APPENDIX II

Attractors in the representations of odors in the antennal lobe have sharp boundaries

Sufficiently similar inputs to the olfactory system lead to equal behavioral responses, and thus presumably to equal neural responses at some level. This means that the time-varying responses to odors must act as dynamic attractors in neural dynamics space. An open question in olfactory research is what the shape of the basins of attraction that lead to the various dynamic attractors coding for odors in the antennal lobe is. A preliminary investigation of intracellular recordings of PNs during presentation of odors at varying concentrations as well as binary mixtures in various proportions revealed sharp transitions in odor responses with minute changes in odor composition and concentration. These changes were equally abrupt in spike rasters and intracellular voltage traces, suggesting the non-linearities were not the result of PN firing thresholds. These results suggest that the basin of attraction for the representation of an odor in the antennal lobe has sharp boundaries in composition and concentration space.

To test the extent to which projection neurons respond to mixtures of components to which they are responsive, and more importantly, the shape of the transition in response patterns as a mixture is morphed from one odor to another, I recorded intracellularly from individual projection neurons in the antennal lobe while delivering various ratios of binary mixtures. What I found was quite surprising. Rather than exhibiting gradual transformations between one odor's representation and another's as their relative concentrations was varied systematically, PN response patterns often displayed abrupt transitions in concentration space (Fig. II.1-II.2) and blend composition space (Fig. II.3-II.4). The abruptness of the changes in response patterns as concentration was changed was present both in extracellular (Fig. II.1) and intracellular traces (Fig. II.2), indicating that the nonlinearity of response patterns is not due to the firing threshold.

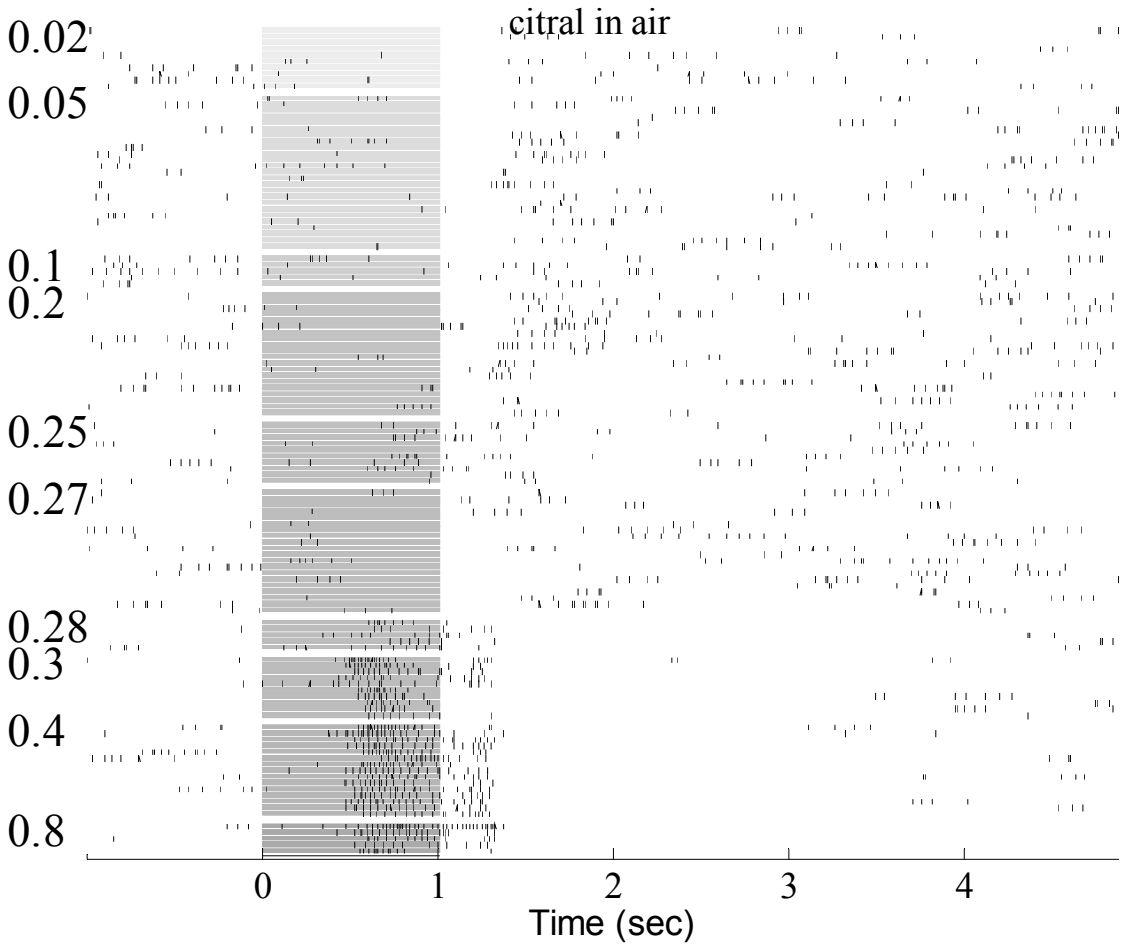

Figure II.1. A PN's response to citral has an abrupt response threshold between 27 and 28% of saturated vapor pressure.

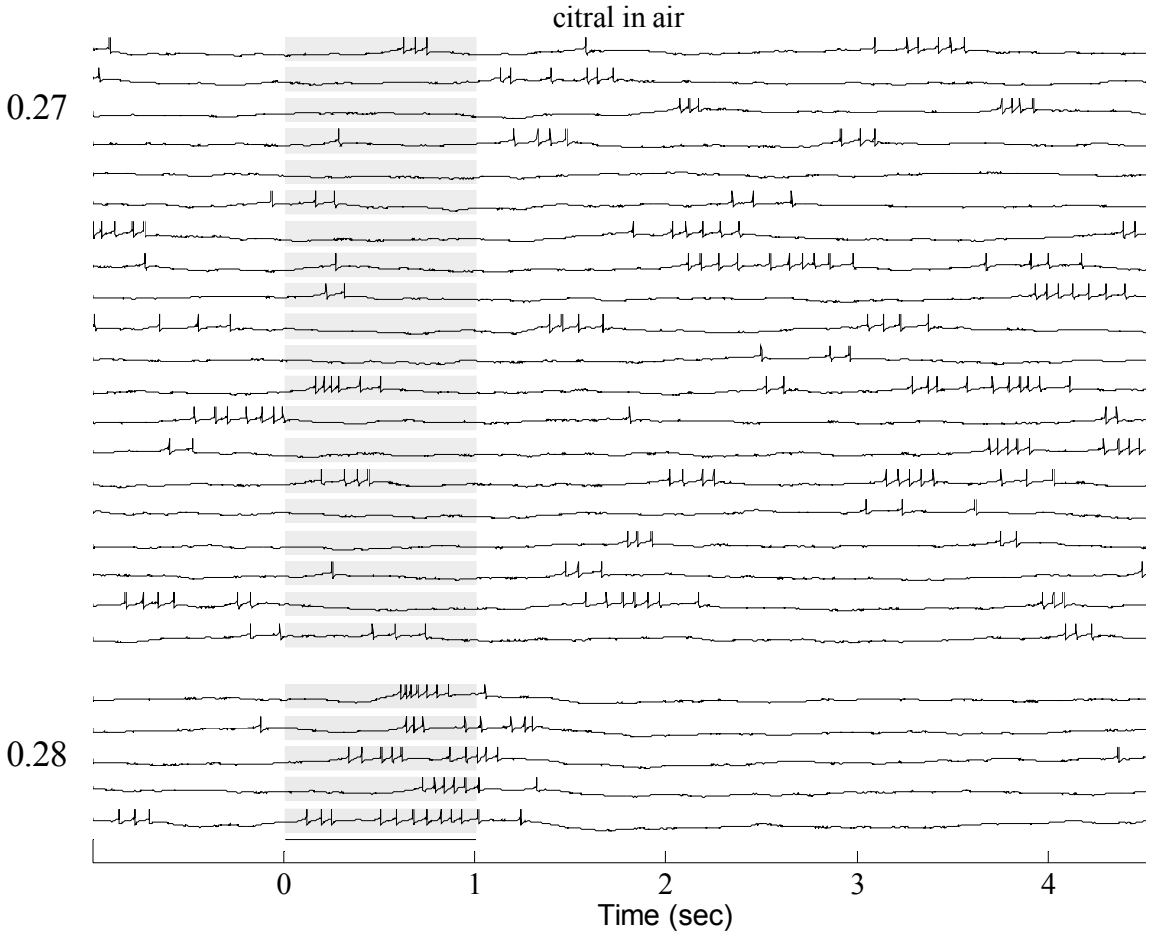

Figure II.2. Intracellular recordings of the same PN as in Fig. I.1 reveals no subthreshols response to the threshold deemed subthreshold with spike rasters.

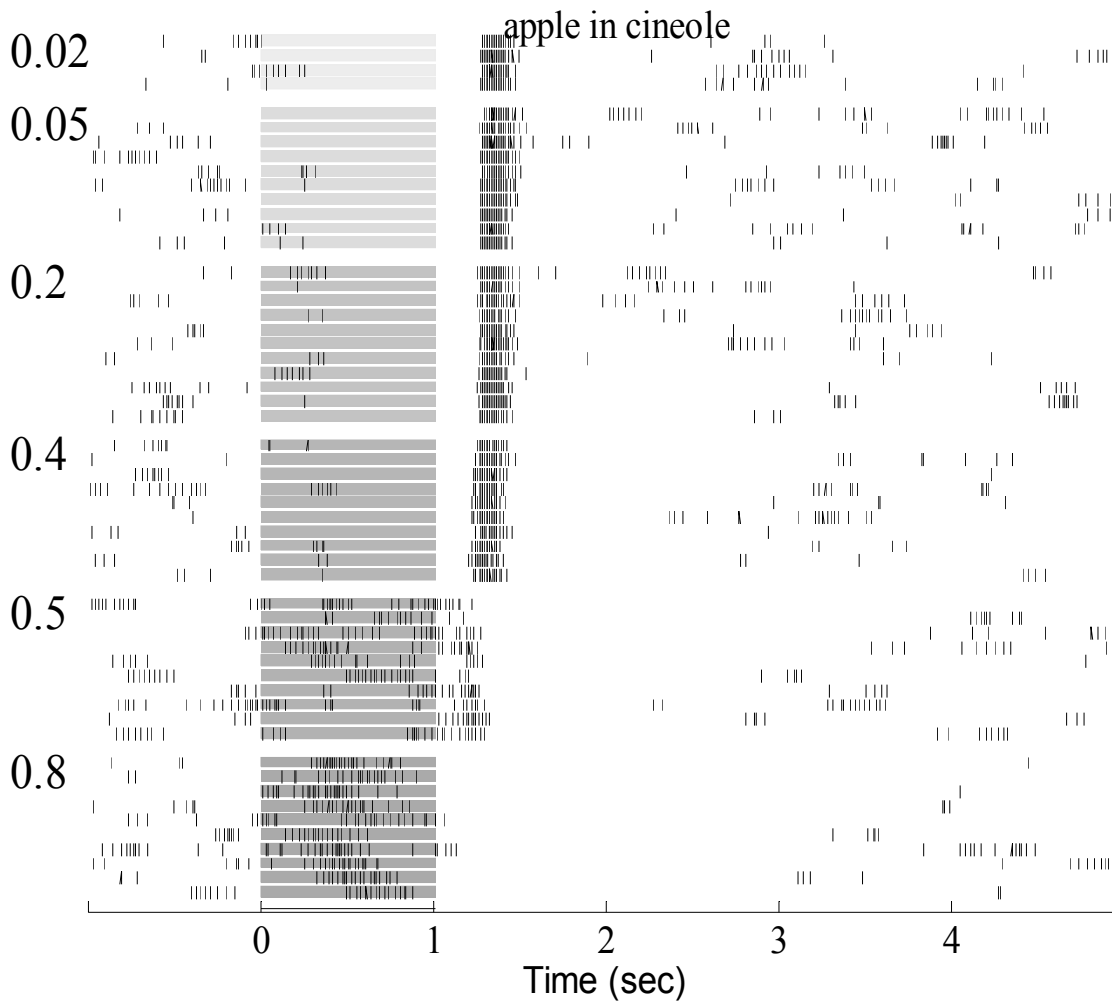

Figure II.3. PN responses exhibit abrupt transitions as a function of mixture composition. Odor mixtures were presented from t=0 to 1 sec.

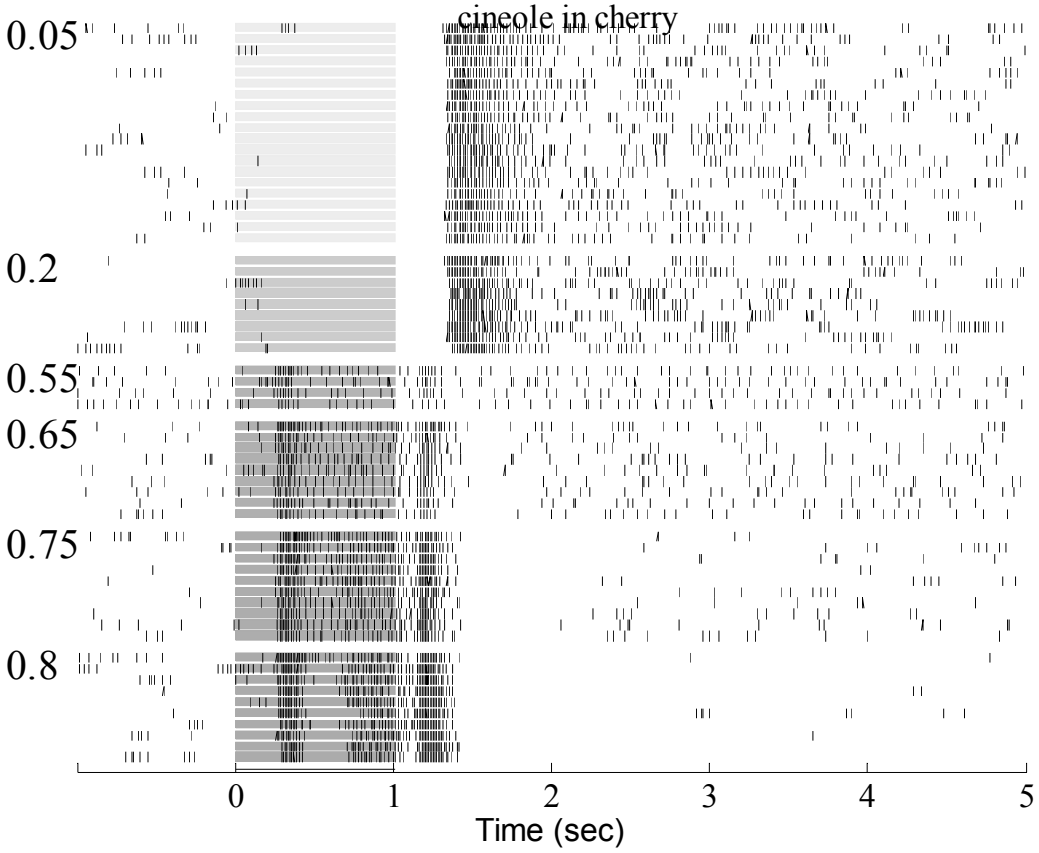

Figure II.4. PN responses exhibit abrupt transitions as a function of mixture composition. A different PN from that in Fig. II.3 is shown. Odor mixtures were presented from t=0 to 1 sec.