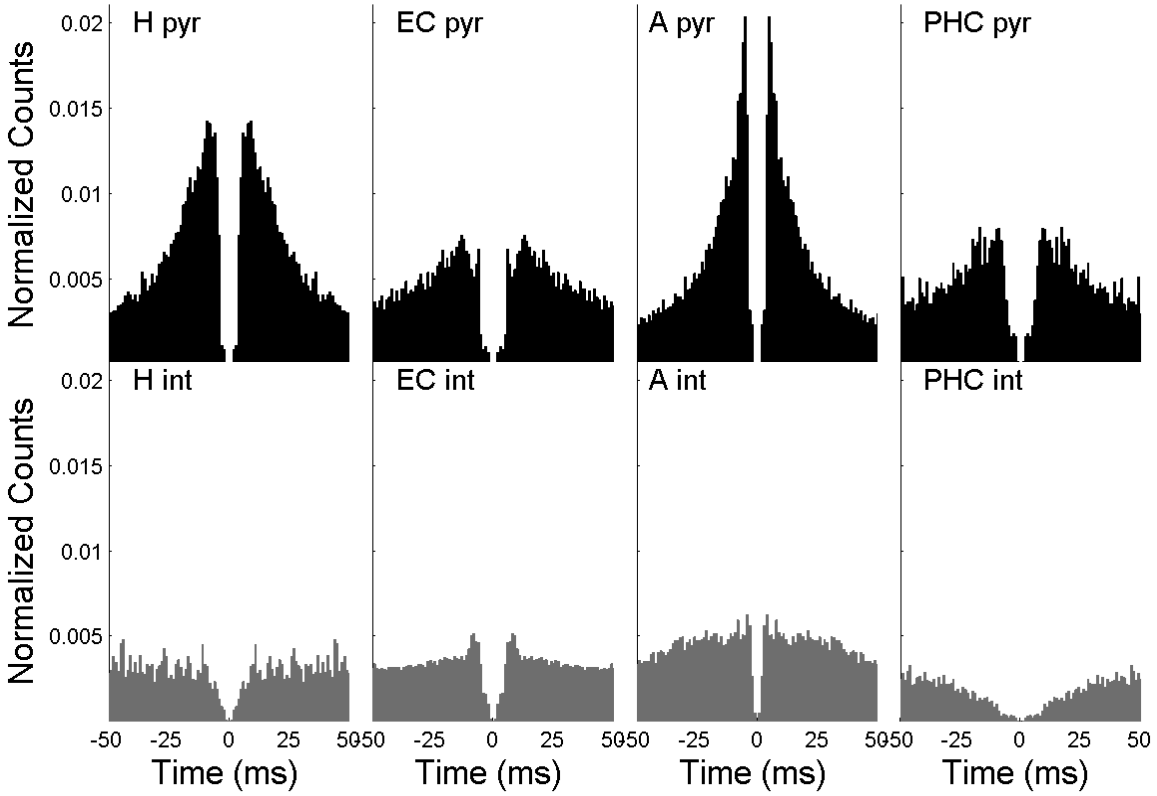


Fig. S1. Average normalized autocorrelograms for putative pyramidal cells and interneurons in all MTL regions. The proportion of pyramidal cells firing in bursts, quantified by the proportion of bursts associated with interspike intervals < 10ms, is much larger in the hippocampus *(<BP>=0.25*) and amygdala *(<BP>=0.25*) (Kruskal-Wallis test with Bonferroni correction) than in entorhinal *(<BP>=0.07*) and parahippocampal *(<BP>=0.06*) cortices.

**Measuring stimulus selectivity in pyramidal cells and interneurons**

In this section, we compare the use of different definitions of selectivity applied to the two populations under study.

The sparseness statistic of the representation of a set of stimuli is defined as (Vinje and Gallant, 2000):

$S_a = \frac{1-a}{1-1/N}$, where N is the stimulus set size, and $a = \frac{\left(\frac{1}{N}\sum_{i=1}^{N} f_i\right)^2}{\frac{1}{N}\sum_{i=1}^{N} f_i^{\,2}}$ is defined as the sparseness (Rolls and Tovee, 1995), where $f_i$ denotes the firing rate of a given neuron to the stimulus. Note that the sparseness statistic $S_a$ is just an inverse and rescaled version of the sparseness a.

The Depth of selectivity (Moody et al., 1998) is defined as:

$$S_M = \frac{N - \sum_{i=1}^{N} f_i \,/\, f_{\max}}{N-1}$$

Where $f_{max}$ denotes the maximum firing of a given neuron.

Non-parametric entropy selectivity (Lehky, Seknowski, Desimone, 2005): In the framework of information theory, a unit with high selectivity, firing mostly to one or very few stimuli, is highly informative and should exhibit a low entropy value. Conversely, a cell firing to most stimuli would show a low selectivity and a high entropy value. Among all the possible response distributions, it can be shown (Shannon, 1997) that the entropy of a Gaussian distribution is maximum for all distributions of a given variance. The non-parametric entropy selectivity index quantifies the decrease of entropy relative to a Gaussian distribution. It is defined as:

$$S_E = 2.074 + \sum_{i=1}^{M} p(r_i)\log_2(p(r_i))\Delta r$$

Where p(r) is the response probability density function, N is the number of images in the stimulus set, $M = \sqrt{N}$, and $\Delta r$ is the bin size.

As early as in 1979, Smith and Travers proposed a selectivity measure based on the entropy. Specifically, they defined the breadth of tuning entropy $S_H$ (Smith and Travers, 1979) as:

$S_E = -kN\sum_{i=1}^{N} p(r_i)\log_2(p(r_i))$, where $p(r_i) = f(r_i)/\sum_{i=1}^{N} f(r_i)$, and k is a scaling constant chosen such that $S_E=1.0$ when the neuron responds equally well to all stimuli in the set.

Lastly, as in (Mormann et al., 2008) we evaluated response selectivity by the total number of stimuli to which a neuron responded.

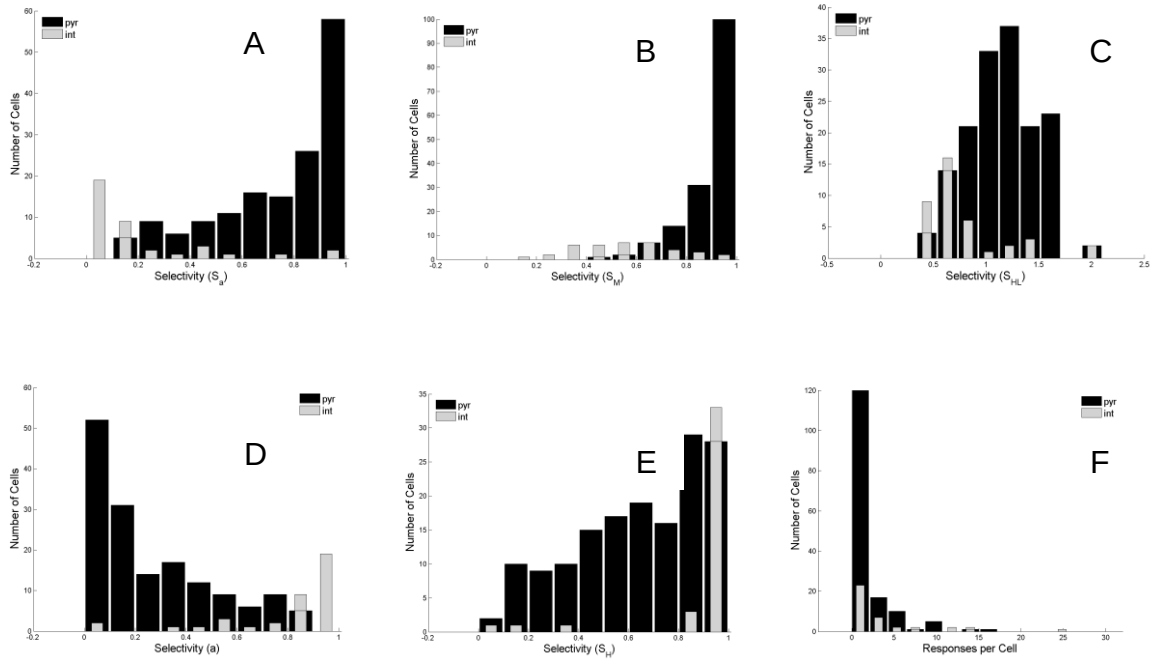


Fig. S2. Distribution of selectivity values for several alternative selectivity measures. (A) Sparseness statistic (Vinje and Gallant, 2000). (B) Depth of selectivity (Moody et al., 1998, Suzuki et al., 2003). (C) Non-parametric entropy selectivity (Lehky, Seknowski, Desimone, 2005). (D) Sparseness (Rolls and Tovee, 1995). (E) Breadth of tuning entropy (Smith and Travers, 1979). (F) Number of responses per cell (Mormann et al., 2008). In (A), (B), (C) a higher value of selectivity indicates a higher specificity (neuron having a larger response to fewer stimuli). In (D), (E), (F) low values indicate higher specificity. In all cases, the differences between putative pyramidal cells and interneurons are highly significant ($p<0.01$, Wilcoxon rank-sum test).

**Effect of response type in stimulus selectivity**

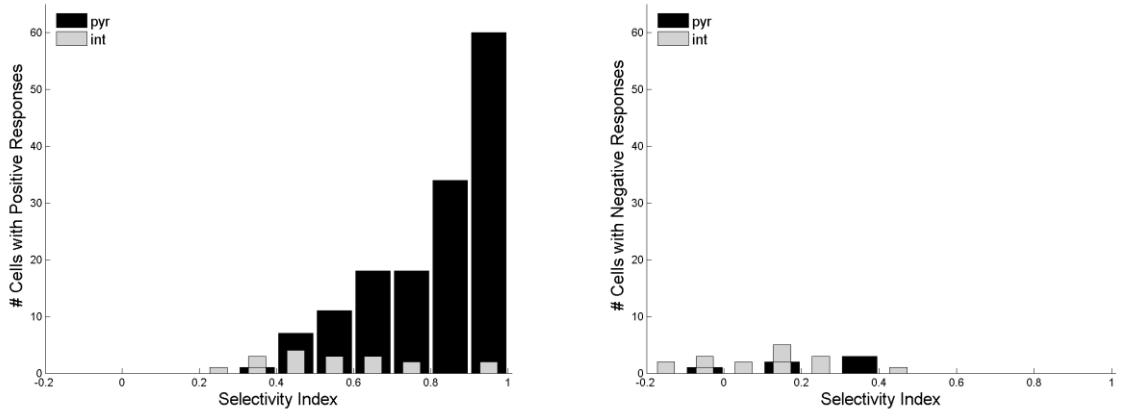


Fig. S3. Distribution of selectivity for responsive pyramidal cells (black bars) and interneurons (gray bars) for neurons exhibiting positive responses (left panel) and negative responses (right panel).

**Selectivity in MTL regions**

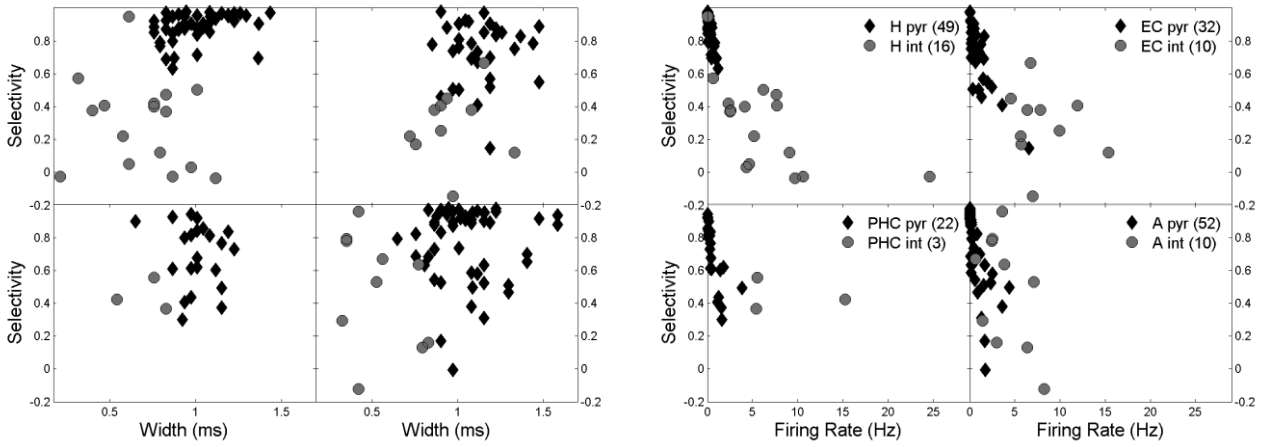


Fig. S4. Scatter plots of selectivity index versus spike width (left panel) and selectivity index versus baseline firing rate (right panel) for all MTL regions.

**Selectivity index in simulated spike trains**

We assessed the effect of the limited number of trials in the calculation of the selectivity we developed a set of simulations of Poisson neurons with the statistics of both neuronal groups and assessed their selectivity for different numbers of simulated trials. For each simulation we generated a Poisson spike train mimicking the responses of real cells to a set of 100 stimuli. The baseline firing rate was taken as the mean baseline firing rate for each neural group (0.6 Hz and 6.4 Hz for putative pyramidal cells/interneurons). On average pyramidal cells in our study responded to 2 different pictures with a mean firing rate of 5 Hz and interneurons to 4 pictures with an average firing rate of 11.6 Hz. Therefore we implemented 2 (4) simulated pyramidal (interneuron) spike trains with a firing rate $\lambda=5$

(11.6) and we implemented the responses to the 98 remaining stimuli with the mean firing rate over all stimuli (0.8 Hz for pyramidal cells and 6.7 Hz for interneurons).

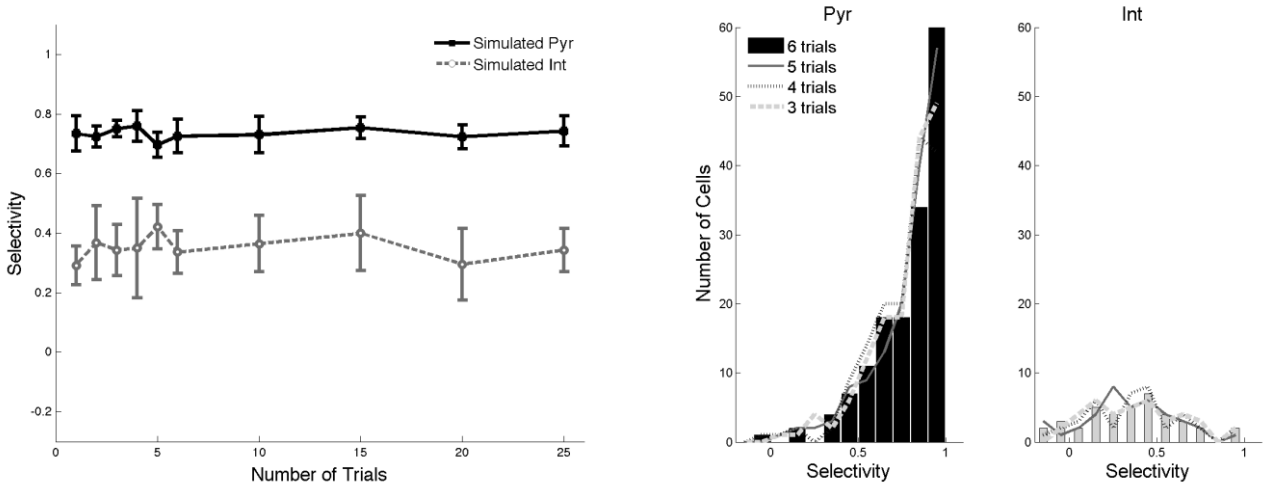


Fig. S5. Left panel: Mean selectivity for a simulated pyramidal cell (black squares) and a simulated interneuron (blue circles) for different numbers of simulated trials. Error bars denote SD over 10 simulations. Right panel: Selectivity distributions of real data for putative pyramidal cells (left panel) and interneurons (right panel) calculated for varying number of trials.

In addition, we recalculated the selectivity of our data for 5,4,3 trials and compared it with the selectivity obtained using 6 trials.

From Fig. S5 it can be seen that, both in simulated and real data, the estimation of selectivity is noisy for a small number of trials. However, this effect is relatively small and cannot account for the significant difference in selectivity between both neuronal groups that we reported.