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What a Tangled Web We Weave: Discriminating between Malingering and Anosmia

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Abstract

Two groups of normosmic subjects were instructed to feign a total olfactory loss when tested with the Olfactory Confusion Matrix (OCM). One of the groups was given specific instructions as to the number of odorants and trials in the test, as well as the number of items that might be expected to be correctly identified by chance. The responses of both groups of malingerers were compared with responses gathered from a group of anosmic patients. The groups did not differ in terms of performance level (percent correct). In spite of the similarity in terms of accuracy level, an analysis of the pattern of OCM responses to an irritant allowed the anosmic patients to be distinguished from subjects attempting to feign a loss. Subjects were given explicit details about the test performed at the same level as those simply told to feign a loss. These results suggest that the OCM is an effective tool in separating malingering from anosmia.

Introduction

'Oh, what a tangled web we weave
When first we practice to deceive.'
(Sir Walter Scott, *Marmion*, Stanza 17)

For purposes of litigation, practitioners at smell clinics are asked, on occasion, to render a professional opinion regarding the nature of a patient's olfactory loss. Although it is easy to simply report test scores, the fundamental question as to the veracity of the patient's claims often remains. Essentially, practitioners must ask themselves, 'Is the smell loss genuine?' It is unfortunate that in a time when the answer to that question is potentially worth many thousands of dollars to the patient, the olfactory practitioner's tools are still rather limited. Currently, the two most common methodologies for separating malingerers from anosmics are medical history and statistical inference.

In the detection method based on medical history, the onus is on the healthcare professional to notice some discrepancy that suggests that the patient is feigning a loss. Inconsistencies in a patient's behavior or in the chronology of a patient's history may be cues that suggest a lack of validity in the patient's complaints. Another cue to the detection of malingering may be that the medical professional notices that the constellation of symptoms reported by the patient seems in violation of generally accepted views of the functioning of the olfactory system. This may be guided by the malingerer's incorrect beliefs about anatomy or function of the human body (Hall and Pritchard, 1996), such as the mistaken belief that a loss of smell precludes detection of all aspects of all odorants or that there is an interdependence of smell and taste. Few lay people realize, for example, that the sensation of nasal irritation should be largely intact after an olfactory loss. Unfortunately, medical professionals do not particularly excel (Ekman and O'Sullivan, 1991) at this detection method and may fail to notice these subtle details.

The second methodology for detecting malingering is based on statistical inference. Most olfactory tests are amenable to this type of analysis. Typically, a significantly lower than chance level performance in a forced-choice experimental paradigm is indicative of malingering. The University of Pennsylvania Smell Identification Test (UPSIT) includes a 'malingering scale', to identify those people attempting to feign an olfactory loss. This scale was generated by statistical inference from the binomial distribution, and was verified by demonstrating that the cheating strategies of 158 people asked to feign a loss deviated from that distribution (Doty *et al.*, 1984). Since the UPSIT is a 40-item four-alternative forced-choice test, one should be able to identify roughly 10 items correctly by chance alone. Based on the binomial distribution, a score of <5 on the UPSIT would be considered probable malingering.

However, in this day of generous compensation for physical loss, patients (and their lawyers) may be highly motivated to find out as much as possible regarding a test. A reasonably well-informed person may be able to 'coach' a patient as to methods for altering the outcome of olfactory tests. Patients may also shuttle between clinics, attempting to understand the testing and to develop ways to avoid appearing to malinger. The existent methodologies of detecting malingering, based on elementary statistical techniques and consistency, may be easily taught to a subject wishing to feign a loss.

The following experiment evaluates a technique of detecting malingerers based on the patterns of odorant mis-identifications in patients whose overall level of performance is consistent with anosmia. This technique utilizes the Olfactory Confusion Matrix (OCM) (Wright, 1987; Kurtz *et al*., 1999b), which is a 121-question 10-alternative forced-choice odorant identification test with a chance performance of 10%. The OCM is an odorant identification test that, because of the large number of trials, random order of stimulus presentation and repeated odorant presentations, should not be readily susceptible to coaching. These same qualities also make the OCM ideally suited for an evaluation of response error patterns. While a general level of loss can be inferred from the number of odorants identified correctly, the potential benefit of the OCM lies in the interpretation of the PATTERN of responses rather than the percent correct *per se*. Thus, the purpose of the present study was to determine if the response patterns created by people pretending to have smell losses were different from those generated by people with genuine anosmia.

Materials and methods

Subjects

Twenty-one normosmic subjects (11 men and 10 women) between the ages of 22 and 57 years (mean ± SD 32.67 ± 9.29 years) were recruited from the community at the SUNY Health Science Center to serve as subjects. All subjects were normosmic by self-report and were paid $8.00 for their participation.

The 21 subjects were divided into two groups. The 11 members (six males/five females) of the first group (Malinger) were asked to pretend to have a total olfactory loss during their OCM testing. The 10 members (five males/five females) of the second group (Coached) were also asked to pretend to have a total olfactory loss during their OCM testing, but were 'coached' with the instruction that 10% of the odorants should be correctly identified. The person who administered the OCM did not have knowledge of a subject's group membership. None of the subjects had previously been tested with the OCM.

Ten anosmic patients (five men, five women; mean age 35.5 ± 15.9 years) also agreed to serve as subjects. These patients were either congenitally anosmic or anosmic due to head injury. None of these patients was involved in litigation related to their olfactory loss.

Table 1 Olfactory stimuli in the OCM

Odorant	Solute	Solute concentration
Ammonia	ammonia (3% household)	6.3% v/v
Cinnamon	*trans*-cinnamaldehyde	1.6% v/v
Licorice	*trans*-anethole	0.19% v/v
Mint	R-carvone	6.3% v/v
Mothballs	naphthalene	0.63% w/v
Orange	D-limonene	0.19% v/v
Rose	phenethyl alcohol	12.5% v/v
Rubbing alcohol	2-propanol	12.5% v/v
Vanilla	vanillin	0.42% w/v
Vinegar	acetic acid	25% v/v
Vex	1,2-propanediol	100% v/v

Stimuli

The 10 odorants (and one vex, or blank) listed in Table 1 were used as stimuli. All odorants were diluted with 1,2-propanediol to a total volume of 15 ml and presented to subjects in opaque amber vials.

Procedure

The OCM was performed in roughly the same fashion that it has been performed over the last 10 years (Wright, 1987; Kurtz *et al.*, 1999b). Briefly, subjects attempted to identify each of the odorants presented in 11 random blocks. Subject responses were made from a list of 10 odorant names (Table 1, with the exclusion of the vex). Block one served as a practice set and the data were omitted from analysis. Responses to the vex were not involved in the present set of analyses.

Results

Initial analysis of OCM performance of the three groups centered on percent correct. The average percent correct for each group was <20%, which is a performance range generally considered to reflect anosmia. A one-way ANOVA showed no difference between the three groups of subjects [$F(2,28) = 1.91$, $P > 0.1$].

As noted above, little difference existed between the performance accuracy of those with a true olfactory loss and those attempting to feign such a loss. Three subjects, however, were reasonably unsuccessful in their portrayal of anosmia. One subject (31% correct) in the Coached group was excluded from future analysis due to performance above the level seen in the anosmic group, and thus would be considered hyposmic. Two subjects from the Malinger group (1% correct each) were also dropped from further analysis because their performance level was less than half chance performance, a level suggested by the binomial distribution as indicative of malingering. With the exclusion of the apparently hyposmic subject and the two obvious malingerers, it would seem that all of the remaining subjects in all three groups performed at an accuracy level consistent with a complete olfactory loss (means of remaining subjects: Malinger = 12.33, Coached = 12.67, Anosmic = 15.20). However, the OCM offers an opportunity to look beyond the simple percent correct as a measure of olfactory performance to differences which could occur as a result of the pattern of subject responses.

Previous work has demonstrated that anosmic subjects can still separate trigeminal and non-trigeminal odorants (Hornung *et al.*, 1993). To explore the possibility that the three groups might differ in terms of pattern of responses on the OCM, odorant and irritant responses to vinegar were evaluated with a χ^2 analysis. Vinegar was selected for the analysis since it was subjectively the strongest trigeminal stimulant in the test. The OCM concentration for ammonia is lower than the level contained in household ammonia while that of acetic acid is higher than household vinegar. As such, ammonia is often not identified on the OCM as an irritant by patients who have no reason to feign an olfactory loss. It was hypothesized that anosmic patients would respond with a trigeminal name, either 'ammonia' or 'vinegar', most of the times that vinegar was presented to them. The response of either 'ammonia' or 'vinegar' was acceptable since both are used by anosmics when presented with an irritant. It was hypothesized that malingerers would be unwilling to indicate the detection of any odorants, and thus would respond randomly to all odorants. Accordingly, a χ^2 was calculated for each person's responses in which the number of times that vinegar was expected to be given a trigeminal name (ammonia, vinegar) by chance was two and given a non-trigeminal name was eight (cinnamon, licorice, mint, mothballs, orange, rose, rubbing alcohol, vanilla).

Figure 1 illustrates the frequency distribution of trigeminal names for anosmic patients and subjects feigning a loss. Note that most of the anosmic patients called vinegar by a trigeminal name nine or more times out of 10, while the malingerers varied considerably in their usage of trigeminal names. This was supported in the χ^2 analysis of each person's responses (Table 2). Most malingerers had small χ^2 values, whereas most anosmics had large χ^2 values. If a cut-off of seven trigeminal names is chosen (χ^2 = 15.625, $P < 0.0001$), then 16 malingerers and nine anosmics are correctly classified.

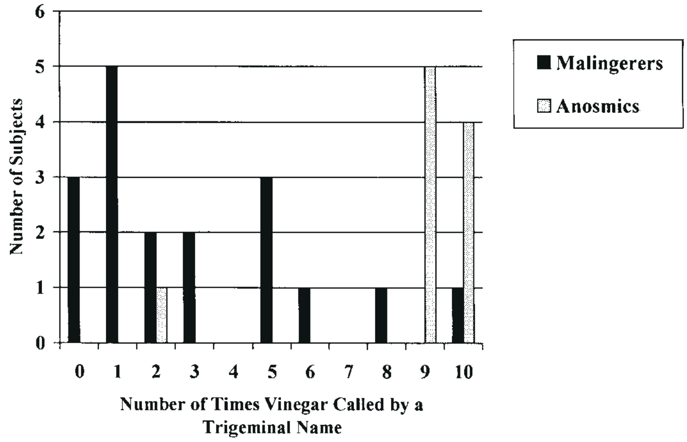

Figure 1 Number of times that vinegar was called by a trigeminal name by experimental group.

Table 2 Chi-square values for each subject's naming of vinegar

χ^2 values	Malingerers	Anosmics
0–10	16	1
11–20	0	0
21–30	0	1
31–40	2	8

Giving vinegar a trigeminal name seven times couesponds to a χ^2 value of 15.625, $P < 0.0001$.

Discussion

Generally, the veracity of a person's claim of total anosmia is assessed based on a patient's history, as well as the probability of producing a particular number of correct responses. However, in the present study there was no difference in the accuracy level of the malingering normosmics and the anosmics. Both groups of subjects produced responses that, if examined only in terms of performance level and coupled with successful deception concerning history details, would have led a clinical expert to produce a diagnosis of anosmia. In spite of the similarity between the three experimental groups in terms of accuracy level, an analysis of a pattern of OCM responses allowed the anosmic patients to be distinguished from subjects attempting to feign a loss.

The present results underscore the benefit of extending analysis beyond performance level in the detection of malingering. The pattern of OCM responses from anosmics was different from the patterns generated by either of the groups of malingerers, specifically in terms of the anosmic response patterns to trigeminal stimulants. The responses from anosmics generally indicated that an odorant had a high trigeminal component by giving it a name consistent with an irritant, while the malingerers did not. The χ^2 analysis performed for each person demonstrated that this particular difference in the pattern of performance (Table 2) could correctly differentiate between most of the malingerers and most of the anosmics. By setting an arbitrary cut-off value at seven trigeminal names, 16 of the 18 included malingers and nine of the 10 anosmics were correctly detected. However, three mis-classifications remained: one false positive and two false negatives. Moving the cut-off value upward to eight would not change this accuracy level, and decreasing it further would increase the rate of false negatives. This analysis has been based solely on the trigeminal/odorant names in response to an irritant. As described previously (Hornung *et al.*, 1993), anosmic subjects tend to apply irritant names to irritants and odorant names to non-irritants. It might be assumed that malingerers would name all odorants randomly, rather than distinguishing between them on the basis of irritation. However, a χ^2 analysis of the responses to individual non-irritants would be insensitive to malingering, due to the preponderance of non-irritants in the current formulation of the OCM. Characterizing malingerers and true anosmics by their entire OCM response pattern would take advantage of all of the response biases typical of a true anosmic (Kurtz *et al.*, 1994, 1999a).

Preliminary application of this approach to the current data suggests that complete separation of malingerers and anosmics is possible (Kurtz *et al.*, 1998).

An indirect effect of the accuracy by anosmics in the identification of irritants discussed above may have been to raise the average number correct in that group above the level expected by chance. The OCM is a 100-item test, and chance performance in the anosmic group was above the 10% level, at roughly 15% correct. Although a low level of residual olfactory ability is possible, it is more likely that the consistency in trigeminal naming resulted in a slightly higher than chance performance level. A similar phenomenon has been observed in results gathered from the UPSIT (Doty, 1984), in which the performance level of anosmics also slightly exceeded the 25% level expected by chance. This reinforces the notion that earnest patients will use whatever methods at their disposal level to attempt odorant identification, and that trigeminal stimulation can be of some use in that process.

Although overt coaching can influence test performance in some instances (Alliger *et al.*, 1996), explicit instructions in the present experiment as to the desired score on the OCM did not appear to influence the cheating strategy of the coached subject group. The two groups of malingerers did not differ in terms of percent correct. It is possible that the uncoached malingerers were able to intuitively initiate effective cheating strategies. This intuition could arise due to the relatively low level of chance performance on the OCM (10%). A subject might realize that some level of correct performance is necessary to mimic anosmic performance, but feel that while an accuracy level of 50% (two-alternative forced choice) or even 25% (four-alternative forced choice) is too high, the 10% accuracy level is acceptable. However, two aspects of the structure of the OCM could have also contributed to the similarity in performance between the coached and uncoached malingerers: the length of the test and the presence of the vex, or blank odorant. Since the OCM is a very long test, it is likely that counting or other strategies that might be effective in a shorter testing situation would be hard to maintain over a large number of trials. Further, since subjects were unaware of the presence of the vex, a counting strategy based on only 10 odorants would be disrupted.

The advantages of the OCM analysis detailed above apply so far only to the detection of someone feigning a total olfactory loss. As described, this analysis would not allow for the detection of other types of less-than-honest response styles. For example, an exaggeration of existent symptoms is less easy to detect than a normosmic individual feigning anosmia. Further, an individual feigning a partial olfactory loss would not be easily discerned. These types of malingering cannot be addressed by simple analyses of performance level alone, though it is possible that pattern analysis will address differences in response strategies that allow the detection of these more difficult malingering styles in the future.

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