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Genetic and demographic influences on odor perception

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Variation in odor perception is well-documented in the human population. Factors such as ancestry, age, gender, and olfactory receptor (OR) genetics influence perception, but the relative contribution of these factors to the perception of individual odors has only been minimally investigated. We examined the contribution of demographic and genetic factors to 276 different olfactory phenotypes in 332 subjects. We first examined the association between the perceived intensity and valence of 68 odors and the genotype of over 400 ORs and found that variation in a single OR frequently associates with odor perception. Using a cell-based luciferase assay, we demonstrate 7 novel cases in which
subjects with non-functional OR haplotypes tend to rate the associated odor to be less intense or more pleasant than subjects with a more functional haplotype. For example, genetic variation in OR11A1 explains a large portion of variance in the perceived intensity of 2-ethylfenchol ($r = 0.36$, $p < 0.001$), and subjects with genetic changes that reduce response to 2-ethylfenchol in vitro rated its intensity of to be lower than subjects with a functional haplotype ($F(3,325) = 13.08$, $p < 0.001$). For some olfactory phenotypes, ancestry is more predictive than the genotype of a particular OR. The perceived valence of vanillin significantly correlates with ancestry ($r = -0.28$, $p < 0.001$), in part driven by the fact that self-reported Caucasians rate it as more pleasant relative to African-Americans ($t(150)=-4.35$, $p < 0.001$). We also find that age and sex contribute to variation in olfactory perception to varying degrees. The perceived intensities of nonanal and linalool negatively correlate with age ($r = -0.25$, $p < 0.001$ and $r = -0.23$, $p < 001$, respectively), while the perceived intensity of terpineol is significantly higher in males relative to females ($t(288)=-3.40$, $p = p< 0.001$). By building a model with all four genetic and demographic factors, we are able to explain between 10 and 20% of the variance in 14 different odor perception phenotypes.

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