

EFFECTS OF BACKGROUND STIMULI ON ODOR DETECTION THRESHOLDS

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Abstract

The ability of humans to distinguish odors is diminished when stimuli are presented in multi-component mixtures (Livermore & Laing, 1996; Goyert et al, 2007). In the present study, we use psychometric functions (Cometto-Muñiz et al, 2008) to study odor mixture suppression. Solutions containing 1, 2 and 3 component combinations of vanillin, l-menthol, and phenethyl alcohol were presented to 18 subjects. Increasing concentrations of vanillin, 0.0001 mM to 1 mM in $\frac{1}{2}$ log steps, were used to determine the detection threshold (ODT) for the vanilla odor. For each concentration, 5 presentations of vanillin were randomized among 5 water controls. The concentration at which correct identification was 75% (midway between chance, 50% and perfect performance, 100%) was defined as threshold. The data were fitted to a 4-parameter sigmoidal function by Sigmaplot and changes in thresholds evaluated by ANOVA. Addition of near-threshold background stimuli to mixtures affected detection of the vanillin component. With the exception of vanillin + l-menthol, the vanillin ODT within mixtures increased by 1 log unit (vanillin + phenethyl alcohol, $p=0.0001$; vanillin + phenethyl alcohol + l-menthol, $p=0.0001$). Thus, the threshold for detection of the vanilla odor increased in the presence of a background containing the rose odor, which we suggest results from competitive mutual suppression between olfactory-bulb glomeruli responding to different stimuli. The mint background odor did not affect the vanilla threshold, which may relate to the intensity or quality of menthol. The background concentration (.03 mM) was further above the threshold for rose than for mint, giving rose a quantitative advantage in the inhibition of vanilla. Menthol elicits a cool sensation through stimulation of the trigeminal nerve. It remains to be tested whether stimuli with a trigeminal component behave differently from pure olfactory stimuli in mixtures.