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Short communication

Extended version of the "Sniffin' Sticks" identification test: Test–retest reliability and validity

A. Sorokowska[a,b,*,1], E. Albrecht[a,1], A. Haehner[a], T. Hummel[a]

[a] Department of Otorhinolaryngology, TU Dresden, Germany
[b] Institute of Psychology, University of Wroclaw, Poland

HIGHLIGHTS

- We examined the reliability of the revised, extended Sniffin' Sticks test.
- We reconfirmed the high test–retest reliability and validity of this test.
- Additionally, we presented normative values for this test.
- The extended identification test is a useful and detailed diagnostic tool.

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ABSTRACT

Background: The extended, 32-item version of the Sniffin' Sticks identification test was developed in order to create a precise tool enabling repeated, longitudinal testing of individual olfactory subfunctions.
New method: Odors of the previous test version had to be changed for technical reasons, and the odor identification test needed re-investigation in terms of reliability, validity, and normative values.
Results: In our study we investigated olfactory abilities of a group of 100 patients with olfactory dysfunction and 100 controls. We reconfirmed the high test–retest reliability of the extended version of the Sniffin' Sticks identification test and high correlations between the new and the original part of this tool. In addition, we confirmed the validity of the test as it discriminated clearly between controls and patients with olfactory loss.
Comparison with existing method(s): The additional set of 16 odor identification sticks can be either included in the current olfactory test, thus creating a more detailed diagnosis tool, or it can be used separately, enabling to follow olfactory function over time. Additionally, the normative values presented in our paper might provide useful guidelines for interpretation of the extended identification test results.
Conclusions: The revised version of the Sniffin' Sticks 32-item odor identification test is a reliable and valid tool for the assessment of olfactory function.

1. Introduction

People are often inaccurate in terms of the ratings of their own olfactory abilities (e.g., Landis et al., 2003). Accordingly, the sense of smell is typically assessed with specialized psychophysical tests (Hummel and Welge-Lüssen, 2006), for example with the "Sniffin' Sticks" which is a well-established tool (Hummel et al., 1997, 2007). The "Sniffin' Sticks" test consists of 3 subtests allowing to diagnose different elements of olfactory function – it enables testing odor threshold (OT), odor discrimination (OD), and odor identification (OI). In addition to the "classical" 16-item version of the identification and discrimination subtests, there is also the extended, 32-item version of these two tests (Haehner et al., 2009). They were developed in order to create more precise tools enabling repeated, longitudinal testing of individual olfactory subfunctions. Previous work has shown the test–retest reliability of these extended subtests (Haehner et al., 2009). However, because the manufacturing source of odors of the 2009 version (items 17–32) had to be changed for technical reasons, the odor identification test needed re-investigation in terms of reliability, validity, and normative values.

* Corresponding author at: Smell and Taste Clinic, Department of Otorhinolaryngology, TU Dresden, Fetscherstrasse 74, 01307 Dresden, Germany.
Tel.: +49 351 458 4189; fax: +49 351 458 7370.
E-mail address: sorokowska@gmail.com (A. Sorokowska).
[1] These authors contributed equally to this work.

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2. Materials and methods

Investigations were performed according to the Guidelines for Biomedical Studies Involving Human Subjects (Helsinki Declaration). The protocol was approved by the Ethics Committee of the Medical Faculty of the TU Dresden (application number 156052012). All subjects provided written informed consent prior to their inclusion to the study.

2.1. Participants

In the study participated 100 healthy controls (49 women and 51 men) aged 22–70 years ($M = 36.3$; $SD = 15.9$) and 100 patients with olfactory loss (61 women and 39 men) aged 24–85 years ($M = 59.2$; $SD = 13.4$). The participants underwent diagnostic evaluation; they received a detailed otorhinolaryngological investigation including structured medical interview and nasal endoscopy.

2.2. Procedure

The participants were examined with the extended, 32-item "Sniffin' Sticks" identification test (compare Haehner et al., 2009). By means of a multiple-choice task, identification of odors was performed from a list of four descriptors each. In the data analysis, we used three test scores for each subject: (a) the first 16 items of the task (i.e., the "classic" Sniffin' Sticks; score 0-no odor identified to 16-all odors identified), (b) the 16 "new" items of the task (score 0–16), and (c) the total of 32 items (i.e., the extended version of the task; score 0–32). In controls, testing was performed again after a mean interval of one week to investigate test–retest reliability.

Statistical analyses were performed by means of Statistica v.10 (StatSoft, Inc., www.statsoft.com, Tulsa, OK, USA). MANOVA analyses with Bonferroni post hoc tests were employed for comparison between scores of (i) patients and controls and (ii) healthy men and women. Correlation analyses were performed using Pearson statistics.

3. Results

3.1. Comparison between healthy subjects and patients with olfactory dysfunction

Table 1 presents the percentages of correct identifications of each item for the patients and the healthy controls. On average, the patients identified the items correctly in 54.9% of the cases, and healthy participants in 83.2% of the cases. As indicated by difference in proportions tests (two-tailed tests), in both groups the percentages of correct identifications were not different in the "classic", the "new" and the extended versions of the test.

In the extended test, the scores of the patients ranged between 3 and 30 and the scores of the controls were between 10 and 31. The patients scored on average 9.05 lower than controls. Table 2 presents the comparison of scores obtained by controls and patients with olfactory dysfunctions. Generally, in all the tests the scores of controls were significantly different than the scores of the patients, as indicated by MANOVA analysis [Wilks' Lambda = .62, $F(2, 197) = 61.49$, $p < .001$, $\eta^2 = .38$]. Bonferroni post hoc tests revealed that in all three conditions, patients scored lower than controls (all $ps < 05$).

With regard to normative data, in the extended, 32-item test the controls aged 22–35 years obtained scores between 22 and 31, with the mean value of $M = 27.6$ ($SD = 2.0$). The 10th percentile for the healthy subjects equaled 25, and this value was taken as the cutoff point separating hyposmia from normosmia. With regard to the patients taking part in our study, 80% of people with smell loss obtained scores equal or lower than this value. Since generally the probability of providing more than 14 correct answers by chance in the 32-item identification test is less than 5%, this result cannot be distinguished from a purely random result and must be interpreted as being consistent with functional anosmia (see e.g., Wolfensberger et al., 2000). It therefore follows that this value should be taken as a cutoff point separating hyposmia from functional anosmia. In our sample, 39% of the patients and none of the controls aged less than 36 years obtained scores equal to or less than this value.

Table 1
Percentages of correct identifications of every item in controls and patients.

Item	Odor	Percentage of correct identifications	
		Controls	Patients
1	Orange	97	68
2	Leather	91	64
3	Cinnamon	73	43
4	Peppermint	98	61
5	Banana	92	57
6	Lemon	66	41
7	Liquorice	87	41
8	Turpentine	42	37
9	Garlic	95	61
10	Coffee	88	64
11	Apple	42	27
12	Cloves	95	71
13	Ananas	85	45
14	Rose	90	66
15	Anise	90	47
16	Fish	94	69
17	Pear	84	56
18	Coke	87	45
19	Lilac	98	69
20	Grapefruit	72	38
21	Grass	79	40
22	Raspberry	88	60
23	Honey	95	71
24	Ginger	75	57
25	Coconut	87	57
26	Lavender	72	52
27	Melon	73	47
28	Peach	84	49
29	Mushroom	98	61
30	Smoked ham	69	56
31	Chocolate	98	79
32	Onion	77	57
	Mean percentage total	83.2	54.9
	Mean percentage items 1–16	82.8	53.9
	Mean percentage items 17–32	83.5	55.9

Table 2
Differences in scores obtained by controls and patients with olfactory disorders.

	Controls		Patients	
	M	*SD*	*M*	*SD*
"Classic" 16-item test	13.25	1.73	8.62	4.16
"New" 16-item test	13.36	2.12	8.94	3.68
Extended 32-item test	26.61	3.34	17.56	7.43

3.2. Effect of sex

Women scored on average 13.2 in the "classic" 16 items, 13.65 in the "new" 16 items, and 26.86 in the full, extended test. Men scored on average 13.29 in the "classic" 16 items, 13.08 in the "new" 16 items, and 26.37 in the full, extended test. Men and women in our sample did not perform differently in any of the tests as indicated by MANOVA analysis [Wilks' Lambda = .98, $F(2, 197) = 1.70$, $p = .19$, $\eta^2 = .02$].