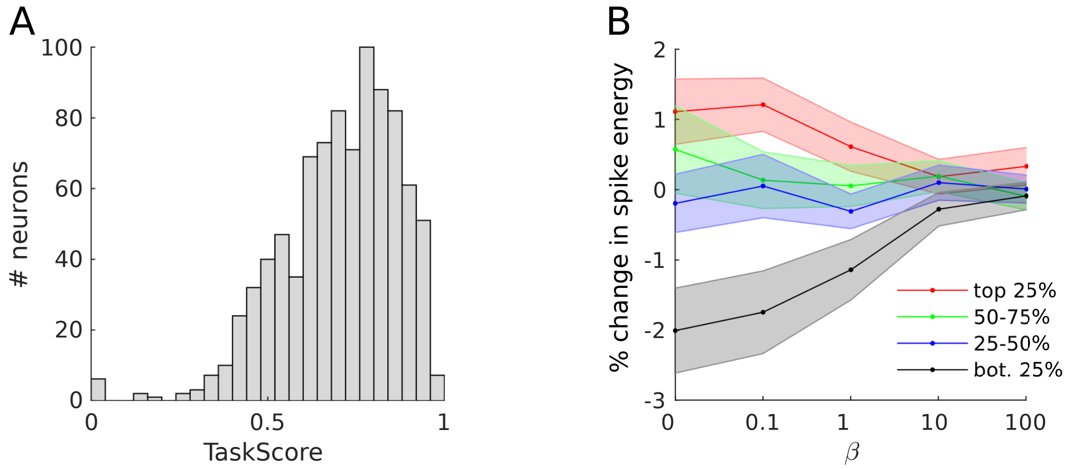

Figure S1: A: TaskScore frequency histogram. B: Mean change in recorded spike energy relative to unmodified CBS. Neurons are grouped via `TaskScore` quantiles. Error bars signify ± 1 SEM.

Prioritizing information-rich neurons

Modified algorithm

In CBS, recording electrodes are selected based purely on the neurons' waveforms, and not on the information content of their spike trains. Our algorithm can be straight-forwardly extended to bias electrode selection towards neurons with greater relevance to a behavioral task or stimulus. We first quantify this relevance with a metric denoted as $\texttt{TaskScore} \geq 0$. For the ith neuron, $\texttt{TaskScore}(i)$ reweights the neuron's contribution to the scatter matrices used in CBS as

$$S_w^\theta \to \sum_{i=1}^{N} \widetilde{\alpha}_i \Sigma_i^\theta \text{ and } S_b^\theta \to \sum_{i=1}^{N} \widetilde{\alpha}_i (\mu_i^\theta - \mu^\theta)(\mu_i^\theta - \mu^\theta)^T,$$

where $\widetilde{\alpha}_i = \alpha_i / \sum_j \alpha_j$ and $\alpha_i = \texttt{TaskScore}(i) + \beta$. $\beta \in [0, \infty]$ is a smoothing parameter that controls how much task-relevance is weighted. If $\beta = 0$, task information dominates selection and the weights are the task scores. When $\beta \to \infty$, we recover the original task-blind score and each neuron is weighted equally.

Experimental validation

We validated this modified selection algorithm on recordings made while the animal performed center-out reaching movements to 7 peripheral targets on a touch screen. For each reach direction, spikes for each neuron were counted in a window from 200 ms prior to and 800 ms following target presentation and averaged across trials. We denote this average spike count for neuron i and reach direction j as $\tau_j(i)$, and set

$$\texttt{TaskScore}(i) := \frac{\max_j \tau_j(i) - \min_j \tau_j(i)}{\max_j \tau_j(i) + \min_j \tau_j(i)}.$$

$\texttt{TaskScore}(i)$ is set to zero if the denominator above is zero. Figure S1A shows the distribution of `TaskScore` values for the neurons studied.

We quantified the modified algorithm's effect on how densely each neuron was monitored by using a normalized spike energy measure. This measure is the sum of the peak-to-peak spike amplitudes for all selected electrodes, divided by the sum of all spike amplitudes on all electrodes. As a neuron is more densely monitored, i.e., as more electrodes surrounding a neuron are selected, the neuron's normalized spike energy approaches 1. We computed the normalized energy for all neurons under different values of β (Fig. S1B). When $\beta = 0$, the top 25% most task-relevant neurons were more heavily monitored, resulting in a 1.1% higher recorded spike energy (p = 0.001, one-sample t-test), whereas task-irrelevant neurons (bottom 25%) were less densely monitored, incurring a 2% decrease in spike energy ($p = 0.018$, one-sample t-test). Interestingly, while statistically significant, the effect of the bias towards task-relevant neurons was relatively small in our data, suggesting that task-blind CBS sufficiently monitors almost all available neurons.