

Cannabis use correlates with schizotypal personality traits in healthy students

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Abstract

The literature suggests that cannabis use and schizotypal traits both constitute risk factors for the later development of schizophrenia. However, their interrelationships remain to be evaluated. The present study examined the association between cannabis use and schizotypal traits in 232 healthy students who ranged in age from 18 to 25 years. All the students had completed the Schizotypal Personality Questionnaire and four of the Chapman Psychosis Proneness Scales: the Magical Ideation Scale; the Perceptual Aberration Scale; the Revised Physical Anhedonia Scale; and the Revised Social Anhedonia Scale. Subjects were divided into three groups according to cannabis use typology: those who had never used cannabis, those who were past or occasional users, and those who were regular users. Higher scores on the Schizotypal Personality Questionnaire and the Magical Ideation Scale characterized the regular and past or occasional users compared with those who had never used cannabis. The co-occurrence of cannabis use and schizotypal traits appeared to be independent of anxiety and depression dimensions. These data suggest that cannabis use and schizotypal traits have to be jointly considered in further longitudinal studies of schizophrenia risk factors. © 2002 Elsevier Science Ireland Ltd. All rights reserved.

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1. Introduction

Co-occurrences of cannabis use/abuse with other psychiatric disorders have been well described (Halikas et al., 1972), particularly with schizophrenia (Tennant and Groesbeck, 1972; Breakey

et al., 1974; Caspari, 1999; Hall and Degenhardt, 2000). Cannabis ingestion in naive users or increasingly heavy use in regular users can precipitate a schizophreniform episode, and heavy users may have an increased risk of later developing schizophrenia (Thornicroft, 1990). The relationships between cannabis use and the onset of schizophrenia were clearly established in a 15-year prospective study based on 45 570 Swedish mili-

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tary conscripts; heavy cannabis users ran approximately three to six times the risk of developing schizophrenia compared with non-users (Andreasson et al., 1987, 1989). In the same way, Allebeck et al. (1993) identified 112 inpatients with both diagnoses of cannabis dependence and DSM-III-R schizophrenia during 12 years of follow-up by means of the Stockholm County inpatient care register. Sixty-nine percent of patients with schizophrenia admitted heavy cannabis consumption at least 1 year before the onset of psychotic symptoms. Such evidence led some investigators to consider cannabis as a full-range etiological factor of schizophrenia (Andreasson et al., 1989). Even if this last viewpoint is far from universally held, cannabis use is widely included among schizophrenia risk factors, at least in individuals at high risk for the disorder (Linszen et al., 1994). On the other hand, it has been shown that schizotypal personality disorder (SPD) or even some schizotypal traits are predictors of the later development of schizophrenia (Chapman et al., 1994; Kwapil et al., 1997).

Although cannabis use and schizotypal personality traits both constitute risk factors for schizophrenia, relatively few investigators have looked into their relationship in non-clinical samples of young individuals (Kwapil, 1996; Williams et al., 1996). Kwapil (1996) reported that subjects with high schizotypal positive traits measured by the Perceptual Aberration Scale (Chapman et al., 1978) and the Magical Ideation Scale (Eckblad and Chapman, 1983) exceeded a control group on rates of substance use disorders. These subjects demonstrated preferential patterns of substance use similar to those reported for patients with schizophrenia. Similarly, Williams et al. (1996) found that high schizotypal traits measured by the Schizotypal Personality Scale (Claridge and Broks, 1984) discriminated subjects who had used cannabis from never-users, whether or not they reported having used other recreational drugs. Furthermore, the relationship between cannabis use and schizotypy could be influenced by other psychopathological traits. Some studies, for example, have found high levels of anxiety and depression symptoms in both individuals with schizotypal traits (Lenzenweger and Loranger, 1989; Braun-

stein-Bercovitz, 2000; Pickard et al., 2000) and cannabis users (Reilly et al., 1998; Troisi et al., 1998).

Hence, the aim of the present study was to assess whether cannabis use correlates with schizotypal traits in young healthy individuals after adjustment for potential confounding factors like anxiety and depression dimensions. We predicted that cannabis users would exhibit more positive (or psychotic-like) schizotypal traits compared with never-users regardless of their anxiety or depression dimension levels.

2. Methods

2.1. Subjects

Healthy students ($n=232$) of both genders and from 18 to 25 years old were recruited from two universities through public advertising that offered \$50 in exchange for participation in a 'study on character traits and personality.' One of them was a university of health sciences (University of Lyon I, France), which included schools of medicine, pharmacology, physiotherapy and dental care, while the other was involved in political sciences (University of Lyon II, France). Experiments were conducted with the understanding and the written consent of each subject after being approved by the responsible Ethical Committee of Lyon B. All subjects were free of serious somatic illness and of a personal history of psychosis as determined by the Schedule for Affective Disorders and Schizophrenia (Fyer et al., 1985); none of them had ever received antipsychotic medications.

Cannabis use was anonymously explored by means of a short personal interview, which contained three dichotomous questions: (1) Did you ever use cannabis in your life, even only once? (2) Do you currently use cannabis? (3) If yes, do you use cannabis more or less than twice a week? The choice of frequency was based on a recent study showing that 94% of long-term cannabis users consume that substance twice a week or more (Reilly et al., 1998). Students were assigned to the following three groups: never-users (NU), who had never used cannabis; past or occasional users (POU), who had used cannabis at least once

in the past or currently used cannabis fewer than two times per week; and regular users (RU), who used cannabis twice a week or more.

2.2. Psychometric investigations

Students were instructed not to report drug-related experiences when they completed their questionnaires.

The specific psychometric evaluation for SPD and psychosis proneness (outcome factors) included the following questionnaires:

1. Four of the Psychosis Proneness Scales (PPS) developed by Chapman and colleagues to study schizotypal traits that are often reported among subjects who later develop psychotic disorders. The Magical Ideation Scale (MIS; Eckblad and Chapman, 1983; French version: Dumas et al., 1999a) and the Perceptual Aberration Scale (PAS; Chapman et al., 1978; French version: Dumas et al., 1999a) were used to assess positive (i.e. psychotic-like) schizotypal traits. The Revised Physical Anhedonia Scale (PhA; Chapman and Chapman, 1978; French version: Assouly-Besse et al., 1995) and the Revised Social Anhedonia Scale (SA; Mishlove and Chapman, 1985; French version: Assouly-Besse et al., 1995) were used to assess negative (i.e. deficit-like) schizotypal traits.
2. The Schizotypal Personality Questionnaire (SPQ; Raine, 1991; French version: Dumas et al., 1999b), which contains nine sub-scales that each correspond to the nine DSM-IV criteria used to define schizotypal personality disorder (SPD): ideas of reference; excessive social anxiety; odd beliefs or magical thinking; unusual perceptual experiences; odd or eccentric behavior; no close friends; odd speech; constricted affect; and suspiciousness (American Psychiatric Association, 1994).

Other variables, namely anxiety and depression dimensions (viewed as confounding factors), were explored with the following questionnaires:

1. The State-Trait Anxiety Inventory (STAI-YA and STAI-YB; Spielberger, 1983; French version: Schweitzer and Paulhan, 1990), which allows investigators to study both the usual

level and the present level of anxiety at the time of testing.

2. The short form of the Beck Depression Inventory (Beck 13; Beck and Beamesderfer, 1974; French version: Bourque and Beaudrette, 1982), which is frequently used to assess the existence and the intensity of a depressive state.

2.3. Statistical analysis

Firstly, we analyzed the demographic characteristics and psychometric scores of the 232 students according to their cannabis use typology. Qualitative characteristics were compared using the chi-square test; quantitative characteristics (mean $\pm$ standard deviation) were compared using ANOVA.

Secondly, the relationship between cannabis use and psychometric scores was explored using a mixed model, i.e. a variance–component analysis (VanLeuwen et al., 1998; Gibbons, 2000) with adjustment for gender, depression score (Beck-13), and state and trait anxiety scores (STAI-YA and STAI-YB). The significance of the effects was tested by *t*-test. In this analysis, independent variables were entered successively: cannabis use for Model 1; cannabis use and gender for Model 2; cannabis use, gender and score on the Beck-13 for Model 3; cannabis use, gender and score on the STAI-YA for Model 4; cannabis use, gender and score on the STAI-YB for Model 5; and all the above variables for Model 6.

The analyses were carried out using SAS (SAS Institute, Cary, NC) and MLwiN (Multilevel Models Project Institute of Education).

3. Results

Table 1 presents comparisons of demographic characteristics in the three groups (NU, POU and RU). The sample comprised 125 female and 107 male students with an average age of 21.17 ± 1.47 years and an average educational level of 13.36 ± 1.06 years. There were 126 subjects in the NU subgroup, 65 subjects in the POU subgroup and 41 subjects in the RU subgroup.

Table 2 presents mean scores on the psychological measures and comparisons by ANOVA among the three cannabis-use subgroups. The three sub-

Table 1

Demographic characteristics in a sample of 232 students according to their cannabis use typology

	All subjects <i>n</i> = 232	Cannabis never users (NU) <i>n</i> = 126	Cannabis past or occasional users (POU) <i>n</i> = 65	Cannabis regular users (RU) <i>n</i> = 41	<i>P</i> value
Gender (males/females)	107 M/125 F	45 M/81 F	27 M/38 F	35 M/6 F	<0.0005 ^a
Age (mean years $\pm$ S.D.)	21.17 $\pm$ 1.47	21.29 $\pm$ 1.48	20.97 $\pm$ 1.44	21.12 $\pm$ 1.47	NS ^b
Educational level (mean years $\pm$ S.D.)	13.36 $\pm$ 1.06	13.43 $\pm$ 1.08	13.32 $\pm$ 1.17	13.20 $\pm$ 0.78	NS ^b

^a Chi-square.^b ANOVA. Significance level at 0.05; NS = non-significant.

groups differed significantly on the MIS ($P=0.002$), SPQ Total ($P=0.002$), SPQ Unusual Perceptual Experiences ($P=0.004$), SPQ Odd or Eccentric Behavior ($P=0.003$), SPQ Constricted Affect ($P=0.023$) and Beck-13 ($P=0.017$) scores. Table 3 presents the potential common effects of cannabis use and covariates (depression, state and trait anxiety) on the schizotypal psychometric variables.

We assessed specific effects of cannabis use on PPS and SPQ total scores for the three subgroups with and without adjustments for covariates. In the NU subgroup, mean MIS and SPQ Total scores remained significantly lower after all adjustments compared with scores for the POU and RU subgroups. The PAS mean score was significantly lower in the NU subgroup than in the RU subgroup, but the difference disappeared after adjustments according to Models 3–6 (i.e. depression and/or anxiety scores as covariates). No difference was observed, with or without adjustments, between the NU and RU subgroups for SA and PhA mean scores. To further assess each DSM-IV criterion for SPD, we analyzed the specific effects of cannabis use on the PPS and the nine SPQ subscale scores, with and without adjustments. Mean scores were significantly lower in the NU than in the POU subgroup for MIS, SPQ Unusual Perceptual Experiences and SPQ Odd Speech with and without adjustment. In the same way, the mean score for SPQ Constricted Affect was lower in the NU subgroup than in the POU subgroup, but the difference disappeared after adjustments according to Models 3–6. There were no other significant differences between these two groups. When the

RU and NU subgroups were compared, significantly lower scores were observed in the NU subgroup for MIS, SPQ Ideas of Reference, SPQ Unusual Perceptual Experiences and SPQ Odd or Eccentric Behavior, with and without adjustments. Similarly, the NU subgroup had significantly lower scores for PAS, SPQ Odd Beliefs or Magical Thinking and SPQ Constricted Affect, but these differences disappeared after adjustments according to Models 3–6 (Table 3 lists only significant values).

4. Discussion

The aim of this study was to examine the association between cannabis use and schizotypal traits in young, healthy individuals after adjustment for potentially confounding factors like depression and anxiety dimensions. The principal findings were in accordance with our predictions: (1) correlations emerged between cannabis use and several positive schizotypal traits (MIS; PAS; SPQ Total; SPQ Ideas of Reference; SPQ Unusual Perceptual Experiences; SPQ Odd Beliefs and Magical Thinking; and SPQ Odd or Eccentric Behavior) and one negative schizotypal trait (SPQ Constricted Affect), with no gender effect. (2) These correlations were not influenced by anxiety and depression scores for most positive schizotypal traits: MIS; SPQ total; SPQ Ideas of Reference; SPQ Unusual Perceptual Experiences; and SPQ Odd or Eccentric Behavior. Such findings are consistent with previous data on the same topic (Williams et al., 1996; Kwapil, 1996).

Table 2

Psychometric mean scores ($\pm$ S.D., range) according to cannabis use typology in a sample of 232 students

Scales		All students (<i>n</i> = 232)	Cannabis never users (NU) (<i>n</i> = 126)	Cannabis past or occasional users (POU) (<i>n</i> = 65)	Cannabis regular users (RU) (<i>n</i> = 41)	<i>P</i> value ANOVA
PPS	SA	7.97 $\pm$ 4.84 (1–28)	7.79 $\pm$ 5.07 (1–28)	7.37 $\pm$ 4.25 (1–22)	9.39 $\pm$ 4.80 (2–21)	0.097
	PhA	11.70 $\pm$ 5.92 (1–35)	12.00 $\pm$ 6.04 (1–35)	10.54 $\pm$ 5.82 (1–26)	12.76 $\pm$ 5.51 (5–26)	0.133
	PAS	5.68 $\pm$ 5.55 (0–33)	4.94 $\pm$ 5.22 (0–26)	6.08 $\pm$ 5.68 (0–33)	7.19 $\pm$ 6.08 (0–24)	0.068
	MIS	8.05 $\pm$ 5.50 (0–25)	6.93 $\pm$ 5.37 (0–25)	8.86 $\pm$ 5.28 (0–24)	10.09 $\pm$ 5.56 (1–21)	0.002
SPQ	Global	23.09 $\pm$ 12.13 (1–54)	20.60 $\pm$ 11.86 (1–51)	25.05 $\pm$ 11.45 (1–54)	27.60 $\pm$ 12.38 (6–52)	0.002
	Ideas of reference	3.09 $\pm$ 2.31 (0–9)	2.70 $\pm$ 2.24 (0–9)	3.34 $\pm$ 2.28 (0–8)	3.90 $\pm$ 2.35 (0–9)	0.008
	Excessive social anxiety	3.00 $\pm$ 2.20 (0–8)	2.83 $\pm$ 2.22 (0–8)	3.18 $\pm$ 2.15 (0–8)	3.20 $\pm$ 2.22 (0–8)	0.472
	Odd beliefs or magical thinking	2.01 $\pm$ 2.01 (0–7)	1.76 $\pm$ 1.89 (0–7)	2.18 $\pm$ 1.93 (0–7)	2.51 $\pm$ 2.40 (0–7)	0.083
	Unusual perceptual experiences	2.94 $\pm$ 2.37 (0–9)	2.48 $\pm$ 2.20 (0–9)	3.34 $\pm$ 2.35 (0–9)	3.71 $\pm$ 2.63 (0–9)	0.004
	Odd or eccentric behavior	2.22 $\pm$ 1.92 (0–7)	1.91 $\pm$ 1.84 (0–6)	2.28 $\pm$ 1.82 (0–7)	3.07 $\pm$ 2.11 (0–7)	0.003
	No close friends	1.42 $\pm$ 1.49 (0–6)	1.33 $\pm$ 1.46 (0–6)	1.45 $\pm$ 1.51 (0–5)	1.68 $\pm$ 1.56 (0–6)	0.407
	Odd speech	3.47 $\pm$ 2.18 (0–8)	3.16 $\pm$ 2.14 (0–8)	3.90 $\pm$ 2.21 (0–8)	3.76 $\pm$ 2.15 (0–8)	0.057
	Constricted affect	1.99 $\pm$ 1.70 (0–8)	1.71 $\pm$ 1.55 (0–7)	2.26 $\pm$ 1.79 (0–8)	2.41 $\pm$ 1.87 (0–8)	0.023
	Suspiciousness	2.46 $\pm$ 2.17 (0–8)	2.24 $\pm$ 2.10 (0–8)	2.62 $\pm$ 2.28 (0–8)	2.88 $\pm$ 2.18 (0–7)	0.205
	STAI-YA	35.25 $\pm$ 11.46 (20–74)	34.45 $\pm$ 11.68 (20–74)	36.08 $\pm$ 10.82 (20–70)	36.41 $\pm$ 11.85 (20–70)	0.506
	STAI-YB	42.40 $\pm$ 10.26 (22–70)	41.79 $\pm$ 10.02 (22–68)	43.43 $\pm$ 9.88 (25–70)	42.61 $\pm$ 11.66 (24–66)	0.575
Beck 13		3.84 $\pm$ 3.73 (0–19)	3.36 $\pm$ 3.35 (0–14)	3.88 $\pm$ 4.03 (0–18)	5.27 $\pm$ 4.07 (0–19)	0.017

Abbreviations: SA: Revised Social Anhedonia Scale; PhA: Revised Physical Anhedonia Scale; PAS: Perceptual Aberrations Scale; MIS: Magical Ideation Scale; SPQ: Schizotypal Personality Questionnaire; STAI-YA: State and Trait Anxiety Inventory (state form); STAI-YB: State and Trait Anxiety Inventory (trait form); Beck-13: Beck Depression Inventory (13-item form); significance level at 0.05; NS = non-significant.

Before discussing these results, we have to address some methodological aspects. Firstly, the fact that subjects were not randomly selected could have led to possible biases. However, the observed ratio of subjects who reported current or past cannabis use (45.7%) was close to those reported in large samples of young, healthy individuals

(Thomas, 1996; Poulton et al., 1997). Secondly, the POU subgroup may be heterogeneous since it contained both cannabis occasional users and currently abstinent cannabis past users. However, the latter subjects were rare and none had ever been a regular user. Thirdly, cannabis use was evaluated only through a direct interview. A more rigorous

Table 3

Specific effect of being cannabis Regular User (RU) vs. Never User (NU) on Psychosis Proneness Scales (PPS: i.e. SA, PhA, PAS, MIS) scores and on each of the nine sub-scale scores on the Schizotypal Personality Questionnaire (SPQ) without and after adjustments for potential confounding factors in a sample of 232 students

Parameters	1	2	3	4	5	6
S.A.						
Ph.A.						
M.I.S.	0.060 (0.019)	0.059 (0.019)	0.041 (0.018)	0.052 (0.018)	0.049 (0.018)	0.043 (0.018)
P.A.S.	0.042 (0.019)	0.041 (0.019)				
SPQ (global)	0.221 (0.067)	0.210 (0.070)	0.145 (0.067)	0.184 (0.067)	0.173 (0.067)	0.153 (0.066)
SPQ subscales						
–Ideas of reference ^a	0.055 (0.019)	0.054 (0.019)	0.036 (0.018)	0.047 (0.018)	0.044 (0.018)	0.038 (0.018)
–Excessive social anxiety ^a						
–Odd beliefs or magical thinking ^a	0.04 (0.019)	0.038 (0.019)				
–Unusual perceptual experiences ^a	0.055 (0.019)	0.053 (0.019)	0.036 (0.018)	0.047 (0.018)	0.043 (0.018)	0.038 (0.018)
–Odd or eccentric behavior ^a	0.064 (0.019)	0.063 (0.019)	0.045 (0.018)	0.056 (0.018)	0.052 (0.018)	0.047 (0.018)
–No close friends ^a						
–Odd speech ^a						
–Constricted affect ^a	0.044 (0.019)	0.042 (0.019)				
–Suspiciousness ^a						

Mean values ($\pm$ S.D.) of multilevel linear estimates of parameters (only significant values are reported). Only significant effect of cannabis used on psychometric scores are reported in the table. Cannabis use for Model 1; cannabis use and gender for Model 2; cannabis use, gender and score at Beck-13 for Model 3; cannabis use, gender and score at STAI-YA for Model 4; cannabis use, gender and score at STAI-YB for Model 5; and all the above variables for Model 6. *Abbreviations*: SA: Revised Social Anhedonia Scale; PhA: Revised Physical Anhedonia Scale; PAS: Perceptual Aberrations Scale; MIS: Magical Ideation Scale.

^a Schizotypal Personality Questionnaire subscales.

method involving biological analyses would have allowed a more accurate assessment of their actual — past or current — cannabis consumption. However, self-reports on cannabis use have been shown to have high correlations with biological measures (Martin et al., 1988).

Men were more likely than women to be regular users of cannabis in our healthy sample. This parallels findings in clinical samples (Compton et al., 2000). Moreover, among scales evaluating schizotypal traits, gender differences were observed only for SA, with significantly higher scores in men ($t=3.566$, d.f. = 231, $P<0.001$), corroborating previous data (Raine, 1992; Miller and Burns, 1995). However, gender did not influence the observed correlations between cannabis

use and schizotypal scores in our sample (Table 3, Model 2). Several studies have shown that SPD may be associated with anxiety and depression (Bornstein et al., 1988; Braunstein-Bercovitz, 2000). Furthermore, links between cannabis use and anxiety or depression have been reported (Troisi et al., 1998; Reilly et al., 1998). In the present sample, anxiety scores did not differ among the three subgroups, but depression scores increased along with the level of cannabis use (Table 2). However, the observed associations between cannabis use and schizotypal traits were influenced both by depression (Model 3) and state or trait anxiety (Models 4 and 5) scores for PAS, SPQ Odd Beliefs and Magical Thinking, and SPQ Constricted Affect (Table 3). Lenzenweger and

Loranger (1989) have also reported strong correlations between anxiety or depression and PAS scores. The fact that no significant correlation was observed between depression, or anxiety, and SPQ Unusual Perceptual Experiences may reflect substantial structural differences between this SPQ subscale and the PAS. The same explanation could apply to the MIS and SPQ Odd Beliefs and Magical Thinking. The correlation between cannabis use and SPQ Constricted Affect, i.e. a negative schizotypal trait, disappeared after adjustment for depression or anxiety scores (Models 3–5). This also could be attributed to the structure of this SPQ subscale. Indeed, when one looks at the eight items that compose it, at least five of them could partially overlap with anxious or depressive symptoms. After adjustment for gender, depression and anxiety, cannabis use was correlated only to positive schizotypal traits (Model 6). Such a relationship could be explained by three hypotheses: (1) direct pharmacological effects of cannabis lead to schizotypal traits; (2) schizotypal traits lead to cannabis use; or (3) there is a direct link between the two phenomena. Concerning the first hypothesis, it is well known that cannabis use can increase positive symptoms in schizophrenic patients (Negrete et al., 1986). Such a relationship could be mediated by dopaminergic hyperactivity. Indeed, cannabinoids are known to increase the activity of dopaminergic neurons in the ventral tegmental area–mesolimbic pathway (Ameri, 1999). Despite a lack of convincing support for a separate clinical diagnosis of so-called ‘cannabis psychosis’ (Thornicroft, 1990), the facilitation of the mesolimbic dopaminergic system could explain the short-term persistence of psychotic-like effects after cannabis intoxication. Precisely to limit the risk of contamination of questionnaire responses by drug effects, we instructed subjects not to report drug-related experiences when they completed the questionnaires. If the pharmacological effect of cannabis cannot fully explain the observed association, the possibility remains that subjects with high schizotypal scores may ‘self-medicate’ with cannabis. In accordance with the ‘self-medication’ hypothesis evoked in schizophrenia (Peralta and Cuesta, 1992), the schizotypal individuals could attempt to reduce their negative symptoms by

using a psychostimulant agent, increasing in return the intensity of their positive symptoms. Finally, the observed association between positive schizotypal traits and cannabis use could be only a co-occurrence without any causal link. However, these two phenomena could both depend on a common ethiopathological factor. On the basis of the cannabinoid hypothesis of schizophrenia (Schneider et al., 1998; Leweke et al., 1999), the endogenous cannabinoid system could be postulated to lead both to a vulnerability to schizophrenia-spectrum symptoms and to a vulnerability to cannabis consumption. These hypotheses each appear viable, and further studies could help to decide between them.

The association between cannabis use and schizotypal traits suggests that further studies on schizophrenia vulnerability might take into account cannabis use among other variables considered to be risk factors for schizophrenia.

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References

- Allebeck, P., Adamsson, C., Engstrom, A., 1993. Cannabis and schizophrenia: a longitudinal study of cases treated in Stockholm County. *Acta Psychiatrica Scandinavica* 88, 21–24.
- Ameri, A., 1999. The effects of cannabinoids on the brain. *Progress in Neurobiology* 58, 315–348.
- American Psychiatric Association, 4th ed., 1994. *DSM-IV: Diagnostic and Statistical Manual of Mental Disorders*. American Psychiatric Association, Washington, DC.
- Andreasson, S., Allebeck, P., Engstrom, A., Rydberg, U., 1987. Cannabis and schizophrenia: a longitudinal study of Swedish conscripts. *Lancet* ii, 1483–1485.

- Andreasson, S., Allebeck, P., Rydberg, U., 1989. Schizophrenia in users and nonusers of cannabis. A longitudinal study in Stockholm Country. *Acta Psychiatrica Scandinavica* 79, 505–510.
- Assouly-Besse, F., Dollfus, S., Petit, M., 1995. Traduction française des questionnaires d'anhédonie sociale et physique de Chapman: validation de la traduction française à partir de témoins et de patients schizophrènes. *Encephale* 21, 273–284.
- Beck, A.T., Beamesderfer, A., 1974. Assessment of depression: the Depression Inventory. In: Pichot, P. (Ed.), *Psychological Measurements in Psychopharmacology. Modern Problems in Pharmacopsychiatry*, Vol. 7. pp. 151–159.
- Bornstein, R.F., Klein, D.N., Mallon, J.C., Slater, J.F., 1988. Schizotypal personality disorder in an outpatient population: incidence and clinical characteristics. *Journal of Clinical Psychology* 44, 322–325.
- Bourque, B., Beaudrette, C., 1982. French version of the Beck 13, Unpublished translation.
- Braunstein-Bercovitz, H., 2000. Is the attentional dysfunction in schizotypy related to anxiety? *Schizophrenia Research* 46, 255–267.
- Breakey, W., Goodel, H., Lorenz, P.C., McHugh, P.R., 1974. Hallucinogenic drugs as precipitants of schizophrenia. *Psychological Medicine* 4, 255–261.
- Caspari, D., 1999. Cannabis and schizophrenia: results of a follow-up study. *European Archives of Psychiatry and Clinical Neurosciences* 249, 45–49.
- Chapman, L.J., Chapman, J.P., 1978. Revised Physical Anhedonia Scale. Unpublished scale. University of Wisconsin, Madison, WI.
- Chapman, L.J., Chapman, J.P., Kwapil, T.R., Eckblad, M.L., Zinser, M.C., 1994. Putatively psychosis prone individuals ten years on. *Journal of Abnormal Psychology* 103, 171–183.
- Chapman, L.J., Chapman, J.P., Raulin, M.L., 1978. Body-image aberration in schizophrenia. *Journal of Abnormal Psychology* 87, 399–407.
- Claridge, G.S., Broks, P., 1984. Schizotypy and hemisphere function: I. Theoretical considerations and the measurement of schizotypy. *Personality and Individual Differences* 5, 633–648.
- Compton, W.M., Cottler, L.B., Ben Abdallah, A., Phelps, D.L., Spitznagel, E.L., Horton, J.C., 2000. Substance dependence and other psychiatric disorders among drug dependent subjects: race and gender correlates. *American Journal of Addiction* 9, 113–125.
- Dumas, P., Daléry, J., Saoud, M., d'Amato, T., 1999. Traductions et adaptations françaises des questionnaires d'idéation magique (MIS; Eckblad and Chapman, 1983) et d'aberrations perceptives (PAS; Chapman et coll. 1978). *Encephale* 25, 422–428.
- Dumas, P., Rosenfeld, F., Saoud, M., Daléry, J., d'Amato, T., 1999. Traduction et adaptation française du questionnaire de personnalité schizotypique de Raine (SPQ). *Encephale* 25, 315–322.
- Eckblad, M.L., Chapman, L.J., 1983. Magical Ideation as an indicator of schizotypy. *Journal of Consulting and Clinical Psychology* 51, 215–225.
- Fyer, A.J., Endicott, J., Mannuzza, S., Klein, D.F., 1985. Schedule for Affective Disorders and Schizophrenia — Lifetime Anxiety Version. New York State Psychiatric Institute, New York.
- Gibbons, R.D., 2000. Mixed-effects models for mental health services research. *Health Services and Outcomes Research Methodology* 1, 91–129.
- Halikas, J., Goodwin, D., Guze, S., 1972. Marijuana use and psychiatric illness. *Archives of General Psychiatry* 27, 162–165.
- Hall, W., Degenhardt, L., 2000. Cannabis use and psychosis: a review of clinical and epidemiological evidence. *Australian and New Zealand Journal of Psychiatry* 34, 26–34.
- Kwapil, T.R.A., 1996. Longitudinal study of drug and alcohol use by psychosis-prone and impulsive-nonconforming individuals. *Journal of Abnormal Psychology* 105, 114–123.
- Kwapil, T.R., Miller, M.B., Zinser, M.C., Chapman, J.P., Chapman, L.J., 1997. Magical ideation and social anhedonia as predictor of psychosis proneness: a partial replication. *Journal of Abnormal Psychology* 106, 491–495.
- Leweke, F.M., Giuffrida, A., Wurster, U., Emrich, H.M., Piomelli, D., 1999. Elevated endogenous cannabinoids in schizophrenia. *Neuroreport* 10, 1665–1669.
- Lenzenweger, M.F., Loranger, A.W., 1989. Psychosis proneness and clinical psychopathology: examination of the correlates of schizotypy. *Journal of Abnormal Psychology* 98, 3–8.
- Linszen, D.H., Dingemans, P.M., Lenior, M.E., 1994. Cannabis abuse and the course of recent-onset schizophrenic disorders. *Archives of General Psychiatry* 51, 273–279.
- Martin, G.W., Wilkinson, D.A., Kapur, B.M., 1988. Validation of self-reported cannabis use by urine analysis. *Addiction Behavior* 13, 147–150.
- Miller, L.S., Burns, S.A., 1995. Gender differences in schizotypic features in a large sample of young adults. *Journal of Nervous and Mental Disease* 183, 657–661.
- Mishlove, M., Chapman, L.J., 1985. Social anhedonia in the prediction of psychosis proneness. *Journal of Abnormal Psychology* 94, 384–396.
- Negrete, J.C., Knapp, W.P., Douglas, D.E., Smith, W.B., 1986. Cannabis affects the severity of schizophrenic symptoms: results of a clinical survey. *Psychological Medicine* 16, 515–520.
- Peralta, V., Cuesta, M.J., 1992. Influence of cannabis abuse on schizophrenic psychopathology. *Acta Psychiatrica Scandinavica* 85, 127–130.
- Pickard, M., Bates, L., Dorian, M., Greig, H., Saint, D., 2000. Alcohol and drug use in second-year medical students at the University of Leeds. *Medical Education* 34, 86–87.
- Poulton, R.G., Brooke, M., Moffitt, T.E., Stanton, W.R., Silva, P.A., 1997. Prevalence and correlates of cannabis use and dependence in young New Zealanders. *New Zealand Medical Journal* 110, 68–70.

- Raine, A., 1991. The SPQ: a scale for the assessment of schizotypal personality based on DSM-III-R criteria. *Schizophrenia Bulletin* 17, 555–564.
- Raine, A., 1992. Sex differences in schizotypal personality in a nonclinical population. *Journal of Abnormal Psychology* 101, 361–364.
- Reilly, D., Didcott, P., Swift, W., Hall, W., 1998. Long-term cannabis use: characteristics of users in an Australian rural area. *Addiction* 93, 837–846.
- Schneider, U., Leweke, F.M., Mueller-Vahl, K.R., Emrich, H.M., 1998. Cannabinoid/anandamide system and schizophrenia: is there evidence for association? *Pharmacopsychiatry* 31, 110–113.
- Schweitzer, M.B., Paulhan, I., 1990. Manual pour l'Inventaire d'Anxiété Trait-Etat (Forme Y). Laboratoire de Psychologie de la Santé, Université de Bordeaux II, Bordeaux, France.
- Spielberger, C.D., 1983. Manual for the State-Trait Anxiety Inventory (Form Y) ('Self-Evaluation Questionnaire'). Consulting Psychologists Press, Palo Alto, CA.
- Tennant, F.S., Groesbeck, C.J., 1972. Psychiatric effects of hashish. *Archives of General Psychiatry* 27, 133–136.
- Thomas, H., 1996. A community survey of adverse effects of cannabis use. *Drug and Alcohol Dependence* 42, 201–207.
- Thornicroft, G., 1990. Cannabis and psychosis. Is there epidemiological evidence for an association? *British Journal of Psychiatry* 157, 25–33.
- Troisi, A., Pasini, A., Saracco, M., Spalletta, G., 1998. Psychiatric symptoms in male cannabis users not using other illicit drugs. *Addiction* 93, 487–492.
- VanLeuwen, D., Barnes, M., Pase, M., 1998. Generalizability theory: a unified approach to assessing the dependability (reliability) of measurements in the health sciences. *Journal of Outcome Measurement* 2, 302–325.
- Williams, J.H., Wellman, N.A., Rawlins, J.N.P., 1996. Cannabis use correlates with schizotypy in healthy people. *Addiction* 91, 869–877.