## Supplementary method 1: Sex differences of the odor-color responses.

We used Bayesian multilevel regression models to estimate the sex differences of color responses using odor-level effects. The response value of a\*-axis for the associated colors was modeled by each odor as a normal distribution as follows:

$$a\_{m\left[j\right]}^{\*}\~ Normal\left(α\_{m\left[i\right]}, σ\_{ma\left[i\right]}\right)$$

$σ\_{ma[i]}$ > 0

$$a\_{f[j]}^{\*}\~ Normal(α\_{f[i]}, σ\_{fa[i]})$$

$σ\_{fa[i]}$ > 0

where *i* indicates the odor ID and *j* denotes the data index. $a\_{m\left[j\right]}^{\*}$ indicates the responses from male participants, and $a\_{f\left[j\right]}^{\*}$ were from female participants. Each coefficient followed a normal distribution with mean coefficients as follows:

$$α\_{m[i]} \~ Normal(α\_{m0} , σ\_{ma0})$$

$$α\_{f[i]} \~ Normal(α\_{f0} , σ\_{fa0})$$

$σ\_{ma0}$ > 0

$σ\_{fa0}$ > 0

where $α\_{m0}$ and $α\_{f0}$ indicates the average coefficients across all odorants in male and female participants.

The differences between sex were calculated from the estimated parameters as follows:

 $$∆α\_{mf0}= α\_{m0}- α\_{f0}$$

$$∆α\_{mf[i]}= α\_{m[i]}- α\_{f[i]}$$

with $∆α\_{mf[i]}$ indicating the coefficient differences in *i*th odor, and $∆α\_{mf0}$ indicating the main effect of sex across all odors.

Regarding the model for a\* value estimation, we modeled the b\*- axis values as follows:

$$b\_{m\left[j\right]}^{\*}\~ Normal\left(β\_{m\left[i\right]}, σ\_{mb\left[i\right]}\right)$$

$σ\_{mb[i]}$ > 0

$$b\_{f[j]}^{\*}\~ Normal(β\_{f[i]}, σ\_{fb[i]})$$

$σ\_{fb[i]}$ > 0

$$β\_{m[i]} \~ Normal(β\_{m0} , σ\_{mb0})$$

$$β\_{f[i]} \~ Normal(β\_{f0} , σ\_{fb0})$$

$σ\_{mb0}$ > 0

$σ\_{fb0}$ > 0

$$∆β\_{mf0}= β\_{m0}- β\_{f0}$$

$$∆β\_{mf[i]}= β\_{m[i]}- β\_{f[i]}$$

Similar to the steps with a\* and b\*, we model the L-axis values as follows.

$$L\_{m\left[j\right]}^{\*}\~ Normal\left(λ\_{m\left[i\right]}, σ\_{mL\left[i\right]}\right)$$

$σ\_{mL[i]}$ > 0

$$L\_{f[j]}^{\*}\~ Normal(λ\_{f[i]}, σ\_{fL[i]})$$

$σ\_{fL[i]}$ > 0

$$λ\_{m[i]} \~ Normal(λ\_{m0} , σ\_{mL0})$$

$$λ\_{f[i]} \~ Normal(λ\_{f0} , σ\_{fL0})$$

$σ\_{mL0}$ > 0

$σ\_{fL0}$ > 0

$$∆λ\_{mf0}= λ\_{m0}- λ\_{f0}$$

$$∆λ\_{mf[i]}= λ\_{m[i]}- λ\_{f[i]}$$

The models were fitted using the R environment (ver.3.4.0) and RStan (ver.2.2.1) with the Markov chain Monte Carlo (MCMC) method. All estimates were made with 3,000 samplings, running four chains to generate random numbers, and a burn-in period of 1,000. We used the Gelman-Rubin statistics $\hat{R}$ to determine if the MCMC estimation converged for all estimation parameters. $\hat{R}$ is generally considered to converge as it approaches 1.10, and each model fit produces $\hat{R}$ <1.10.

The mean differences and their 95% CI of main effects and odor-level differences were estimated using these multilevel models. The posterior distribution and its 95% CI for sex differences did not include 0. These results indicated that the color responses were not significantly fluctuated between sex groups in response to any odorant.