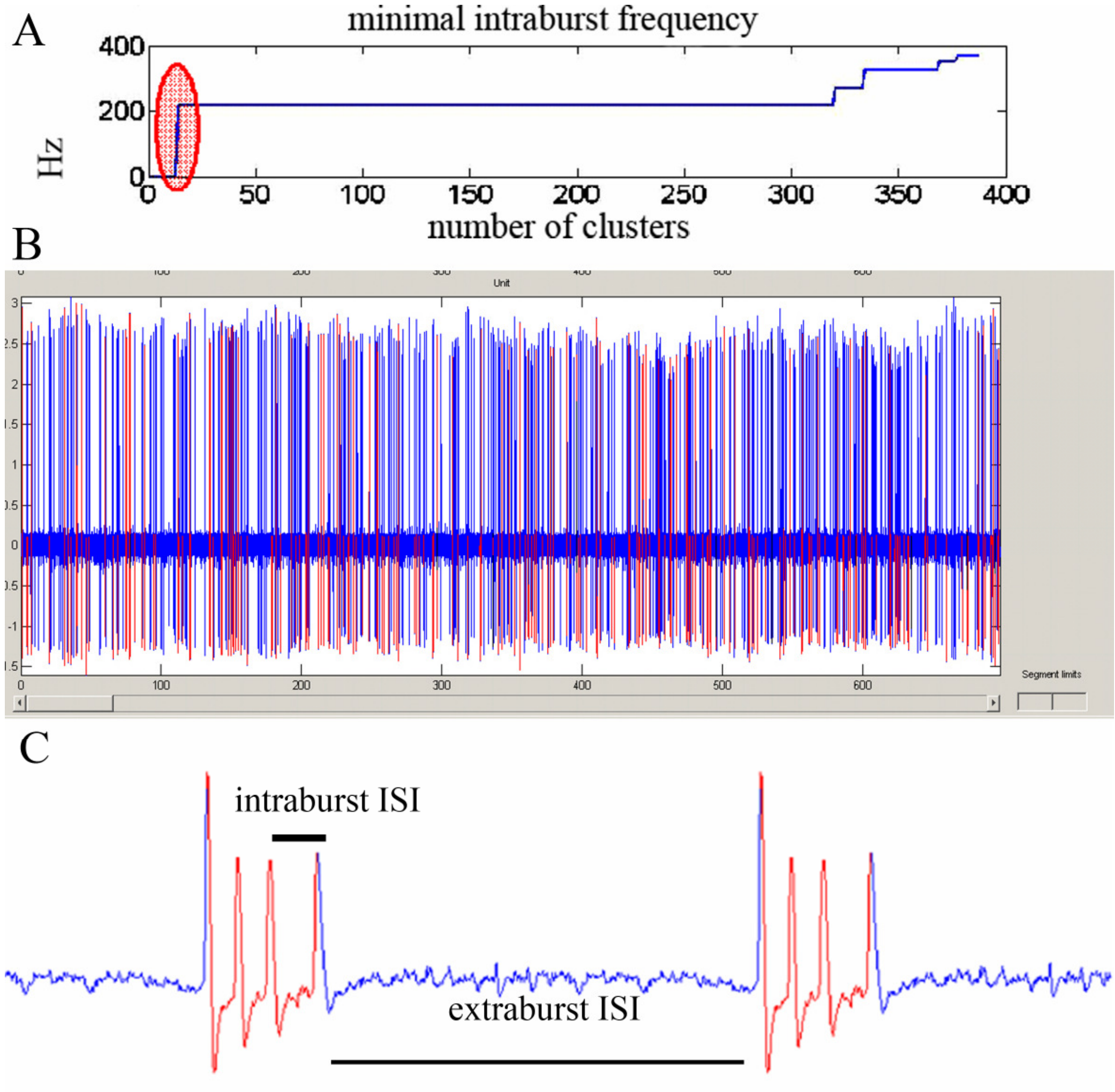
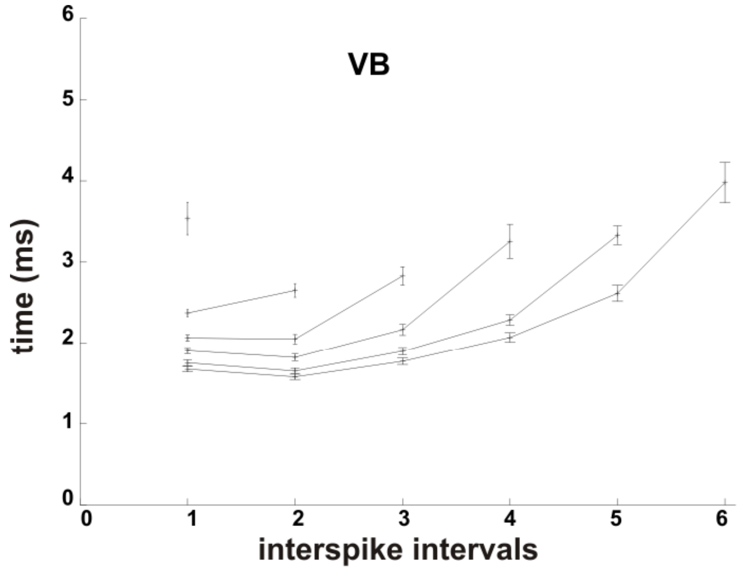
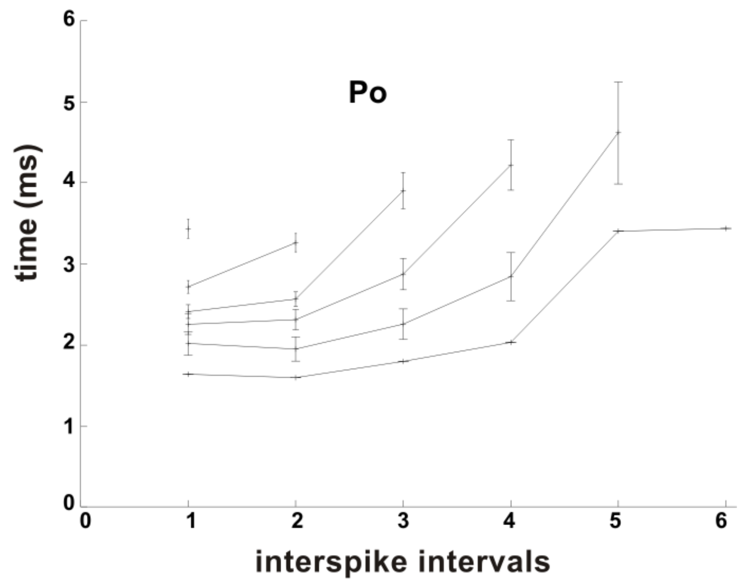
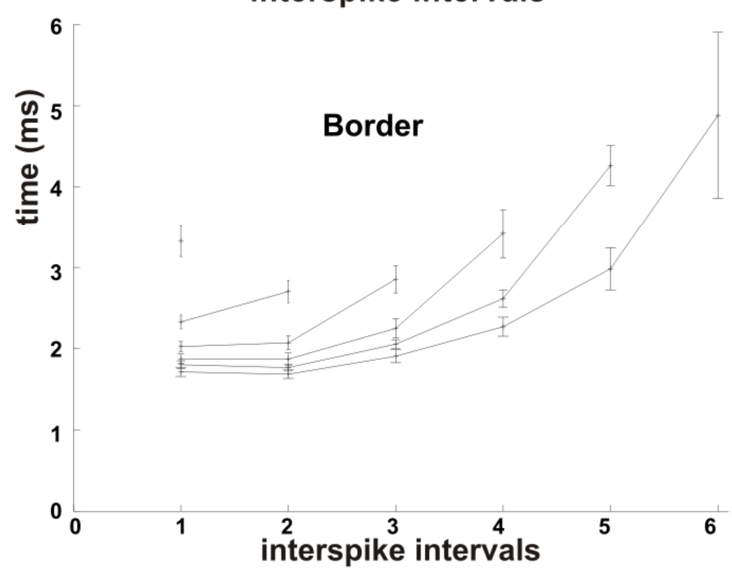


Supplemental Figure1 **Burst-detection method**

A: Minimal intraburst frequency in the function of the number of clusters. We determined the cluster number after the largest non-excluded step (red circle). **B**, **C**: The program allowed post-hoc verification by visual examination; intraburst interspike intervals (intraburst ISI-s) were red-labeled, whereas extraburst interspike intervals (extraburst ISI-s) were in blue.


VB
time (ms)
interspike intervals
0
1
2
3
4
5
6


Po
time (ms)
interspike intervals
0
1
2
3
4
5
6

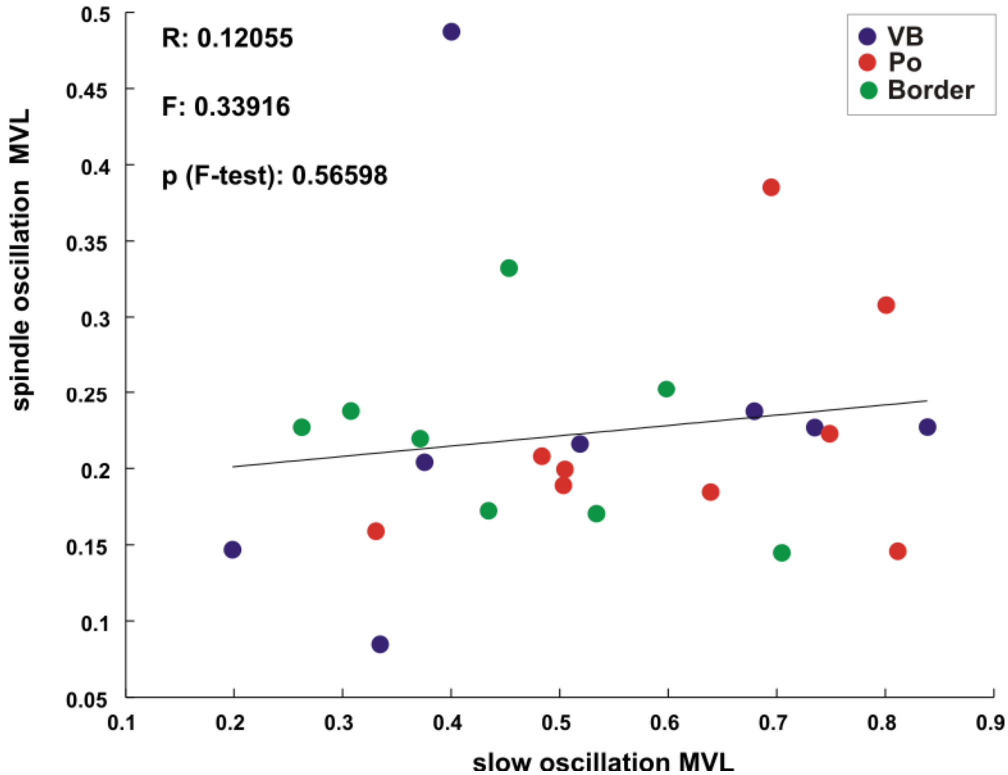

Border
time (ms)
interspike intervals
0
1
2
3
4
5
6

Supplemental Figure 2 **Burst dynamics of VB, Po and Border cells**

This figure shows the length of the interspike intervals (ISI-s) in the function of intraburst spike number in the examined three cell groups. **Individual lines represent bursts with increasing spikes per burst. For each data point the average ISI of several cells was calculated. For the number of cells see the table below.** Note that the ISI length distribution is similar among the groups. Po ISI-s are longer at all serial positions.

The number of neurons used to calculate each data point

ordinal ISI	**1**	**2**	**3**	**4**	**5**	**6**
VB	15	15	14	13	11	9
Po	15	15	14	9	4	1
Border	7	7	7	7	6	5



Supplemental figure 3 **Correlation between the phase consistency of relay cell firing relative to slow cortical oscillations vs. spindle oscillations**

The figure shows the mean vector length of relay cell firing relative to the slow oscillation in the function of the mean vector length of relay cell activity relative to spindle oscillation. **Each dot represents one neuron**. There is no linear correlation between the phase consistency of relay cell firing relative to the two examined oscillation. Blue dots; VB cells, red dots; Po neurons, green dots; Border cells.

Supplemental Notes

Detailed explanation of the burst detection algorithm

Interspike intervals (ISI) were automatically arranged in groups by Ward's clustering method (Ward, 1963). This algorithm minimizes the within-cluster variance, which ensures that ISIs of similar length get into the same group, while ISIs with substantially different length are sorted into different clusters. The cluster containing the shortest ISI should comprise the intraburst intervals, since the smallest interspike interval always occurs within a burst, if at all a burst event appears within a spike train. Consecutive intraburst intervals (i.e., ISIs from the cluster containing the shortest ISI) formed a burst of action potentials, thus burst events could be defined by the cluster analysis.

The major caveat of all hierarchical clustering algorithms is that the number of clusters should be chosen by the experimenter, which choice can significantly affect the result of the clustering. To overcome this technical problem, we applied the following method for determining the optimal number of clusters. First, we performed the clustering for all possible cluster numbers, each of which yielded a putative set of burst events. Intraburst frequency for all of these putative bursts was calculated and minimal intraburst frequency was plotted in the function of cluster number (Supplemental Figure 1A). In case the number of clusters reaches a value which is sufficient for separating the burst events, a large step appears in the above function. Based on this observation, implausibly low values of minimal intraburst frequency (below ca. 80 Hz) were disregarded and the largest step that reached a non-excluded frequency value was selected (marked in red in Supplemental Figure 1A). The optimal number of clusters was determined as the one corresponding to this step (14 in Supplemental Figure 1A). Bursts were post hoc verified by visual inspection (Supplemental Figure 2B-C) and in a few cases, optimal cluster number was changed to the neighboring step in the minimal intraburst frequency function.

Last ISIs of bursts could be substantially longer than the shortest extraburst intervals, in which cases the last spikes of these bursts were missed by the algorithm. To correct for this effect, we plotted the length histogram of the ISIs after the putative burst events, and in case a clearly separable peak of short intervals (typically < ~15 ms) could be detected, the ISIs forming this peak were added to the bursts.

Ward J (1963) Hierarchical Grouping to optimize an objective function. J Am Stat Assoc 58:236-244.

Supplemental Table 1 **Burst properties and firing characteristics of VB, Po and Border cells**

	Firing Frequency* (Hz)	**Burst frequency** (Hz)**	**Burstiness index**	**Intraburst frequency (Hz)**	**Intraburst spike number**	**Burst length (ms)**
VB (n=15)	5.82	1.44	0.960	423.16	3.69	6.21
Po (n=15)	3.88	1.22	0.934	341.68	2.67	5.86
Border (n=7)	6.24	1.49	0.941	418.72	3.77	7.00

***Firing frequency was calculated by including all spikes of the bursts as well as single spikes.**

**** Burst frequency refers to the number of bursts per second.**

Supplemental Table 2 **Phase preference and phase consistency relative to slow cortical oscillations**

	Mean angle	**Mean vector length**
VB (n=13)	13.21	0.416
Po (n=14)	-35.71	0.479
Border (n=7)	-35.33	0.378

Supplemental Table 3 **Phase advancement of burst with increasing spike numbers**

	α	β	γ
VB	-3.29 n=8	-2.24 n=11	-10.80 n=10
Po	-18.08	-8.27	-5.23

	n=12	n=11	n=7
Border	-17.55 n=7	-25.67 n=7	-20.41 n=7

Supplemental Table 4 **Phase preference and phase consistency relative to 7-20 Hz oscillations**

	Mean angle	**Mean vector length**
VB (n=8)	150.95	0.142
Po (n=9)	125.40	0.186
Border (n=7)	116.05	0.214