



Revista de Psiquiatría y Salud Mental

www.elsevier.es/saludmental



ORIGINAL ARTICLE

The Spanish version of two olfactory scales: Reliability and validity[☆]

Emma Burón^{*}, Antonio Bulbena, Guillem Pailhez, Andrea Bulbena Cabré

Parc de Salut Mar, Institut de Neuropsiquiatria i Addiccions (INAD), Barcelona, Spain

Received 6 June 2011; accepted 28 July 2011

Available online 15 February 2012

KEYWORDS

Olfactory perception;
Behavior;
Cognition;
Emotions;
Psychometrics

Abstract

Background: It is well known that smells have marked effects on behavior, cognition and on emotional responses. Therefore, it is very useful to have at our disposal instruments that allow us the measure these effects.

Objective: The aim of this study was to translate and validate the Spanish version of the Affective Impact of Odors scale (AIO) and the Odor Awareness Scale (OAS).

Material and methods: This study was carried out on a sample of 100 participants from the general population. The internal consistency was measured by Cronbach's alpha and the test-retest reliability, by the intraclass correlation coefficient (ICC). Convergent validity was assessed by means of Pearson correlation coefficient between the scales and three olfactory measures used as external criteria. As an additional measure of convergent validity, the relationship between AIO and OAS was also assessed. An exploratory factor analysis was carried out to determine the internal structure of the scales.

Results: The Spanish version of AIO and OAS showed a good internal consistency level with Cronbach's alpha of 0.727 and 0.906, respectively. ICC values pointed out a high test-retest reliability (AIO = 0.780; OAS = 0.895). Convergent validity of these measures was overall satisfactory. A one-factor solution was found for every scale.

Conclusions: The Spanish version of OAS and AIO scales meets psychometric criteria for establishing satisfactory reliability and validity. Thus, they could be considered as suitable research tools for the assessment of the olfactory function in Spanish general population.

© 2011 SEP y SEPB. Published by Elsevier España, S.L. All rights reserved.

[☆] Please cite this article as: Burón E, et al. Versión española de dos escalas olfatorias: fiabilidad y validez. Rev Psiquiatr Salud Ment (Barc.). 2011;4:187–94.

^{*} Corresponding author.

E-mail address: emmaburon@gmail.com (E. Burón).

PALABRAS CLAVE

Percepción olfatoria;
Conducta;
Cognición;
Emociones;
Psicometría

Versión española de dos escalas olfatorias: fiabilidad y validez**Resumen**

Introducción: Es bien conocido que los olores ejercen una influencia considerable en nuestra conducta, cognición y emociones. Por este motivo, resulta de gran utilidad disponer de instrumentos que nos permitan evaluar estos efectos.

Objetivo: Traducir y validar la versión española de la escala sobre el Impacto Afectivo de los Olores (AIO) y de la Escala sobre la Consciencia Olfatoria (OAS).

Material y método: La muestra estuvo formada por 100 participantes de la población general. La consistencia interna se evaluó mediante el alfa de Cronbach y la fiabilidad test-retest, a partir del coeficiente de correlación intraclase (ICC). Para determinar la validez convergente, se establecieron correlaciones de Pearson entre las escalas y tres medidas olfatorias utilizadas como criterio externo. Como medida adicional de validez convergente, se analizó la relación entre las escalas AIO y OAS. La estructura interna de ambas escalas se estudió mediante el análisis factorial exploratorio.

Resultados: La versión española de las escalas AIO y OAS mostró un buen nivel de consistencia interna con un alfa de Cronbach de 0,727 y 0,906, respectivamente. Los valores del ICC apuntaron un alto nivel de fiabilidad test-retest (AIO=0,780 y OAS=0,895). Así mismo, la validez convergente fue globalmente satisfactoria. Ambas escalas pueden considerarse unidimensionales.

Conclusiones: Los datos disponibles indican que las versiones españolas de las escalas AIO y OAS satisfacen adecuadamente los criterios psicométricos de fiabilidad y validez. Por este motivo, pueden considerarse herramientas de investigación útiles para la evaluación de la función olfatoria en la población general española.

© 2011 SEP y SEPB. Publicado por Elsevier España, S.L. Todos los derechos reservados.

Introduction

It is well known that smells have marked effects on behavior, cognition and on emotional responses.¹⁻⁵ However, several studies suggested that odors do not affect everybody in the same way, neither in the same magnitude. There are also substantial differences regarding to what extent people are conscious about odors and their impact.^{3,6} This variability may pertain to psychobiological propensities controlled by genetic determinants, individual exposure effects, gender, development or health, or to more general influences linked to cultural biases or expertise.⁷

Taking into account the impact of odors on our lives and the existence of individual differences, at a research level, it is very useful to have at our disposal instruments that allow us to measure it. These instruments can help us to a better understanding of the relationship between olfaction and emotion, cognition and behavior. For example, as specific applications, they can give us useful information in predicting reactions to environmental odors in various in- or outdoor settings where annoyance or adverse health effects may be an issue. Likewise, from a commercial point of view, the widespread and instrumental use of artificial fragrances for commercial applications, such as applied in store environments nowadays, evokes the question whether people notice these fragrances and how they react to them. Another valuable application of these tools could be that in an experimental setting, in mood induction studies, they

could help to identify subjects who are likely to show odor-manipulation effects.^{3,6}

There are a number of existing questionnaires in which people give self-reports related to their sense of smell.^{3,6,8-10} For example, The Odours in Everyday Life Questionnaire (OELQ), developed by Chupchik et al.,⁸ surveys the perceived role of odors in assessment of the environment, everyday life practices, sexuality, social relations, and memories. It seems to be designed with a special interest in body odors either related or unrelated to sexual attraction, as well as odor masking. It contains several items that are only very indirectly related to the olfactory function such as "Do you wear the same clothes two days in a row?". Ferdenzi et al.⁹ designed The Children's Olfactory Behavior in Everyday Life (COBEL), a tool that aims to measure the active seeking of odors, the awareness and the affective reactivity to odors of food, people and the environment, in child population. Martin et al.,¹⁰ developed a scale to explore attitudes and beliefs about the sense of the smell, The Attitudes to the Sense of Smell Questionnaire (SoSQ). Specifically, it requests information concerning liking for people, places and objects associated with odor; emotional response to odor; dispensability of odor; and uses and efficacy of odor.

There are two olfactory scales for adults that show better psychometrical properties than the aforementioned measures. We are referring to the Affective Impact of Odor (AIO) scale, developed by Wrzeniewski et al.³ and The

Odor Awareness Scale (OAS), designed by Smeets et al.⁶ The 8 AIO items ask about the impact of liked and disliked smells on reactions to new foods, new places, new cosmetic/health products and new persons. The response format for these 8 items is a four-point scale (scored 0–3). The AIO scale is calculated taking the mean of 8 items, with higher scores indicating more impact of odors on liking the aforementioned topics. In the initial study, AIO showed an adequate level of internal consistency with Cronbach's alpha estimates of 0.73 and 0.75 for the US and Belgium samples. Regarding the validity of AIO, the authors included several measures that they considered possibly related to the affective impact of odor in order to begin providing some evidence of convergent and discriminant validity for the scale. AIO was correlated with the following measures: Odor-mediated memory ($r=0.56$, $p<0.01$), Attention to odor ($r=0.30$, $p<0.01$), and Odor affect via association ($r=0.40$, $p<0.01$). The principal component analysis showed one dominant factor.

The OAS is a 32-item scale designed to assess self-reported awareness of odors in the environment. Thus, OAS captures a person's tendency to notice, pay attention to, or attach importance to odors in the environment, covering topics like food and drink, civilization, nature, and man. Response categories are not always the same, but vary considerably. Five-point scales are used in most cases, with higher scores indicating higher odor awareness. The OAS score is calculated as the sum of the items. The authors tested the hypothesis that the positive and negative odor awareness, each one separately, fitted to a single factor solution, using a confirmatory analysis on the questionnaire. The analysis showed good fit on these solutions, resulting in a positive awareness subscale (11 items with loadings between 0.343 and 0.701 and Cronbach's alpha = 0.77) and a negative awareness subscale (21 items with loadings between 0.230 and 0.637 and Cronbach's alpha = 0.80). However, it has to be mentioned that the authors performed two separate factor analysis, one for each category of items (positive and negative). The correlation between the scores of both categories was substantial ($r=0.67$, $p<0.001$). With this method of analysis it is not possible to distinguish between the solution of a single factor comprising all the items (not tested in the original paper) and the solution of two factors highly correlated.

Since there was no Spanish version of AIO and OAS, the present study aimed to validate both scales in two phases: first, scale translation and adaptation into Spanish; and secondly, the study of their psychometric properties in the healthy adult population in Spain.

Materials and methods

Subjects

The initial sample consisted of 106 Caucasian adult subjects. The inclusion criteria in our study were that participants should be between 18 and 45 years, and should be physically and psychologically able to complete the questionnaires. According to the literature on possible causes of olfactory dysfunction,^{11–15} the exclusion criteria were: (1) any condition that could alter the airflow to the

olfactory receptors, (2) any condition that could damage the olfactory membrane or the central nervous system structures involved in olfaction, (3) systemic disturbances that could alter the sense of smell, and (4) psychiatric conditions such as schizophrenia and major depressive disorder. Due to these criteria, six participants were excluded. The final sample comprised 100 participants (41 female and 59 male) between 19 and 45 years (mean age of 30.81 years and standard deviation of 7.27 years).

Participants were recruited by word of mouth from authors and took part in the study voluntarily and without receiving economical compensation. The questionnaires were introduced as ones of odors, whose purpose it was to learn about the role of the odors in our lives, and how people perceive them in their environment. All participants read and signed an informed consent form after study procedures had been fully explained. Sociodemographic data, including age, sex, and race were recorded. The anonymity of the participants' answers was preserved. The protocol for the study was reviewed and approved by the Ethics Committee of Clinical Investigation (CEIC) of the Parc de Salut Mar. This study was carried out in Catalonia (Spain) during 2009/2010.

Translation

Translation of AIO and OAS was carried out in two phases and coordinated by the Department of Psychiatry of the Parc de Salut Mar in Barcelona, Spain. First, the Spanish version was written by clinical translators. Secondly, a back-translation was carried out by an English researcher to assess the accuracy of the Spanish version. The authors of the original scales supervised and approved the back-translation. The translation and adaptation procedures were performed according to the technical guidelines for adapting tests.^{16,17}

Measures

In addition to AIO and OAS, other olfactory measures were administered to the participants. They were also used by AIO's authors³ for checking the convergent validity of their scale. They are the following: Odor-mediated memory, Attention to odor, and Odor affect via association measures. As previously mentioned in *Introduction* section, AIO's authors found that these measures correlated with AIO. For this reason, these items were selected and also translated and validated in order to assess the convergent validity of the Spanish version of AIO and OAS scales. The translation procedures were the same as for main scales.

In the Odor-mediated memory scale, 4 items assess the frequency with which good and bad smells elicit memories of places and persons. The response format is a four-point scale (scored 0–3) with the choices 'never, rarely, sometimes and often'. The memory scale is calculated as the mean of these four items, with higher scores indicating more odor-mediated memory.

The Attention to odor scale is a 3-item measure which assesses subjective attention to odors. The response format is a four-point scale (scored 0–3) with the choices

“never, rarely, sometimes and often” and a five-point scale (0–4) with the choices “a lot less, a little less, about the same, a little more and a lot more”. The attention scale is calculated as the mean of these 3 items, with higher scores indicating more attention to odor.

In the Odor affect via association scale, 2 items assess whether an odor ever came to be liked or disliked because of association with a liked or disliked person. The response format is “no and yes” (0–1). The association scale is calculated as the mean of these two items, with higher scores indicating more impact of affective responses to a person on affective response to odors associated with the person.

Statistical analysis

Data were analyzed using SPSS for Windows, version 18. Descriptive data on mean, standard deviation, percentage, median, and range were used for the sociodemographic characteristics and the questionnaires scores.

In the light of a documented higher olfactory performance in women on tests of olfactory function,^{18–20} Student’s *t*-test for independent samples was used to compare the scores between both sexes. Since it has been observed that olfactory function changes with age,^{18,21} correlations between this variable and the olfactory scales were tested by Pearson coefficient correlation.

The evaluated psychometric properties of the questionnaires included the following: (a) The internal consistency of the scales was calculated with Cronbach’s alpha coefficient.^{22,23} (b) Test–retest reliability analysis was assessed by means of intraclass correlation coefficient (ICC).^{24,25} The interval between test and retest was of one week. (c) Convergent validity was evaluated by calculating the Pearson correlation coefficient between AIO/OAS and Odor-mediated memory scale, Attention to odor scale and, Odor affect via association scale. Since we considered that the affective impact of odors (AIO) and the odor awareness (OAS) could be related, the correlation between both scales was also analyzed as an additional measure of convergent validity. (d) For the internal structure analysis for AIO and OAS scales, an exploratory factor analysis was conducted. A principal axis analysis was performed over the correlation matrix of OAS and AIO scales. Decisions regarding factor retention were based on (1) eigenvalues of at least one, (2) the theoretical interpretability of factors, and (3) the scree test.^{23,26} For original report of AIO, principal component analysis was conducted, but factor loadings of every item were not published. For the OAS, the reported results were based on a dubious approach (see *Introduction* section). Because of this, we preferred exploratory analysis, instead of confirmatory.

AIO’s authors³ formulated a question in their study about the desirability of permanent loss of the sense of smell, the hearing in one ear or the small toe. Later, OAS’ authors⁶ included this question in OAS (item 30), but they did not include it in the total score of the scale and neither in the psychometric analysis, since it was not

considered a direct measure of odor awareness. According to OAS’ authors, in the present study, this item was not included in the total scale score and it was analyzed separately: it would be expected that people who considered the loss of their smell as most unacceptable, also score higher on olfactory measures. Thus, the percentage of every response was calculated and two groups were established: (a) people who would miss most their sense of smell, and (b) people who would miss most hearing in one ear or their small toe. By means of *t* Student test for independent samples the olfactory scores of two groups were compared.

Concerning OAS,⁶ initially, item 33 included three subitems (33a, 33b and 33c). Since OAS’ authors retained only one of these subitems (33b) to improve the model fit, we carried out the statistical analysis according to this criterion.

A result was considered statistically significant if $p < 0.05$.

Results

Scale descriptives

Scores of the olfactory measures are shown in [Table 1](#). Data of the test (and not retest) have been used for the descriptive analysis. The responses of participants confirmed the wide range of importance of odors. Globally, mean scores of olfactory scales were centred in the central point of the scale, without evidence of ceiling or floor effects.

Gender and age

There were significant differences for gender only in OAS scale, i.e., mean scores were significantly higher for female than for male participants [OAS: $t(98) = 2.053$, $p = 0.043$; AIO: $t(98) = 1.092$, $p = 0.277$]. There was no significant relationship between age and olfactory scores in either scale (OAS: $r = -0.054$, $p = 0.595$; AIO: $r = -0.003$, $p = 0.073$).

Psychometric properties of the scales

Internal consistency

Cronbach’s alpha coefficient was of 0.727 for AIO and 0.906 for OAS, suggesting a good internal consistency of the scales. Cronbach’s alpha for Memory scale was 0.819, and for Attention and Association scales was 0.740 and 0.701, respectively, showing also a satisfactory internal consistency level.

Test–retest reliability

ICC for total scale was 0.780 for AIO and 0.895 for OAS, indicating a good agreement. Regarding Memory, Attention and Association scales, ICC for total score was 0.810, 0.782 and 0.702, respectively, showing all of them a good agreement.

Convergent validity

Pearson correlation coefficients between the olfactory scales are shown in [Table 2](#). AIO correlated significantly

Table 1 Descriptive data of the scales.

Scales (range of the scale)	Mean \pm SD	Median	Range
AIO (0–3)	1.99 \pm 0.41	2.00	1.125–3
OAS (32–158)	117.24 \pm 14.88	116.00	79–144
Memory (0–3)	1.86 \pm 0.66	2.00	0–3
Attention (0–3.3)	2.18 \pm 0.60	2.33	0.60–3.33
Association (0–1)	0.54 \pm 0.43	0.50	0–1

Standard deviation (SD).

and moderately with Memory and Attention, while the relationship with Association was non-significant. OAS scale showed a significant relationship with all the olfactory measures. Specifically, there was a marked correlation between OAS and Attention scores. The relationship with Memory was moderate and with Association was low. Likewise, AIO and OAS were significantly and moderately correlated. The scales used as external criteria were themselves significantly intercorrelated.

Internal structure analysis

A principal axis analysis was performed over the correlation matrix of OAS and AIO scales. The number of factors to retain was determined by the inspection of the eigenvalues, scree test and theoretical interpretability of the solution. Based on these criteria, authors considered that the internal structure of both scales could be satisfactorily explained with a one-factor solution. Concerning AIO, one dimension explained the 26.40% of the total variance. All the items showed loadings above 0.3 except item 5, and three items had loadings above 0.5 (item 3, 7 and 8) (Table 3). Regarding OAS, one factor explained the 25.87% of the total variance. 30 items loaded above 0.30 on this factor and 19 items, above 0.5. There were only two items with loadings lower than 0.3 (item 20 and 32) (Table 4).

Other questions

OAS item 30: About 50% of subjects rated the loss of their sense of smell as most unacceptable, a 46% rated the loss of their hearing in one ear as the worst option and the 3%, their little toe. Results showed that participants who valued their olfaction in a greater manner also scored significantly higher on OAS [$t(97) = 3.772$, $p < 0.001$]. Differences in AIO were only marginally significant [$t(97) = 1.865$, $p = 0.065$].

Discussion

This study aimed to translate and evaluate the psychometrical properties of the Spanish version of OAS and AIO scales. Both measures showed a good internal consistency level and the test–retest reliability was equally satisfactory. Indeed, Cronbach's alpha coefficient was 0.727 for AIO and 0.906 for OAS, suggesting that items of the scales were overall homogeneous and contributed to the internal consistency of the scales. ICC for total scale score was 0.780 for AIO and 0.895 for OAS. These data pointed out the scales displayed a good stability at an interval of one week. With reference to AIO, these results were comparable

Table 2 Pearson correlation coefficient between all olfactory scales.

Scale	AIO	OAS	Memory	Attention
OAS	0.508 ^a			
Memory	0.433 ^a	0.490 ^a		
Attention	0.405 ^a	0.692 ^a	0.428 ^a	
Association	0.182	0.246 ^b	0.448 ^a	0.217 ^b

^a $p < .001$.

^b $p < .05$.

with those of the original version since for the US and Belgium samples, Cronbach's alpha value estimates were of 0.73 and 0.75, respectively. Regarding the original OAS, the authors did not calculate Cronbach's alpha value for the total scale, but for the two dimensions they extracted (positive awareness = 0.77/negative awareness = 0.80) which was not directly comparable to the alpha value from the present study. Original OAS and AIO versions did not assess test-retest reliability.

Convergent validity was also adequate in all scales. Most correlations between the scales were only moderate and it could be explained by the following way: all the instruments assess the olfactory function but, each one is focused on a specific shade of this function. OAS correlated positively with all the olfactory measures and AIO too, except for the Association scale. This suggests that OAS and AIO were valid measures of the olfactory function. The lowest correlation between AIO and Association scale could be explained by the lower number of items of the Association scale, or perhaps this tool assesses an olfactory question less related to the olfactory construct that AIO measures. As previously mentioned, AIO's authors also found this scale was correlated with Memory ($r = 0.56, p < 0.01$), Attention ($r = 0.30, p < 0.01$) and Association ($r = 0.40, p < 0.01$). Except for the Association scale, the relationship between AIO and these measures was higher in the present study. OAS' authors did not assess the convergent validity of the scale.

Regarding the internal structure, factor analysis extracted only one dimension for every scale. These data agree with the original AIO version which displayed a factor solution of one dimension, accounting for 29% (Belgium sample) and 36% (US sample) of the total variance (principal components analysis). In contrast, OAS' authors showed that the negative and positive dimensions separately were unidimensional. We considered that a better approach was to analyze all the items simultaneously. By doing so, we found that a single factor was enough to account for the common variance. Taking into account that in both scales the unifactorial solution did not reach the 50% of the total explained variance, the construct validity of them is quite low.

Memory, Attention and Association scales were included in the study to provide more evidence of convergent validity for AIO and OAS. However, there was no Spanish version of them and as a result, they also had to be translated and their psychometrical properties had to be tested. Data suggested they were reliable and valid measures and therefore they could be used to study the convergent validity of AIO and OAS.

In this study, OAS item 30 was analyzed separately. About 50% of participants ranked their loss of smell as most unacceptable compared to the loss of hearing in one ear and the loss of their little toe. It coincided with the data of AIO's authors who also reported a 50% while OAS' authors found a higher percentage of 59.4%. It was expected that people who would miss most the sense of smell also would score higher on olfactory measures, but the differences were only statistically significant for OAS scale. Possibly, items of this scale are better than those of

Table 3 Factor loadings on the individual items of AIO scale on one factor resulting from exploratory factor analysis and the explained variance (%).

1	0.467
2	0.430
3	0.632
4	0.494
5	0.269
6	0.397
7	0.661
8	0.632
Explained variance (%)	26.40

AIO at capturing the conceded importance to the olfactory sense.

Data were analyzed according to age and gender. There was no significant relationship between age and olfactory scales. However, there was a trend towards a negative relation. It has been largely observed that olfactory function changes with age and markedly decreases above the 55–60 years.^{18,21,27} However, some studies reported that above 35 years, this function begin to decrease.^{21,27} In our sample of participants aged by 19–45 years, the results partially supported these data since the trend was present, but not reach statistical significance. In the original version of both scales, data was not assessed by age. Concerning gender, the analysis yielded that female scored higher than male in OAS, but not in AIO scale. Our results partially

Table 4 Factor loadings on the individual items of OAS scale on one factor resulting from exploratory factor analysis and the explained variance (%).

1	0.568	17	0.554
2	0.436	18	0.486
3	0.506	19	0.339
4	0.588	20	0.115
5	0.555	21	0.518
6	0.390	22	0.502
7	0.622	23	0.526
8	0.508	24	0.687
9	0.632	25	0.542
10	0.341	26	0.656
11	0.353	27	0.542
12	0.497	28	0.346
13	0.505	29	0.794
14	0.499	31	0.522
15	0.415	32	0.236
16	0.560	33b	0.383
Explained variance (%)			25.87

agree with the literature since many studies¹⁸⁻²⁰ showed a higher performance in women on tests of olfactory function. OAS' authors performed an analysis by gender on the two factor dimensions (positive and negative olfactory awareness), finding no differences between groups. Concerning AIO, our data agree with those of the original study where no significant differences were found between males and females for both US and Belgian samples.

This study had several limitations. First, potential participants who suffered some conditions that could alter markedly the olfactory sense were excluded by way of a standard interview, without exploring these conditions in depth. And secondly, the sample size of this study was small. Future research could be addressed to study these olfactory scales with larger sample sizes, in order to test their psychometric properties again. Thus, data will be statistically highly robust and it will allow the inspection of the less satisfactory items and also a more complex factor analysis. Furthermore, it would be interesting to correlate these subjective olfactory scales to psychophysical objective measures. In fact, some studies revealed that increased awareness or attention was associated with enhanced perception of olfactory and taste stimuli.^{6,28}

In conclusion, this study has yielded that Spanish versions of AIO and OAS scales are reliable and valid instruments, and therefore they may be considered as appropriate tools for the assessment of the affective impact of odors and the olfactory awareness in Spanish population. To our knowledge, these are the first olfactory scales translated into Spanish and then validated.

Conflict of interest

The authors of this study declare no conflict of interest.

Acknowledgements

The authors would like to thank Fabricio Berrios and Neil Hossack for their linguistic support and also Juan Ramón Barrada and Klaus Langohr for their help in data analysis.

References

- Baron RA. Environmentally induced positive affect: Its impact on self-efficacy, task performance, negotiation, and conflict. *J Appl Soc Psychol.* 1990;20:368-84.
- Ehrlichman H, Bastone L. The use of odour in the study of emotion. In: Toller SV, Dodd GH, editors. *Fragrance: the psychology and biology of perfume.* Londres: Elsevier Applied Science; 1992. p. 143-59.
- Wrzesniewski A, McCauley C, Rozin P. Odor and affect: individual differences in the impact of odor on liking for places, things and people. *Chem Senses.* 1999;24:713-21.
- Fiore AM, Yah X, Yoh E. Effects of a product display and environmental fragrancing on approach responses and pleasurable experiences. *MAR.* 2000;17:27-54.
- Larsson M, Willander J. Autobiographical odor memory. *Ann N Y Acad Sci.* 2009;170:318-23.
- Smeets MAM, Schifferstein HNJ, Boelema SR, Lensvelt-Mulders. The Odor Awareness Scale: a new scale for measuring positive and negative odor awareness. *Chem Senses.* 2008;33:725-34.
- Wysocki CJ, Pierce JD, Gilbert AN. Geographic, cross-cultural, and individual variation in human olfaction. In: Getchell TV, Doty RL, Bartoshuk LM, Snow JB, editors. *Smell and taste in health and disease.* Nueva York: Raven Press; 1991. p. 287-314.
- Chupchik G, Phillips K, Truong H. Sensitivity to the cognitive and affective qualities of odours. *Cogn Emot.* 2005;19:121-31.
- Ferdenzi C, Coureaud G, Camos V, Scaal B. Human awareness and uses of odor cues in everyday life: results from a questionnaire study in children. *Int J Behav Dev.* 2008;32:417-26.
- Martin GN, Apena F, Chaudry Z, Mulligan Z, Nixon C. The development of an attitudes towards the Sense of Smell Questionnaire (SoSQ) and a comparison of different professions' responses. *N Am J Psychol.* 2001;3:491-502.
- Norès JM, Biacabe B, Bonfils P. Troubles olfactifs et pathologie générale. Analyse et revue de la littérature. *Rev Med Intern.* 2000;21:95-104.
- Norès JM, Biacabe B, Bonfils P. Troubles olfactifs d'origine médicamenteuse. Analyse et revue de la littérature. *Rev Med Intern.* 2000;21:972-7.
- Doty RL, Saito K, Bromley SM. Disorders of taste and smell. In: Basbaum AI, Kaneko A, Shepherd GM, Westheimer G, editors. *The senses: a comprehensive reference.* Oxford: Elsevier Academic Press; 2008. p. 859-77.
- Doty RL, Bromley SM. Effects of drugs on olfaction and taste. *Otolaryngol Clin North Am.* 2004;37:1229-54.
- Atanasova B, Graux J, El Hage W, Hommet C, Camus V, Belzung C. Olfaction: a potential cognitive marker of psychiatric disorders. *Neurosci Biobehav Rev.* 2008;32:1315-25.
- Hambleton RK. Issues, designs, and technical guidelines for adapting tests into multiple languages and cultures. In: Hambleton RK, Merenda P, Spielberger, editors. *Adapting educational and psychological tests for cross-cultural assessment.* Mahwah, NJ: Lawrence Erlbaum; 2005. p. 3-38.
- Downing SM. Twelve steps for effective test development. In: Downing SM, Haladyna TM, editors. *Handbook of test development.* Mahwah, NJ: Lawrence Erlbaum; 2006. p. 3-25.
- Doty RL, Shaman P, Applebaum SL, Giberson R, Sikorski L, Rosenberg L. Smell identification ability: changes with age. *Science.* 1984;226:1441-3.
- Brand G, Millot JL. Sex differences in human olfaction: between evidence and enigma. *Q J Exp Psychol.* 2001;54:259-70.
- Doty RL, Cameron EL. Sex differences and reproductive hormone influences on human odor perception. *Physiol Behav.* 2009;97:213-28.
- Delahunty CM. Changing sensitivity of odour, taste, texture and mouth-feel with ageing. Workshop summary: how do age-related changes in sensory physiology influence food liking and food intake? *Food Qual Prefer.* 2004;15:907-11.
- Cronbach LJ. Coefficient alpha and the internal structure of test. *Psychometrika.* 1951;16:234-97.
- Nunnally LC, Bernstein JR. *Psychometric theory.* Nueva York: McGraw-Hill; 1994.

24. Fleiss JL. The design and analysis of clinical experiments. Nueva York: Wiley; 1986.
25. Prieto L, Lamarca R, Casado A. La evaluación de la fiabilidad en las observaciones clínicas: el coeficiente de correlación intraclass. *Med Clin (Barc)*. 1998;110:142-5.
26. Cattell RB. The scree test for the number of factors. *Multivariate Behav Res*. 1966;1:245-76.
27. Hummel T, Kobal G, Gudziol H, Mackay-Sim A. Normative data for the Sniffin' Sticks including tests of odor identification, odor discrimination, and olfactory thresholds: an upgrade based on a group of more than 3000 subjects. *Eur Arch Otorhinol*. 2007;264:237-43.
28. Marks LE, Wheeler ME. Attention and detectability of weak taste stimuli. *Chem Senses*. 1998;23:19-29.