

# A Self-administered Odor Identification Test Procedure Using the “Sniffin’ Sticks”

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## Abstract

Assessment of smell function in clinical routine is often limited due to a lack of time and/or costs of the personnel administering the test. The aim of the present study was to validate a procedure allowing for self-administered olfactory testing in a clinical setting. Seventy-four healthy subjects (13 male, 61 female) from 18 to 30 years of age (mean 20.3 years) were tested on 2 days (interval 7–21 days, mean 8.7 days) with 16 odors of the “Sniffin’ Sticks” identification test kit. On one occasion, the test was administered by an examiner. On another occasion, subjects administered the test to themselves, with the odors being identified after they had been “painted” on a sheet of paper. No significant differences were obtained between the results from both test procedures. With a maximum score of 16, assisted testing yielded a mean score of 13.7 [standard deviation (SD) 1.3] while the self-administered procedure yielded an average score of 13.8 (SD = 1.5) ( $P = 0.72$ ). The mean difference between the assisted and the self-administered smell test procedures was 0.05 (SD = 1.28). The 95% confidence interval of differences ranged from –2.51 to 2.61. These results suggest that odor identification with the Sniffin’ Sticks can also be administered by the subjects themselves.

**Key words:** clinical, olfaction, self-administration, smell, Sniffin’ Sticks, test

## Introduction

Assessment of olfactory function in patients with smell and taste complaints is a central part of the diagnostic process (Doty, 1995). The methods used in clinical routine should be validated and practicable. Many smell tests need to be administered by an investigator due to technical reasons (e.g., threshold procedure, discrimination task). However, if time and personnel are limited, olfactory tests amenable to self-administration are desirable. The Smell Identification Test (also known as University of Pennsylvania Smell Identification Test) is the most widely used smell test in the USA and many other parts of the world (Doty *et al.*, 1984). This test is an odor identification test based on a “scratch and sniff” technique, which is applicable as a self-administered test. The most widely used test in Germany, Austria, and Switzerland is the “Sniffin’ Sticks” test battery which has been introduced by Kobal *et al.* (1996). It comprised three subtests, namely an

odor identification test, an odor discrimination test, and a test for olfactory threshold (Hummel *et al.*, 1997). This test has been thoroughly validated; normative data are based on investigations in more than 1000 subjects (Kobal *et al.*, 2000). However, for the Sniffin’ Sticks, no procedure amenable to self-administration has been presented so far.

Consequently, the aim of the present study was to validate a procedure allowing for self-administered smell testing using 16 items of the Sniffin’ Sticks odor identification test kit. The procedure should not require any additional technical equipment. Moreover, basic rules of hygiene should be fulfilled.

## Materials and methods

The study was carried out in the Department of Otorhinolaryngology at the Medical University of Vienna. It was

conducted according to the guidelines of the Declaration of Helsinki on biomedical research involving human subjects.

The investigation included 74 subjects [13 male, 61 female; range 18–30 years, mean 20.3 years, standard deviation (SD) 2.7]. The subjects had to restrain from eating or drinking anything, except water for at least 1 h prior to testing. Testing took place in a well-ventilated room at approximately the same time on 2 days (interval 7–21 days, mean 8.7 days, SD 3.3). Initially, the history was obtained regarding conditions causing smell dysfunction using a standardized questionnaire. Subsequently, physical examination of the nose was performed with anterior rhinoscopy in order to detect obstruction of the nasal cavity or signs of inflammation of the nasal mucosa. Patients with acute infections of the upper respiratory tract were not eligible for the study due to possible damage to the olfactory system (Schiffman, 1983).

Before smell testing, subjects had to perform two cognitive tests (see below). Moreover, the subjects had to rate their sense of smell on a visual analogue scale (VAS) ranging from 0 (no sense of smell) to 100 (excellent sense of smell). After smell testing, the test situation had to be rated on a VAS ranging from 0 (very unpleasant) to 100 (very pleasant). One session lasted approximately 1 h. Subjects received 10 € for their participation.

### Cognitive tests

A test for verbal intelligence (“Wortschatztest,” WST; Lehrl *et al.*, 1995) and for general cognitive function (mini-mental state examination, MMSE; Folstein *et al.*, 1975) was administered prior to smell testing. The WST consisted of 42 words presented with five distractors of not existing words each. The subjects’ task was to check the correct word on the presented list. The score ranged from 0 to 42. The MMSE consisted of 11 questions/tasks concerning orientation and general cognition with a score ranging from 0 to 30.

### Olfactory testing

Smell function was measured using the Sniffin’ Sticks odor identification test kit (Burghart Medical Technology, Wedel, Germany) which is based on pen-like odor dispensing devices (Hummel *et al.*, 1997). The pens are approximately 14 cm long, with an inner diameter of 1.3 cm. Instead of liquid dye, the pen’s tampon is filled with 4 ml of liquid odorants. Using a four-alternative forced-choice paradigm, odor identification was assessed for 16 common odors. The subjects’ scores ranged from 0 to 16. The same odor pens were used during the two test sessions at a minimum interval of 1 week. One half of the subjects started with assisted olfactory testing, the other subjects started with self-administered olfactory testing (see below).

### Self-administered olfactory testing

Prior to testing the subjects had to read the following instruction explaining the details of the procedure: “1. Please read

the four possible answers presented with odor pen 1, then take pen 1, remove the cap and “paint” a few curves on the paper in front of you. 2. Smell the surface of the paper, compare the odor with the four possible answers, and check the pen’s odor on the form. This is also necessary, if you do not perceive any odor, or an odor which is not contained in the list of descriptors. In that case you have to guess which odor the pen might contain. 3. Put the small paper in the basket and proceed with pens 2–16 in the same way.” The duration of self-administered testing was noted. No feedback was given to the subject by the investigator during testing.

### Assisted olfactory testing

Again written information was provided prior to testing: “Prior to the presentation of an odor pen you will be told four possible answers, which you will also find on a form. Then the odor pen is presented under your nose; please be careful not to touch it. Compare the odor with the four possible answers and indicate your choice to the investigator. This is also necessary, if you do not perceive any odor or an odor which is not contained in the list of descriptors. In that case you have to guess which odor the pen might contain.” The number of accidental touching of the tip of the stick during assisted smell testing was noted.

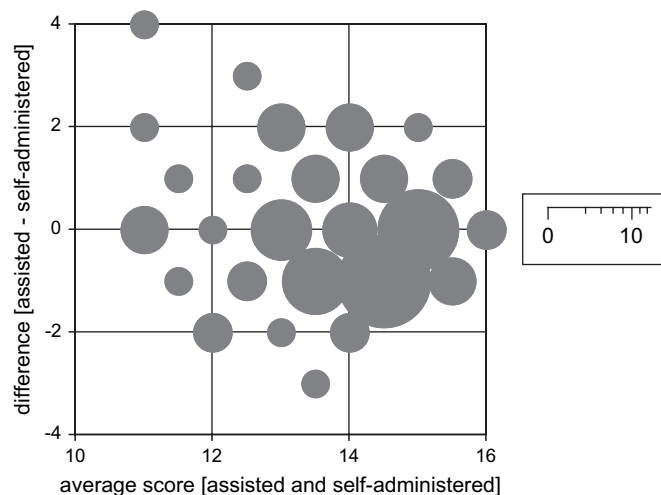
### Statistical analysis

Spearman’s statistics were used for correlation analysis. Student’s *t*-tests for paired samples were used for comparisons between groups. “Bland and Altman plots” were used for graphical presentation of the equivalence of assisted and self-administered olfactory test procedures (Bland and Altman, 1999). The SPSS program package (version 12.0 for Windows; SPSS Inc., Chicago, IL) was used for analyses. The alpha level was set at 0.05.

### Results

The mean score (with SD) of the assisted odor identification test was 13.7 (SD 1.3). The newly investigated self-administered procedure yielded a score of 13.8 (SD 1.5). Mean comparison revealed no statistically significant differences between the two tested procedures ( $t = 0.36$ ,  $P = 0.72$ ). Correlation analysis of the results of both procedures revealed a correlation coefficient of  $r_{74} = 0.60$ , ( $P < 0.01$ ). Bland and Altman plots also demonstrated a reasonable equivalence of the results obtained with both techniques (see Figure 1). The mean difference between the assisted and the self-administered smell test procedures was found to be 0.05 (SD 1.28). The 95% confidence interval of differences ranged from –2.51 to 2.61.

The average self-rating of the subjects’ sense of smell was 63.9 (SD 17.7). Ratings of the pleasantness of the situation during the self-administered olfactory test was 77.8 (SD 19.1) and 76.2 (SD 18.4) for assisted testing. There was no



**Figure 1** Bland and Altman plot of results from assisted and self-administered odor identification test. The difference between results from the two tests is plotted against the average of the two test results. The size of the bubbles indicates the number of data points contributing to the bubble (see legend on the right side of the graph). Most data were centered around the baseline, indicating that there was little difference between results from the two tests. The relatively homogeneous distribution of the data suggests that test results exhibited similar reproducibility regardless whether subjects had generally low or high scores in the odor identification test.

significant difference between ratings of pleasantness for both tests ( $t = 0.83$ ,  $P = 0.41$ ).

The results of the cognitive tests revealed scores within the normal range for both, test of verbal intelligence (WST, mean score 30.5, SD 4.0) and MMSE (mean score 29.8, SD 0.7). The duration of the assisted procedure was significantly shorter than the self-administered testing (mean 5.5 min, SD 2.4 vs. 6.9 min; SD 2.5;  $t = 4.105$ ,  $P < 0.01$ ). Four subjects accidentally touched the pen during the assisted procedure.

## Discussion

The present study established a good equivalence between the assisted Sniffin' Sticks identification smell test and the newly investigated self-administered smell test procedure. The Sniffin' Sticks test kit is a well validated and widely used test of olfactory function in Europe, which has been applied in numerous studies (e.g., Hummel *et al.*, 1997; Kobal *et al.*, 1996, 2000; Wolfensberger *et al.*, 2000; Hummel *et al.*, 2001; Mueller and Renner, 2006). Its most extended version comprised an olfactory threshold procedure, an odor discrimination task, and an odor identification test. Unlike other validated smell tests, like the Smell Identification Test (Doty *et al.*, 1984), self-administration has not been validated yet. We wanted to do so with the odor identification subtest without changing or adding any material except the test procedure. Olfactory testing in patients with smell complaints seems to be important for the assessment of the exact degree of smell loss, time course of the disease, evaluation of therapy, and counseling of the patients.

The procedure used for this investigation was inspired through the Japanese odor stick identification test which is made of odorants packed in microcapsules, mixed in paste, and hardened in form of lipsticks (Hashimoto *et al.*, 2004). For odor presentation, each odor stick is painted on paper, and odors are then released through scratching and presented to the patient. Similarly, as the odor pens of the present study are filled with liquid odorants, we found that writing curves on small pieces of regular printer paper is sufficient to release enough odors for the identification task. Moreover, the problem of touching the tip of the odor stick can be avoided, which might produce microbiological contamination of the pen.

Results of the present study show that the proposed procedure of self-testing is suitable for testing odor identification abilities. The odor identification scores did not differ significantly between assisted and self-administered testing. Regarding the pleasantness of the test situation, the new procedure itself was rated the same in comparison to the assisted procedure. This indicates that the tested subjects did not feel stressed with the demands of the test. Although the time needed for self-testing was longer than for the assisted test, the difference was less than 2 min.

The present study does not answer the question which patients would be suitable for self-administration of the odor identification test in clinical routine. The investigation involved a series of young, healthy, normosmic subjects. All subjects had normal cognitive function and verbal capability as measured by MMSE and WST. Future studies will compare the results of both tested procedures in patients of older ages as well.

Taken together, the results of our study showed the usefulness of the newly described procedure. The new procedure with self-administration should spare time and personnel resources in clinical settings and physicians' practice.

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