Olfactory power law exponents and water solubility of odorants: A comment on Cain's (1969) study

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Cain (1969) compared the exponent of the power law for olfactory intensity from seven chemicals of a diverse chemical nature and found that the more water soluble the substance, the higher the exponent. This correlation held under two methods of stimulus presentation; olfactometric methods produced higher exponents than from sniffing at cotton wool soaked in odorant, but the relative values of the exponents remained unchanged. Cain gives no variance measures for his group exponents, nor is he completely clear how these were obtained. He stated that certain of his data points "exhibited excessive variability," and that there was "variability in the exponents yielded by individual Os." This being the case, it would have seemed incumbent on Cain to display the robustness of his assertions by some statistical justifications. Cain cited Jones's (1958) results for six odorants, which followed the same trend as his own, but again, no individual measures were available for differences between chemicals to be checked statistically.

A number of studies have emerged from this laboratory, citing individual exponents, or variability thereof, these measures having been obtained by a least-squares linear regression of $\log \psi$ on $\log \phi$. Using an Ough and Stone (1961) olfactometer, Gregson et al (1969) and Mitchell and Gregson (1968, 1970) have not been able to support Cain. They have found that for eugenol, a chemical of very low water solubility, exponents can

range from 0.55 to 0.96 (which is higher than the highest value he quotes for water-soluble substances) with *apparent* dependence upon factors such as scaling method, form of response mode, anchor stimulus intensity, explicitness of anchor, stimulus range, number of stimuli, and others. The adjective "apparent" is used advisedly here, since the wide individual differences in exponents ($SD > 0.3$ for most groups) rendered statistical tests insignificant. The only dependent variable shown to have a consistent influence on exponents was the level of masking odor (Mitchell & McBride, 1970, in press); exponents for eugenol decreased (to 0.14) as the level of masking odor (n - propanol) increased. Mitchell and Gregson (in press) have compared exponents for eugenol with water-soluble propanol in a repeated-measures study which tested 20 Os on four separate occasions, twice with eugenol and twice with propanol; all other things were held as equal as possible. The means of the individual exponents in each group were almost identical (0.65 and 0.63 for eugenol, 0.63 and 0.63 for propanol, with SDs ranging from 0.33 to 0.39); no differences were found between the substances.

Berglund et al (1970) have published what is perhaps the most telling evidence against Cain. They obtained exponents for 28 different chemicals of widely varying physicochemical and psychological (qualitative and hedonic) attributes. They found a very low correlation (0.27)

between group exponents and water solubility. It would appear that Cain's generalization cannot be extended from the small number of odorants he tested; his high correlation between group exponents and water solubility was very likely coincidental.

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