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The low- and higher-order factor structure of symptoms in patients with a first episode of psychosis

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ABSTRACT

Background: The phenotype of psychotic disorders is presumed to be heterogeneous, but the best way to describe this heterogeneity remains unclear.
Objective: To examine the lower-order and higher-order symptomatic architecture of psychotic disorders by means of factor analysis and the Schmid–Leiman transformation.
Methods: Patients experiencing their first episode of psychosis (n = 486) were comprehensively examined for 70 symptomatic variables, which were subjected to principal components analysis followed by a Promax rotation. First-order factors were subjected to second-order factor analysis, and influence of second-order factors on primary factors was removed using the Schmid–Leiman transformation.
Results: First-order factor analysis revealed 13 primary factors that were substantially intercorrelated. Second-order factor analysis showed 5 higher-order factors with no substantial intercorrelations. The Schmid–Leiman transformation revealed that whereas the second-order factors accounted for most of the symptom covariance (63.5%), the first-order factors still accounted for an additional 36.5%. According to this transformation, five second-order factors (bipolar negative-mania, disorganization, psychomotor retardation, hallucinations and grandiosity) plus four first-order factors (depression, catatonia, bizarre delusions and paranoid delusions) best explained the factor structure of the symptoms.
Conclusions: The phenotype of psychosis is more complex than previously acknowledged as it embraces a multidimensional hierarchical structure organized into nonredundant first- and second-order factors.

1. Introduction

The phenotype of psychotic disorders is presumed to be heterogeneous, but the best way to describe this heterogeneity remains unclear (Kraemer et al., 2004; Mathalon and Ford, 2012). It is widely accepted that psychotic symptoms segregate into several symptom dimensions and there exists a broad agreement among the DSM-V planners about the need for a dimensional approach to mental disorders in general, and to psychoses in particular. Studies have produced inconsistent findings regarding the number and type of factors that underlie the symptoms of the psychoses, since between 2 and 18 factors have been reported (Peralta and Cuesta, 2001). Notwithstanding, there is some consensus about the existence of "big five" dimensions of the psychotic symptoms, namely reality-distortion, disorganization, negative, mania and depression (Lindenmayer et al., 1995; Allardyce et al., 2007). However, unresolved questions include the extent to which these big psychopathological domains are sufficient to describe the psychosis phenotype, such as their primary or higher-order nature.

Although much of the factor analytic literature has focused on the problem of how many factors comprise a given instrument, a considerable more important question is how many and what factors best describe the universe of psychosis-related symptoms. While a number of methodological problems may account for the continuing uncertainties regarding this issue (Peralta and Cuesta, 2001), two of them appear to be of particular relevance for addressing this question. The first is that many of the analyses have focused on instruments with inadequate symptom coverage. The second is that most previous studies do not take into account the fact that domains of psychopathology are correlated and often co-occur in the same patient, and thus, the presence of higher-order factors that putatively account better for correlations among symptoms gets undetected. Only two previous studies have sought to empirically determine the higher-order factor structure of psychotic symptoms. Lorr et al. (1962) found that 9 first-order dimensions clustered together into 3 second-order dimensions corresponding to a "bipolar excitement vs. retarded withdrawal" factor, a "paranoid-hostility" factor and a "thinking disorganization" factor. In a previous study from our group (Peralta and Cuesta, 1999), we found 11 primary factors, which in turn resulted in 4 second-order factors labelled "negative", "disorganization", "psychosis" and "other delusions".

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While there is some evidence for a hierarchical structure of psychotic symptoms (Cuesta and Peralta, 2001; Cuesta et al., 2003), the question would arise as to the relative importance of higher- vs. lower-order dimensions, in tandem with the caution that the future nosology should not become overly reductionistic. Identifying these fundamental low- and higher-order dimensions would allow us to better shape thinking about organization of symptoms, syndromes and diagnoses. Since, typically, psychiatry has relied on syndromes (i.e. sets of symptoms which occur together more frequently than would be expected by chance alone) to define disorders, it is essential to maximize the internal validity of syndromes (Tandon, 2012).

In the present study, we sought to empirically address the hierarchical factor structure of the psychosis phenotype in patients with a first-episode of psychosis, which were comprehensively assessed for their psychopathological manifestations. The study has three primary and related goals: 1) to examine the first-order factor structure of a broad array of symptoms of psychotic disorders, 2) to empirically determine the higher-order structure of the primary factors, and 3) to establish a generalizable model of first- and higher-order factors of psychotic symptoms by means of the Schmid–Leiman transformation (SLT). The SLT is an emerging methodology to study the factor structure of dimensionally complex traits (Canivez and Watkins, 2010; Jennrich and Bentler, 2011), which facilitates interpretation of primary factors relative to higher-order factors by computing direct relations between primary variables and second-order factors. This method allowed us, for the first time, to determine the extent to which severity ratings of a broad range of psychotic symptoms can be explained by primary and higher-order factors.

2. Methods

2.1. Participants

This study is part of an ongoing prospective and naturalistic study on the phenomenology and stability of symptoms, syndromes and diagnosis of patients with a first episode of psychosis. The study sample for the present study was made of psychotic patients who were consecutively admitted for the first time to the Psychiatric Unit-B of the Complejo Hospitalario de Navarra in Pamplona (Spain), between 1990 and 2009.

The following specific criteria were employed in subject selection: first admission for in-patient care due to psychotic symptoms, a diagnosis of functional psychotic disorder according to the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV, APA, 1994), age 15–65 years and residing in the catchment area of the hospital. Exclusion criteria were: lack of reliable sources of external information (i.e. that provided by close relatives), premature discharge from the hospital not allowing completing in-patient treatment, previous pharmacological treatment for more than 6 months and presence of drug abuse or dependence confounding diagnosis. The study was approved by the institutional review board, and patients provided written informed consent after receiving a complete description of the study. The final study sample comprised 486 patients. The main demographic and clinical characteristics of the patients are shown in Table 1. All diagnoses of functional psychotic disorders were represented, and most of the patients (n = 365, 75.1%) were receiving their first treatment with antipsychotics.

2.2. Assessments

Patients underwent an extensive examination by means of the Comprehensive Assessment of Symptoms and History (CASH) (Andreasen et al., 1992), which is used routinely in our center as part of the standard clinical examination of first-admitted patients with psychotic symptoms. All the assessments were performed by VP, who was the treating psychiatrist of the patients.

Table 1
Characteristics of the sample (n = 486).

	N (%)	Mean (SD)
Gender (male)	289 (59.5)	
Civil status (single)	356 (73.3)	
DSM-IV diagnosis:		
Schizophrenia	156 (32.1)	
Schizophreniform disorder	77 (15.8)	
Brief psychotic disorder	78 (16.9)	
Delusional disorder	35 (7.2)	
Schizoaffective disorder	23 (4.7)	
Bipolar disorder	42 (8.6)	
Major depressive disorder	55 (11.3)	
Psychosis Not Otherwise Specified	20 (4.1)	
Age		30.0 (11.7)
Years of education		10.4 (3.6)
Age at illness onset		27.9 (11.1)

DSM-IV = Diagnostic and Statistical Manual of Mental Disorders (4th edn).

The CASH served for assessing demographics, illness-related variables, psychopathology and diagnosis. The main outcome measure was the evaluation of the current condition from the CASH, which includes the assessment of 74 symptoms of psychotic and mood disorders, excluding symptom specifiers. Symptoms are rated on a six-point Likert-like scale, excepting catatonia signs that are rated on a three-point scale, for all of which detailed anchor points are provided. To rate symptoms, all the available information was employed including several interviews with the patient and information provided by close relatives, nursing staff and clinical records. Each symptom was rated as its worst over the past month. Good inter-rater reliability has been shown for most CASH symptoms (Andreasen et al., 1992), and in our center the mean intraclass correlation coefficient for the global severity ratings was .87 (range .78–.92) and that for the individual symptoms was .84 (range .42–.99).

2.3. Statistical analyses

Of the 74 CASH symptoms, four items were excluded from the analyses, 2 because low prevalence rates (<5%, clanging and jealous delusions) and 2 because redundancy in definition (pressure of speech and distractible speech from the positive formal thought disorder subscale were omitted because similarity in definition with those from the mania subscale). The remaining 70 symptoms were included in the analyses.

Three set of analyses were carried out. We first examined the dimensional structure of the 70 symptoms by means of principal component analysis (PCA) followed by rotation to an oblique solution using Promax at a power of 4. Because a normal distribution could not be assumed for most CASH items, they were standardized by means of Z-scores before entering the PCA. The eigenvalue >1 criterion was used to determine the number of factors to retain. We then estimated scores on the resulting primary factors by the regression method, and examined the second-order factor structure, again using PCA. We rotated the factors to an oblique solution to determine correlations between second-order factors and hence the possibility of higher-order solutions. To address the stability of the factor structure, we examined alternative procedures for extracting factors including principal axis factoring and generalized least squares. The results were virtually the same, and only those obtained by PCA will be reported.

The final step of the analysis was to obtain an integrated hierarchical factor structure using the SLT (Schmid and Leiman, 1957). This procedure maximizes information obtained by high-order factor analysis by providing direct relations between higher-order factors and primary variables. Furthermore, factor loadings and variance explained are transformed to represent the independent contribution of factor levels. In the SLT, lower-order factor loadings are essentially partial correlation coefficients between lower-order factors and variables, where