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Dimensions of schizophrenic positive symptoms: an exploratory factor analysis investigation

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Abstract Current psychopathology classifies schizophrenic positive symptoms into four groups: delusions, hallucinations, formal thought disorder, and catatonic symptoms. The present study explores the factor structure of different positive symptoms to refine this classification. The 35 positive symptoms of 429 psychiatric patients, consecutively admitted to any of 95 mental hospitals, with diagnosis of the ICD-10 F20 schizophrenia, were studied. After excluding those items with a base rate of 10% or less, factor analysis yielded six factors. The first factor was loaded by most of Schneider's first-rank symptoms and two specific auditory hallucinations; the second by all the catatonic symptoms and incoherence; the third by bodily delusions/hallucinations; the fourth by delusions of persecution and reference; the fifth by grandiose and religious delusions; and the sixth by visual and miscellaneous hallucinations. The finding that schizophrenic positive symptoms may have more than four dimensions suggests the need for reclassification of schizophrenic symptoms and for reconsideration of evidence-based diagnostic criteria for the disorder.

Key words Positive symptoms · Schizophrenia · Factor analysis

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Introduction

The positive-negative dichotomy of schizophrenic symptoms, proposed in the late 1970s and the early 1980s (Strauss et al. 1974; Wing 1978; Wing and Brown 1970; Crow 1980, 1985; Andreasen et al. 1982), has attracted the interest of many clinicians and researchers. This categorization was supported by the findings of biological studies that positive symptoms were related to dopaminergic hyperactivity in the brain, whereas negative symptoms were associated with ventricular enlargement (Crow 1985; Johnstone et al. 1988; Andreasen et al. 1982). Categorization of the symptoms of any disorder has heuristic value, because it may illuminate pathological processes involved in the different aspects of the disorder.

Recent efforts of investigators of schizophrenic symptoms have been concerned with the number of categories that would be most appropriate to classify them. Crow (1985) proposed the positive-negative dichotomy, but some investigators (Liddle 1987; Liddle and Barnes 1990; Peralta et al. 1992; Thompson and Meltzer 1993), for example, have claimed that these symptoms should be classified into three; psychomotor poverty (poverty of speech, blunted affect, etc.), disorganization (formal thought disorder, poverty of content of speech, etc.), and reality distortion (delusions and hallucinations). In these studies positive symptoms were split into two categories, but Minas et al. (1994) demonstrated that dimensions of positive and negative symptoms could meaningfully be increased into five components: negative signs, social dysfunctions, thought disorder, delusions, and hallucinations. Factor-analyzing positive symptoms only, Stuart et al. (1995) claimed that they could be divided into paranoia, hallucinations, grandiose delusions, and "loss of boundary" delusions (e.g., thought broadcasting). Kitamura et al. (1995) carried out a factor analysis of symptoms of psychotic inpatients regardless of diagnostic categories and found that catatonic symptoms constituted a discrete syndrome from the other positive syndrome, and that delusions would not converge into a single factor. The positive-negative di-

chotomy has also been criticized by other authors (Arndt et al. 1991; McKenna et al. 1991; Mortimer et al. 1990).

Most recent investigators of schizophrenic symptomatology have relied on two methods, structured interviews (or similarly operationalized rating scales) and exploratory factor analysis, which are closely linked. Structured interviews and rating scales that are applied to patients or case notes yield data of which items are subjected to factor analyses. Although factor analysis is potentially able to disentangle complex constellations of symptoms, its power is limited by reliance on the content and numbers of symptoms listed in the interview or rating scale. Thus, the results of factor analysis may differ even among the same subjects, if a different set of symptoms is being assessed. Statistical requirement is to reduce the number of symptomatic items into one that will enable the results of factor analysis to be stable. However, this makes it difficult to examine whether a group of symptoms can be further divided. If, for example, all hallucinations were combined to make a single composite scale, it would be impossible to examine whether a specific group of hallucinations [e.g., those defined as first rank by Schneider (1959) and non-auditory hallucinations] constitute a factor independent of the others. In their search for factor structure of schizophrenic symptomatology, both Schulberg et al. (1990) and Toomey et al. (1997) used the Scale for the Assessment of Positive Symptoms (SAPS; Andreasen and Olsen 1982) and the Scale for the Assessment of Negative Symptoms (SANS; Andreasen and Olsen 1982). Schulberg et al. (1990) factor-analyzed four positive (hallucinations, delusions, bizarreness, and formal thought disorder) and five negative subscales. Toomey et al. (1997) factor-analyzed all the SAPS and SANS items, but their evaluation of hallucinations included only three items: auditory hallucination, voices conversing, and voices commenting.

The past decade has also seen a trend toward a view that the rubric "delusion" should expand to include symptoms often termed "ego disorder" ("Ichstoerung"), such as passivity experience, thought insertion, thought broadcasting, thought withdrawal, and "Gedankenlautwerden" (Trethowan 1979; Sims 1988). These are a part of Schneider's (1959) first-rank symptoms of schizophrenia, and are often singled out as essential for diagnosing schizophrenia in operationalized diagnostic criteria, e.g., the Research Diagnostic Criteria (Spitzer et al. 1981) and CAT-EGO (Wing et al. 1974). The glossary appended to the DSM-III-R included ego disorder symptoms under the heading of "delusion." However, empirical validation of this assimilation of symptoms may be needed before it can be taken as true.

The heterogeneity of positive symptoms may also be suggested by empirical evidence that among inpatients with psychoses, some delusions (e.g., grandiosity, poverty, and guilt) did not have a high loading on the factor which included the other positive symptoms, but rather on those of depressive and manic symptoms (Kitamura et al. 1995).

There seems to have been more research emphasis on the classification of negative symptoms (Gibbons et al.

1985; Bilder et al. 1985; Kulhara et al. 1986; Kitamura and Suga 1991), whereas less attention has been paid to the empirical classification of positive symptoms. We report here a study on the factor structure of positive symptoms in a large population of schizophrenic patients.

Methods

Details of the sample selection and assessment have been published elsewhere (Kitamura et al. 1995). This study is part of a nationwide multicenter field trial (Fujinawa 1990; Kitamura et al. 1995) of the 1988 draft of the ICD-10. Of the 584 psychotic patients consecutively admitted to any of the 95 participating mental hospitals between November 1989 and January 1990, 429 were diagnosed as suffering from ICD-10 F20 schizophrenia. They were 223 (52%) men and 188 (44%) women (gender was not recorded among 18 cases). The mean age was 37.8 years (SD 12.1 years; range 15–76 years). The subcategories of schizophrenia were: paranoid 194, hebephrenic 90, catatonic 53, undifferentiated 56, residual 27, simple 2, other 1, and unspecified 6. For 99 (23%) of the subjects, the current episode was the first; 66 (15%) had one past episode; 49 (11%) had two past episodes; 182 (42%) had three or more past episodes. (For 33 subjects, the number of past episodes was missing.) The duration of the current episode was less than a month for 67 (16%) subjects, a month or more but less than 2 months for 103 (24%) subjects, 2 months or more but less than a year for 72 (17%) subjects, 1 year or more but less than 2 years for 34 (8%) subjects, and 2 years or more for 148 (35%) subjects. For 5 subjects the duration of the current episode was missing. Thus, the sample subjects were characterized by short to medium duration of the current episode with frequent past episodes of the disorder.

An ad hoc semistructured diagnostic interview (Fujinawa 1990) was used to measure positive, negative, manic, and depressive symptoms. The positive symptoms that were assessed included 17 delusions, 9 hallucinations, 2 kinds of formal thought disorder, and 7 catatonic symptoms. Each symptom was rated as 0 (absent) or 1 (present). The interrater reliability (calculated by κ) of the positive symptoms was moderate to substantial (Table 2).

The base rate frequencies of all the positive symptoms were inspected, and any symptoms were excluded from further analyses if they were observed in 10% or less of the sample. Symptoms excluded on these bases were delusion of "royal blood" (9.8%), delusion of poverty (4.4%), delusion of guilt (9.6%), delusion of jealousy (8.9%), olfactory hallucination (7.7%), neologism (4.7%), catalepsy (7.5%), waxy flexibility (1.6%), and command automatism (1.2%). All the remaining positive symptoms were factor-analyzed (principal components analysis). To determine the most appropriate number of factors, we followed Cattell (1966) and Zwick (1982). The eigenvalues of all the factors were examined after each factor was extracted until a large jump or discontinuity was observed, after which the factors that remained were retained (the screen test). Oblimin method, one of the diagonal rotation, was employed. The SPSS-X program (SPSS Inc. 1986) was used for statistical analysis.

Compositional variables (syndromal dimensions) were calculated by adding scores of items having the factor loading of 0.4 or more on the same factor. These compositional variables were correlated with demographic and clinical variables. They included (a) gender, (b) current episode, (c) age of onset of the current episode (in months), (e) duration of the current positive symptoms (in months), (f) number of the past episodes, and (g) age of first onset of the positive symptoms (Table 1).

Results

Factor analysis yielded eight factors with an eigenvalue greater than 1.0. Their eigenvalues were 4.34, 2.18, 1.62,

1.49, 1.42, 1.31, 1.14, and 1.05. The screen test identified six of these as being most appropriate (Table 2).

The first factor was loaded by most of the Schneider's first-rank symptoms and two specific auditory hallucinations; the second by all the catatonic symptoms and inco-

Table 1 Demographic and clinical variables among the subjects

	Valid (n)	Mean (SD)	1	2	3	4	5	6
Gender	411	1.46 (0.50)	–					
Age (years)	424	37.8 (12.1)	0.17**	–				
Age at onset of current episode	419	33.0 (11.6)	0.16**	0.76**	–			
Duration of current episode (months)	424	56.4 (97.2)	0.04	0.40**	–0.23**	–		
Duration of current positive symptoms (months)	406	30.7 (69.1)	0.03	0.34**	–0.06	0.66**	–	
No. of current positive symptoms (months)	396	3.9 (10.1)	–0.02	0.09	0.02	0.11*	0.14**	–
Age at onset of first positive symptoms	419	33.0 (11.6)	0.20**	0.58**	0.62**	–0.06	0.04	–0.07

* $P < 0.05$; ** $P < 0.01$

Table 2 Base rates and factor loadings of positive symptoms among 429 schizophrenic patients

Symptoms	Base rate (%)	Factors						Interrater reliability
		I	II	III	IV	V	VI	
“Gedankenlautwerden”	20.7	0.719	0.111	0.004	–0.042	–0.083	–0.003	0.85
Thought withdrawal	24.7	0.708	0.087	–0.029	–0.012	–0.091	–0.102	0.82
Thought insertion	25.4	0.694	0.118	–0.033	0.045	–0.129	–0.102	0.82
Passivity experience	40.3	0.631	–0.055	0.032	0.174	0.019	0.005	0.84
Thought broadcasting	38.0	0.588	–0.053	–0.141	0.093	0.013	–0.245	0.90
Voices talking to patient	58.7	0.534	–0.155	0.059	–0.022	0.271	0.172	0.92
Voices talking to each other	31.0	0.520	–0.005	0.217	0.172	–0.039	–0.023	0.85
Voices coming from inside the body	19.1	0.476	–0.018	0.177	–0.207	0.194	0.082	0.86
Voice giving running commentary	32.6	0.465	–0.094	0.018	0.146	0.294	0.118	0.80
Negativism	25.6	–0.032	0.779	0.092	0.033	–0.034	0.042	0.77
Catatonic excitement	33.3	–0.063	0.721	0.047	0.080	0.173	0.030	0.68
Stupor/muteness	19.3	0.137	0.663	0.008	–0.088	–0.251	–0.034	0.87
Bizarre posture	14.7	0.035	0.650	–0.051	–0.114	0.147	–0.016	0.82
Incoherence	56.6	0.033	0.277	–0.088	0.208	0.271	0.083	0.71
Somatic delusion	17.7	–0.148	–0.014	0.754	–0.024	0.038	–0.085	0.71
Hypochondriacal delusion	18.9	0.075	0.080	0.682	0.185	–0.018	0.238	0.78
Tactile hallucination	11.0	0.079	0.027	0.603	–0.078	–0.066	–0.359	0.82
Persecutory delusion	73.7	–0.020	–0.002	0.003	0.802	–0.046	–0.068	0.83
Delusion of reference	73.9	0.103	–0.002	–0.051	0.781	0.030	0.069	0.69
Delusional precept	42.4	0.065	0.008	0.168	0.458	0.035	–0.128	0.68
Religious delusion	11.0	–0.048	0.065	–0.014	–0.042	0.696	–0.204	0.75
Grandiose delusion	18.6	–0.080	0.074	–0.070	0.053	0.680	–0.034	0.82
Other delusions	13.3	0.107	–0.046	0.114	–0.022	0.420	–0.030	0.66
Visual hallucination	12.6	0.061	–0.025	0.096	0.023	0.122	–0.679	0.87
Other verbal hallucination	19.6	0.083	0.007	–0.023	–0.090	0.159	–0.608	0.86
Non-verbal auditory hallucination	17.0	–0.014	–0.035	0.014	0.209	–0.048	–0.586	0.75
Factor intercorrelations	Factor II	0.049						
	Factor III	0.170	–0.042					
	Factor IV	0.208	0.028	0.074				
	Factor V	0.200	0.056	0.083	0.102			
	Factor VI	–0.127	0.008	–0.088	–0.063	–0.017		

Table 3 Six syndromal dimensions and demographic and clinical variables

	Loose ego boundary	Catatonic	Hypochondriacal	Paranoid	Grandiose	Visual hallucinatory
Gender	0.02	0.02	0.08	−0.02	−0.04	0.16**
Age (years)	−0.12**	−0.13**	0.07	0.01	−0.04	−0.08
Age at onset of current episode	−0.14**	−0.09	0.00	0.02	−0.06	−0.05
Duration of current episode (months)	0.06	−0.10	0.14**	0.03	0.05	0.01
Duration of current positive symptoms (months)	0.05	−0.13**	0.11*	0.06	0.09	0.01
No. of past episodes	−0.00	−0.05	0.16**	0.06	−0.04	−0.01
Age at onset of first positive symptoms	−0.01	−0.08	0.02	0.10	−0.03	0.02

* $P < 0.05$; ** $P < 0.01$

herence; the third by bodily delusions/hallucinations; the fourth by delusions of persecution and reference; the fifth by grandiose and religious delusions; and the sixth by visual and miscellaneous hallucinations.

The correlations between two factors were modest ranging between −0.127 and 0.208 (Table 2).

Six composite variables (syndromal dimensions) were calculated by counting the number of observed symptoms out of those that had shown factor loadings of 0.40 or more in each factor. These subscales were termed as (a) loose ego boundary, (b) catatonic, (c) hypochondriacal, (d) paranoid, (e) grandiose, and (f) visual hallucinatory.

It was found that the loose ego boundary subscale was correlated with younger current age and younger onset of the current episode, the catatonic subscale with younger current age and shorter duration of the current positive symptoms, the hypochondriacal subscale with longer duration of the current episode, longer duration of the current positive symptoms, and greater number of the past episodes, and the visual hallucinatory subscale with female gender (Table 3).

Discussion

The factor structure may be determined by the extent to which rating items cover psychopathological phenomena. Thus, subtle distinctions between items may be absorbed into a single factor if the whole set of items encompasses a large area, whereas these may emerge as different factors if the item set includes only those items similar to each other in their content. By factor-analyzing positive, negative, depressive, and manic symptoms, we observed that positive symptoms were dispersed into five factors: grandiose delusion came under the manic factor; delusions of poverty and guilt under the depressive factor; incoherence and neologism under the negative factor; catatonic symptoms constituted its own factor; and all other delusions and hallucinations constituted another discrete factor. In the present analysis, a subgroup of the same sample schizophrenic population used in our previous study was examined using only the positive symptoms, so that fine distinctions between the symptoms were more

likely to emerge; the positive symptoms were found to yield a total of six factors. To decide whether six subcategories of the positive symptoms is the appropriate number may require a validation study using external criteria which reflect underlying pathophysiology. The issue might also be further clarified by applying confirmatory factor analysis. Before stepping into these stages, however, an exploratory factor analysis like the present one should be carefully examined because use of confirmatory factor analysis cannot be suggested without sufficient factor loading matrices that had been produced by exploratory factor analyses.

The salient finding of the present analysis is that the bulk of “other” delusions and hallucinations that were identified in our previous study (Kitamura et al. 1995) may be further divided into a few different categories.

The highest eigenvalue was obtained by the factor 1, which was constituted by all Schneider's first-rank symptoms (except delusional percept) and two other symptoms; voices talking to the patient and voices coming from inside the body. These are “ego disorder” symptoms and auditory hallucinations which the traditional psychopathology has long been regarding as specific to schizophrenia. The symptom, voices coming from inside the body, is not a Schneiderian symptom but is listed as a diagnostic item of schizophrenia in the ICD-10. It is of note here that delusional percept, another Schneiderian first-rank symptom, did not have a high factor loading on the factor 1; it was closer to non-ego-disorder delusions. It may be argued that all the symptoms listed in factor 1 may reflect reduced boundary of ego with the outer world, whereas delusional percept is a special form of the onset of delusions. More empirical studies on the differentiation of the first-rank symptoms may be warranted.

Less specific auditory hallucination, and visual and olfactory hallucinations, constituted a discrete factor. Non-ego-disorder delusions, such as persecutory delusion and delusion of reference, together with delusional percept, also emerged as a discrete factor.

Other delusions seemed to be dispelled among three factors which reflect the content of the experiences. Thus, factor 5 represents grandiosity, and factor 3 somatic hypochondriacal concern.

In our factor analysis, somatic delusion, hypochondriacal delusion, and tactile hallucination shared the same factor. Through cases studies, some authors (Munro 1980; Reilly 1977) claimed discrete entity of monosymptomatic hypochondriacal psychosis. This includes, as suggested by Munro (1980), delusion of skin infestation, delusion of internal parasitosis, false belief that there are lumps or small seed-like objects under the skin, dysmorphic delusion, olfactory delusion, "phantom bite," and others. These clinical conditions are rare but may deserve further empirical investigations.

In their detailed analysis of catatonic symptoms, McKenna et al. (1991) suggested that they could be subdivided into "positive" and "negative" phenomena. This may be explained by the fact that McKenna et al. (1991) factor-analyzed only catatonic symptoms; our factor analysis encompassed the whole range of positive symptoms.

Empirical validation of the six dimensions of schizophrenic symptoms emerging in this study is beyond the scope of the present investigation. However, different correlational profiles of them with basic clinical variables may provide indirect support. For example, the hypochondriacal dimension was more likely to appear among patients with longer durations of the current episode and the current positive symptoms and greater number of past episodes, whereas these variables had no association with the other five symptomatic dimensions.

What are the implications of the present study for clinical and research psychiatry?

In clinical psychiatry, recent operational diagnostic criteria for schizophrenia seem to have become much simpler. Thus, DSM-IV requires that for the diagnosis of schizophrenia, at least two of the following be fulfilled; (a) delusions; (b) hallucinations; (c) disorganized speech; (d) grossly disorganized or catatonic behavior; and (e) negative symptoms. It is also noted that the criteria require only one symptom if delusions are bizarre or hallucinations consist of a voice keeping a running commentary on the person's behavior or thoughts, or two or more voices conversing with each other. However, present findings suggest that schizophrenic diagnostic criteria should perhaps be reconsidered. For example, Schneiderian first-rank symptoms and other symptoms with high factor loadings on the first factor may warrant the diagnosis of schizophrenia by themselves, whereas non-Schneiderian delusions or hallucinations need to be present with other schizophrenic symptoms to confirm the diagnosis. Thus, a patient with grandiose delusions alone should not be diagnosed as schizophrenic, but may be so if these are accompanied by, for example, somatic delusions (if, of course, the other criteria, such as the duration and absence of organic etiology, are fulfilled). This means that DSM-IV may have the opportunity for further refinement: the term "bizarre" may be more specified for the diagnosis of schizophrenia, whereas the two non-Schneiderian forms of auditory hallucinations may be given higher status as a diagnostic marker.

Many symptom or severity rating scales regard a variety of delusions or hallucinations as a single category. Similarly, there has been little research on which neuroleptics are effective for which types of positive symptoms. Reilly (1977) reported that pimozide was effective for monosymptomatic hypochondriacal delusions, but we are not aware of any study that has been undertaken on differential therapeutic effects of pimozide on other types of delusions. Nor have any randomized controlled trials been carried out. Drug-symptom specificity may well be an issue that is worth investigating, particularly in relation to the positive symptoms of schizophrenia. For research of this kind, the global assessment of positive symptoms or their traditional dimensions (delusions, hallucinations, etc.), e.g., by the Brief Psychiatric Rating Scale (Overall and Gorham 1962), may not be sufficient. Detailed rating scales based on empirical symptoms, such as the ones investigated in this study, should be developed and used widely.

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