Deviant olfactory experiences as indicators of risk for psychosis.

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Abstract:

Developed and tested a rating scale for assessing olfactory experiences of psychotic and psychotic-like deviancy. It was examined whether deviant olfactory experiences in a nonpsychotic sample predict the development of clinical psychosis. 31 college students who reported deviant olfactory experiences at their initial assessment exceeded the remaining 477 Ss on Diagnostic and Statistical Manual of Mental Disorders-III-Revised (DSM-III-R) psychosis and on measures of psychosis proneness at a 10-yr followup. Hypothetically psychosis-prone Ss identified by a perceptual aberration and magical ideation scales exceeded controls on ratings of olfactory experiences at both initial and follow-up assessments.

Keywords: olfactory perception | perceptual disturbances | psychosis | hallucinations | deviant olfactory experiences | psychosis proneness| college students | psychology

Article:

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Olfactory hallucinations have long been reported in patients suffering from psychotic illnesses including schizophrenia and bipolar disorder (Bleuler 1911/1950; Kraepelin 1919/1971). Olfactory hallucinations are most commonly associated with psychotic illnesses, but they can also result from epileptic seizures, senile dementia, and alcohol withdrawal syndrome (Adams and Victor 1989), or precede the onset of migraine headaches (Fuller and Guilloff 1987). Clinical lore has suggested that such symptoms in psychotic patients are indicative of severe psychopathology and poor prognosis (Sakel 1958), although little empirical support was available. The present study investigates whether deviant olfactory experiences in a nonpsychotic sample predict the development of clinical psychosis.

Olfactory Hallucinations in Psychotic Patients

Pryse-Phillips (1970, 1975) investigated 137 psychiatric patients with olfactory hallucinations. Following Zilstorff (1966), he distinguished between true hallucinations, which involve a subjective perception of an odor without an objective stimulus, and parosmias or illusions of smell, which involve a distortion in olfactory perception. Zilstorff (1966) claimed that both olfactory hallucinations and illusions occur in schizophrenia, but that hallucinations indicate more severe pathology. Pryse-Phillips (1970, 1975) indicated that olfactory hallucinations reported by patients with schizophrenia are rarely the dominant symptoms of the illness. He distinguished extrinsic hallucinations, which the patient interprets as arising externally and being caused by another person or agency, from intrinsic hallucinations, which usually involve unpleasant odors that the patient perceives as coming from himself or herself. He reported that olfactory hallucinations experienced by people with schizophrenia were typically extrinsic and odd in content, such as smells of holiness or of space aliens, and did not result in active attempts to remove the odor. The author contrasted these symptoms with the nonpsychotic olfactory reference syndrome (ORS), which is characterized by intrinsic olfactory hallucinations, an overwhelming “contrite” response to the experience, and depressive symptoms. He described ORS as “akin” to depressive disorders and did not believe that patients with ORS were necessarily at risk for developing schizophrenia.

Prognostic Implications of Olfactory Hallucinations

The relationship of olfactory hallucinations to the severity and prognosis of schizophrenia is unclear. Rubert et al. (1961) reviewed the early literature and noted a longstanding psychiatric tradition that olfactory hallucinations portend a poor prognosis. In contrast, they reported from

their own data that olfactory hallucinations are not useful prognostic indicators. However, their conclusions are questionable because they lacked a control group.

Incidence of Olfactory Hallucinations

In a review of the literature, Rubert et al. (1961) found that olfactory symptoms were uncommon (1%–4% of patients with schizophrenia). In striking contrast, however, they found that 83 percent of their own hospitalized schizophrenia patients reported olfactory hallucinations on interview. The rate of olfactory hallucinations was inflated by limiting the sample to patients who were already known to report hallucinations in at least one modality. The investigators also believed that the high rate of olfactory hallucinations was due to their asking specific questions about olfactory hallucinations, rather than assessing hallucinations through case review. They added that if the questions had not been asked, the rate would likely have fallen below 5 percent. Goodwin et al. (1971) also examined patients who were known to report at least one type of hallucination. In response to specific inquiry, 20 percent of schizophrenia patients and 18 percent of affective disorder patients reported olfactory hallucinations.

Psychoticlike Experiences and Clinical Psychosis

Chapman and Chapman (1980) reviewed clinical reports that patients with psychotic disorders often demonstrate mild or transient “psychoticlike” symptoms before decompensating into psychosis. Furthermore, in their own research, they found that hypothetically psychosis-prone college students identified by paper-and-pencil scales demonstrated a variety of psychoticlike experiences and isolated or transient psychotic symptoms. The authors concluded that psychotic symptoms could be viewed as continuously distributed between normal experiences and severe psychotic symptoms, rather than dichotomously as deviant or nondeviant. Accordingly, Chapman and Chapman (1980) developed an interview-based system for rating the deviancy of six classes of psychotic and psychoticlike experiences: thought transmission, passivity experiences, voice experiences, thought withdrawal, aberrant beliefs, and visual experiences. Each class of experiences is rated on an 11-point scale, scored 0 to 10. Scores of 2 to 5 indicate experiences considered psychoticlike, while scores of 6 to 10 are used for experiences of psychotic deviancy. A score in the psychotic range does not indicate that an individual is clinically psychotic, but rather that the experience is of the severity typically seen in psychotic patients.

Validity of Psychoticlike Experiences as a Measure of Psychosis Proneness

Chapman et al. (1994) reported the results of a 10-year longitudinal study of hypothetically psychosis-prone subjects identified by interview-based reports of psychoticlike experiences and by scores on paper-and-pencil measures of psychosis proneness. These measures included the Perceptual Aberration Scale (PerAb; Chapman et al. 1978), the Magical Ideation Scale (MagicId; Eckblad and Chapman 1983), the Impulsive-Nonconformity Scale (Noncon; Chapman et al. 1984), the Revised Physical Anhedonia Scale (PhyAnh; Chapman et al. 1976), and the Revised

Social Anhedonia Scale (SocAnh; Eckblad et al. 1982). Chapman et al. (1982) reported that the PerAb and MagicId scales are highly correlated, so subjects who scored deviantly on either scale were combined into a single Per-Mag group. Chapman et al. (1994) reported that, as hypothesized, subjects who were rated as having moderately psychoticlike experiences at the initial assessment had significantly elevated rates of clinical psychosis at the 10-year followup, and the subjects who were not clinically psychotic had more severe psychoticlike experiences.

Chapman and Chapman's (1980) rating manual did not provide a scale for assessing the deviancy of olfactory experiences. This article describes the development of such a scale and reports its usefulness for predicting psychosis and psychosis-proneness.

Method

Subjects

Subjects participating in the Chapman et al. (1994) longitudinal study of psychosis-proneness were used in the present study. The PerAb, MagicId, Noncon, PhyAnh, and SocAnh scales were administered to approximately 8,000 undergraduate students enrolled in introductory psychology courses at the University of Wisconsin-Madison during the late 1970s and early 1980s. Subjects who received a standard score of at least 1.96 on the PhyAnh, PerAb, MagicId, or Noncon scales were invited to participate in the study. This cutoff score, which was chosen because it is widely used as a method of identifying subjects with atypical personality measures, assigns an average of 6.2 percent of the subjects to the Per-Mag group, 3.3 percent to the Noncon group, and 5.5 percent to the PhyAnh group. Fourteen subjects who had combined standard scores of 3.5 or greater on the PerAb and MagicId scales were included in the PerMag group, despite the fact that they did not have standard scores of 1.96 or greater for either individual scale. An additional group of subjects who did not score deviantly on the PerAb, MagicId, PhyAnh, or Noncon scales, but had combined standard scores of at least 2.75 on the four scales were also included and referred to as the Combined Score group. Subjects whose standard scores were less than 0.5 on each of the four scales were selected as control subjects. The SocAnh scale was not used to select subjects, but scores were obtained for all subjects in the study.

At the initial selection, 34 subjects qualified for both the PerMag and Noncon groups (33 of these subjects were reinterviewed at the 10-year followup), while two subjects qualified for both the Noncon and PhyAnh groups (1 was reinterviewed). For the purpose of data analyses, these subjects were assigned to the group for which they had the highest z score. A complete description of the subjects and the longitudinal study is presented in Chapman and Chapman (1987) and in Chapman et al. (1994).

Scale for Rating Olfactory Experiences

The scale for rating olfactory experiences of psychotic and psychoticlike deviancy (see Appendix) was developed to cover the range of olfactory experiences described in the literature

and to be consistent in format with Chapman and Chapman's (1980) rating scales. It was developed by two of the authors (T.R.K. and L.J.C.), who had extensive experience assessing psychoticlike experiences. Olfactory experiences are scored on a 10-point scale of deviancy, ranging from no scorable experience, to the subject's suspicion that he or she was briefly smelling a familiar odor that no one else could smell (score of 2), to the firm conviction of smelling something judged to be very odd or deviant (score of 9). The scoring criteria listed in the rating manual represent the midpoint of a 3-point range of possible scores and are intended to be the most frequently used score for that category of experience. However, the rater may score the experience 1 point higher if it is especially deviant for that category of experience or occurs frequently, or 1 point lower if the experience is less deviant than usual. The rating scale takes into account the subject's belief in the veridicality of the experience, the duration of the experience, and the degree to which the olfactory experience is odd or implausible. For example, a report of smelling a space alien's breath would be considered more deviant than a report of smelling liver and onions.

Ratings are made only for olfactory experiences, not for the mere abstract belief that such an experience is possible. For example, the experience of smelling angels would be scored, while the mere belief that one could smell angels would not be scorable as an olfactory experience. Belief in olfactory experiences is evaluated in terms of the subject's belief in the experience at the time it occurred. For example, a subject may have genuinely believed that he or she smelled odors of death and decay but now reports the mere suspicion that it might have happened. In this scoring system, the experience would be scored as a belief because the subject believed that the experience was real when it occurred.

Experiences that are not odd and are attributed entirely to a "keen sense of smell" receive a score of 0. The interviewer should determine whether others were able to smell the odor. Olfactory experiences shared by others also are scored 0. Experiences that occur only during pregnancy, migraine headaches, or epileptic seizures, should be scored as 0, along with those that are secondary to known head injuries or occur while the subject is under the influence of drugs or alcohol. The interviewer should inquire carefully about such circumstances to rule them out as scorable phenomena. Simple experiences of smelling smoke or leaking gas are scored 0 because they tend to be relatively common and can have an adaptive value. At the followup evaluation, six subjects (three Per-Mag, two Noncon, and one control) reported relatively normal smoke or gas experiences (score of 0), while two subjects (one Per-Mag and one PhyAnh) reported deviant, scorable smoke or gas experiences, including one psychotic subject who briefly smelled smoke that no one else could smell and believed that he was "smelling the future—like a forecast" (score of 7). We score experiences only if they occurred after the subject's 13th birthday to rule out childhood fantasies.

Problems in Evaluating Hallucinations

Judging olfactory experiences as hallucinatory presents the same problems as evaluating experiences in other sensory modalities. Our scoring manual makes the conventional distinction between hallucinations (perceptual experiences in the absence of sensory stimulation) and illusions (perceptual distortions of sensory stimulation). The manual provides mostly lower scores for illusions. If the subject reports an olfactory experience together with a seemingly credible belief about the presence of underlying physical stimulation, we score the experience accordingly. However, one often lacks information on whether sensory stimulation was present. For example, if the subject reports hearing the devil threaten him or her or smelling the devil, the clinician usually does not have any information on whether any sound or odor was present. Our solution, which we believe is also the common solution in clinical practice, is to judge such experiences to be hallucinatory on the basis of the deviancy of the content.

Materials and Procedure

Subjects were interviewed after their selection into the study and again at a 10-year followup. None of the subjects were diagnosed with a psychotic illness at the initial evaluation. Table 1 presents the number of subjects in each group at the initial and followup assessments. Data analysis was limited to the 508 subjects who participated in both assessments.

Table 1. Numbers of subjects interviewed at the initial evaluation and reinterviewed at the 10-year followup

Group	Initial testing	10-year followup
Per-Mag	193	182
Noncon	74	71
PhyAnh	75	70
Combined score	33	32
Control	159	153
Total *n*	534	508

Note.—Per-Mag = Perceptual Aberration-Magical Ideation (Chapman et al. 1978; Eckblad and Chapman 1983); Noncon = Impulsive Nonconformity (Chapman et al. 1984); PhyAnh = Physical Anhedonia (Chapman et al. 1976). Combined score = subjects who did not qualify for any high-risk group but were deviant on combined scores for the four scales.

Numbers of subjects interviewed at the initial evaluation and reinterviewed at the 10-year followup

The evaluations consisted of a modified version of the Schedule for Affective Disorders and Schizophrenia-Lifetime Version (SADS–L; Spitzer and Endicott 1977) diagnostic interview. The interviews assessed psychosis, mood disorders, mental health treatment, and substance abuse. The SADS–L was modified to obtain additional information about psychoticlike experiences, including frequency, duration, and severity of symptoms, subject’s response to the experience, belief in the veridicality of the experience, subject’s explanation for the experience at the time

that it occurred, and whether the experience occurred only at particular times (such as under the influence of drugs, during a known medical condition, etc.).

The 10-year followup interview also included portions of the Personality Disorder Examination (PDE; Loranger 1988), which assesses schizotypal, schizoid, and paranoid personality disorders. In addition, subjects were rated on several measures of overall functioning, including Hollingshead's (1957) two-factor measure of social position and the Global Adjustment Scale (GAS; Endicott et al. 1976).

At both the initial and followup interviews, the subjects were asked whether they had ever experienced "strange smells that other people did not smell." During the followup interview, subjects were also asked (later in the interview, as part of the PDE) whether they "ever experienced a certain taste or odor for no apparent reason." Only 5 of the 33 subjects who gave responses other than "no" to the second question provided additional scorable information beyond that obtained by the first question. Therefore, we believe that the initial and followup interviews were comparable in obtaining information about olfactory experiences and that the reliability of the olfactory ratings should be comparable at the two assessments. If the subject acknowledged olfactory experiences, additional questions were asked to determine the specific details of these experiences and to rule out those that occurred only during particular states. Questions dealt with (1) the description of the most recent occurrence; (2) other occurrences; (3) frequency of occurrences; (4) duration of occurrences; (5) whether the experience occurred only under specific conditions, such as while in sleep states, during specific medical conditions, or under the influence of drugs; (6) the subject's explanation for the experience; (7) the subject's belief in the veridicality of the experience; (8) the subject's reaction and response to the experience; (9) the subject's belief about whether the experience was commonplace or unusual; and (10) whether, in subjects who suffered from a mood disorder, the experience occurred only during manic or depressed states.

The interviews, ratings, and diagnoses were conducted by clinical psychologists and advanced graduate students in clinical psychology who had received extensive diagnostic training. Interviewers and raters were unaware of the subjects' group membership. Diagnoses of psychotic disorders were made according to DSM–III–R criteria (American Psychiatric Association 1987). Ratings of olfactory experiences at the followup interview were completed by two independent raters (T.R.K. and M.B.M.) to assess interrater reliability, while one rater (T.R.K.) rated olfactory experiences at the initial interview. The intraclass correlation of the two raters on olfactory experiences at the followup ($r = 0.82$) and kappa ($\kappa = 0.97$) indicated high interrater reliability. The intraclass correlation was based on the assumption that differences between judges are random effects. To compute kappa, subjects were divided into those with a score of below 2 and those with a score of 2 and above. The calculation of kappa and the intraclass correlation was based only on the 59 subjects who reported any olfactory experiences at the followup (i.e., responses other than "no"), not on the entire sample. This was done to ensure that the correlation was not inflated by the obvious agreement between raters on the large number of

subjects who did not report any such experience. Reliability measures were not available for the initial interview ratings. However, we believe that the reliability of the initial ratings should be consistent with the high interrater reliability for the followup ratings because the same rater (T.R.K.) and rating scale were used and because the kind of information available in the two interviews was substantially the same.

Results

Olfactory Experiences at the Initial Interview as a Predictor of Psychosis and Psychosis Proneness

To assess whether olfactory experiences predicted risk for psychosis in a nonpsychotic sample, subjects who reported scorable psychotic or psychoticlike olfactory experiences (defined by scores of 2 or above) at the initial interview (n = 31) were compared with the remaining subjects (n = 477) at the followup assessment on the rate of clinical psychosis and on measures regarded as indicative of psychosis proneness. These measures included the subject's most deviant psychoticlike experience other than olfactory experiences, severity of schizophrenia-spectrum personality disorder symptoms, measures of overall functioning, and report of first-or second-degree relatives suffering from psychosis. Table 2 summarizes these results. The Fisher's Exact test was used to compare the groups on categorical data, while the separate-variance t-test was used for quantitative data. The 31 subjects with initial olfactory experiences included 19 PerMag, 6 Noncon, 3 PhyAnh, 1 combined score, and 2 control subjects.

Table 2. Comparisons of subjects who reported olfactory experiences at initial interview with remaining subjects

Measure	With olfactory experience (n = 31)	No olfactory experience (n = 477)
Psychosis at followup	9.7%[1]	2.3%
Relatives with psychosis	12.9%	9.4%
Highest psychoticlike experience	2.84[2]	0.99
Schizotypal dimensional score	3.35[3]	1.27
Paranoid dimensional score	1.39	0.76
Schizoid dimensional score	0.42	0.68
Global adjustment score	64.9[3]	72.1
Social position score[4]	32.3[3]	26.5

[1] $p < 0.05$ (comparisons with controls).
[2] $p < 0.001$ (comparison with controls).
[3] $p < 0.01$ (comparison with controls).
[4] Social position is a weighted composite rating of educational and occupational functioning for which higher scores indicate poorer functioning (Hollingshead 1957).

Comparisons of subjects who reported olfactory experiences at initial interview with remaining subjects

A higher proportion of subjects who reported olfactory experiences at the initial interview developed clinical psychosis at the followup evaluation than subjects who reported no such experiences ($p < 0.05$). The three subjects (all PerMag subjects) with initial olfactory experiences who became psychotic were diagnosed with paranoid schizophrenia, bipolar disorder with psychotic features, and psychosis not otherwise specified (NOS). The patient with psychosis NOS met all of the criteria for a diagnosis of schizophrenia except for a marked decline in functioning.

The subjects with initial olfactory experiences also exceeded the number of remaining subjects at the followup on ratings of most deviant psychoticlike experience other than olfactory ($p < 0.001$) and ratings of schizotypal dimensional score ($p < 0.01$). The subjects with initial olfactory experiences also were poorer at the followup assessment on ratings of global adjustment and social position (both analyses, $p < 0.01$). The groups did not differ on ratings of paranoid and schizoid dimensional score or on the proportion of subjects with psychotic relatives.

Similar results were found when the analyses were limited to the subjects initially identified as psychosis-prone by the Per-Mag scales. The Per-Mag subjects with initial olfactory experiences significantly exceeded the remaining Per-Mag subjects at the followup on highest psychoticlike experience rating, global adjustment ratings, and schizotypal dimensional score (all analyses $p < 0.01$). This group also tended to have a greater proportion of subjects who were discovered at the followup to have been psychotic ($p < 0.10$).

The finding that initial olfactory experiences predicted risk for psychosis at the followup assessment is consistent with the results for subjects identified by Chapman and Chapman's (1980) scales of psychoticlike experiences. Subjects identified by these scales at the initial assessment (with the exception of thought withdrawal, which was very rare in the sample) exceeded the number of remaining subjects on rate of psychosis and severity of psychoticlike experiences at the followup. The rate of psychosis at the followup for the initial olfactory subjects (9.7%) fell within the range of psychosis found for subjects with the other classes of initial psychoticlike experiences (7.5%–10.0%), excluding thought withdrawal. Likewise, the GAS ratings for the initial olfactory subjects (64.9) were at the low end (signifying poorer adjustment) of the narrow range found for subjects with other classes of initial psychoticlike experiences (64.9–68.1).

Olfactory Experience Ratings in Psychosis-Proneness Groups

The mean olfactory experience ratings for each group at initial and 10-year followup assessments were determined and a groups-by-interview repeated-measures analysis of variance (ANOVA) was computed. Neither the groups-by-interview interaction nor the main effect for interview was significant, ($F = 0.11$, $df = 4,503$ and $F = 0.38$, $df = 1,503$, respectively). The main effect for group was significant ($F = 4.66$, $df = 4,503$, $p < 0.01$). The Per-Mag group exceeded the control

group in olfactory experience ratings (Dunnett's separate-variance $t = 3.19$, $df = 194$, $p < 0.01$). Table 3 presents the proportion of subjects in each group who reported scorable olfactory experiences at the initial and followup assessments. The Per-Mag subjects and Noncon subjects significantly exceeded the control subjects on olfactory experiences at both assessments. Comparisons were limited to hypothetically psychosis-prone groups versus the control group, because the initial hypotheses of the study were limited to these comparisons. However, at the request of an editorial reviewer, we compared each experimental group with each other experimental group using the Tukey test for the ANOVA and Fisher's Exact test for the frequency data. These analyses replicated the initial findings, but none of the additional comparisons were significant.

Table 3. Proportion of subjects in each group with scorable olfactory experiences at initial evaluation and 10-year followup, %

Assessment	Per-Mag (n = 182)	Noncon (n = 71)	PhyAnh (n = 70)	Combined score (n = 32)	Control (n = 153)
Initial	10.4[1]	8.5[2]	4.3	3.1	1.3
Followup	7.7[3]	7.0[2]	4.3	6.2	1.3

Note.—Per-Mag = Perceptual Aberration-Magical Ideation (Chapman et al. 1978; Eckblad and Chapman 1983); Noncon = Impulsive Nonconformity (Chapman et al. 1984); PhyAnh = Physical Anhedonia (Chapman et al. 1976); Combined score = subjects who did not qualify for any high-risk group but were deviant on combined scores for the four scales.

[1] $p < 0.001$ (comparison with controls).
[2] $p < 0.05$ (comparison with controls).
[3] $p < 0.01$ (comparison with controls).

Proportion of subjects in each group with scorable olfactory experiences at initial evaluation and 10-year followup, %

Of the 182 Per-Mag subjects reinterviewed, 14 reported scorable olfactory experiences at the initial interview, while 9 did so at the 10-year followup. Five of these subjects reported olfactory experiences at both evaluations. Per-Mag subjects who reported olfactory experiences at the initial interview were more likely to report olfactory experiences at the followup than were the remaining Per-Mag subjects (Fisher's Exact test, $p < 0.01$). The comparable analyses for each of the other groups were not statistically significant. However, the difference was significant for the entire sample as a whole (Fisher's Exact test, $p < 0.001$).

Rates of Olfactory Experiences

Five percent of the entire sample reported scorable olfactory experiences at the followup evaluation. For comparison, the percentage of subjects who reported the six classes of psychoticlike experiences rated using Chapman and Chapman's (1980) manual at the followup included aberrant beliefs, 16 percent; thought transmission, 13 percent; visual experiences, 7 percent; voice experiences, 6 percent; passivity experiences, 4 percent; and thought withdrawal,

1 percent. Seventy-seven percent of the subjects who reported olfactory experiences at the followup also reported at least one other scorable psychoticlike experience. Tables 4 and 5 present intercorrelations of the highest ratings on each of the seven classes of psychoticlike experiences for all subjects at the initial interview and at the 10-year followup evaluations. It is important to note that individual psychotic and psychoticlike experiences were scored as only one class of experience, so the nonzero correlations did not reflect single events scored as different classes of psychoticlike experiences.

Table 4. Intercorrelations of the highest ratings on each of seven categories of psychoticlike experiences for all subjects at initial evaluation

Psychoticlike experience	TT	PE	AE	TW	AB	VE	OE
Thought transmission (TT)	1.00						
Passivity experiences (PE)	0.36[1]	1.00					
Auditory experiences (AE)	0.26[1]	0.40[1]	1.00				
Thought withdrawal (TW)	0.10[2]	0.21[1]	0.01	1.00			
Aberrant beliefs (AB)	0.38[1]	0.22[1]	0.25[1]	0.13[1]	1.00		
Visual experiences (VE)	0.27[1]	0.21[1]	0.29[1]	0.07	0.20[1]	1.00	
Olfactory experiences (OE)	0.18[1]	0.12[1]	0.17[1]	0.03	0.20[1]	0.19[1]	1.00

[1] $p < 0.01$.
[2] $p < 0.05$.

Intercorrelations of the highest ratings on each of seven categories of psychoticlike experiences for all subjects at initial evaluation

Table 5. Intercorrelations of highest ratings on each of seven categories of psychoticlike experiences for all subjects at 10-year followup evaluation

Psychoticlike experience	TT	PE	AE	TW	AB	VE	OE
Thought transmission (TT)	1.00						
Passivity experiences (PE)	0.44[1]	1.00					
Auditory experiences (AE)	0.27[1]	0.40[1]	1.00				
Thought withdrawal (TW)	0.12[1]	0.12[1]	0.05	1.00			
Aberrant beliefs (AB)	0.44[1]	0.51[1]	0.46[1]	0.06	1.00		
Visual experiences (VE)	0.36[1]	0.45[1]	0.43[1]	0.12[1]	0.45[1]	1.00	
Olfactory experiences (OE)	0.34[1]	0.35[1]	0.28[1]	0.14[1]	0.33[1]	0.37[1]	1.00

[1] $p < 0.01$.

Intercorrelations of highest ratings on each of seven categories of psychoticlike experiences for all subjects at 10-year followup evaluation

Olfactory Experiences in Psychotic Subjects at Followup

Fourteen subjects were diagnosed with clinical psychosis at the 10-year followup. These psychotic subjects exceeded the remaining subjects on the severity of olfactory experiences at the followup (t [separate variance] = 4.88, df = 506, $p < 0.001$). Olfactory experiences were

reported by 29 per cent of the psychotic subjects and 4 percent of the remaining subjects, a significant difference (Fisher's Exact test, $p < 0.01$).

Discussion

The present study found that deviant olfactory experiences in an initially nonpsychotic sample predicted the development of clinical psychosis at a 10-year reevaluation. Subjects who reported olfactory experiences at the initial assessment were also found to have higher rates of psychoticlike experiences, schizotypal symptoms, and poorer overall levels of functioning at the followup. These findings remained substantially unchanged when the analyses were limited to the Per-Mag group, indicating that the overall findings were not simply the result of a greater proportion of psychosis-prone Per-Mag subjects in the initial olfactory experiences group. Thus, the olfactory rating scale appears powerful enough to help identify the more psychosis-prone subjects from within a high-risk group. Furthermore, the finding that initial olfactory experiences predicted risk for psychosis and poorer overall functioning at the followup assessment is consistent with the results for subjects identified by Chapman and Chapman's (1980) scales of psychoticlike experiences.

Olfactory experiences occurred in 5 percent of our entire sample of subjects at the 10-year followup. This rate fell within the range of rates for the six other classes of psychoticlike experiences (1%–16%) reported by our entire sample at the followup. Therefore, while deviant olfactory experiences are less common than aberrant beliefs and thought transmission, they are more common than passivity experiences and thought withdrawal. Per-Mag and Noncon groups had higher proportions of subjects with scorable olfactory experiences than the control subjects at both the initial and followup evaluations. Furthermore, subjects who reported scorable olfactory experiences at the initial interview were more likely to experience further olfactory experiences during the following 10 years (23%) than the remaining subjects (4%). Parallel with Pryse-Phillips' (1970) findings for patients with schizophrenia, we found that most of our subjects who reported scorable olfactory experiences also reported at least one other scorable psychoticlike experience.

The finding that Noncon subjects exceeded control subjects on the rate and severity of olfactory experiences is consistent with the findings of Chapman et al. (1994), who reported that Noncon subjects exceeded control subjects on ratings of psychoticlike symptoms, despite the fact that they were not at a heightened risk for developing clinical psychosis. However, 10 of the Noncon subjects also qualified for the Per-Mag group. When these subjects were omitted, the Noncon group did not exceed the control group on the rate or severity of olfactory experiences at either assessment. These results suggest that the deviancy of the Noncon group on olfactory experiences may have resulted in part from the overlap of the Per-Mag and Noncon groups.

While subjects who reported initial olfactory experiences were at an increased risk for developing psychosis, the risk was not limited to schizophrenia. The initial olfactory subjects

developed both schizophrenia and affective psychosis. These findings parallel Goodwin et al.'s (1971) report of olfactory hallucinations in hallucinating affective patients and findings by Lewis et al. (1984) of olfactory hallucinations in bipolar patients.

In assessing olfactory experiences, one encounters two potential difficulties: (1) distinguishing between olfactory hallucinations (perceptions in the absence of sensory stimulation) and illusions (perceptual distortions of actual sensory stimulation) and (2) distinguishing between olfactory experiences and delusions of interpretation of sensory events that may or may not have been accurately perceived. We recognize that it may be more difficult to determine whether olfactory experiences are hallucinatory than to make that determination for visual or auditory experiences. However, we address this problem by carefully inquiring about the experience, including the subject's explanation of the phenomenon. Experiences are judged to be hallucinations, as opposed to illusions, based on information about possible odors, the subject's explanation of the experience, and the deviancy of the experience. The second problem is also not unique to olfactory experiences. Hallucinations in any sensory modality involve both the perceptual experience and the subject's interpretation of the experience. Thus, olfactory hallucinations (and, in fact, all hallucinations) involve an aberrant belief in response to the perceptual experience. We address this potential problem by categorizing an experience as a deviancy of perception or of belief based on its most prominent feature and by rating a report within only one category of psychoticlike experiences. Furthermore, we rate only reported experiences, not the belief in the possibility of such an experience.

Chapman and Chapman's (1980) manual for rating psychoticlike experiences has proven helpful in identifying groups of subjects at heightened risk for developing psychosis, and the scale for assessing deviant olfactory experiences appears to provide a useful addition to the original manual. Research on olfactory hallucinations has been rare and difficult to interpret. The present findings that deviant olfactory experiences predict both psychosis and indicators of psychosis-proneness encourage more systematic investigation of olfactory experiences. The rating scale offered here should be a useful tool in such research.

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APPENDIX

APPENDIX A: Scale for Rating Olfactory Hallucinations and Other Olfactory Experiences

Olfactory experiences are scored on a 10-point scale of deviancy. The scoring criteria represent the midpoint of a 3-point scoring range and are intended to be the most frequently used scores. However, the rater may score the experience 1 point higher if it is especially deviant for that category of experience or occurs frequently, or 1 point lower if the experience is less deviant than usual. The relative deviancy of an olfactory experience should be judged by the implausibility or bizarreness of the experience, by the embellishment of detail, and by the amount of time spent preoccupied with the experience. The highest rating attainable is a score of 10.

Ratings are made only for olfactory experiences, not for the mere abstract belief that such an experience is possible. The rating scale takes into account the subject’s belief in the veridicality of the experience, the duration of the experience, and the degree to which the olfactory experience is odd or implausible. Belief in olfactory experiences is evaluated in terms of the subject’s belief at the time the experience occurred, not at the time of the report. If the subject believed that the event was really happening at the time of the experience, it is treated as a belief, even if the subject no longer entertains the belief. If the subject merely suspected an experience

occurred or reported having incomplete belief or belief with uncertainty about an experience, it should be scored lower than firmly believed experiences.

The scoring criteria make the conventional distinction between hallucinations (perceptual experiences in the absence of sensory stimulation) and illusions (perceptual distortions of sensory stimulation). Illusory experiences tend to be scored lower than hallucinations. As with deviant perceptual experiences in other sensory modalities, it is not always possible to determine definitively whether sensory stimulation was present, even when a thorough inquiry is made by the examiner. However, as in clinical practice, deviant olfactory experiences are considered to be hallucinatory in the absence of reports of sensory stimulation.

Olfactory experiences that receive subcultural support are rated lower than experiences that do not receive such support. The extent of the subcultural support should be carefully investigated by the examiner. This includes thoroughly assessing the subject's religious or subcultural background and the degree of concordance between the content of the olfactory experience and the subject's background.

Experiences that are not odd and are attributed entirely to a "keen sense of smell" receive a score of 0. Olfactory experiences shared by others also are scored 0. Experiences that occur only during pregnancy, migraine headaches, or epileptic seizures, should be scored as 0, along with those that are secondary to head injuries or occur while the subject is under the influence of drugs or alcohol. Odors of smoke or leaking gas are scored 0 unless they are especially deviant, because we believe they are common and they tend to be adaptive. Experiences are scored only if they occurred after the subject's 13th birthday, to rule out childhood fantasies. Examples of criteria for deviancy are provided from diagnostic interviews with our subjects.

C. Same experience as in either "A" or "B" above, but subject merely suspected that the experience was veridical (or felt it even if he or she knew better) for more than a few minutes. **3**
Example: Subject suspected that he smelled chemical odors that others could not smell.

D. Same experience as in either "A" or "B" above, but subject believed the experience was veridical no longer than a few minutes or never believed it was veridical. **2**
Example: Subject has an incongruous "smell sensation" but does not believe it is real.

II. Subject hallucinated odors in a presumably hypnogogic or hypnopompic state (while resting or meditating).

A. Subject later continued to believe the experience was veridical.

1. The experience was odd. **7**
Example: While resting, subject smelled chemicals and attributed them to the influence of secret agents.

2. The experience was odd but had some subcultural support. **5**
Example: Subject experienced a foul odor while meditating and attributed it to "satanic tricks" being played on her mind.

3. The experience was not odd. **4**
Example: While meditating, subject smelled food that was not present.

B. Subject later continued to suspect the experience was veridical. **3**

C. Subject did not believe or suspect it was veridical later. **2**

III. Subject missmelled odors that are physically present continuously for more than a few moments while not resting or meditating.

A. Subject believed the experience was veridical for longer than a few minutes.

1. The experience was odd. **7**
Example: Subject misperceived an odor as garbage and believed that it came from space aliens.

2. The experience was odd but had some subcultural support. **5**
Example: Subject misperceived an odor as perfume and believed that it came from his dead girlfriend.

3. The experience was not odd. **3**
Example: Subject smelled paint and believed it was the smell of dead animals.