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Supplemental Information

**Cortical cellular encoding
of thermotactile integration**

Philipp Schnepel, Ricardo Paricio-Montesinos, Ivan Ezquerra-Romano, Patrick Haggard, and James F.A. Poulet

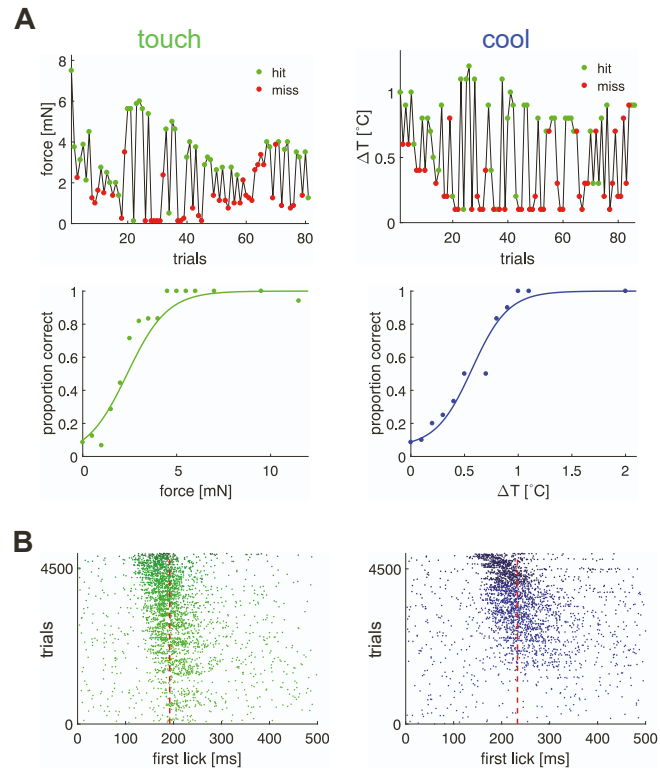


Figure S1. Staircase stimulation procedure during behavioral testing and behavioral latency related to Figure 1

(**A**) Top shows behavioral results from stimulus staircase procedure for an example session from one mouse for both touch and cool stimuli; bottom shows corresponding psychometric curve fit. (**B**) Raster plots showing lick timing across trials for all mice for touch (left) and cool (right) unimodal stimuli. Plots are ordered by stimulus intensity (top strong to bottom weak) and show longer latency for weaker stimuli. Red dotted line denotes median first lick latency.

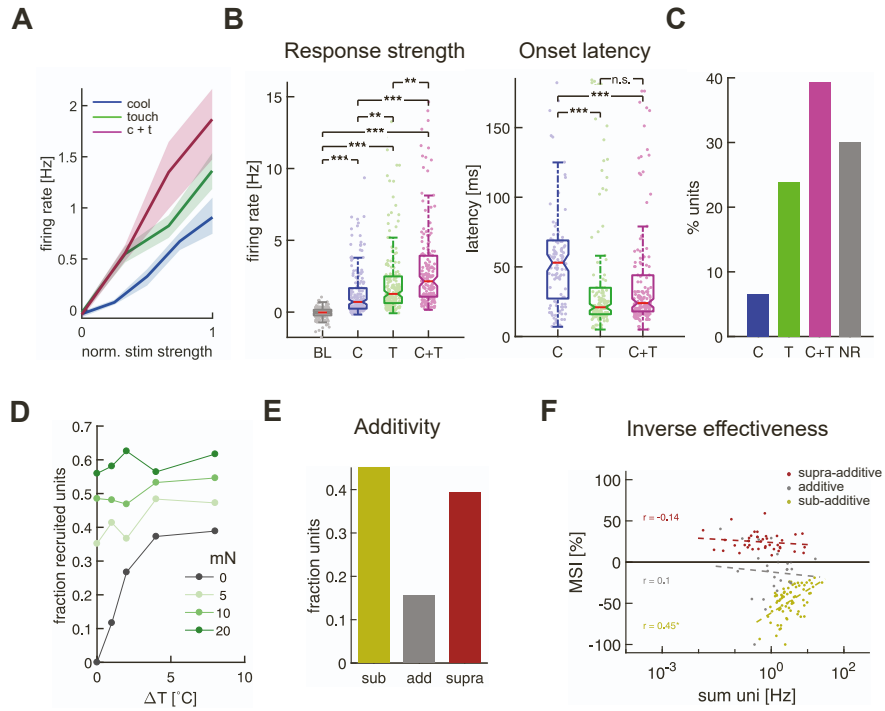


Figure S2. Recruitment and additivity during thermotactile integration are preserved under isoflurane anesthesia, related to Figures 3 and 4

(A) Average firing rate of all responsive units to increasing stimulus intensity for touch (T), cool (C) and cool+touch (C+T) stimulation. (B) Median response strength (left) and onset latency (right) for all responsive units for all stimulus conditions (BL = baseline). Significant differences were determined by multiple comparison testing (Kruskal-Wallis test). (C) Fractions of responsive and unresponsive single units ($n = 259$ total) at maximum intensity stimulation. (D) The fraction of recruited units as a function of stimulus intensity. (E) Fractions of units in different sub-populations show that most units are either sub- or supra-additive. (F) MSI plotted against the arithmetic sum of the corresponding unimodal stimulus response. Inverse effectiveness is estimated by linear fits to the different sub-populations of neurons ($r = 0.3$, $p = 0.14$; $r = -0.14$, $p = 0.37$; $r = 0.45$, $p = 0.0001$ for the additive and supra-/sub-additive populations, respectively).

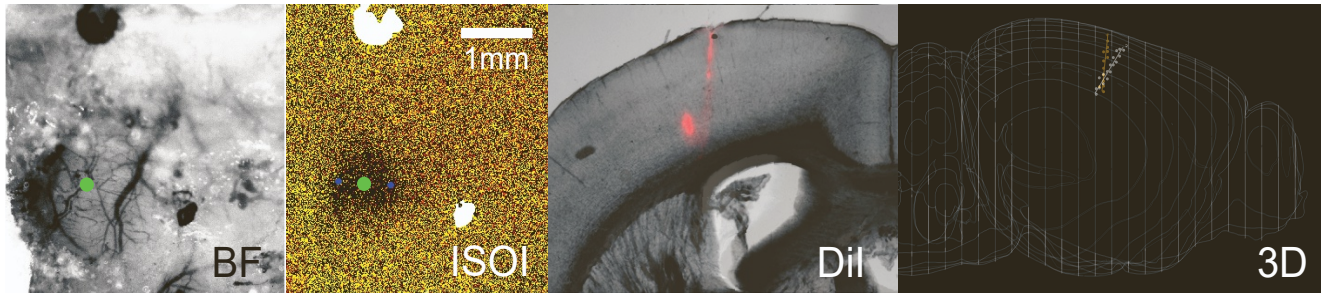


Figure S3. Identification of forepaw S1 and tracking of recording electrode location in an example mouse, related to Figure 2

Panels from left to right: Craniotomy under brightfield (BF) illumination; corresponding intrinsic signal optical imaging (ISOI). Darker area denotes response to tactile stimulation of the forepaw. Green dot denotes the same spot in both panels. (iii) Dil-staining in a horizontal brain slice (100 μm thickness) of two Neuropixel probe tracts and (iv) 3-D reconstruction of both probe trajectories in a normalized mouse brain model (SHARP-track / Allen mouse brain atlas).

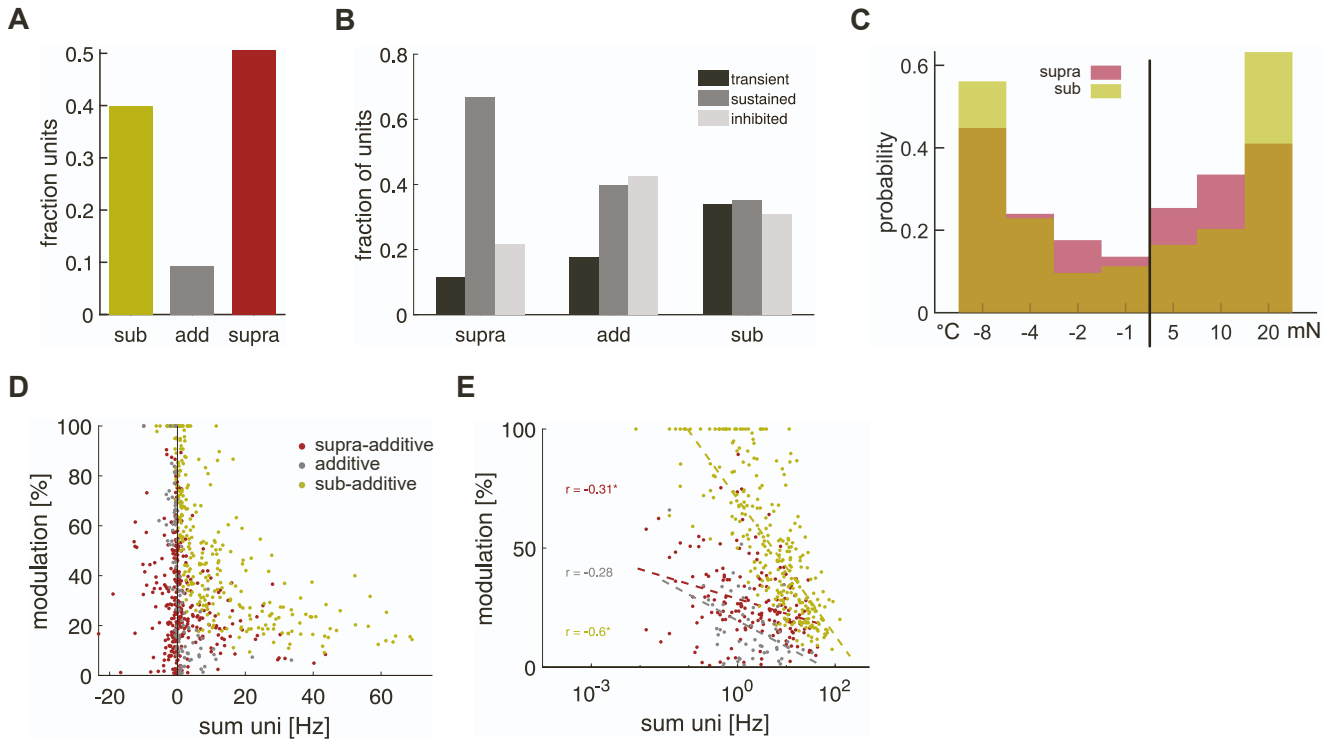


Figure S4. Comparison of additivity sub-populations and absolute response modulation for inverse effectiveness, related to Figure 4

(A) Fraction of excited units in respective sub-populations after additivity analysis. (B) Fraction of units that showed transient, sustained or suppressed response dynamics in each sub-population. (C) Distributions of stimulus combinations that produce 'best' responses during bimodal stimulation for the sub-additive (yellow) and supra-additive (red) population. (D) Absolute modulation (normalized quantification of bimodal enhancement/suppression) plotted against the arithmetic sum of the corresponding unimodal stimulus responses. (E) Same as in D but on a semi-log scale. A linear regression of the data reveals a significant negative correlation (i.e. inverse effectiveness) for both sub- and supra-additive populations, but not for the additive population.

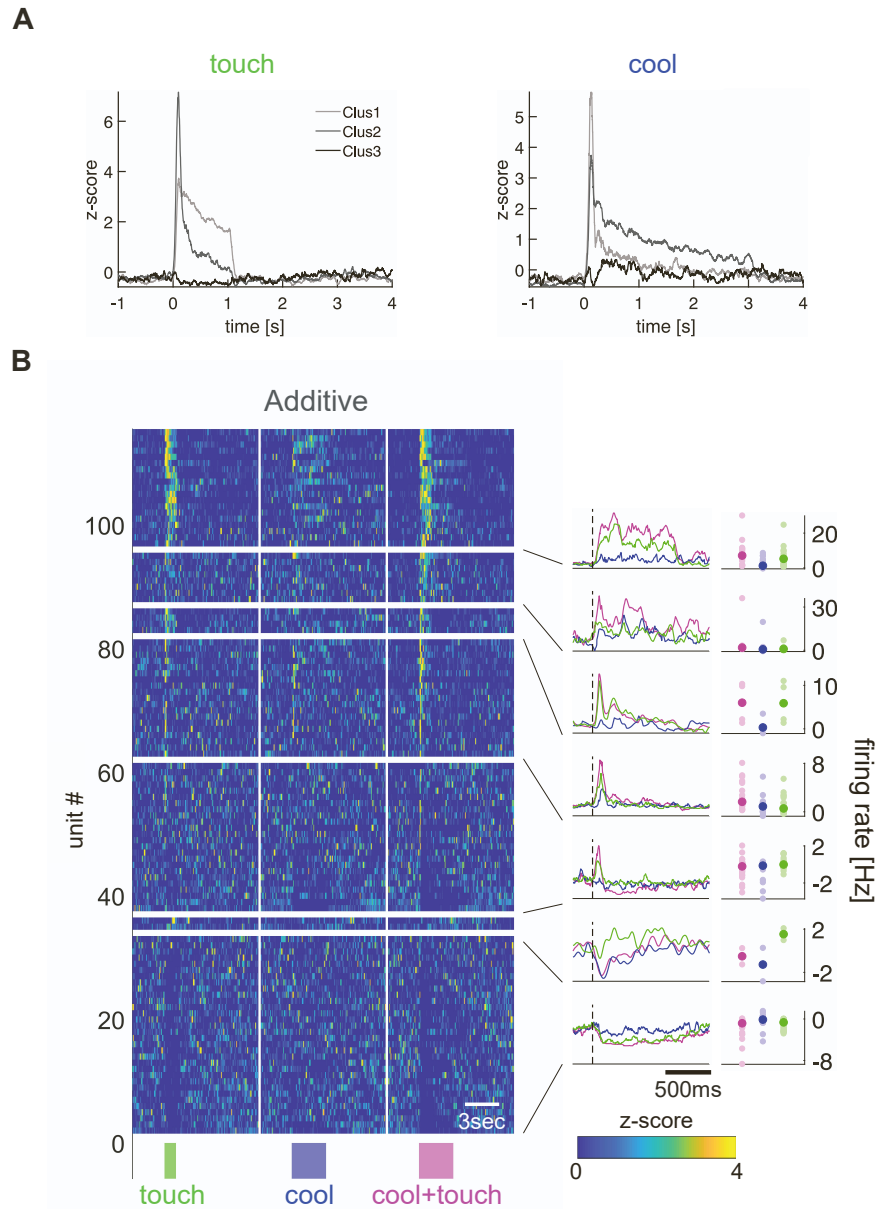


Figure S5. Temporal dynamics and clustering of the additive sub-population, related to Figure 5

(A) Average z-scored responses of sub-clusters after hierarchical 3-by-3 clustering for touch (left) and cool (right). (B) Hierarchical 3-by-3 clustering of ‘best’ bimodal responses of the additive sub-population. Each row shows the concatenated, z-scored responses to touch (left), cool (middle) and cool+touch (right) stimulation for each unit. Clusters are ordered by temporal dynamics of the average cool+touch response (left side panels) from sustained over transient to no inhibited/unresponsive. Within each cluster, units are ordered by peak response strength in the cool+touch condition. Right side panels show the median responses from 0-1200ms of each cluster. There were no significant differences between conditions.

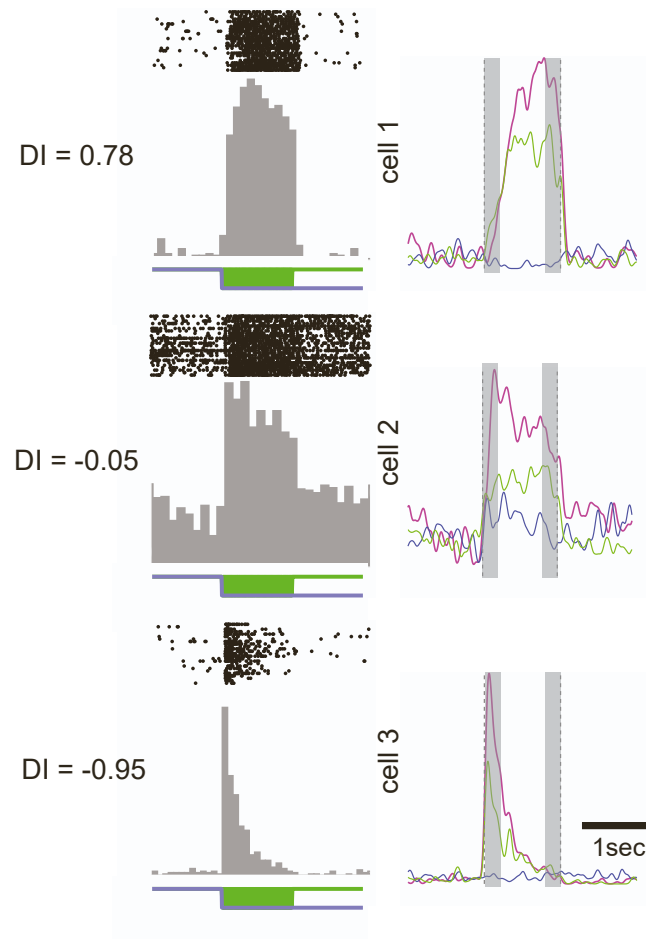


Figure S6. Example units with different duration indices, related to Figure 6

Left, PSTHs and raster plots for example units with different duration indices (DI). Right, early and late response phases for the same cells are marked with gray bars in the KDE-plots.