Patient Adjustment to Reduced Olfactory Function

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Objective: To compare the importance of olfaction in daily life between patients with olfactory disorders and healthy normosmic individuals.

Design: Quasiexperimental.

Participants: A total of 470 individuals (235 anosmic or hyposmic patients and 235 normosmic control individuals).

Main Outcome Measures: The Individual Importance of Olfaction Questionnaire (IO) and olfactory testing using the “Sniffin’ Sticks” test kit.

Results: The IO scores were lower in people with smell disorders compared with normosmic subjects ($P < .001$) and lower in patients with anosmia compared with hyposmic patients ($P < .001$).

Conclusions: These scores suggest adjustment processes in the daily use of the sense of smell by patients. Patients attach less importance to their current sense of smell in daily life than do normosmic individuals. This adjustment might be an example of regaining psychological health despite acquired and long-lasting impairments.

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Disorders of the sense of smell are common. In the general population, hyposmia varies from 13% to 18% and anosmia (total loss of olfactory function) from 4% to 6%.1,2 The main causes of olfactory disorders are viral infections, head trauma, sinonasal disease, and neurodegenerative diseases.3 Most olfactory dysfunctions seem to be associated with aging.4 Having said this, one would expect olfactory disorders to be a major reason for consulting in ear-nose-throat outpatient clinics. In contrast, there is a gap between the low number of patients actively seeking help for olfactory disorders and the high rates of smell disorders in the population.5 This gap is not yet satisfactorily explained. One speculation is that many patients simply do not notice a smell impairment either because they do not use this sense or because the impairment developed gradually. Alternatively, one could hypothesize that patients do notice their olfactory impairment but simply do not attach any importance to it. This could be part of the coping strategies and adjustment processes that start to take place once olfactory function is affected.

The lack of sensory input could be compensated for by experience, for example, in food cooking, in which patients continue successfully mixing ingredients as they always did. Similar findings for the visual system show that elderly people with impaired vision seem to cope with this impairment. This is further supported by depression scores, which do not increase much when one considers the extent of vision impairment.6 Depression scores, which have been shown to be an indicator of failed coping strategies, increase transiently when 2 senses are lost, which has been interpreted as adjustment processes.7

People with olfactory disorders who search for medical help typically complain about difficulties with cooking, a lack of appetite, and low interest in eating.8,9 In addition, they are subject to an increased risk of hazardous events.10 Furthermore, these patients report daily life problems associated with social situations.11 Approximately 17% to 30% of patients with olfactory disorders report a decreased quality of life, including symptoms of depression12-14 (for an overview, see the study by Hummel and Nordin15). Although many studies suggest psychological modifications after olfactory impairment, little is known about how patients adjust and cope with a reduced sense of smell.

It could be hypothesized that patients adjust to reduced olfactory function by...
using it less frequently in daily life. Instead, they rely more on cognitive experience about how things used to smell or on other senses. In a preliminary study, Blomqvist et al.16 studied coping strategies and the importance placed on olfaction. However, they asked patients only how important olfactory function was when they compared it with the state before they experienced olfactory impairment. This within-subject investigation revealed that patients attached more importance to olfaction after they had lost smell function. However, there is no information available about how patients with acquired olfactory impairment rate olfactory importance compared with healthy individuals. The aim of the present study was to compare the importance of olfaction in daily life between patients with olfactory disorders and healthy subjects. This approach was based on the validated Individual Importance of Olfaction Questionnaire (IO).17

### METHODS

#### PARTICIPANTS

Of the 470 participants, 235 were patients with smell disorders and 235 were normosmic control individuals. Participants in the patient group were older (mean [SD] age, 54 [14] years) than control individuals (mean [SD] age, 27 [12] years). In both groups, more females than males participated (patients: 132 females and 95 males [sex was missing for 8]; control individuals: 134 females and 76 males [sex was missing for 5]). Participants in the patient group were diagnosed as having post–upper respiratory tract infection (n=62) and idiopathic (n=56), posttraumatic (n=46), sinonasal (n=49), and other (n=22) olfactory disorders. The mean (SD) duration of the disorder was 38 (59) months (range, 0-560 months).

#### QUESTIONAIRES

All the participants answered the IO.17 This questionnaire consists of 20 four-scaled items formulated as personal statements. Eighteen items refer to 3 subscales (Association, Application, and Consequence). The Association subscale reflects emotions, memories, and evaluations that are triggered by the sense of smell; the Application subscale reflects how much a person uses his or her sense of smell in daily life; and the Consequence subscale asks how many people use their sense of smell for decision making. Scale scores are calculated as the sum of the referring items. Two additionally inserted items are summed to an Aggravation subscale. Fifty-five participants in the patient group additionally completed the Beck Depression Inventory (BDI).18,19 a questionnaire designed for the self-evaluation of depressive symptoms.

#### TEST OF OLFACTORY FUNCTION

Olfactory function was assessed using the “Sniffin’ Sticks” test kit, which consists of penlike odor dispensers (Burghart GmbH, Wedel, Germany).20 The tampon of the pen is filled with a liquid odorant instead of a liquid dye. To present the odor, the pen’s cap was removed by the experimenter for approximately 3 seconds, and the tip of the pen was placed 1 to 2 cm in front of the participant’s nostrils. The interval between presentations of individual pens from a triplet was approximately 3 seconds. Odor thresholds were obtained for phenyl ethyl alcohol (a roselike odor) diluted in propylene glycol. Using a 3-alternative forced-choice paradigm, the participants had to identify the pen that contained the odorant presented at various concentrations. Two successive correct identifications of the pen containing the odor or 1 incorrect identification triggered a reversal of the staircase to the next higher or lower dilution step, respectively. Odor thresholds were determined as the mean of the final 4 of 7 staircase reversals.

For the test of odor discrimination, 16 triplets of odors were presented and participants had to choose within a 3-alternative forced-choice paradigm which odor of a triplet differed from the other two. The test result was the sum of correctly identified odors. Odor identification was assessed using 16 common odors, each presented in 1 pen. Using a 4-alternative forced-choice paradigm, identification of each individual odor was performed from a written list of 4 descriptors. The test result was the sum of correctly identified odors. Based on the test results, patients can be diagnosed as normosmic, hyposmic, or functionally anosmic (“further termed “anosmic”).20

The 3 tests of olfactory function were performed in all the patients. For control individuals, odor threshold was assessed in 143 participants, odor discrimination was assessed in 51, and odor identification was assessed in 68. Participants in the control group who did not receive the full “Sniffin’ Sticks” test were screened with a 1.2-item odor identification test21 so that normosmic patients can be diagnosed as normosmic, hyposmic, or functionally anosmic.

#### STATISTICAL ANALYSIS

Data were analyzed using a commercially available software program (SPSS version 17; SPSS Inc, Chicago, Illinois). First, both groups were compared according to their answers on the IO and their olfactory function. Differences between groups were analyzed using a multivariate analysis of variance with age and sex as covariates. Then, both groups were analyzed separately according to the effect of sex on IO scores using t tests. The effect of age and olfactory function on IO scores was analyzed using correlation analyses. The level of significance was set at \( P < .05 \) for mean differences; for correlation analyses, the level of significance was set at \( P < .01 \) to avoid spurious false-positive results.

#### IMPORTANCE OF OLFACTION: PATIENTS VS CONTROL INDIVIDUALS

The IO scores were significantly lower for each of the 3 subscales in patients compared with normosmic control individuals (\( P < .001 \)) (Table and Figure 1). Because of the large age difference between normosmic control individuals and patients, age was added as a covariate in the analysis.

In addition, we checked whether the effect of significantly reduced IO scores remained stable, if age was distributed equally in both groups. Therefore, age was used as a selection criterion for a random filtering procedure fitting age in both groups. This procedure revealed 95 patients (age range, 18-78 years; mean [SD] age, 41.7 [12.7] years) and 75 control participants (age range, 20-80 years; mean [SD] age, 38.1 [17.1] years). Comparing those groups, IO scores were still significantly lower in patients compared with control individuals for each subscale (\( P > .001 \)).

In addition, for all the subscales we found a difference between anosmic and hyposmic patients, with anosmic patients reporting significantly reduced impor-
tance of olfaction in each subscale compared with
hyposmic patients ($P < .001$) (Figure 2). There was a
trend for the Application subscale to correlate with the
duration of the smell disorder. Patients who had the smell
disorder for less than 1 year tended to have higher mean
$\text{(SD)}$ Application subscores than did patients who had it
for 1 year or longer ($7.2 \pm 5.4$ vs $5.8 \pm 4.8$; $P = .09$). This
effect was irrespective of the degree of olfactory loss
(Figure 3).

The Aggravation subscale was analyzed separately. Pa-
tients scored slightly lower on the Aggravation subscale
than did normosmic control individuals (mean $\text{[SD]}$: $1.9$
$\pm 1.5$ vs $2.2 \pm 1.2$). However, after reducing the sample
size following the age-fitting procedure described pre-
viously herein, the difference between patients and norm-
osmic control individuals in the Aggravation subscale
missed the level of significance.
The main result of the present study is that patients with olfactory disorders rate the importance attached to their olfactory sense to be lower in general and also in all the investigated subscales compared with healthy normosmic subjects.

Although a previous study\(^\text{16}\) showed that the same patients said olfaction seemed much more important to them since they lost this function, comparison with individuals with a normal sense of smell reveals that they attach less importance to their sense of smell in daily life. This finding strongly suggests that patients, although they might not be aware, seem to adjust to their olfactory constraints. Their sense of smell seems to be of less importance to them in daily life when it is reduced. So they report fewer olfactory-triggered emotions and memories, which seems reasonable because patients with olfactory disease experience fewer olfactory triggers. In accord, they also report to use their sense of smell less and to rely less on this sense in decision making. Herein, the Application subscale showed a tendency toward these adjustment processes lasting more than 1 year. Thus, it seems to require some time after disease onset to abandon a behavior that is meaningful for normosmic people.

The present results also confirm previous research\(^\text{22}\) in which the subjects’ scratching behavior was used as a gauge of interest in the sense of smell. Specifically, in this study,\(^\text{22}\) the University of Pennsylvania Smell Identification Test was applied to anosmic, hyposmic, and normosmic individuals. Using this test, subjects release odors with a pen by scratching the surface of a foil with microencapsulated odors. The pens leave marks on the foil and they tended to be older (\(P=.09\)). Patients with high aggravation scores exhibited significantly higher scores on all the subscales of the IO (\(0.008 < P < 0.02\)).

For depression, we found a significant coherence with aggravation. However, because only some of the patients completed the BDI, only 6 patients with high aggravation scores were compared with 47 patients with low aggravation scores. Those with high aggravation scores exhibited significantly higher depression scores (mean [SD] BDI score: low aggravation, 7.2 [6.0]; high aggravation, 15.1 [8.5]; \(P=.005\)).

**EFFECT OF SEX AND AGE ON IO SCORES**

We found no effect of sex on IO scores in patients. In normosmic control individuals, however, females scored higher on the Application (\(P=.003\)) and Consequence (\(P < .001\)) subscales than did males (Figure 4). In the correlation analysis, we found no effect of age on IO scores in normosmic control individuals or patients.

**EFFECT OF OLFACTORY FUNCTION ON IO SCORES IN NORMOSMIC PARTICIPANTS**

For normosmic control individuals, we found no significant coherence between IO scores and odor threshold, odor discrimination, or odor identification.

**AGGRAVATION IN PATIENTS**

Of 218 patients, 29 (13.3\%) scored more than 3 points on the Aggravation subscale (high aggravation) and 189 (86.7\%) scored 1 to 3 points (low aggravation). Both groups were compared with each other. Patients with high aggravation scores did not differ in sex (\(P=.52\)) or olfactory function as assessed using the “Sniffin’ Sticks” test (\(0.25 < P < .65\), meaning that the coils of the olfactory nerve are not damaged. Special cells line the floor of the nose, called olfactory epithelial cells. These cells have hair-like projections called cilia that extend into the small. Special cells line the floor of the nose, called olfactory epithelial cells. These cells have hair-like projections called cilia that extend into the small. Special cells line the floor of the nose, called olfactory epithelial cells. These cells have hair-like projections called cilia that extend into the small.

**COMMENT**

The present study\(^\text{22}\) also aimed to determine whether the same pattern of results could be found in anosmic and hyposmic patients. To this end, we applied the Individual Importance of Olfaction Questionnaire to anosmic and hyposmic patients. Patients who had the smell disorder for less than 1 year tended to have higher Application subscores than did patients who had it for 1 year or longer (\(P=.09\)). This effect was irrespective of the degree of olfactory loss (threshold). Error bars represent SD.

**Figure 1.** Box plots showing the distribution of odors for normosmic individuals (control) and for patients. The points beyond the whiskers are outliers beyond the 90th or 25th percentiles, respectively. The points in the middle of each box indicate the median, and the top and bottom borders of the box mark the 75th and 25th percentiles, respectively. The whiskers above and below the box mark the 90th and 10th percentiles, respectively. The points in the middle of each box indicate the median, and the top and bottom borders of the box mark the 75th and 25th percentiles, respectively. The whiskers above and below the box mark the 90th and 10th percentiles, respectively. The points in the middle of each box indicate the median, and the top and bottom borders of the box mark the 75th and 25th percentiles, respectively. The whiskers above and below the box mark the 90th and 10th percentiles, respectively. The points in the middle of each box indicate the median, and the top and bottom borders of the box mark the 75th and 25th percentiles, respectively. The whiskers above and below the box mark the 90th and 10th percentiles, respectively.

**Figure 2.** Box plots showing the distribution of odors for normosmic individuals (control) and for patients. The points beyond the whiskers are outliers beyond the 90th or 25th percentiles, respectively. The points in the middle of each box indicate the median, and the top and bottom borders of the box mark the 75th and 25th percentiles, respectively. The whiskers above and below the box mark the 90th and 10th percentiles, respectively. The points in the middle of each box indicate the median, and the top and bottom borders of the box mark the 75th and 25th percentiles, respectively. The whiskers above and below the box mark the 90th and 10th percentiles, respectively.
that can be easily traced. In this study, it was shown that anosmic patients scratched significantly less than did hyposmic patients, which was interpreted to mean that anosmic patients had less interest in the test and possibly also in smelling as such, similar to the present findings.

We interpret the adjustment to reduced sense of smell as an adequate coping mechanism, which may help the patient accept the disease. However, a subgroup of approximately 13% of the patients had high aggravation scores and significantly enhanced scores on the IO compared with the remaining patients. These patients exhibited significantly higher depression scores, suggesting mild to moderate depression. Patients who are less able to adjust might have difficulties in accepting the disease. This difficulty might be associated with depression, fixation, and overestimation of the sense of smell. This reduced adjustment to olfactory impairment in a subgroup of patients might explain the enhanced depression scores and the reduced quality of life that is typically observed in patients with olfactory loss. It also seems possible that people who experience depression are less able to adjust to decreasing olfactory function. However, note that we draw these hypotheses from a very small sample of patients, so further research on this topic is necessary.

Coping and adjustment processes seem to lead to compensation and also help estimate the deficit in a more realistic manner, as is suggested by the Aggravation subscale results observed herein. The impaired sense of smell might be integrated into the perception of the self and might even become unconscious as long as patients are not confronted with the deficit. It is possible that the “normal” personality is able to cope in this way with diseases in general, similar to how it is (and has to be) able to cope with impairments related to aging. Thus, the adjustment processes we discovered in smell disorders might be an example of regaining subjective psychological health despite chronic impairment.

From a clinical point of view, the present results suggest some interest in asking about the importance attached to olfaction. Physicians dealing with olfaction could inform patients that although they are experiencing smell loss, approximately 87% of patients adjust well to this loss within the first year. For those 13% who do not adjust to olfactory impairment, as indicated by high scores on the Aggravation subscale, one should also consider depression. In those patients, further therapy, for example, psychological help to cope with the disease, might be indicated.

For the effect of sex and age on IO scores in normosmic people, we replicated the results of a previous study using the same questionnaire and in another study in normosmic individuals in which importance was rated using a visual analog scale. It may be argued that for normosmic people, the basic olfactory sensitivity expressed as odor threshold has no effect on the importance placed on olfaction or, alternatively, that assessment of olfactory thresholds is relatively independent of cognitive variables. In contrast, this sensitivity may be different for tasks involving odor identification and discrimination, which seem to be more strongly affected by cognitive variables. In this study, we did not find coherence between the secondary processing tasks and the self-rated importance of olfaction, yet a correlation between odor discrimination and odor identification and visual analog ratings of the importance of olfaction was found in previous research.

In conclusion, most patients attach less importance to their current sense of smell in daily life than do normosmic individuals and adjust to their reduced olfactory function. This behavior might be an example of regaining psychological health despite acquired and long-lasting impairments. Long-term studies focusing on treatment outcome in patients with high and low adjustment scores seem to be especially important and promising.

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