

The Five-Factor Structure of the PANSS: A Critical Review of its Consistency Across Studies

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Abstract

General Purpose: Twenty principal component analyses of the PANSS revealed that a five-factor solution representing positive, negative, disorganization, depression/anxiety and excitability/hostility symptoms better explained the scale structure than the original three-subscale solution. Our goal was to identify to which of these five factors each of the PANSS items could be attributed based on the consistency of published factor analyses. **Methodology:** For each study reporting a five-factor solution, the items were assigned to any of the five factors according to the factor on which it had the strongest factor loading. Items were then rated as reaching or not our between-study stability criteria of 70% of agreement. **Results:** Ten items did not meet our stability criteria: Grandiosity, Stereotyped thinking, Somatic concern, Tension, Mannerism/posturing, Disorientation, Lack of judgment/insight, Disturbance of volition, Preoccupation, and Active social avoidance. **Conclusions:** A broad and a narrow definition of the new PANSS structure are presented according to the stability level of every item.

Key Words: Positive and Negative Syndrome Scale, PANSS, Principal Component Analysis, Factor, Schizophrenia

Introduction

The Positive and Negative Syndrome Scale (PANSS) (1, 2) is a widely used psychiatric instrument aimed at assessing the core symptoms of schizophrenia (SZ) and schizophrenia spectrum psychotic disorders (SZ SPD). The PANSS is particularly used in various research settings, especially for

clinical trials involving antipsychotic or other treatment options and as a group characterization instrument in SZ and SZ SPD studies. A quick MEDLINE search using “Positive and Negative Syndrome Scale” yielded over 1,000 articles, illustrating its wide use.

The PANSS includes thirty items grouped into three scales based on theoretical and heuristic considerations: the Positive, Negative, and General Psychopathology scales (2). Further factor analytic studies have been performed to investigate whether the thirty symptoms cluster into specific dimensions that might underlie distinct processes in schizophrenia. The vast majority (i.e., 23 among 32 factor analyses of the PANSS that we identified) supported a five-factor structure explaining from 51 to 72.3% of the variance. These five factors typically include Positive, Negative, Cognitive/Disorganization, Depression/Anxiety, and Excitability/Hostility dimensions (3-24). Various methodological considerations such as sampling methods, the phase of the illness

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Clinical Implications

There is certainly a need for additional very large studies with different settings (i.e., investigating the stability across phases of illness) and using confirmatory factor analysis techniques to reliably conclude on the attribution of every item to each of the PANSS factors. Nonetheless, the current examination strongly suggests that the PANSS five-factor structure represents a more valid distribution of the items than the original three-factor solution, and that agreements across studies can be reached for many items on which items represent each of those five factors. Altogether, these studies strongly reiterate the need for clinicians to fully appreciate the clinical diversity and multi-dimensionality of psychotic disorders.

in which participants were assessed (i.e., acute episode vs. stabilized state), or the statistical methods could explain that a few studies did not observe a five-factor solution. Furthermore, the additional factors generally represented a partition of these five factors and did not add clinical meaning (7, 25). In a confirmatory factor analysis with a large data set ($N=5,769$), van der Gaag et al. (26) confirmed the five-factor structure of the PANSS, although an acceptable fit for any of the published five-factor models could not be established. This led van der Gaag et al. (27) to conduct a ten-fold cross-validation study applied on that dataset, which assessed the stability of the factor structure by randomly partitioning the sample in ten subsets of data. This later revealed that twenty-five PANSS items consistently loaded on the same factors, and that the five remaining items (Somatic concern, Preoccupation, Mannerism, Lack of judgment and insight, Disturbance of volition) were less consistently attributed to a specific factor. The five-factor structure of the PANSS is now widely accepted and represents a better way to analyze data since it highlights relevant clinical dimensions in schizophrenia. The interest of distinguishing these five factors is eloquently shown by the results of van den Oord et al. (28) who have uncovered distinct patterns of correlations between each factor and external validators (e.g., age of onset, drug use).

Given the strong tendency for a consensus over a five-factor structure, and given the increasing number of studies analyzing data through that five-factor structure (29-32), there is now a need to address the consistency across studies of the PANSS items distribution over the five factors. To our knowledge, such a consistency study has never been published. Hence, the aim of this study was to determine to which of five PANSS factors (Positive, Negative, Cognitive/Disorganization, Depression/Anxiety, and Excitability/Hostility) the items included in the PANSS could be assigned in order to derive a consistent five-factor structure of the PANSS.

Methods

The electronic search involved MEDLINE and PsychInfo databases (end time of the revision: October 2008). The following key words were used: "PANSS," "Positive and Neg-

ative Syndrome Scale," "factor," "factor analysis," and "principal component analysis." Following the electronic search, manual searches of the bibliographies of identified articles were performed. Our review included every report that fulfilled the following four criteria. First, the study reported a five-factor structure solution. Second, the study provided sufficient information on the factor structure to allow attributing each item to a specific factor. Third, the study was written in English or in French. Fourth, the participants were diagnosed as meeting criteria for SZ or SZ SPD according to the *Diagnostic and Statistical Manual of Mental Disorders, Third Edition (DSM-III)* (33), *DSM-III-R* (34), *DSM-IV* (35) or the *International Classification of Diseases-10 (ICD-10)* (36).

For every factor analysis included in the study, the distribution of each item over the five factors is described in Table 1. For each article, the items were assigned to any of the five factors according to the factor on which it had the strongest factor loading, consisting on a relatively liberal criterion. Indeed, while a factor loading of 0.71 is often recommended as a cutoff to assign a variable to a given factor, since it means that 50% of the variance is accounted by variance shared with other items of the factor (37), we rather decided on using the strongest loading to minimize the proportion of items not assigned to any of the five factors.

Table 2 indicates percentages of agreement between the twenty factor analyses according to criteria related to sample sizes and factor loadings. To guide the assignment of each item to any of the five factors, we reviewed the extent to which they meet the following criterion 1 and 2. In criterion 1, all the studies ($N=20$) were included notwithstanding sample size. In criterion 2, only studies with a sample size power of at least 150 (ten studies) were considered. In both instances, the criterion was met if at least 70% of the studies assigned a given item to the same factor. Criterion 1 was aimed at taking advantage of all studies published, while criterion 2 was aimed at according more importance to studies with larger sample sizes which are expected to yield more stable factor assignment. Ideally, given the widely used rule of thumb requiring at least ten observations per variable (37), we sought to highlight studies with a sample size ≥ 300 but, since only five studies reached such a sample size, we

Table 1 Distribution of the PANSS's Thirty Items over the Five Factors Across Studies

PANSS Items/Study (first author)	Levine (23): N=1,284	White (19): N=1,233	Emsley (16): N=535	Lindenmayer (14): N=517	Marder (16): risperidone; N=342	L'kouras (15): N=258	Mass (17): N=253	Lindenmayer (14): N=240	Langdon (13): chronic phase, ⁵	Fresàn (21): N=150	Tirupati (24): N=143	Wolthaus (20): N=138	Langdon (13): acute phase; N=118	Lee (22): N=105	Marder (16): placebo; N=86	Marder (16): haloperidol; N=85	El Yazajif (6): N=81	Kawasaki (9): N=70	Dofus (5): discharge; N=57	Dofus (5): admission; N=57	
Positive Scale																					
P1. Delusions	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
P2. Conceptual disorganization	3	3	3	†	3	3	3	3,5	3	1	3	1	3	3	3	3	3	3	3	*	3
P3. Hallucinatory behavior	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
P4. Excitement	5	5	5	5	5	5	3,5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
P5. Grandiosity	3	*	1	1	1	5	1	1	1	*	*	1	1	1	5	1	1	*	1	1	1
P6. Suspiciousness and persecution	1	1	5	1	1	1	1	1	1	1	1	1	1	1	*	1	1	*	1	*	1
P7. Hostility	5	5	5	5	5	5	5	5	5	1	5	5	5	5	5	5	5	5	5	5	5
Negative Scale																					
N1. Blunted affect	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
N2. Emotional withdrawal	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
N3. Poor rapport	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
N4. Passive/apathetic social withdrawal	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
N5. Difficulty in abstract thinking	*	*	3	2	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
N6. Lack of spontaneity	2	2	2	2	2	2	2	2	2	2	3	2	5	2	2	2	2	2	2	2	2
N7. Stereotyped thinking	5	5	2	3	1	1	3	*	3	2	3	*	5	2,3	3	1	1	3	3	3	3
General Psychopathology																					
G1. Somatic concern	4	5	4	4	1	1	4	*	1	4	4	*	4	*	5,4 [‡]	4	*	4	4	4	4
G2. Anxiety	4	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
G3. Guilt feelings	*	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
G4. Tension	4	5	5	*	4	4	4	5	4	4	4	5	5	5	5	5	4	4	4	4	4
G5. Mannerism and posturing	*	3	2	3	3	3	3	*	*	3	3	*	3	5	2,3 [‡]	3	3	3	3	2	3
G6. Depression	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
G7. Motor retardation	2	2	2	2	2	2	2	2	2	3	3	2	2	*	2	2	*	2	2	2	2
G8. Uncooperativeness	5	5	5	*	5	5	5	*	5	3	5	*	5	5	5	5	5	5	5	5	5
G9. Unusual thought content	3	3	1	1	1	1	3	1	1	*	1	1	1	1	1	1	*	1	1	1	1
G10. Disorientation	*	4	3	*	3	3	3	3	3	*	*	3	3	*	3	3	3	3	3	*	3
G11. Poor attention	3	3	3	2	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3	3
G12. Lack of judgment and insight	1	1	3	1	5	5	1	1	1	*	5	1	1	5	1,4 [‡]	1	*	1	*	4	4
G13. Disturbance of volition	2	2	2	2	3	3	3 [‡]	*	3	3	2	*	3	5	2 [‡]	3	*	2	3	3	3
G14. Poor impulse control	*	*	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
G15. Preoccupation	2	2,3	1	2	1	3	3	*	3	4	4	*	4	5	2 [‡]	1	*	3	3	3	3
G16. Active social avoidance	3	*	5	2	5	2	2	2	2	*	4	2	2	2	5 [‡]	2	2	2	*	2	2

1=Positive factor; 2=Negative factor; 3=Cognitive/Disorganization factor; 4=Depression/Anxiety factor; 5=Excitability/Hostility factor.
 *The factor analysis does not classify the item. †The factor analysis concludes that the item does not belong to any of the five factors. ‡The factor analysis concludes that the item does not belong to any of the five factors, but the analysis reveals which of the five factors is related to the highest factor loading. §The sample sizes of each of the three subgroups are not available. We know, however, that the total sample size is 512.

Table 2 Percentages of Attribution of Every PANSS Items to One of the Five Factors Across Studies

PANSS Items/Factors	According to all the 20 factor analyses							According to the 10 factor analyses in which N>150						
	1	2	3	4	5	U	O	1	2	3	4	5	U	O
Positive Subscale														
Delusions	95					5		90					10	
Conceptual disorganization	10		80		5	5	5	10		80			10	
Hallucinatory behavior	100							100						
Excitement			5		100							100		
Grandiosity	65		5		10	20		70				10	20	
Suspiciousness and persecution	80				5	15		70					30	
Hostility	5				95							100		
Negative Subscale														
Blunted affect		100							100					
Emotional withdrawal		100							100					
Poor rapport		100							100					
Passive/apathetic social withdrawal		100							100					
Difficulty in abstract thinking		10	80			10				100				
Lack of spontaneity		90	5		5				80	10		10		
Stereotyped thinking	20	15	40		15	10		20	10	60		10	10	
General Psychopathology														
Somatic concern	15			55	10	20					70	10	30	
Anxiety				90	10						100			
Guilt feelings				95		5					100			
Tension				55	30	5					60	40		
Mannerism and posturing		15	65		5	20			20	70		10	10	
Depression			5	95							100			
Motor retardation		80	10			10			70	10			20	
Uncooperativeness			5		80	15						90	10	
Unusual thought content	75		15			10		90					10	
Disorientation			65	5		30				70			30	
Poor attention		10	90						10	90				
Lack of judgment and insight	55		5	10	20	15		50			20	20	20	
Disturbance of volition		35	40		5	15			30	40		10	20	
Poor impulse control					90	10						100		
Preoccupation	15	20	35	15	5	15		10	10	30	20	10	20	
Active social avoidance		60	5		15	15			70		10	10	10	

1=Positive factor; 2=Negative factor; 3=Cognitive/Disorganization factor; 4=Depression/Anxiety factor; 5=Excitability/Hostility factor; U=the factor analysis is unable to classify the item; O=the factor analysis concludes that the item does not belong to any of the five factors.

Note: 1) Percentages have been rounded up to the nearest unity; 2) Some percentages exceed 100%. This is because i) some of them have been rounded up to the nearest unity and/or ii) some analyses concluded that the item is equally related to two factors.

rather used a cutoff of a $N \geq 150$ to stratify studies to determine whether the attribution of items differed according to sample size. Criterion 1 was nevertheless considered given the limited number of studies resulting from using the more stringent criterion 2.

We used this approach instead of meta-analytic techniques since those meta-analyses may hide genuine inter-studies heterogeneity, which may result, for instance, from differences in sampling (e.g., using ratings performed during acute psychotic episodes vs. during the stabilized stage). In addition, such meta-analytic techniques require detailed information (i.e., correlations matrix) that was generally missing in the studies reviewed. We should also emphasize that published studies on the PANSS factor structure typically did not use tools suggested in the statistics literature to examine congruency and factor invariance (38, 39) which could, therefore, not be used in the current review.

Results

Twenty-two articles met the selection criteria (3-24). Five of them were excluded because of redundancies with other listed studies: i) the Bell et al. (3) and the Dolfus et al. (4) articles since they were included in the White et al. article (19); ii) the Higashima et al. (8) article since 53 out of 73 participants were included in the Kawasaki et al. (9) article; and, iii) after personally contacting the authors, three articles from Lançon et al. (10-12) were withdrawn since they were part of an article subsequently published by the same group (13). Hence, our detailed analysis of the attribution of items on each factor was based on sixteen articles reporting factor analyses on twenty separate samples in which a five-factor solution was observed using principal component analyses. Two studies (20, 23) used oblique rotation among which one (20) also performed orthogonal rotation that resulted in the same factor structure. The following reports will refer to those twenty factor analyses.

Table 1 shows, for each study, which factor yielded the highest loading for each variable. Table 2 then shows the percentage of studies for which each variable belonged to any of the five factors.

Ten items did not meet both criteria 1 and 2: Grandiosity, Stereotyped thinking, Somatic concern, Tension, Mannerism and posturing, Disorientation, Lack of judgment and insight, Disturbance of volition, Preoccupation, and Active social avoidance. However, among them, five items did meet either criterion 1 or 2 (they met criterion 2 without meeting criterion 1): Grandiosity, Somatic concern, Mannerism and posturing, Disorientation, and Active social avoidance.

Discussion

Consistent results with regards to factor assignment were found for twenty out of thirty of the PANSS items,

highlighting a relatively stable five-factor structure across studies from independent samples. The other ten items were less consistently attributed to one factor or to the other. Given those inconsistencies, further studies using the PANSS five factors would benefit focusing on items consistently attributed to any of these five factors. Based on the results of the current review, we provide in Table 3 a narrow and a broad definition of the five factors, taking into account the degree to which these ten items showed inconsistencies in their attribution to these five factors. The narrow definition includes twenty items that consistently met both the criteria 1 and 2 outlined above, thus excluding ten items (Grandiosity, Stereotyped thinking, Somatic concern, Tension, Mannerism and posturing, Disorientation, Lack of judgment and insight, Disturbance of volition, Preoccupation, and Active social avoidance).

The broad definition includes the five supplementary items that met either criterion 1 or 2 (Grandiosity, Somatic concern, Mannerism and posturing, Disorientation, and Active social avoidance) and takes into account the fact that the degree of inconsistency in factor assignment differed across the items. Indeed, we propose that the Lack of judgment and insight item could also be included in a broad definition of a five-factor version of the PANSS because its assignment was less problematic than that of the remaining four items (see following paragraph). The item Lack of judgment and insight was assigned to the positive factor (factor 1) in 55% of all studies and was attributed to the Excitability/Hostility factor (factor 5) in only 20% of the studies and a similar pattern was observed in studies with a sample size above 150. The broad definition thus includes twenty-six items. The advantage of such a broad definition is that it minimizes the loss of information resulting from withdrawing variables.

We propose that the four remaining items could clearly not be assigned to any of the five factors and could thus be dropped, given that the presence of heterogeneous symptoms within a single dimension might blur statistical analyses that seek to examine specific dimensions of the disorder. Indeed, there was no factor to which Disturbance of volition and Preoccupation were assigned in at least 50% of the studies. Tension was attributed to factors 4 and 5 in an almost similar proportion of studies (55% and 30% in all studies; 60% and 40% in studies in which $N > 150$). Stereotyped thinking was assigned to factor 3 in only 40% of all the studies, to factor 1 in 20%, to factor 2 in 15% and to factor 5 in 15% of all the studies. These inconsistencies may have different sources. First, imperfect reliability (random error) decreases the maximum loading that an item can achieve, a phenomenon related to psychometric attenuation. Previous reports of poor inter-rater reliability for some items (e.g., Disturbance of volition: intra-class correlation coefficient = .27) (40) suggest that this is a plausible explanation

Table 3 Conclusions about the New Attributions of the PANSS's Items

PANSS Items Original attribution to one of the three subscales	New Attribution
Positive Subscale	
Delusions	Positive
Conceptual disorganization	Cognitive/Disorganization
Hallucinatory behavior	Positive
Excitement	Excitability/Hostility
Grandiosity	Positive*
Suspiciousness and persecution	Positive
Hostility	Excitability/Hostility
Negative Subscale	
Blunted affect	Negative
Emotional withdrawal	Negative
Poor rapport	Negative
Passive/apathetic social withdrawal	Negative
Difficulty in abstract thinking	Cognitive/Disorganization
Lack of spontaneity	Negative
Stereotyped thinking	---
General Psychopathology Subscale	
Somatic concern	Depression/Anxiety*
Anxiety	Depression/Anxiety
Guilt feelings	Depression/Anxiety
Tension	---
Mannerism and posturing	Cognitive/Disorganization*
Depression	Depression/Anxiety
Motor retardation	Negative
Uncooperativeness	Excitability/Hostility
Unusual thought content	Positive
Disorientation	Cognitive/Disorganization*
Poor attention	Cognitive/Disorganization
Lack of judgment and insight	Positive*
Disturbance of volition	---
Poor impulse control	Excitability/Hostility
Preoccupation	---
Active social avoidance	Negative*

*Item included in the broad definition only.

for some inconsistency in factor assignment. Second, this inconsistency may stem from the description of the items and of their severity levels, simultaneously capturing various psychopathological constructs. For instance, the wording of the item Tension and its ambiguous loading on both factors 4 (Depression/Anxiety) and 5 (Excitability/Hostility) suggests that it captures increased levels of psychomotor activity that can be linked either to anxiety or frank psychotic agitation. Third, this inconsistency may reflect that the five-

factor structure does not fully explain variations across the thirty PANSS items, and that there may be other underlying constructs that are not assessed with a sufficient number of PANSS items to be identified in these factor analyses. These may include, for instance, catatonic or obsessive-compulsive disorder symptoms.

The new PANSS structure emerging from the twenty factor analytic studies resulted in modifications of all three original subscales. First, only four out of seven items from the original Positive Subscale remained on the positive factor (Delusions, Hallucinatory behavior, Grandiosity, Suspiciousness and persecution) and two items from the General Psychopathology Subscale switched to the positive factor (Unusual thought content and Lack of judgment/insight; broad definition only). Second, five out of seven items from the original Negative Subscale remained on the negative factor (Blunted affect, Emotional withdrawal, Poor rapport, Passive withdrawal, and Lack of spontaneity) and two items from the General Psychopathology Subscale (Motor retardation and Active social avoidance) switched to the negative factor. Third, the original General Psychopathology Subscale did not represent a stable construct since its items were attributed to one or the other of the five factors and three of its items from the original Psychopathology Subscale appeared to be unclassifiable (Tension, Disturbance of volition, Preoccupation), even in our broad definition of the five factors outlined above. Fourth, three factors not included in the original subscales consistently emerged: the Cognitive/Disorganization dimension including items originating from all three original subscales, the Excitability/Hostility dimension including items from the original Positive and General Psychopathology Subscales, and the Depression/Anxiety dimension including items from the original General Psychopathology Subscale. Given overall significant modifications of the PANSS structure that we are thus objectifying through the current detailed analysis, a modification in the pattern of results of studies using the PANSS is to be expected.

Our observation of consistent results for twenty out of thirty items is in line with the van der Gaag et al. (27) ten-fold cross-validation study that also observed a relative stability of twenty-five out of thirty PANSS items. The five items that were problematic to van der Gaag et al. (27) were among the ten less consistently attributed items of the current analysis. Thus, the inconsistencies that we observed have also been observed in the van der Gaag et al. (27) study conducted with 5,769 participants, which increases the strength of the current results. The fact that we identified a larger number of items that are not consistently assigned to a factor may be due to our including several studies with a broad variety of types of samples drawn from various countries and assessed by distinct research teams. Given these methodological variations across studies, our review probably represents

a particularly stringent test of the robustness of the factor structure of the PANSS.

Several issues should be considered while interpreting our results. First, we acknowledge that our attribution of the items to each of the five factors was based on somewhat arbitrary criteria requiring that a large proportion of the studies (70%) were consistently attributing items to a similar factor.

Second, most of the studies reviewed did not use an empirical method for the determination of how well a model fits the data. Hence, it could be argued that the first studies that have yielded a five-factor structure have influenced subsequent investigators in concluding to a five-factor solution. However, the consistency in item assignment that we observed and the face validity of these five factors suggest that such an influence is unlikely to totally invalidate the conclusions of the current review, although it may have contributed to increasing the level of consistency across studies.

Third, distributing items over five factors instead of three subscales and dropping items inevitably resulted in having few items on some factors. For instance, the Depression/Anxiety factor only includes three items in its narrow definition (and four items in the broad definition). Hence, this modest number of items may result in a decrease in accuracy in measuring these constructs, due to which the concomitant use of specialized scales (e.g., Calgary Depression Scale) may be required for accurately measuring these constructs.

Fourth, it should be remembered that these results regarding the factor structure of SZ symptoms apply to the PANSS and that other rating scales that have item coverage different from that of the PANSS are known to yield different factor structures.

As mentioned previously, there might be slight differences in the PANSS items distribution across each of the factors according to sample characteristics, such as phase of illness, subtype of schizophrenia, etc. Consequently, more than one scoring system may be needed. Future research settings might benefit by addressing this issue. Further studies should also focus on the validation of the PANSS constructs in looking for specific correlates (e.g., neurocognitive deficits) for each of the five factors. Finally, to allow a comprehensive understanding of the PANSS factor structure, further studies would also benefit from reporting factor congruency coefficients and factor invariance.

Conclusions

In conclusion, there is certainly a need for additional very large studies with different settings (i.e., investigating the stability across phases of illness) and using confirmatory factor analysis techniques to reliably conclude on the attribution of every item to each of the PANSS factors. Nonetheless, the current examination strongly suggests that the PANSS

five-factor structure represents a more valid distribution of the items than the original three-factor solution, and that agreements across studies can be reached for many items on which items represent each of those five factors.

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