Smell Identification Ability: Changes with Age

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Abstract. Smell identification ability was measured in 1955 persons ranging in age from 5 to 99 years. On the average, women outperformed men at all ages, and nonsmokers outperformed smokers. Peak performance occurred in the third through fifth decades and declined markedly after the seventh. More than half of those 65 to 80 years old evidenced major olfactory impairment. After 80 years, more than three-quarters evidenced major impairment. Given these findings, it is not surprising that many elderly persons complain that food lacks flavor and that the elderly account for a disproportionate number of accidental gas poisoning cases each year.

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after the seventh (11). That this drop is unlikely the result of changes in memory, per se, is suggested by a study of 47 elderly subjects, whose scores on this test were not significantly correlated with those on the Wechsler Memory Scale (even though, individually, each of these measures was negatively correlated with age) (12).

The changes in smell identification scores with age resemble changes seen in perceptual measures from several other major sensory systems. For example, peak performance occurs in a number of measures of visual and auditory function in the third and fourth decades of life, with subsequent declines commonly following the general pattern seen in Fig. 1 (13–15). A comparison of the present data with those from suprathreshold measures of vision and hearing is presented in Fig. 2. Despite the likelihood of different physiological bases for these changes, the quality of suprathreshold sensory perception diminishes similarly in these three senses in the later years. This is not surprising if one views the senses functionally as interactive systems for extracting environmental information, rather than as solely independent entities (16).

Although superior female performance has been noted in a number of earlier odor identification studies (17), the present results reveal that the sex difference is present within all age categories, including prepubertal ones. This finding is in accord with reports that prepubertal girls outperform prepubertal boys on a number of odor detection tasks (18), and throws into question the widely held notion that sex differences in olfactory perception are due to differences in concurrent levels of circulating gonadal hormones (19). Similar sex differences have been noted in vision, audition, touch, and kinesthesis (20).

As in most sensory systems, the anatomic and physiologic bases for the age-related changes in smell ability are probably multiple, interacting, and complex. Although the causes of the changes are not known, there is strong circumstantial evidence that degenerative processes within the olfactory epithelium may be involved. Histological studies of human and rodent olfactory epithelia and olfactory bulbs reveal striking differences between old and young specimens (21), and viruses and chronic inflammatory nasal diseases are known to adversely affect olfactory receptors (22). Anosmia due to upper respiratory infection of viral origin occurs more often in clinic patients over the age of 50, suggesting that the olfactory epithelium of older individuals may be less resistant to viral attack (23).

In addition to damage to the olfactory receptor epithelium, changes in more central neural pathways may also contribute to age-related decreases in olfac-

tory function. Such a hypothesis gains support from studies demonstrating relations between aging and behavioral events correlated with the activity of specific neurotransmitters (for example, arousal, attention, and memory) (24), and recent evidence that scores on the smell identification test used in this study are significantly correlated, in Korsakoff’s psychosis patients, with cerebral spinal fluid levels of a major metabolite of norepinephrine (7).

Regardless of the neuroanatomical bases of these changes, the data strongly suggest that large numbers of elderly persons have major dysfunction of the olfactory sense. Indeed, these data reveal that (i) more than 80 percent of the persons tested over the age of 80 years evidenced major olfactory impairment, with nearly 50 percent being anosmic, and (ii) more than 60 percent of the persons tested aged between 65 and 80 years evidenced major olfactory impairment, with nearly a quarter being anosmic (25). Given these findings, it is not surprising that many elderly persons complain that their food lacks flavor (26). Aside from influencing food intake and nutrition (27), decreased smell function undoubtedly compromises the ability of this expanding segment of society to detect and avoid life-threatening fires and gas leaks in the home (28).

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10. H. Scheffe, The Analysis of Variance (Wiley, New York, 1959). Incomplete information precluded inclusion of data from 29 subjects. In the regression equation, age in years appeared as a cubic polynomial (linear coefficient = 0.598, $t = 12.83$, $P < 0.001$; quadratic coefficient $= -0.0126$, $t = -10.23$, $P < 0.001$; cubic coefficient $= 0.0000674$, $t = 6.75$, $P < 0.001$). The other variables and coefficients were: gender, 1.128 ($t = 7.97$, $P < 0.001$, 0 = male, 1 = female); current smoking behavior, −0.377 ($t = -2.14$, $P < 0.05$, 0 = nonsmoker, 1 = smoker); self-report of a taste or smell problem, −0.992 ($t = -3.89$, $P < 0.001$, 0 = no, 1 = yes); and residence in a home for the elderly, −8.017 ($t = -8.24$, $P < 0.001$, 0 = no, 1 = yes). The statistical significance of the last variable stems from (i) the poor performance of such residents compared to others of the same age and (ii) the connection between the variable and a portion of the age range (sample sizes for decades seven through ten were 11, 34, 90, and 29 for the residents and 173, 82, 4, and 0 for the others). Effects of smoking may be underestimated, since some current nonsmokers previously smoked. Although ethnic background was also significant ($t = 1.111$, $t = 6.61$, $P < 0.001$, 0 = white, 1 = nonwhite), this variable is likely confounded with other factors (for example, socioeconomic level and cultural experiences with odors). None of the interaction terms was statistically significant. Collinearity problems were not present.

11. An item analysis revealed that a statistically significant decrease in performance occurred for each odorant across the age range. Although the percentage of correct identification differed slightly among the stimuli across age, these differences are difficult to interpret given the diversity of suprathreshold psychophysical response functions among odorants (R. L. Doty, Percept. Psychophys. 17, 492 (1975)) and the multichemical basis of some of the stimuli.

19. Menstrual cycle-related changes in smell sensitivity of women taking oral contraceptives is also in support of this notion (R. L. Doty, P. J. Snyder, G. R. Huggins, L. D. Lowry, J. Comp. Physiol. Psychol. 55, 45 (1963)).
21. J. W. Hinds and N. A. McNelly, J. Comp. Neurol. 171, 345 (1977); ibid. 203, 441 (1981); R. Naessen, Acta Otolaryngol. 71, 49 (1971); T. Nakishima, personal communication. The apoposition of bone around the cribriform plate openings through which olfactory neurons pass may be one cause of their degeneration (J. Krompotic-Nemanc, Acta Otolaryngol. 67, 217 (1969)).