Differential representation of auditory categories between cell classes in primate auditory cortex

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Supplemental Material:

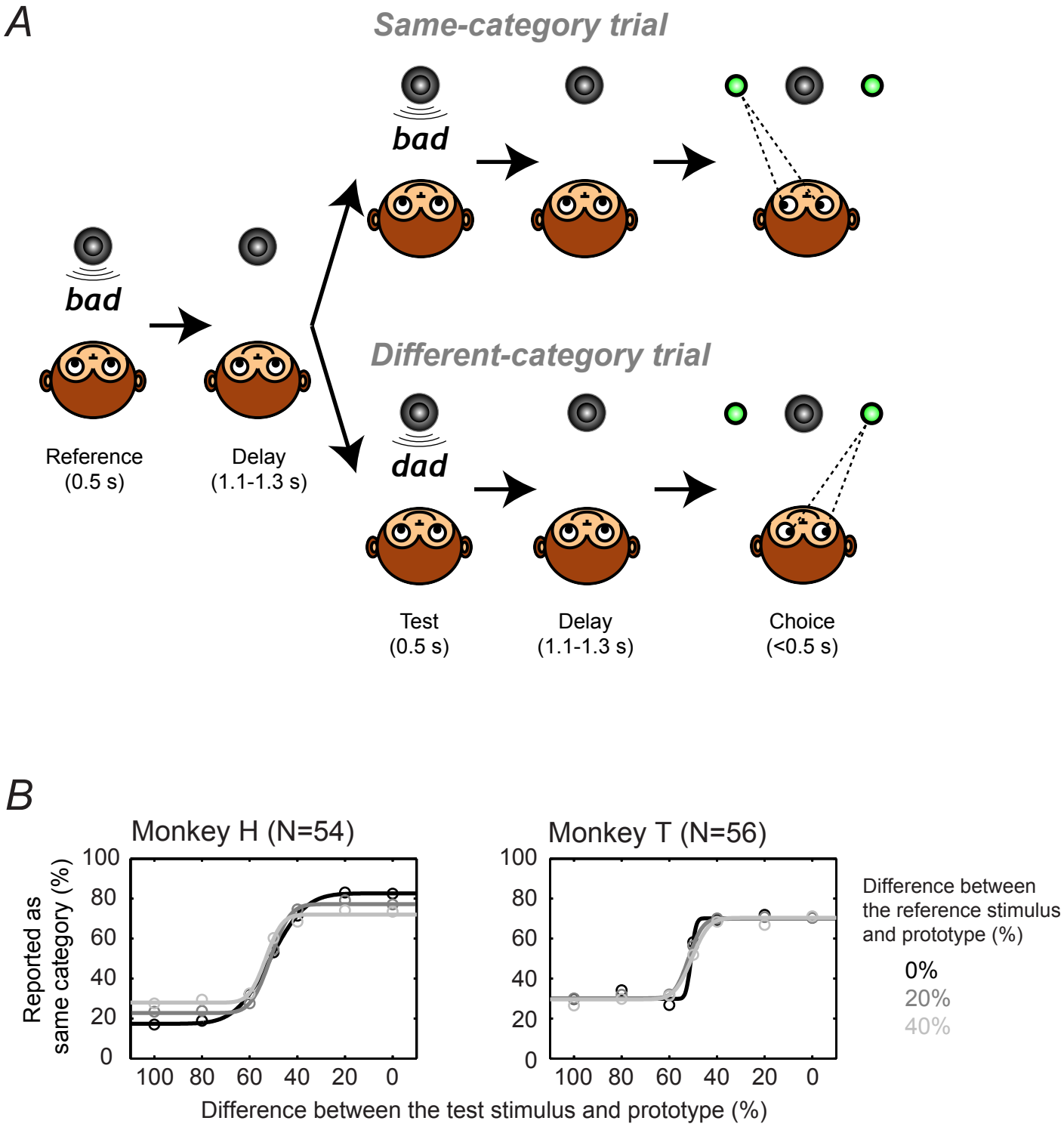

Figure S1: Match-to-category task and behavioral performance. (***A***) Following the presentation of a reference stimulus, a test stimulus was presented. The auditory stimuli consisted of two prototype spoken words (*bad* or *dad*) and linear morphs between these two prototypes. *Bad* was operationally defined as the 0% morph, whereas *dad* was defined as the 100% morph. The reference stimulus could be either of the prototypes or any of the morphs except for the 50% morph. The test stimulus could be any of the auditory stimuli. When the reference and test stimuli belonged to the same category, the monkeys made a saccade to the left LED; the monkeys' eye positions are indicated by the dotted lines. When the reference and test stimuli belonged to different categories, the monkeys made a saccade to the right LED. (***B***) Psychophysical performance of monkey H (left panel) and monkey T (right panel) from all of the experimental sessions in which we recorded auditory neurons. The data in black were generated from those trials when the reference stimulus was one of the two prototypes (i.e., the 0% and the 100% morphs). The data in dark grey were generated from those trials when the reference stimulus was 20% different from the two prototypes (i.e., the 20% morph and the 80% morphs). The data in light grey were generated from those trials when the reference stimulus was 40% different from the two prototypes (i.e., the 40% morph and the 60% morphs). In order to plot the data from these pairs of reference-stimulus morphs (i.e., the 0% and 100% morphs; the 20% and 80% morphs; and the 40% and the 60% morphs) on the same x-axis, we calculated the absolute distance ("difference") between the test stimulus and the prototype that was closest to the preceding reference stimulus. The circles represent the percentage of trials that the monkey reported that the reference and test stimuli belonged to the same category as a function of the test stimulus. The data were fit (solid line) with a cumulative Gaussian function. More details about the monkeys behavior can be found in Tsunada et al. (2011).

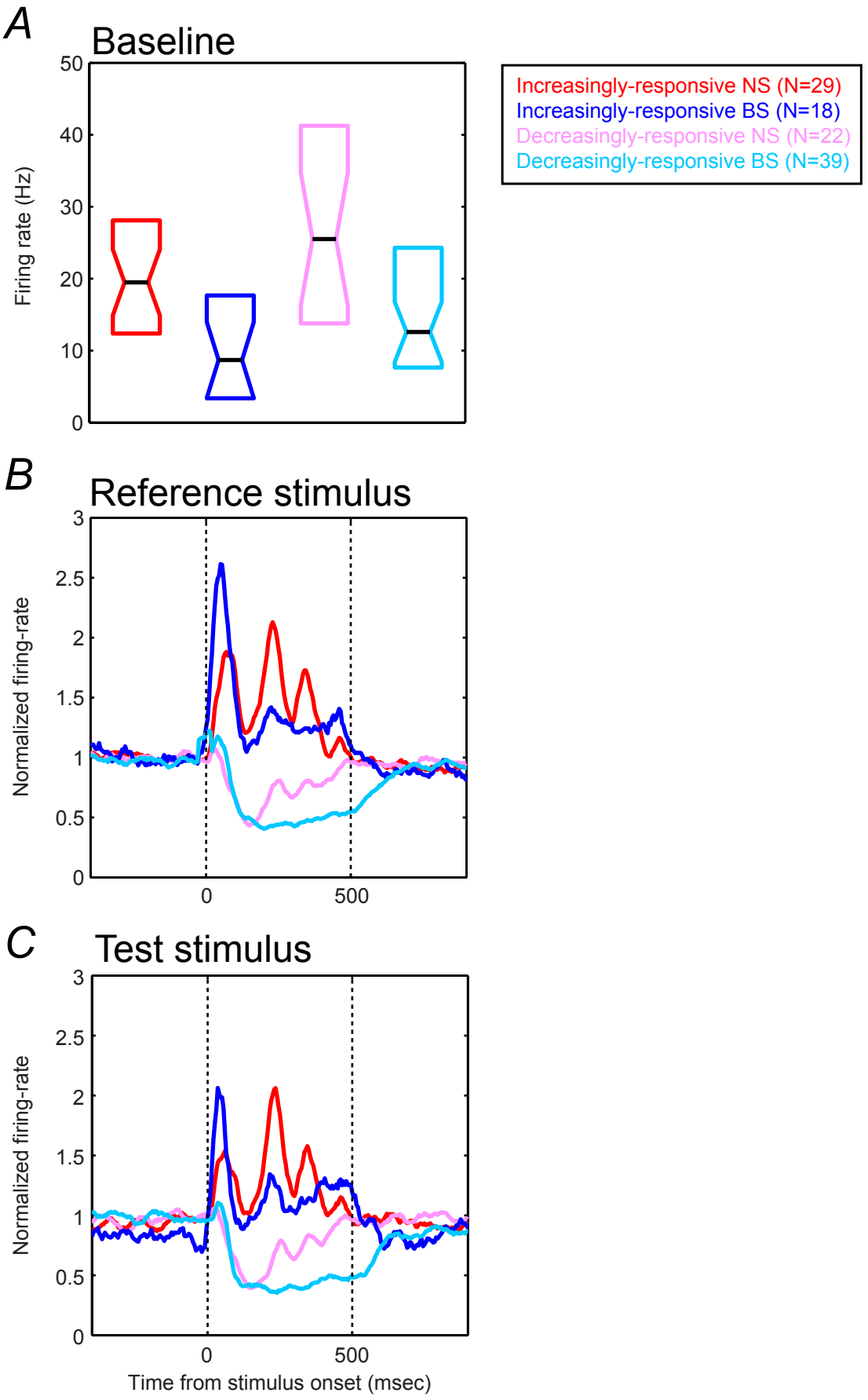

Figure S2: Properties of each type of neurons at the population level. (***A***) The baseline firing rates of increasingly- and decreasingly-responsive NS and BS neurons. The notches indicate the median. The boxes indicate the lower quartile and upper quartile values. The baseline firing rate was reliably different between cell classes (Friedman test for cell class [NS neurons versus BS neurons] and response type [increasingly responsive versus decreasingly responsive] as factors, $p < 0.05$ for both factors). The normalized firing rates of increasingly- and decreasingly-responsive BS and NS neuronal populations during (***B***) the reference-stimulus period and (***C***) the test-stimulus period. The baseline normalization was performed by dividing the stimulus-period firing rate by the mean baseline firing rate. For panels ***B*** and ***C***, the two vertical dotted lines indicate stimulus onset and offset, respectively.

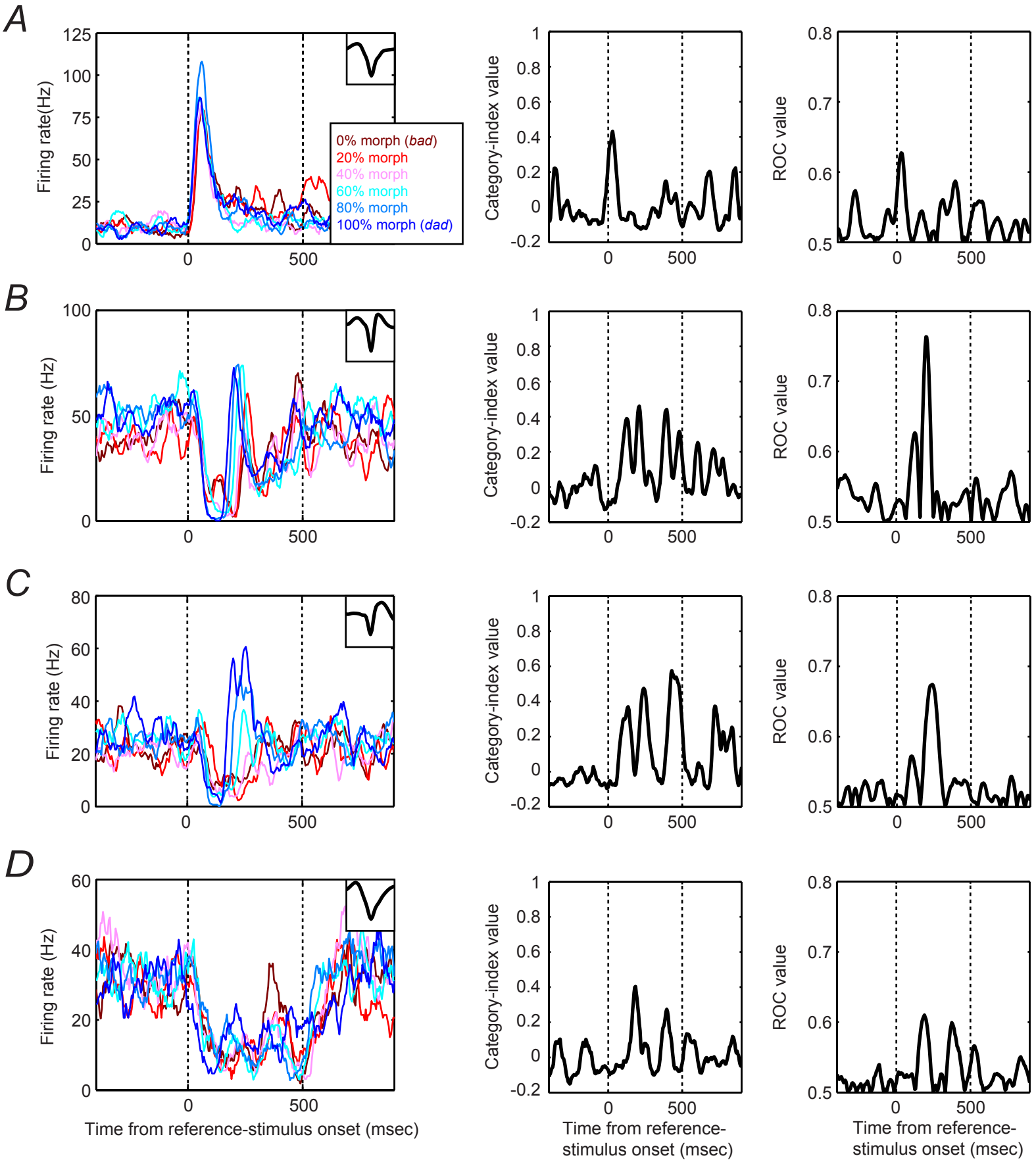

Figure S3: Neural responses of (*B, C*) NS neurons and (*A, D*) BS neurons during presentations of the reference stimulus. Unlike the neurons shown in Figure 2 in the main text, the firing rates of the neurons in panel *B, C, D* were decreased by the reference stimulus presentation. The data in the left column show the mean firing rates as a function of the reference stimulus. The inset in the upper graph of each plot shows the neuron's waveform. The middle column shows each neuron's category-index values as a function of time. The right column shows ROC values as a function of time. For all of the panels, the two vertical dotted lines indicate stimulus onset and offset, respectively.

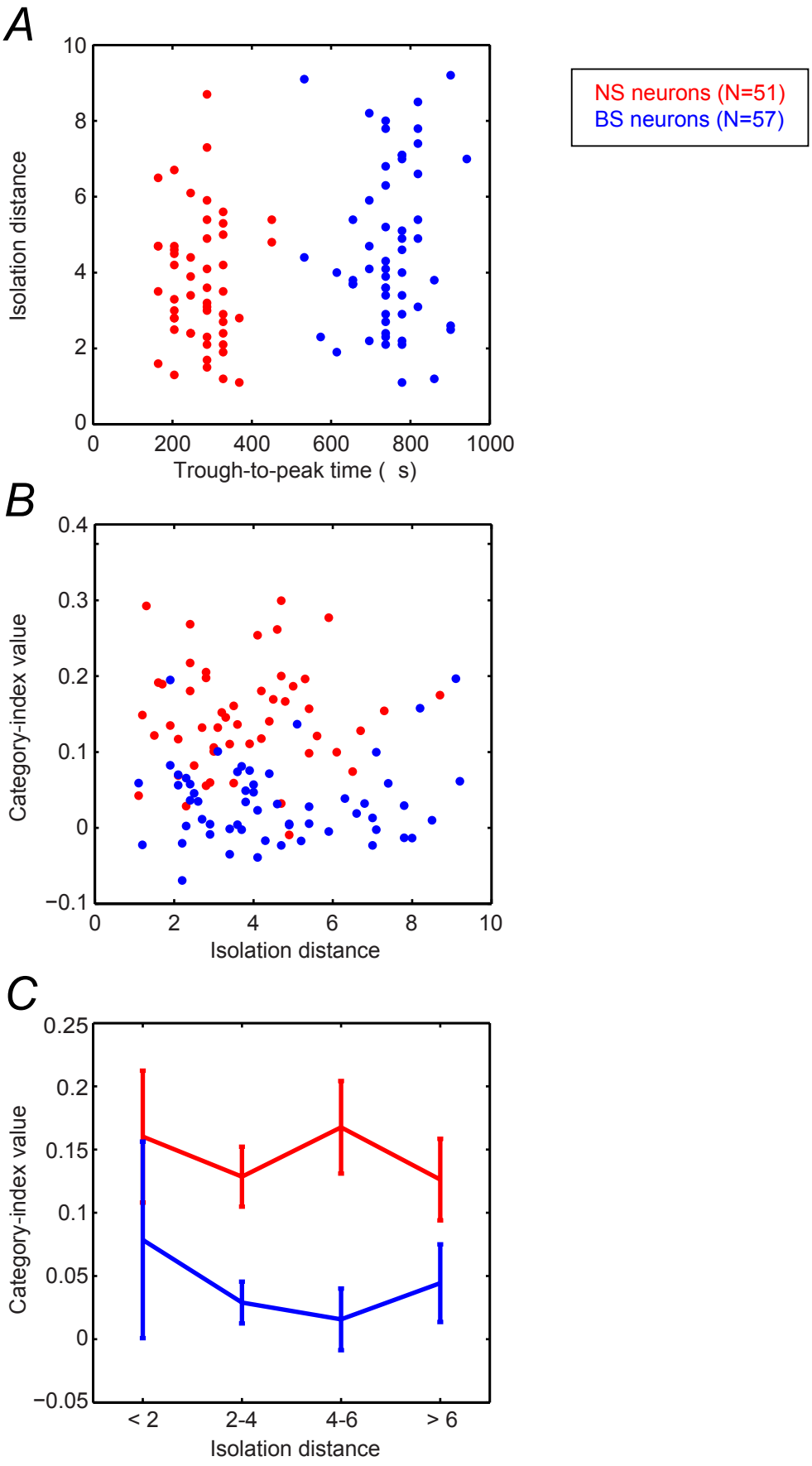

Figure S4: Effects of the quality of the isolation on spike trough-to-peak times and category-index values. (***A***) The relationship between the trough-to-peak time and the isolation distance. Red: NS neuron (N=51); Blue: BS neuron (N=57). (***B***) The relationship between the isolation distance and the category-index value. (***C***) The effect of the isolation diatance on the category-index value for NS neurons (red) and BS neurons (blue). The error bars indicate bootstrapped 95% confidence intervals. Even when we controlled for the isolation distance, the category-index value of NS neurons was still reliably greater than that of BS neurons (two-way ANOVA with cell class [NS neurons versus BS neurons] and isolation distance [< 2, 2-4, 4-6, > 6] as factors, $p < 0.05$ for cell class).

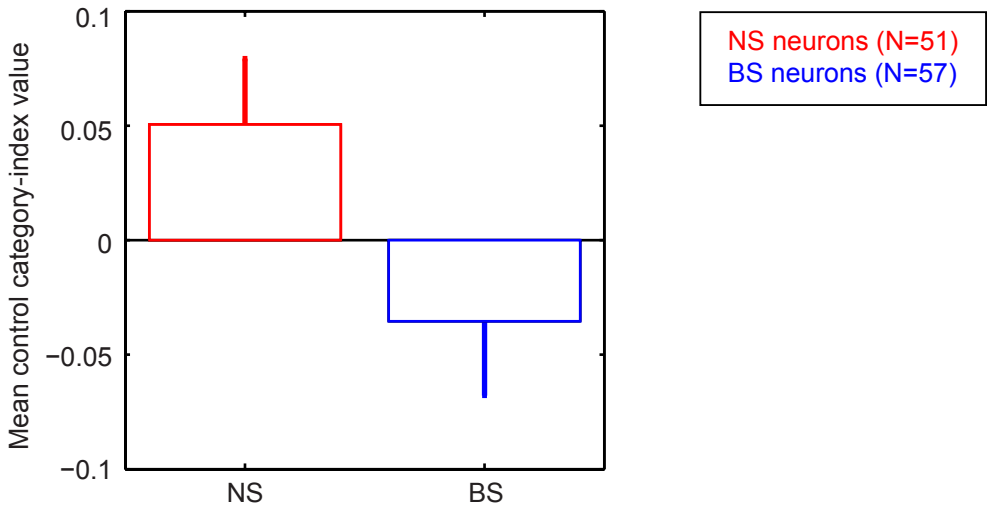

Figure S5: Control analysis for category index. Population mean control category-index values during presentations of the reference stimulus were shown. To calculate the category-index values, we used absolute differences in firing rate between the 20% and 60% morphs and between the 40% and 80% morphs as between-category differences and absolute differences in firing rate between the 0% and 40% morphs and between the 60% and 100% morphs as within-category differences. NS neurons showed greater category-index values than NS neurons (*t*-test, $p < 0.05$). Error bars indicate bootstrapped 95% confidence interval.