Psychological Medicine, 2002, **32**, 347–358. © 2002 Cambridge University Press
DOI: 10.1017/S0033291701005141 Printed in the United Kingdom

Evidence that three dimensions of psychosis have a distribution in the general population

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ABSTRACT

Background. The aims of the study were: first to examine, using clinical symptoms of patients as a template, whether the correlated but independent dimensions of positive, negative and depressive symptoms that have been identified in clinical psychosis, also have a distribution as non-clinical experiences in the general population; and second, to establish to what degree population variation in experience of positive and negative features of psychosis is actually independent of experience of depression.

Method. In a representative population sample of 932 young men, we measured experiences of positive, negative and depressive features of psychosis, using a 40-item self-report instrument. Confirmatory factor analysis was used to compare the fit of hypothesized one-, two- and three-factor solutions.

Results. A three-factor model of separate depressive, positive and negative dimensions provided a better fit to the data than either a two-factor or unidimensional model. All three dimensions were correlated with each other, but also showed good discriminant validity in relation to established scales, confirming their relative independence.

Conclusion. The data suggest that the correlated dimensions of clinical psychosis also have a distribution in the general population, and that depressive symptoms may form an integral part of psychosis-like experiences in the general population.

INTRODUCTION

A substantial body of research suggests that the symptoms of patients with psychotic disorders show replicable patterns of correlation with each other. Multivariate analyses of psychotic features have consistently yielded clusters of positive, negative and disorganization symptoms, not only in patients with schizophrenia (Bilder *et al.* 1985; Liddle, 1987; Peralta *et al.* 1992, 1994; Grube *et al.* 1998), but also in patients with schizoaffective and other psychotic disorders (Maziade *et al.* 1995; Peralta *et al.* 1997; Ratakonda *et al.* 1998). As affective symptoms tended to be excluded from these first generation symptom-analytical studies even though they form an integral part of schizophrenia and other psychotic syndromes (Soni *et al.* 1992; Sax *et al.* 1996), more recent endeavours that were less biased by Kraepelinian concerns of dichotomizing affective and non-affective syndromes, included depressive and manic symptoms. These investigations yielded additional dimensions of depressive and manic/excitement symptoms but less consistent evidence of a conceptual disorganization factor (Kitamura *et al.* 1995; Lindenmayer *et al.* 1995*a*, *b*; McGorry *et al.* 1998; Van Os *et al.* 1999*a*).

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Most studies used multivariate techniques where orthogonality was imposed on the factorial solutions, producing uncorrelated symptom dimensions. However, zero-correlation of symptom dimensions strains reality (for example, positive and negative symptoms tend to co-occur together), and studies using statistical techniques which allowed for correlation between factors did find that the various symptom dimensions covaried with each other (Peralta *et al*. 1994; Peralta & Cuesta, 1998). The dimensional representation of the psychosis phenotype therefore suggests that psychosis is the simultaneous variation of up to five distinct, albeit correlated, symptom dimensions.

The dimensional representation facilitates the view that psychosis is a quantitative trait, the distribution of which may well extend into the general population. Just as there is evidence that suggests that the depression phenotype may exist as a continuous distribution of symptoms in the population (Anderson *et al*. 1993; Whittington & Huppert, 1996; Kendler & Gardner, 1996), the symptom dimensions of psychosis may similarly be measurable in the general population (Johns & Van Os, 2001). Broadly, two approaches can be distinguished. The first approach is to measure in the general population the same symptoms that are seen in patients with psychotic disorders. The implicit assumption of this approach is that experiencing 'symptoms' of psychosis such as delusions and hallucinations is not inevitably associated with presence of disorder. The latter may be dependent on symptom factors such as intrusiveness, frequency and co-morbidity of symptoms on the one hand, and personal and cultural factors such as coping, illness behaviour, societal tolerance and the development of functional impairments on the other. Thus, even though the prevalence of the clinical disorder is low, the prevalence of the symptoms can conceivably be much higher. The second approach is different, and assumes that in the sub-disorder range along the continuum, the expression of the trait is attenuated and takes on the form of 'schizotypal' signs and symptoms. Studies using various measures of schizotypy have proposed two or three factor solutions resembling those of schizophrenia excluding affective symptoms. Thus, symptom factors resembling positive, negative and conceptual disorganization dimensions have been reported by several authors (Bentall *et al*. 1989; Raine *et al*. 1994; Venables & Bailes, 1994; Williams, 1994; Vollema & Van den Bosch, 1995; Claridge *et al*. 1996; Gruzelier, 1996). However, several questions remain to be answered. First, although measures of schizotypy are strongly associated with neuroticism and depression in cross-sectional, longitudinal and family studies (Chapman *et al*. 1980, 1994; Schulz *et al*. 1986; Allen *et al*. 1987; Lenzenweger & Loranger, 1989; Tien *et al*. 1992; Torgersen *et al*. 1993; Corruble *et al*. 1996; Kaney *et al*. 1997; Kwapil *et al*. 1997; Hafner *et al*. 1999; Verdoux *et al*. 1999), measures of affective symptoms have universally been excluded from schizotypy scales. It is thus not known whether variation in positive and negative psychosis-like experiences are in fact an expression of depressive symptomatology, or co-vary with depression. Previous work suggests that the expression of experience of positive symptoms of psychosis is dependent on the level of depression (Van Os *et al*. 1999*b*). In the current study, therefore, experiences of depression were measured simultaneously with other dimensions. A second issue is that the schizotypy scales do not always cover the type and range of experiences seen in clinical patients, making it difficult to compare patients with individuals in the general population. It has been shown, for example, that schizotypy scales measuring delusions tend to be incomplete (Peters *et al*. 1999). For the current study, a different approach was therefore adopted, based more on the measurement of the psychotic symptoms themselves rather than the hypothesized attenuated experiences.

Peters and colleagues recently developed and validated a self-report instrument to measure delusional ideation (scored dimensionally) in the general population (Peters *et al*. 1999). Contrary to scales measuring schizotypal signs and symptoms, the PDI measures are directly based on clinical delusions as described in the Present State Examination, 9th Edition, covering the range of delusional experiences (Wing *et al*. 1974) and scoring them dimensionally. The face validity of the items is ensured by keeping as close as possible to the form of questioning suggested by the PSE, but most questions are

toned down by adding 'as if' to the questions (for example: 'Do you ever feel as if electrical devices such as computers can influence the way you think?). The 21-item version of the scale, with three additional items on hallucinatory experiences, has been used in population-based research (Verdoux *et al.* 1998*a*; Van Os *et al.* 1999*b*). The current study was designed to test the hypothesis that several distinct, but correlated dimensions of psychosis can be identified in the general population. To this end, items tapping into other symptom dimensions were added to the PDI, again using clinical symptoms seen in patients with psychotic disorders as reference. As self-report measures were used in order to obtain a large enough population sample size for the multivariate analyses, no attempt was made in this study to measure dimensions of mania and conceptual disorganization, since these measures are much less likely to be reliably captured by self-report instruments in the general population (Rodgers & Mann, 1986; Vollema, 1999). This study therefore focused on the three dimensions of positive, negative and depressive symptoms. Confirmatory factor analysis (CFA) without imposing orthogonality was used to test statistically the tenability of the specified three-factor population dimensional model, in comparison with models of two dimensions or a single undifferentiated dimension. The two-dimensional model used in this study was based on the hypothesis that what is measured by 'negative symptoms' in the general population is in fact the expression of an underlying dimension of depression. Thus, the two-dimensional model consists of a positive and a depressive factor. The exclusion of a single undifferentiated psychopathology factor underlying seemingly different symptom dimensions in the general population is particularly important. For example, recent investigations of childhood psychopathology across very large population samples found that the existence of up to eight dimensions of child problem behaviour derived from exploratory factor analysis of the Child Behaviour Checklist (Achenbach *et al.* 1989) were not supported by empirical data using CFA. In fact, support was found for one undifferentiated factor explaining a large proportion of the co-variation of all symptoms (Greenbaum & Dedrick, 1998; Hartman *et al.* 1999).

METHOD

The CAPE

The basic instrument used was the PDI-21, with some modifications and additions. First, items on religious delusions were omitted because of concerns that it might confuse religious study subjects. Secondly, some items that subjects in previous investigations had reported to be ambiguous were omitted or rephrased (Verdoux *et al.* 1998*b*). Thirdly, two items on auditory hallucinations were added. Finally, each item required ticking only two dimensional scales (compared with one dichotomous presence/absence item and three dimensions of conviction, preoccupation and distress in the PDI): the first scale on the frequency of the experience (on a four-point scale of 'never', 'sometimes' 'often' and 'nearly always', to avoid 'ticking the middle box' bias), the second scale on the degree of distress ('not distressed', 'a bit distressed', 'quite distressed' and 'very distressed'). The reduction to only two dimensions of frequency and distress per symptom was introduced as previous research with the PDI-21 in a large general population sample (Verdoux *et al.* 1998*b*) had shown that individuals in such a sample fail to consistently rate three different scales per symptom, so that in practice only the first presence/absence scale can be used in the analyses with loss of dimensional information. A total of 18 items of positive psychotic symptoms was used.

Fourteen items on negative symptoms were added to the PDI. These items were derived, where possible (not all items are suitable for self-report), from the SANS (Andreasen, 1989), and an instrument of subjective experience of negative symptoms, the SENS (Selten *et al.* 1998). The phrasing of the questions followed that of the PDI items, and was based on the descriptions and questions in the SANS and the SENS. Examples of items are: 'Do you ever feel that you have few or no emotions at important events?', or: 'Do you ever feel that you are lacking in motivation to do things?', or: 'Do you ever feel that you are neglecting your appearance and personal hygiene?', and: 'Do

you ever feel that you have no interest to be with other people?'.

As some of the items that are used to measure negative symptoms are also sensitive to depression, we wished to include a number of items on depression that do not overlap with the items on negative symptoms. Previous work suggests that especially cognitive symptoms of depression (e.g. sadness, pessimism, hopelessness, feeling a failure, feeling guilty), discriminate between depression and negative symptoms (Kibel *et al.* 1993). A total of eight items on depression was thus included.

The instrument with the 18 positive symptom items, 14 negative symptom items and eight depressive symptom items will hereafter be referred to as the CAPE (Community Assessment of Psychic Experiences – see: http://cape42.homestead.com/index.html). It was translated from English into Greek by consensus of three Greek-speaking psychiatrists trained in English-speaking countries. It was back-translated by an independent professional translator. Differences between the original and back-translated versions were resolved by the translator and back-translator, followed by a small pilot involving 15 subjects after which some additional small changes were made.

Sample

The ASPIS (Athens Study of Psychosis Proneness and Incidence of Schizophrenia) is an investigation of schizotypy and psychosis dimensions in newly recruited air force conscripts undergoing basic training as part of their compulsory military service in Greece (Stefanis *et al.* 2001). This sample was specifically chosen as there is consistent evidence that individuals at this age are most likely to display the clinical and sub-clinical experiences of psychosis, thus increasing the statistical power (Rust, 1988; Claridge *et al.* 1996; Verdoux *et al.* 1998*b*; Peters *et al.* 1999; Van Os *et al.* 2000). In eight separate waves, 1944 subjects were examined. In order to verify the degree of collaboration with the self-report scales, three test questions were added to the total interview package, that read, for example, as follows: 'please answer this question by ticking box 4'. The 1413 individuals (73%) who had correctly ticked the boxes on all four questions were included in the analyses. The CAPE was used in the last six waves of interviews, and reports meeting the four-question criterion were available for 1028 individuals. Due to partial non-response, individuals with non-missing responses on all 40 items were 932 for the frequency dimensions, and 876 for the distress dimensions.

Analyses

It is possible to test predictions of patterns of clustering of the experiences of psychosis using CFA. For hypothesis testing purposes, CFA is superior to exploratory factor analysis (EFA), which identifies possible factors that account for co-variation among items in a sample, but may only give a very rough idea of true underlying dimensions in the population (Bollen, 1989; Byrne, 1989). In CFA, predictions can be examined by relating the hypothesized symptom dimensions to empirical data in a factor analytical model. According to this model, the unobserved symptom dimensions are constructs, or latent variables, that cannot be studied directly. However, they may be studied indirectly through individual symptoms that can be considered as their indicators. The factor analytical model assumes that the latent variables account for the co-variation between the observed variables. The gap between observed symptoms and latent symptom dimensions can thus be bridged by analysis of the co-variance between the observed symptoms. This analysis makes it possible to ascertain the extent to which the hypothesized symptom clusters that are thought to be indicative of underlying latent dimensions are consistent with the covariance structure in the data. The hypothesis of the current investigation was that a model of three distinct but correlated dimensions would be more consistent with the data than: (*i*) a model of two dimensions where depressive symptoms are not distinct from negative symptoms, leaving two dimensions of negative/depressive *versus* positive symptoms; and (*ii*) a uni-dimensional model where positive, negative and depressive symptoms in the general population are not separable from each other and can thus be seen as indicators of the same undifferentiated psychopathology dimension.

CFA was carried out using MPLUS (Muthén & Muthén, 1998). In CFA, three parameters are of interest. The first concerns the factor loadings, or the extent to which the observed symptoms

are related to the latent dimensions. The second is the co-variance between the common factors, or the extent to which the latent dimensions are related to each other. The third regards the unique factors of the observed symptoms, or the degree to which the observed symptoms contain variance that is unrelated to the latent dimensions (measurement error). With these three parameters, an estimated covariance matrix of the observed symptoms can be constructed. The values of the three parameters, which are unknown, are estimated such that the estimated symptom covariance matrix is as close as possible to the observed symptom covariance matrix. If the estimated covariance matrix is close to the observed co-variance matrix, the model is said to fit the data well. The model fit is most commonly evaluated with the maximum likelihood method yielding a chi-square test statistic. The smaller the chi-square statistic, the more the estimated and observed covariance matrix are consistent with each other. The chi-square test statistic of different models can be compared with each other, in order to establish which one provides the best fit. If the models that are being compared are not nested in each other (one, two or three-dimensional models of psychotic symptoms are not nested in each other), direct comparisons of the chi-squared goodness-of-fit index of the different models is not possible. A common procedure is then to modify the difference in chi-squared goodness-of-fit index of the models to take account of the number of free parameters in the model, as an indicator of the degree of parsimony of the model. One popular index is the Akaike information criterion (AIC), the model with the lowest AIC being considered as the best compromise between goodness-of-fit and parsimony (Sham, 1998).

While indices derived from the chi-square statistic are useful for the comparison of the fit of several competing models, it is not, once the model that is most consistent with the data has been selected, necessarily a good measure of how consistent this model actually is with the observed data, especially in large samples. This is because large samples lead to large chi-square values, which may result in false rejection of the model. In addition to the chi-square statistic, several other indices of goodness-of-fit can be used that are less biased by sample size. The RMSEA root mean square error of approximation (RMSEA) allows for the description of discrepancy between the hypothesized model and the observed data, corrected for the size of the model. It therefore can more easily accommodate acceptance of the model that the sample size-sensitive fit of the chi-square statistic (Heck, 1998). An RMSEA value of 0·05 or less has been proposed as indicative of reasonable fit between model and data (Browne & Cudeck, 1993). In order to examine whether any results would be dependent on a small number of individuals with high values on all dimensions who might really be cases of clinical psychosis, a sensitivity analysis was conducted excluding the individuals with the 25% highest scores on the SCL-90 Paranoia scale and the SCL-90 Psychosis subscale

Validity analyses

Discriminant validity

In order to assess whether the CAPE discriminates between dimensions of positive, negative and depressive symptoms as purported, the following analyses were conducted. First, we selected several established self-report scales measuring these dimensions. For depression we used the Depression scale of the Symptom Checklist-90 (SCL-90; (Donias *et al*. 1991)); for the positive symptoms we used i) the Perceptual Aberration Scale (PAS; (Chapman *et al*. 1978), which is very strongly associated with the Magical Ideation Scale (Chapman & Chapman, 1987)) and ii) the SCL-90 Paranoia subscale (included because the PAS does not contain items on paranoid ideation); for negative symptoms we used the Social Isolation and Flat Affect subscales of the Schizotypal Personality Questionaire (SPQ; (Raine, 1991). All subjects rated themselves using these scales in the same session during which they filled in the CAPE. We hypothesized that: (*i*) the CAPE depression dimension would show the strongest association with the SCL-90 Depression subscale; (*ii*) the CAPE negative symptom dimension would show the strongest association with the SPQ scales Social Isolation and Flat Affect; and (*iii*) the CAPE positive dimension would show the strongest association with the PAS and the SCL-90 Paranoia subscale. In order to test these hypotheses, a multivariate regression procedure was carried out in STATA version 6 (STATA,

1999). Multivariate regression differs from multiple regression in that several dependent variables (in this case: PAS, SCL-90 Paranoia subscale, SPQ scales and SCL-90 Depression scale) are jointly regressed on the same independent variables (in this case: CAPE positive, negative and depressive dimension scores). The individual coefficients and standard errors produced in multivariate regression are identical to those that would be produced by multiple regression, but the difference is that multivariate regression also estimates the between-equation co-variances, so that coefficients across equations can be tested. Thus, multivariate regression allowed us to directly test, for example, the null hypothesis that the coefficient of the regression of the PAS on the CAPE positive dimension score did not differ from the coefficient of the regression of the PAS on the CAPE negative dimension score. In order to remove scale difference, CAPE positive, negative and depression scores were expressed as units standard deviation (standardized scores).

Distress validity

In order to establish the clinical validity of the positive, negative and depression dimensions of the CAPE, we tested for associations between the frequency and distress scales for each item. We hypothesized that for each item, higher reported frequency of the experience would not be neutral, as evidenced by large and significant correlations with measures of distress.

RESULTS

Comparison of one-, two- and three-dimensional models of psychopathology

The analyses suggested that for the items of the CAPE, scored in terms of frequency of occurrence, a three-factor model provided a better fit to the data than the other two models. The unidimensional model provided the poorest fit (Table 1). The RMSEA showed a similar pattern, the three-dimensional model giving the lowest RMSEA (0·045), which suggests that the model is reasonably close to the data. Given reports that non-bizarre and bizarre positive psychotic symptoms may appear as separate factors in clinical samples (Cardno *et al.* 1999; Van Os *et al.* 1997*a*), we tested a four-factor model with a separate dimension of bizarre, 'first rank' psychotic experiences (passivity experiences, thought insertion, thought broadcasting, thought withdrawal, thought echo, voices conversing with each other, electrical devices influencing the thoughts of the person). This model did not provide additional improvement of fit over the three-factor model (AIC = 65821, RMSEA = 0·045, 95% CI 0·043, 0·047) and could therefore be rejected on grounds of parsimony. The sensitiviy analysis with exclusion of the 25% highest scorers on the SCL-90 Paranoia and Psychosis subscales revealed a similar pattern of results (one factor, AIC = 33207, RMSEA = 0·055, 95% CI 0·052, 0·059; two factors, AIC = 32583, RMSEA = 0·048, 95% CI 0·045, 0·051; three factors, AIC = 32506, RMSEA = 0·046, 95% CI 0·043, 0·049).

As expected, the dimensions co-varied with each other, with correlations between the three dimensions in the range of 0·7, indicating that variation in one dimension explains around 50% of the variance in another (positive–negative correlation $r = 0{\cdot}67$; positive–depressive correlation, 0·72; negative–depressive correlation, 0·72). In order to examine whether the correlations between depression on the one hand, and experiences of positive and negative symptoms of psychosis on the other were simply the result of feelings of distress associated with

Table 1. *Fit indices of one-, two- and three-dimensional models of psychosis features in the general population*

	Frequency dimension				
Model	χ^{2*}	df	*P*	AIC*	RMSEA (95% CI)
A (Unidimensional)	2960	740	<0·001	66636	0·057 (0·055, 0·059)
B (Two-dimensional)	2341	739	<0·001	66019	0·048 (0·046, 0·050)
C (Three-dimensional)	2141	737	<0·001	65822	0·045 (0·043, 0·047)

* Rounded to nearest integer.

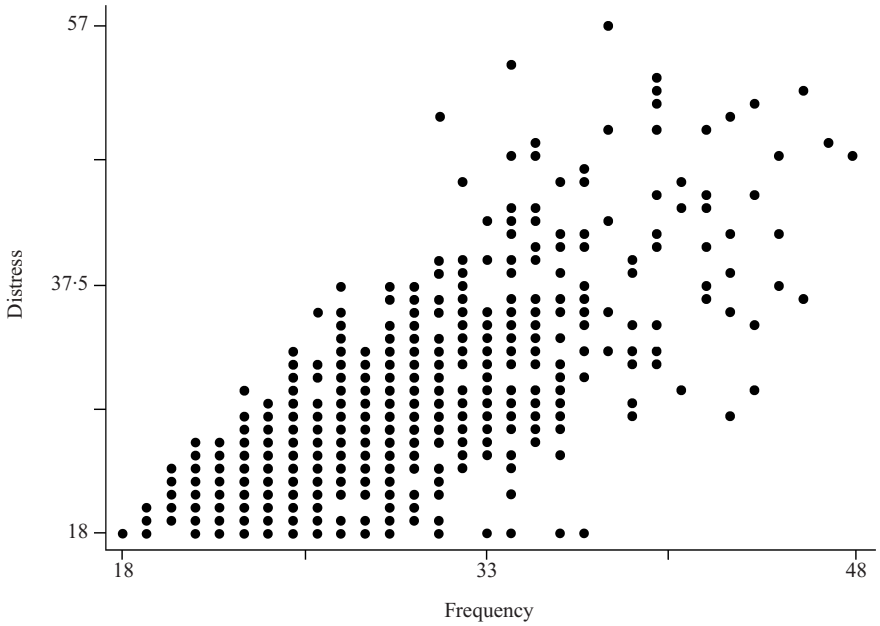

FIG. 1. Plot of CAPE frequency and distress scores of positive symptom dimension.

Table 2. *Testing for differential contributions of CAPE dimensions to measures of positive (POS), negative (NEG) and depressive (DEP) symptoms*

Variables			Comparison of coefficients across equations		
Independent	Dependent	Coefficient (95% CI)	Symptoms	*F* (1,801)	*P**
PAS	CAPE positive	5·35 (4·06, 6·64)	—		
	CAPE negative	1·97 (0·53, 3·42)	POS = NEG	9·15	0·0026
	CAPE depression	2·75 (1·31, 4·20)	POS = DEP	5·45	0·020
SCL-90 Paranoia	CAPE positive	0·33 (0·27, 0·39)	—		
	CAPE negative	0·03 (−0·03, 0·10)	POS = NEG	38·15	<0·0001
	CAPE depression	0·14 (0·08, 0·20)	POS = DEP	15·58	0·0001
SCL-90 Depression	CAPE positive	0·11 (0·066, 0·15)	DEP = POS	32·58	<0·0001
	CAPE negative	0·094 (0·050, 0·14)	DEP = NEG	27·80	<0·0001
	CAPE depression	0·30 (0·26, 0·35)	—		
SPQ Social Isolation	CAPE positive	0·005 (−0·01, 0·02)	NEG = POS	14·41	0·0002
	CAPE negative	0·056 (0·04, 0·07)	—		
	CAPE depression	0·017 (−0·0004, 0·08)	NEG = DEP	6·39	0·012
SPQ Flat Affect	CAPE positive	0·003 (−0·015, 0·02)	NEG = POS	14·68	0·0001
	CAPE negative	0·060 (0·04, 0·08)	—		
	CAPE depression	0·025 (0·006, 0·04)	NEG = DEP	4·02	0·045

* A result with $P < 0{\cdot}05$ means the null hypothesis of no difference can be rejected.

experiences of positive and negative symptoms of psychosis, partial correlations were calculated. Thus, when distress associated with positive symptoms was held constant, the partial correlation between positive and depressive experiences was reduced but remained significant ($r = 0{\cdot}25$, $P < 0{\cdot}0001$). Similarly, when distress associated with negative symptoms was held constant, the partial correlation between negative and depressive experiences was reduced but remained significant ($r = 0{\cdot}41$; $P < 0{\cdot}0001$).

Correlation between frequency and distress

The mean Pearson correlation coefficient between the dimensions of frequency and distress was 0·71 (S.D. = 0·16, range 0·27–0·94), and was

of similar magnitude for the three hypothesized dimensions (depressive symptoms, 0·74; negative symptoms, 0·73; positive symptoms, 0·67). The lowest correlations were for the positive symptom items with a grandiose content: 'Do you ever feel as if you are destined to become someone very important?' (r = 0·27) and 'Do you ever feel that you are a very special or unusual person?' ($r = 0·32$). Inspection of the graphical plots of measures of frequency and distress suggested a linear, dose-response pattern of association. An example is given for measures of frequency and distress of the positive symptom dimension in Fig. 1.

Discriminant validity

The associations between CAPE dimensions of positive, negative and depressive experiences of psychosis and established scales measuring these symptoms confirmed the hypothesized pattern. Thus, the CAPE positive symptom score displayed stronger associations with the PAS and the SCL-90 Paranoia subscale than the negative and depression scores; the CAPE negative symptoms score displayed stronger associations with the SPQ negative symptom scales, and the CAPE depressive symptoms score displayed stronger associations with the SCL-90 Depression scale (Table 2).

DISCUSSION

The two starting points of this investigation were: (*i*) to examine to what degree variation in positive and negative dimensions of psychosis is independent of experience of depression; (*ii*) to examine, using clinical symptoms of patients as a template, whether the correlated but independent symptom dimensions of psychosis have a distribution in the general population. In a population sample of 932 young men in the age range most at risk of psychotic experiences, there was evidence for the existence of three independent yet correlated dimensions of experiences resembling the main symptom dimensions of psychotic illness that are encountered in clinical samples: depression, negative symptoms and positive symptoms. These factors were not occasioned by a few individuals with very high levels of psychotic experiences and with possible psychotic disorder. Frequency of occurrence of the experiences was strongly associated with level of distress, with the exception of experiences of grandiosity. The instrument used to simultaneously assess positive, negative and depressive experiences of psychosis showed discriminant validity with established scales, and again suggested relative independence of measures of depression in relation to experience of positive and negative features of psychosis.

The findings suggest that the symptoms of psychosis have a distribution in the general population, and that psychosis can be seen as a continuum of variation in several correlated symptom dimensions. Although the respondents were healthy subjects, the fact that frequency and distress were associated with each other in a linear, dose-response fashion, suggests that the frequency measures used are not entirely neutral clinically. Thus, it is possible that higher frequency of occurrence will facilitate help-seeking behaviour, eventually resulting in patient status (Johns & Van Os, 2001).

The fact that dimensions of positive, negative and depressive experiences of psychosis were correlated, parallels the situation in clinical samples. However, the correlations of around 0·7 between the three dimensions are larger than those in CFA analyses in clinical samples, where reported correlations are in the order of 0·2–0·6 (Peralta *et al.* 1994; Peralta & Cuesta, 1998). A likely reason for this discrepancy is that expression of symptom dimensions in the general population is much more attenuated than in clinical samples, making it much more difficult to measure them sensitively and discriminate between them. Another possible explanation is that in clinical samples, high scores on one dimension may overshadow symptoms from another. For example, in patients with very high levels of negative symptoms, co-morbid positive psychotic symptoms may be less likely to be elicited, resulting in reduced correlations between symptom dimensions. Regardless of which explanation applies, however, confirmatory factor analysis in our sample suggested a three- rather than a two- or unidimensional solution fitted the data best, and the discriminant validity of the three dimensions appeared satisfactory.

The data suggest that experience of depression accompanies experience of positive and negative features of psychosis, not only in clinical samples, but also in the general population. One

explanation may be that the distress associated with positive and negative experiences simply generates feelings of depression. Although our data showed that was in part the case, it is unlikely to be the sole explanation, given that when distress was controlled for associations between depression and the other dimensions remained highly significant. Work in clinical samples suggests that affective and non-affective psychotic syndromes share at least some important aetiological factors, as indicated by studies that suggest overlap in familial clustering of psychosis in individuals with affective and non-affective psychotic disorders (Kendler *et al*. 1993), overlap in cognitive impairment and high levels of neuroticism prior to the onset of depression and schizophrenia (Jones *et al*. 1994; Krabbendam *et al*. 2001; Van Os *et al*. 1997*b*, 2001), overlap in cerebral ventricle enlargement in schizophrenia and affective disorder (Elkis *et al*. 1995) and overlap of risk functions associated with life events, ethnic group, prenatal famine, urban birth and having a relative with depression (Bebbington *et al*. 1993; Maier *et al*. 1993; Van Os *et al*. 1996; Marcelis *et al*. 1998; Brown *et al*. 2000). Sharing of some areas of risk would be a plausible explanation of correlated symptom distributions, at least in clinical samples. It is attractive to speculate that the same shared risk factors that cause the co-occurrence of depressive and non-affective experiences of psychosis at the clinical level, are also involved in the co-occurrence of the subclinical experiences. This would in fact amount to the view that there is continuity between correlated dimensions of psychosis at the clinical and the subclinical level. This hypothesis is supported by the fact that, at least as far as the experience of positive symptoms is concerned, similar neuropsychological abnormalities and a similar pattern of demographic and risk factor associations is apparent for the clinical and subclinical manifestations (Rust, 1988; Lenzenweger *et al*. 1991; Lyons *et al*. 1991; Claridge *et al*. 1996; Voglmaier *et al*. 1997; Chen *et al*. 1998; Verdoux *et al*. 1998*b*; Peters *et al*. 1999; Van Os *et al*. 2000). It is also supported by population and twin studies suggesting that depression exists in nature as a distribution of symptoms rather than a dichotomously defined disorder (Anderson *et al*. 1993; Whittington & Huppert, 1996; Kendler & Gardner, 1998), with similar emerging evidence for positive symptoms of psychosis (Van Os *et al*. 200l). While such an interpretation of the data remains speculative, it may nevertheless prove useful to further examine the experiences of psychosis along these lines.

The results should be interpreted in the context of several limitations. First, only three dimensions of psychosis were considered suitable for inclusion in the self-report scale. However, the positive and negative dimensions are considered the two most robust non-affective symptom domains, and depression is the most common affective symptom domain in psychosis. Nevertheless, it remains necessary to also collect interview data including items on the mania and disorganisation dimensions. Secondly, our findings are based on self-report data, which inevitably results in more misclassification and therefore yields less precise results, especially in the case of psychotic symptoms. Therefore, replication with interview data is necessary. Thirdly, of the original eligible individuals, nearly 30% was excluded because of probable non-collaboration. It is quite possible that, as a group, these excluded individuals were different from the included respondents on certain personality characteristics that are associated with experiences of psychosis. In as much as this is the case, caution should be exercised in generalizing the results to all populations of young men. Similarly, no women were included in the sample, so that the results are not necessarily applicable to this group. Fourthly, structural equation modelling suggested that a three factor model provided a better fit to the observed data than the other models, but this cannot be taken as proof of the existence of three dimensions in nature. Structural equation models are a test of an *a priori* hypothesized relationship among variables; if these *a priori* assumptions are incorrect, the model will also be incorrect, no matter how close the resulting statistical fit. However, the hypothesis that experience of psychosis consists of various dimensions as examined in this paper is widely accepted and has been subject to numerous empirical investigations. Fifthly, while the 'as if' approach to ask about delusional ideation is considered suitable to assess psychotic experiences along a hypothesized continuum by some (Koehler 1979; Peters *et al*. 1999), others use the 'as if' experience as a qualitative cut-off

in the assessment of delusions, the 'as if' experience indicating that the idea is not held with total conviction (Sims, 1988). The choice of approach depends on the purpose: in clinical practice a dichotomous treatment decision is necessary, in which case a qualitative cut-off point for delusional thinking may be more appropriate. In observational research in the general population, however, a continuum approach may be more useful than use of a qualitative cut-off point. Finally, we have used the umbrella term 'psychosis' to include both subclinical experiences reported by individuals in the general population and clinical symptoms reported by patients with psychotic disorders. The problem with this approach is that psychopathological resemblance between patient and non-patient samples does not *per se* constitute formal proof that clinical and subclinical experiences form part of the same continuum. However, evidence presented elsewhere suggests that, apart from psychopathological resemblance, psychosis-like experiences in the general population and psychotic symptoms in clinical samples also share risk factors, psychological mechanisms and epidemiological patterns of variation (Sharpley & Peters, 1999; Johns & Van Os, 2001; Van Os *et al*. 2001).

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