

## Individual significance of olfaction: development of a questionnaire

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Received: 4 December 2008 / Accepted: 7 July 2009 / Published online: 22 July 2009  
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**Abstract** Clinical experience shows that the individual significance of olfactory function varies between subjects. In order to estimate these individual differences we developed a questionnaire to study the subjective importance of the sense of smell. Questions were arranged within three subscales: association with olfactory sensations, application of the sense of smell, and the readiness to draw consequences from the olfactory perception. The questionnaire was shown to be time efficient, suitable for normosmic subjects and patients with hyposmia or anosmia. It exhibited a good internal reliability (Cronbach's Alpha = 0.77). First results in 123 subjects indicate that the subjective importance of the sense of smell stays at the same level throughout life-span despite of a decreased olfactory sensitivity. Furthermore, women reported a higher importance of olfaction. It is hoped that this questionnaire will contribute to clarify, for example, cross-cultural differences in the perception of odours.

**Keywords** Smell · Subjective significance · Questionnaire · Anosmia · Nose · Quality of life

### Introduction

During the last decade a number of studies have been published on the epidemiology of olfactory loss. It could be

shown, that smell disorders are very common in the general population. For Germany Vennemann et al. [1] showed that 3.6% of the randomly selected population are functional anosmic and that an additional 18% show olfactory dysfunction. For Sweden Bramerson et al. found similar high rates of olfactory impairment. In this large, population-based study olfactory dysfunction occurred in 19.1% of the participants, split in 13.3% with hyposmia, and 5.8% with anosmia [2]. A robust effect of decreasing olfactory function with age and with male gender has been found in various studies [2–5].

Interestingly, although many people exhibit olfactory impairments, relatively few people complain about this in everyday life. This is partly explained by studies focussing on the relationship between measured olfactory function and ratings of olfactory function [4, 6, 7]. Results from these studies indicate that there is only a weak to moderate correlation between rated olfactory function and measured function for anosmic and hyposmic patients. Normosmic subjects do even worse in rating their own olfactory sensitivity. In fact, Landis et al. [7] showed that ratings of nasal airflow correlated better with measured olfactory function than did ratings of olfactory sensitivity.

On a clinical level, there are numerous studies indicating that patients with anosmia or hyposmia do suffer from their olfactory impairment in daily life [8, 9], although it has to be kept in mind that all these observations are based on reports from patients presenting themselves to specialised centres seeking help for their chemosensory loss. These patients report problems with daily life situations, like cooking or eating [10], experience more accidents and hazardous situations [11, 12], and suffer from daily life problems associated with social situations [13]. Furthermore, people with smelling disorders have slightly higher depression scores [14] and report a generally reduced quality of life [15].

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**Table 1** Questionnaire with reference to the subscales

<i>Importance of Olfaction</i>					
This questionnaire refers to the role your sense of smell plays in your daily life. Please answer all of the questions spontaneously, there are no right or wrong answers.					
Scale		I totally agree	I mostly agree	I mostly disagree	I totally disagree
Ass	The smell of a person plays a role in the decision whether I like him/her.				
App	I smell foods to find out whether it is spoiled or not.				
App	I sniff on food before eating.				
Con	Please imagine you visit a museum. There is an offer to get additionally smell-presentations to underline the overall impression for the price of 2 €. Would you take this offer?				
Con	When I don't like the smell of a shampoo, I don't buy it.				
Ass	When I smell delicious food, I'm getting hungry.				
Agg	Without my sense of smell, life would be worthless.				
Con	I try to locate the odor, when I smell something.				
Ass	I feel rather quickly disturbed by odours in my environment.				
Ass	Certain smells immediately activate numerous memories.				
App	Before drinking coffee/tee, I intentionally smell it.				
App	When I buy tomatoes, I pay attention to their odour.				
Con	If my partner has a nasty smell, I avoid kissing him.				
Ass	Certain smells immediately activate strong feelings.				
App	I smell my clothes to judge whether I have to wash them or not.				
Con	When there is a nasty smell in the office/apartment of a colleague, I leave the room as soon as possible.				
Ass	Certain odors can stimulate my fantasy.				
Agg	To me it is more important to be able to smell than to be able to see or hear.				
App	Sometimes I smell a person (e.g. my partner or my child) to judge, if he/she has drunken alcohol or smoked.				
Con	I cannot pass good smelling candles in a store without buying one.				

Ass association, App application, Con consequence: not printed when questionnaire is presented to the subjects. The items of the aggravation-scale (Agg) are added

Considering these studies it appears that the sense of smell has a profound impact on our life. However, the significance of olfactory function seems to vary within the general population. To study this further, aim of the present investigation was to develop a questionnaire that would provide a gauge of the individual significance of olfactory function. Based on review of the existing literature and on clinical experience, the questionnaire was divided in three subscales: "Association," "Application," and "Consequence."

The *Association-scale* reflects the emotions, memories, and evaluations that are triggered by the sense of smell

(e.g., "I feel rather quickly disturbed by odours in my environment"). These processes are mostly unconscious, automatic, and very rapid due to the close connection between the olfactory and the limbic system [16–18].

*Application* means, how much a person uses his or her sense of smell in daily life. Here, we wanted to know how people differ in the intentional application of smelling behaviour in different situations (e.g., "When I buy tomatoes, I pay attention to their odour").

In the *Consequence-scale* we focussed on the conclusions, persons draw from their olfactory impressions. In other words, we wanted to learn about the importance

**Table 2** Correlation between the subscales and the whole questionnaire score ( $n = 123$ ; all  $P < 0.001$ )

	Application	Consequence	Questionnaire score
Association ( $r$ )	0.50	0.40	0.81
Application ( $r$ )		0.50	0.83
Consequence ( $r$ )			0.77

someone attributes to the sense of smell in daily decisions (e.g., “When I don’t like the smell of a shampoo, I don’t buy it”).

**Materials and methods**

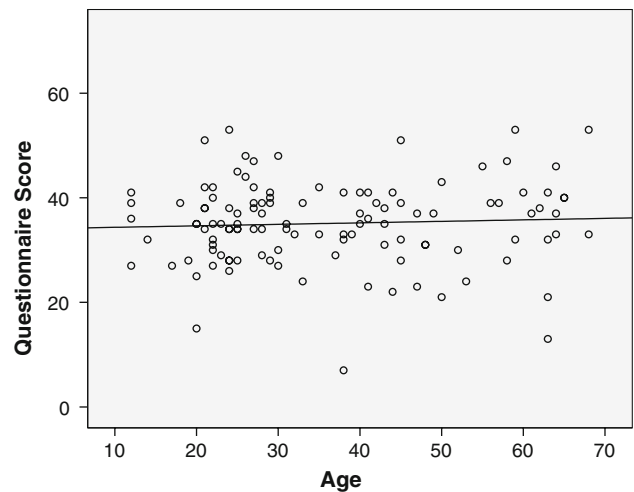
The ‘Importance of Olfaction Questionnaire’ consists of 18 four-scaled items, formulated as a personal statement. The subjects indicate how much they agree with this statement (“I totally agree” to “I totally disagree”). Six items each refer to one subscale. To develop the questionnaire, we first designed 42 different items referring to the three subscales. These items were pre-tested on a small sample of 16 subjects to check for comprehensibility, redundancy, and coherence with the main score and the subscales. The whole questionnaire is shown in Table 1. It is designed to be time efficient and suitable for normosmic subjects as well as for patients with olfactory loss.

We presented this questionnaire to 123 subjects. The sample was recruited on a public scientific event of the University of Dresden, addressed to the general population. Out of 123 subjects 67 were female, 49 male, in 7 questionnaires the sex was missing. The age range was 12–68 years, with a mean age of 36 years and a standard deviation of 15.

**Results**

Focussing on the structure of the questionnaire, the data showed that the three scales are correlated ( $r = 0.40–0.50$ ;  $P < 0.001$ ), but can be discriminated from each other. Furthermore each scale shows expectable high correlations with the main score ( $r = 0.77–0.83$ ;  $P < 0.001$ ). These data are presented in Table 2. The questionnaire offers a good internal reliability (Cronbach’s Alpha = 0.77).

Focussing on the subject’s perspective, we analysed the coherence of the questionnaire scores with age and sex of the participants. Figure 1 shows that there was no significant coherence between age and the importance of olfaction in the main score, nor there was in any of the subscales ( $r = 0.0–0.1$ ). With regard to sex-related differences, in the subscale “consequence” women reported significantly higher scores ( $P = 0.013$ ). For all other subscales, as for

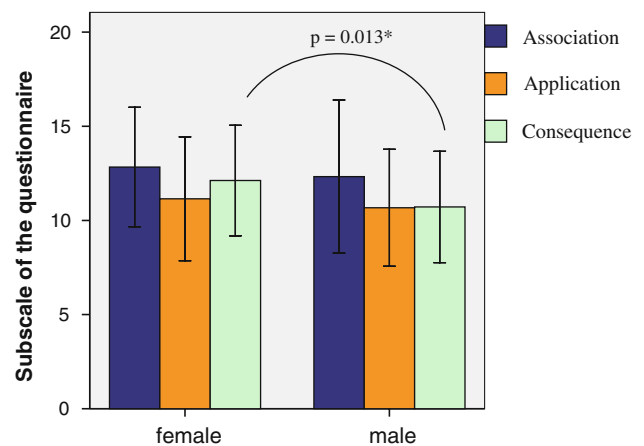


**Fig. 1** Coherence between importance of olfaction and age

the main score, there were no significant differences between men and women (Fig. 2).

**Discussion**

The present study provided the following major results: (1) The questionnaire appears to be a reliable instrument providing three related, but independent subscales. (2) The significance of olfactory function seems to be independent of age. This result is especially interesting due to the fact that olfactory performance decreases with age [19]. Thus, although the sense of smell deteriorates with age, its importance does not seem to decrease, but to stay at the same level throughout life. This has been shown using psychophysical, electrophysiological, and imaging techniques [20]. While the reasons for this age-related loss of olfactory function are manifold, the loss of olfactory



**Fig. 2** Mean and single standard deviation of the questionnaire subscales in men and women

receptor neurons with aging appears to be of high significance in this process [21]. Here it is interesting to note that relatively few elderly complain about their olfactory loss. Interestingly, the present results seem to indicate that the significance of the sense of smell does not change with age, while this is very different with olfactory function. One reason for this discrepancy may be that olfactory loss is barely noted by the subjects, especially as age-related olfactory loss seems to occur gradually which allows other senses (mechanosensation, heat, coolness, trigeminal chemoreception, taste etc.) to gradually replace olfactory sensations, e.g., during eating and drinking. (3) Olfaction seems to be more important to women compared to men. This is consistent with a generally higher olfactory sensitivity of women compared to men [22]. Women typically outperform men in terms of olfactory tasks [3]. As with aging, it is not entirely clear why this is so—the simple substitution of estrogens, e.g., after menopause, or the loss of estrogen production does not seem to result in a corresponding change of olfactory function [23]. Interestingly, women also suffer more from olfactory loss compared to men [13] which may also reflect better olfactory function, and, subsequently, a higher significance of the sense of smell in women.

These results have to be interpreted against the background of the constraints of the analysed sample. As used voluntary subjects, recruited on a public scientific event, we would expect the typical constraints of these voluntary samples, like having a better education level, higher perceived social status, higher intelligence and sociability [24] compared to general population.

Questionnaires of clinical application typically suffer from the problem that certain response biases cannot be excluded. For example, a patient with olfactory loss who seeks medical counselling will respond differently to health-related questions compared to a subject with olfactory loss who does not wish to receive medical diagnostics and/or treatment. Thus, to make the present questionnaire more practicable for clinical application, we added an “aggravation scale” to the final version (compare [13]). Using this aggravation scale as a filter we will be able to measure the tendency of the patients to overestimate the significance of their olfactory loss.

For clinical practice the questionnaire seems to be a time efficient and handy instrument to get an impression of the subjective meaning of the olfactory deficit. Further research will be necessary to analyse stability of the questionnaire scores over time and to learn about the coherence between the importance of olfaction and olfactory performance in healthy subjects and patients. We hope that the questionnaire will provide information as to why some people with olfactory loss search medical counselling, while others do not even complain of their loss of the

sense of smell. For example, we would hope to clarify whether the impact of the smelling disorder on quality of life [14, 15] is mediated by the subjective importance of olfaction. Additionally it is hoped that this questionnaire will allow us to study cross-cultural differences in the perception of odours in greater depth.

**Conflict of interest statement** This research had no external sponsor.

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