

The Factor Structure of Schizophrenic Symptoms: Which Model is Supported by Independent Item Analysis?

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Abstract

Objective: Most studies that have investigated the symptom dimensions of schizophrenia utilizing the Scale for the Assessment of Positive Symptoms (SAPS) and the Scale for the Assessment of Negative Symptoms (SANS), both global rating scales, favored a 3-factor model. Only a few studies have examined the factor structure at the item level and they suggest a wider dimensional structure. The factor structure of schizophrenic symptoms has not been previously studied in Turkey, nor has the construct validity of these scales. The present study sought to determine the factor structure of the independent items and the construct validity of the scales.

Method: The study included 180 schizophrenia patients (diagnoses based on DSM-IV criteria). The standard statistical methods of principal component analysis (PCA) and varimax rotation were used to extract factors.

Results: PCA of the global items yielded a 3-factor solution, representing positive, negative, and disorganization dimensions. Item-level factor analysis revealed 12 factors: Psychomotor poverty, positive formal thought disorder, auditory/visual hallucinations, social and occupational dysfunction, bizarre delusions, attention/stereotypy, paranoid features, somatic hallucinations/delusions, appearance, grandiose/religious delusions, inappropriate affect, and delusions of jealousy.

Conclusion: Consistent with previous studies, neither the global nor the item-level factor structures supported the simple positive-negative dichotomy or the composition of the sub-scales; therefore, future studies should make use of the single items, especially when positive symptoms are being studied.

Key Words: Factor analysis, negative symptoms, positive symptoms, schizophrenia

INTRODUCTION

Several studies that defined the symptom dimensions of schizophrenia were conducted in order to better understand schizophrenia, which is a heterogeneous disorder, and to investigate its neurobiological components. A dimension/factor approach based on gathering related symptoms into a symptom cluster was developed using some statistical methods (internal reliability, correlation analysis, factor analysis, etc.), and after Andreasen and Olsen (1982) empirically differentiated positive and negative symptoms this approach found widespread use. The work of these researchers has accelerated the study of the symptom dimensions of schizophrenia during the last 20 years. Use of the Scale for the Assessment of Positive Symptoms (SAPS) and the Scale for the Assessment of Negative Symptoms (SANS), both developed

by Andearsen et al. (1990), resulted in the introduction of models using 2 or more dimensions; however, subsequently most studies supported the 3 dimensional model (positive/psychotic, negative/psychomotor poverty, and disorganization) developed by Liddle (1987) instead of a positive-negative dichotomy (Peralta and Cuesta, 2001). Nevertheless, almost all of these studies accepted the general assessment that the last item of each sub-scale based on the pre-assumption that all empirically defined sub-scale structures were valid (based on high internal consistency values) (for example, “the general assessment of delusions” item of “the delusions” subscale). The mentioned studies were criticized because of their unreliability and it was suggested that exploring symptom dimensions on the level of independent items instead of the general assessments of symptom dimen-

sions would be more beneficial. Factor analysis studies conducted at the item level were criticized because they were few in number and the results were unreliable because of methodological problems (small sample, different statistical methods, etc.) (Peralta and Cuesta, 2001; Stuart et al, 1999).

A percentage of the studies conducted on the symptom dimensions of schizophrenia were cross-cultural studies. The similarity of their results regarding negative symptoms were interpreted by researchers to mean that negative symptoms are universal (Emsley et al, 2001; Lin et al; 1998; Kulhara et al, 2003; Gureje et al, 1995). To the best of our knowledge, there haven't been any studies conducted in Turkey on the symptom dimensions of schizophrenia, except for an unpublished study investigating the factor structure of first-rank (Turgut et al, 2004) and another study conducted with a small sample on the level of general sub-scale items (Veznedaroğlu et al, 2005).

The present study aimed to explore the factor structure of schizophrenic symptoms assessed with SAPS and SANS in a sample large enough to enable us to conduct an item-based study using standard statistical methods. Moreover, the only reliability study of SAPS and SANS conducted in Turkey (Erkoç et al, 1991a, Erkoç et al, 1991b) assessed only their internal reliability. The second aim of the present study was to assess the construct validity of these scales based on factor analysis.

METHOD

Sample

The study included 180 patients aged 14-65 years that presented to the inpatient and outpatient clinics between 2001 and 2004, and who were diagnosed with schizophrenia based on DSM-IV criteria (APA). Among them, 152 patients (84.4%) were diagnosed with undifferentiated-type, 23 (12.8%) were diagnosed with disorganized-type, and 4 (2.2%) were diagnosed with residual-type schizophrenia. Schizophrenia patients assessed with SAPS and SANS were included in the study sample. These scales were administered by clinicians trained in their use. Patients with an Axis I disorder were excluded from the study.

In all, 56.7% (n = 102) of the participants consisting of patients hospitalized in inpatient unit for psychotic disorders (n=92), patients presented to outpatient clinic (n=62) and patients monitored in daytime hospital (n=26) are males. Mean age of the participants was

33.79 ± 12.75 years, most were not married (71.7%), and mean duration of education was 10.9 ± 3.61 years. In total, 58 patients (32.2%) could not work because of their disability, 41 (22.8%) were working, 37 (20.6%) were housewives, 25 (13.9%) were students, 16 (8.9%) were retired, and 3 patients (1.7%) were unemployed and looking for work. Mean age of onset was 23.1 ± 7.51 years, mean duration of disorder was 128.8 ± 127.29 months, and mean duration of psychotherapeutic treatment was 95.5 ± 112.5 months. The average number of hospitalization was 2.9 ± 3.01 and the average duration of hospitalization was 2.9 ± 4.29. 151 (83.9%) were on anti-psychotic drugs and 29 were not during the assessment.

INSTRUMENTS

The Scale for Assessment of Positive Symptoms (SAPS)

SAPS is a scale designed to measure the level, distribution, and intensity of positive symptoms. It's a 35-item instrument containing the following sub-scales: hallucinations, delusions, bizarre behavior, and formal thought disorder. The 35th item is inappropriate affect and is considered an additional sub-scale (Aydemir and Köroğlu, 2000a).

The Scale for Assessment of Negative Symptoms (SANS)

SANS is a scale designed to measure the level, distribution, and intensity of negative symptoms. It's a 25-item instrument containing the following subscales: affective flattening, alogia, apathy, anhedonia and attention (Aydemir and Köroğlu, 2000b).

Both scales are scored based on observations during interviews and the data obtained from the relatives of patients. Each item is rated on a 5-point Likert scale. Internal consistencies of the Turkish version of the scales was taken as an evidence for the validity of the scales (Erkoç et al, 1991a, Erkoç et al, 1991b).

Statistical Analysis

Factor analysis was conducted on the SAPS and SANS global assessment items, and on the 50 independent items of these scales. Principal components analysis (PCA) was performed to determine the factor analytic structure, the number of factors were defined according to the Kaiser criteria, and varimax rotation method, which is by far the most popular rotation method, was

Table I. Factor structure on the global item level, eigen-values, variance, and Cronbach's alpha values.

Global Items	F1	F2	F3
Hallucinations		0.695	0.127
Delusions	-0.187	0.749	0.293
Bizarre Behavior		0.733	
Thought Disorder		0.352	0.664
Inappropriate Affect	0.269		0.716
Affective flattening	0.817		
Alogia	0.765		0.217
Apathy	0.557	0.514	
Anhedonia	0.540	0.590	-0.168
Attention	0.698		0.157
Eigen-value	3.005	1.928	1.024
Variance (%)	30.046	19.275	10.236
Cronbach's alpha values	0.727	0.609	0.200

†Correlation values <,010 are not presented.

The highest correlation values between items and factors are written in bold.

used. The consistency of the data with the factor model was assessed with the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) (Özdamar, 2002). Additionally, the high-frequency items (scored 2 or higher), which indicate the definitive existence of symptoms, were calculated. Low-frequency items were excluded and a second factor analysis was conducted because low-frequency items could have limited the potential correlation range. Items were assigned to factors with the highest factor loadings and named according to the factor content in all 3 analyses. All statistical analyses were carried out by SPSS 10.0.

RESULTS

Results Based on the level of Global Items

The 3 factors that explained 59.9% of the total variance with an eigen-value > 1 were identified on the level of the global assessment of SAPS and SANS. These factors are: The negative factor, including the affective flattening, alogia, apathy and attention sub-scale items, the positive factor, including the hallucinations and delusions sub-scale items, and the disorganization factor, including the thought disorder and inappropriate affect sub-scale items. Factor structures, eigen-values, variance percentages, and Cronbach's alpha values of the factors are presented in Table I. Anhedonia had similar

loadings as both the positive and negative factors. This analysis determined that the Kaiser-Meyer-Olkin value was 0.743 (indicating that the factor model of data is consistent) Table I.

Results Based on the Level of Items

In all, 13 factors explained 68.3% of the total variance with an eigen-value > 1 (when all items were included in the factor analysis) and the Kaiser-Meyer-Olkin value was 0.766 (indicating that the factor model of data is consistent). In total, 9 items were weakly loaded (< 0.50) according to MSE; persecutory delusions, delusions of reference, aggressive and agitated behavior, repetitive or stereotyped behavior, pressure of speech, clanging, physical anergia, and inattentiveness.

At the end of a second analysis conducted on the item level, 4 items (thought withdrawal, incoherence, distractible speech, and clanging) were excluded because they were low-frequency items (< 10%). Then, 12 factors, which explained 68% of the total variance, were identified after analyzing the last 46 items. Factor structures, eigen-values, variance percentages, and Cronbach's alpha values of the factors are presented in Table II. These factors are psychomotor poverty, positive formal thought disorder, auditory/visual hallucinations, social and occupational disability, bizarre delusions, attention/

Table II. Factor structure on the item level, eigen-values, variance, and Cronbach's alpha values.

Items	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Auditory hallucinations		,108	,793	,121	,143		,240	,121		,132		
Voices commenting			,865		,173							
Voices conversing			,799	,139		,117						
Somatic/tactile hallucinations			,244		,165	,168		,754				
Olfactory hallucinations			,110	,101	,175			,683		,256	,208	
Visual hallucinations			,605		,191		,130	,380	,133			
Persecutory delusions	-,248	,122	,340	,180	,227		,482	-,218	,124	,294		
Delusions of jealousy						,124					-,109	,867
Delusions of guilt			-,172		,500	,113	,399	,193	-,104	-,251		
Grandiose delusions		,256			,214		,190		,115	,743		
Religious delusions Dinsel sanrilar		,368	,236			,105		,204		,652	,105	
Somatic delusions		,191	,114		,128		,205	,681	,162			
Delusions of reference	-,128		,280		,478	,102	,461	-,199		,118	,273	
Delusions of being controlled			,436		,550	-,116	,164	,194				
Delusions of mind reading	-,105		,282		,690		-,151	,147	,138			
Delusions of thought broadcasting		,136	,123	,123	,666	,149		,177		,172	-,178	
Delusions of thought insertion		,145	,391		,571	-,222		,112				
Clothing and appearance		,270	,121				,195	,148	,632		,218	
Social and sexual behaviour		,196					,640		,239		,120	
Agitated and aggressive behaviour			,166	,270			,685	,133		,269	-,144	
Repetitive/stereotyped behaviour	,189		-,143	,115		,435	,224	,280	,178			
Derailment		,862	,130					,121				
Tangentiality		,834			,103			,107		,175		
Illogicality		,798							,130			
Circumstantiality	-,356	,658				,170				,171		
Pressured speech	-,250	,556		,165				-,132	,125	,218		
Inappropriate affect	,143	,125						,110			,794	
Unchanging facial expression	,855			,120								
Decreased spontaneous movements	,750										,157	
Paucity of expressive gestures	,828			,121		,107	-,111					

stereotypes, paranoid features, somatic hallucinations/delusions, appearance, grandiose/religious delusions, inappropriate affect, and jealousy. Table II.

DISCUSSION

As a result of the factor analysis of the global items, a structure similar to the model designed by Liddle (1987)

Table II. Continued.

Items	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Poor eye contact	,642					,146	,199		,133		,333	
Affective non-responsiveness	,815			,122			,158		,114			
Lack of vocal inflections	,855			,178								
Poverty of speech	,679			,134		,324						
Poverty of content of speech		,597		,159		,522			,122	-,116		
Blocking	,262			,106		,706			-,196	,128		
Increased latency of response	,554			,127		,488	,181		-,254			
Grooming and hygiene	,273	,143		,278			,185		,712			
Impersistence at work/school	,269	,154	,173	,530	,110	,122	,188		,180		-,147	
Physical anergia	,423	-,175		,443	,237		-,173		,378	,162		
Recreational interests and activities	,214			,770	,164	,112		,178				
Sexual activities	,207			,358	,188						,407	
Ability to feel intimacy and closeness	,249	,117	,124	,721	-,124		,302					
Relationships with friends andpeers	,172			,825							,141	
Social inattentiveness	,495			,128		,485	,117		,351		,219	
Inattentiveness during mental examination	,241	,119	,165			,620			,172			
Eigenvalues	5,8	3,8	3,4	2,9	2,5	2,4	2,2	2,2	1,7	1,6	1,4	1,3
Variance(%)	12,7	8,3	7,4	6,3	5,5	5,1	4,8	4,8	3,7	3,6	3	2,8
Cronbach's α values	0,913	0,848	0,851	0,784	0,723	0,641	0,696	0,713	0,619	0,681		

†Correlation values <,010 are not presented.

The highest correlation values between items and factors are written in bold.

was revealed. It's remarkable that the anhedonia item contained similar positive and negative loadings (0.540 and 0.590). Anhedonia was associated with positive symptoms as well as negative symptoms.

On the item level, 2 different analyses were conducted that included all items and excluded the low-frequency items, and the results were compared. It was observed that high-frequency (70% and 77.2%) items such as persecutory delusions and delusions of reference were distributed to different dimensions and had low factor loadings. Yet, the exclusion of the core symptoms that are frequently scored was concluded to be inaccurate and, consequently, only 4 low-frequency items were excluded. Both analyses resulted in similar factor loadings, which explained 68% of the total variance.

Different methodologies used by researchers complicated comparison of the results; yet, similar factor structures were obtained in previous studies (Liddle, 1987; Malla et al, 1993; Minas et al, 1995; Andreasen et al, 1995; Toomey et al, 1997; Peralta and Cuesta, 1999; Emsley et al, 2001). The symptoms related to the negative factor, which were identified as a result of the analysis of global items, were loaded on the 2 main factors (psychomotor poverty and social/occupational disability), and other symptoms related to the positive and disorganization factors were distributed to the other factors. The first 4 factors supported by the previous research had high internal reliability.

In both analyses poverty of speech and affective flattening were loaded on the same factor, as was previously

reported (Liddle, 1987; Andreasen et al, 1995; Toomey et al, 1997; Emsley et al, 2001). Additionally, this factor, which included social inattentiveness, was referred to as psychomotor poverty, which is consistent with the description of Liddle. Physical energy, which was loaded to the mentioned factor in the first analysis loaded to social/occupational disability, together with anhedonia, apathy in the second analysis.

It is rational that the poverty of content of speech item clustered with the other thought disorders because of its definition, and this factor was named, positive formal thought disorder. This result is consistent with previous studies (Malla et al, 1993; Miller et al, 1993; Minas et al, 1994; Peralta and Cuesta, 1999).

Delusions of being controlled, delusions of mind reading, thought broadcasting, and thought insertion items, which are grouped in the first-order symptoms of Schneider, were clustered in the same factor, which is consistent with the previous research. This factor, which also includes delusions of guilt, was named bizarre delusions because of its bizarre characteristics. Grandiose delusions and religious delusions were clustered in the same factor as the general clinical considerations and were named grandiose/religious delusions. Olfactory hallucinations, somatic hallucinations, and somatic delusions were also under the same factor. These 2 results are consistent with the factor structure reported by Kitamura et al (1998). Auditory and visual hallucinations, on the other hand, formed a different factor, which is not supported by previous studies.

Another remarkable point is that the attention sub-scale items were grouped with different factors. Social inattentiveness was placed under the psychomotor poverty factor in both analyses and this result is consistent with the studies suggesting social inattentiveness is associated with negative symptoms, especially affective flattening (Malla et al, 1993; Minas et al, 1994; Andreasen et al, 1995; Toomey et al, 1997; Peralta and Cuesta, 1999; Emsley et al, 2001).

A study conducted by Atbaşoğlu et al. (2003) revealed that these 2 items weren't interrelated; Social inattentiveness was related to bizarre behavior and alogia, but was not related to performance during neuropsychological tests.

On the other hand, the same study indicated that the inattentiveness item was related to performance during neuropsychological tests. In the present study the inattentiveness item was loaded with blocking, increased la-

tency of response, and repetitive/stereotypical behavior; this factor was named attention. Other studies conducted on the item level didn't clarify the relationship of this item with other items because it was excluded prior to analysis or wasn't included in the factor structure; however, the results of the present study are consistent with Peralta and Cuesta's (1999), indicating that inattentiveness was loaded with blocking and increased latency of response according to MSE.

It's clinically remarkable that the sexual interest and activity item was in the same factor group as inappropriate affect; nonetheless, the same item loaded to social/occupational disability and was included in this factor because it was clinically more appropriate.

Grooming and hygiene were grouped in the same factor in both analyses and were referred to as appearance. As the study conducted by Peralta and Cuesta (1999) indicates, delusions of jealousy formed a separate factor. This may be as a result of its being a low-frequency scored item (12.8%).

The major limitation of this study is the medium/low levels of internal reliability of some factors (attention/stereotypy, paranoid properties, somatic hallucinations/delusions, appearance, and grandiose/religious delusions), possibly because the participants experienced different phases of schizophrenia. The study used a cross-sectional design and most of the participants had the paranoid-type of schizophrenia, and the effect of psychotherapeutic medication on participants wasn't explored; these are additional limitations. Despite all these limitations, factor structures that adequately explain the variance indicated that the model was valid.

To conclude, the present study indicated that SANS symptoms group under 2 main factors, and SAPS symptoms are more heterogeneous and are distributed to other factors. Psychomotor poverty, positive formal thought disorder, auditory/visual hallucinations, and social/occupational dysfunction factors had high internal reliability scores, which indicates that these dimensions are homogeneous. The results indicate that, in particular, psychomotor poverty and social/occupational dysfunction factors were independent of culture and the results are consistent with Emsley et al. (2001). Additionally, although they had high internal reliability scores, the Turkish versions of SAPS and SANS didn't have valid sub-scale structures.

Consequently, it is thought that the implementation of SAPS and SANS global items or total scores may lead

researchers who study the neurobiological and clinical components to false conclusions. Accordingly, further studies should focus on the dimensional level or even on the symptom level of positive symptoms. On the other hand, although SAPS and SANS have a large spectrum

of symptoms, they don't include depressive, catatonic, or manic symptoms. From this point of view, these scales cannot be considered adequate for investigating the symptom dimensions of schizophrenia and their factor structures should be studied in greater detail.

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