Brit. J. industr. Med., 1961, **18**, 213.

OLFACTION TESTS

BY

I. DINGWALL FORDYCE

From the Nuffield Department of Occupational Health, University of Manchester

(RECEIVED FOR PUBLICATION OCTOBER 11, 1960)

A simple olfaction test, based on graded solutions of phenol in liquid paraffin, was examined for repeatability. Of 98 persons tested, 79 repeated their initial result to within ± one grade on a second occasion. The time interval between tests (varying from a few hours to three weeks), observers, age, smoking habits, or initial grade did not appear to affect the degree of repeatability. There was a tendency to improve the grading on the second occasion.

Tests on 147 persons provided no evidence of an association between cigarette smoking and acuity of smell. There was an indication that pipe smoking had an adverse effect. An association between age and acuity was shown.

The measurement of anosmia in field studies presents considerable difficulty. No accurate and simple tests suitable for such studies have been perfected; all are liable to subjective bias and little is known about individual variation from time to time.

An attempt has been made to examine this problem more closely, especially in regard to individual repeatability, using one very simple test. At the same time a guide has been sought to the possible correlation of acuity of smell with age and smoking habits.

Method

The method was kept as simple as possible with a view to use in group studies of men at their places of work.

The olfacts were solutions of phenol in liquid paraffin, sp. gr. 0·880 (Proetz, 1941). The concentrations used are shown in Table 1; eight grades of olfact were used.

TABLE 1

CONCENTRATIONS OF SOLUTIONS OF PHENOL IN LIQUID PARAFFIN

Relative Strength of Olfact	Concentration (g./l.)	Grade of Olfact
1	0·0192	1
2	0·0384	2
5	0·0960	3
10	0·1921	4
25	0·4802	5
50	0·9605	6
100	1·9210	7
200	3·8420	8

These solutions had a characteristic odour, were not irritating to the mucous membrane, were reasonably stable, and were of low volatility. They were kept in wide-mouthed, glass-stoppered bottles, filled almost to the stopper. Tests were begun with the weakest solution and continued in order until smell was noticed. The room used was not especially free of adventitious odours; it was an office situated near laboratories. The subjects were not medically examined.

The test population included porters, cleaning women, technicians, secretaries, and medical staff. Everyone who was asked to do so took part. The repeat tests were randomly selected.

The first 100 persons, allocated at random to two observers, returned for a second test at intervals ranging from within 24 hours to 12 days. Three weeks later 35, selected at random, were tested a third time. An additional 49 persons were tested once.

Results

Two of the series of 100 duplicate tests were discarded. One subject had developed an acute nasopharyngitis between tests. The other gave wildly oscillating answers, claiming at one time to notice a smell at two olfacts but none at 200.

The results of the tests on the remaining 98 persons, 35 of whom were later tested for a third time, were examined for repeatability.

Repeatability.—Twenty-eight people gave the same grade of olfact at both tests, 51 differed by

TABLE 2
REPEATABILITY AND TIME INTERVAL

	Time Interval	Difference in Grade of Olfact				No. in Group
		0	±1	±2	±3 and More	
98 duplicate tests						
	Within 24 hours	11	27	6	2	46
	2-4 days	17	21	7	2	47
	6-12 days	0	3	0	2	5
35 triplicate tests						
First and second test	1-4 days	14	12	7	2	35
Second and third test	3 weeks	14	15	4	2	35

± one grade, 13 by ± two grades and six by ± three or more grades.

It was thought possible that the time interval between tests, experience, observers, age, smoking habits, or initial grade might affect the degree of repeatability.

(*a*) *Time Interval.*—The second tests were made at intervals ranging from within 24 hours to 12 days and the third test three weeks later. The length of time which elapsed between tests was found to have little effect upon the consistency of the results (Table 2).

(*b*) *Experience.*—There was a tendency to record a higher degree of acuity at the second test than at the first. Forty-eight persons improved their rating, 22 deteriorated, a difference which is probably significant ($p<0{\cdot}01$, $\chi^2=9{\cdot}7$). This bias towards improvement rather than deterioration was also apparent in the third test; details are given in Table 3.

TABLE 3
POSSIBLE EFFECT OF EXPERIENCE

Apparent Degree of Acuity	Duplicate Tests (98)	Triplicate Tests (35)	
		First and Second	Second and Third
Constant	28	14	14
Improved	48	12	12
Deteriorated	22	9	9

(*c*) *Observer Differences.*—The degree of consistency was found to be similar whether both tests were carried out by the same or different observers. Nor was there any evidence of difference between observers as measured by improvement or deterioration at the second test. Details are given in Table 4.

TABLE 4
DIFFERENCE BETWEEN OBSERVERS

Consistency	Same Observer Both Tests (31)	Different Observer at Second Test (67)	Different Observers	
			A First B Second (40)	B First A Second (27)
Constant	9	19	9	10
Improved	17	31	19	12
Deteriorated	5	17	12	5

Smoking and Acuity of Smell.*—In all 147 persons were tested, of whom 90 did not smoke, 46 smoked cigarettes only, 10 smoked a pipe, and one smoked only cigars.

In order to examine the possibility that smoking had a deleterious effect upon the acuity of smell the mean grades of olfacts of non-smokers, cigarette smokers, and others were compared (Table 5). There was no evidence of any difference between cigarette smokers and non-smokers. There was, however, an indication of a possible decrease in acuity among other smokers, but the numbers involved were too small for firm conclusions.

Age and Acuity of Smell.—For the purpose of investigating the effects of ageing the 10 pipe smokers, the cigar smoker, and one woman aged 37 with virtual anosmia were excluded from the sample.

Details of the mean olfacts in age groups of the remaining 135 persons are given in Table 6.

Although an overall decrease in acuity with increasing age is apparent it is difficult to explain, other than by chance, the very low grading in the age group 35-44. However, the sharp decline in this age group was apparent in all sub-divisions of the total sample.

Conclusions and Summary

The olfaction test, described above, although crude and subjective proved repeatable to within + one grade by 81% of the sample of 98 persons. No appreciable difference in accuracy was noticed whether the time interval was less than 24 hours or as long as three weeks. When there was a change,

*The age distribution of the subjects was not representative of the general population and this may, in part, account for the difference found in smoking habits. Among the younger men, who were over-represented in the sample, about 50% were smokers, whilst among those over 45 the incidence rose to about 65%. Of the women over the age of 25 approximately 38% smoked.

TABLE 5

MEAN GRADES OF OLFACTS OF SMOKERS AND NON-SMOKERS

Smoking Habits	Age Group				
	15-24	25-34	35-44	45-54	55-70
Number of non-smokers*	31	18	16	16	8
Mean olfact	2·6	2·6	7·9	4·6	5·1
Number of cigarette smokers	11	11	9	9	6
Mean olfact	3·1	2·7	9·3	2·2	4·3
Number of other smokers	1	1	4	3	2
Mean olfact	2	5	21·1	7·1	10 and 100

*One woman of 37, graded > 200, has been excluded.

TABLE 6

MEAN GRADES OF OLFACT IN THREE AGE GROUPS

Group		Age Group		
		15-34	35-44	45-70
Total* (excluding pipe smokers, etc.)	Mean olfact	2·7	8·4	4·1
	Variance	4·9	136·3	11·5
	No.	71	25	39
First Series	Mean olfact	3·0	8·0	4·2
	No.	54	12	28
Second series	Mean olfact	1·7	8·8	3·9
	No.	17	13	11
Men	Mean olfact	2·8	10·7	4·2
	No.	27	11	12
Women	Mean olfact	2·6	6·6	4·2
	No.	44	14	27

*Difference in means at ages 15-34 and 45-70 is probably significant ($p > 0{\cdot}01$, $t = 2{\cdot}62$).
Difference in means at ages 35-44 and 45-70 is possibly significant ($p > 0{\cdot}05 > 0{\cdot}01$, $t = 2{\cdot}1$).

the tendency was for the grade to improve, perhaps as a result of previous knowledge of the particular smell. There was no evidence that individual observers influenced the results. Age, smoking habits, and initial degree of acuity had no measurable effect upon the consistency of results found in this sample.

There was no evidence of any correlation between cigarette smoking and acuity of smell. Pipe smoking, however, may possibly have a deleterious effect although the number of such smokers in this sample was too small for any valid conclusions to be drawn.

Although there was a significant decrease in acuity of smell with increasing age the results were not straightforward. The age group 35-44 was more affected than the older groups, an effect which was noticed in all sub-sections of the sample. There is no ready explanation for this possibly chance phenomenon.

This test appears to be of practical use in field studies of moderately large groups of men. The negative correlation between acuity of smell and age (slight but probably conclusive) would have to be taken into account in analysis of results and choice of controls. Until further evidence is available it would be wise to assume that there is also a negative correlation between acuity of smell and pipe smoking although cigarette smokers appear to be unaffected.

REFERENCE

Proetz, A. W. (1941). *Essays on the Applied Physiology of the Nose*, p. 96. Annals Publishing Co., Saint Louis, U.S.A.

Olfaction Tests

I. Dingwall Fordyce

Br J Ind Med 1961 18: 213-215
doi: 10.1136/oem.18.3.213