A Factor Analysis of the Signs and Symptoms of Mania

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**Background:** No adequate factor analyses of signs and symptoms of mania have been reported. From limited past reports, the view has arisen that 2 main symptom clusters (euphoric-grandiose and paranoid-destructive) occur in patients with mania, along with so-called core symptoms of psychomotor pressure. In this view, dysphoric mania is associated with paranoid-destructive symptoms and with psychosis.

**Methods:** We rated 237 patients with DSM-III-R–defined bipolar disorder, manic (n=204) or mixed (n=33), on 15 classic features of mania and 5 features related to dysphoric mood. Principal components factor analysis was applied to the ratings.

**Results:** Five clearly interpretable and clinically relevant factors were identified. The first and strongest factor represented dysphoria in mania, with strong positive loadings for depressed mood, lability, guilt, anxiety, and suicidal thoughts and behaviors and a strong negative loading for euphoric mood. Factors 2 through 5 represented psychomotor acceleration, psychosis, increased hedonic function, and irritable aggression, respectively. The distribution of weighted scores on factor 1 was bimodal, whereas the corresponding distributions of factors 2 through 5 were unimodal. Contrary to all past reports, no general factor denoting overall severity of mania was found. Factors previously proposed by Beigel and Murphy were not confirmed.

**Conclusions:** Five independent factors representing dysphoric mood, psychomotor pressure, psychosis, increased hedonic function, and irritable aggression were identified. The conventional view of symptom factors in mania was not confirmed. Dysphoric features are statistically salient in patients with mania, and the bimodal distribution of the dysphoria factor is consistent with the possibility that mixed bipolar disorder is a distinct state.

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Careful descriptions of manic subtypes date back at least to Weygandt and Kraepelin, who divided bipolar illness into manic, depressed, and mixed states and thereby explicitly recognized the depressive and labile features of mania. Numerous later researchers noted prominent dysphoric symptoms in mania, coexisting with the 4 classic defining features of mania: euphoric mood, psychomotor pressure, grandiosity, and irritable aggression. However, no empirical studies support the various ad hoc definitions of mixed bipolar states. Factor analysis provides one way of examining this issue, with the goals of establishing the relationships among signs and symptoms in patients with mania and of suggesting possible clinical subtypes of the disorder.

Early factor analysis studies of manic features relied on small samples. The view of symptom factors in patients with mania derives from the limited studies of Beigel and Murphy, conducted more than 25 years ago. These researchers proposed 2 manic subtypes, paranoid-destructive and euphoric-grandiose, based on a first analysis of only 12 patients and a subsequent study of 30 patients. A first, general factor loaded positively for all items. The second, statistically bipolar factor contrasted euphoria and grandiosity with paranoia, depression, and hostility. Other factors were not readily interpretable. Despite the small samples, these reports have been generally accepted, although attempts to confirm the Beigel-Murphy typology of manic states have met with limited success. Loudon et al, studying 16 patients with mania, did not confirm the 2 predicted groups. Double, studying 81 patients with mania, found the predicted first general factor and the predicted second, statistically bipolar factor contrasting hostility, depression, and heightened suspicions with euphoria. On reviewing the distribution of scores on the second factor,
PATIENTS AND METHODS

After a careful review of the literature on manic subtypes, existing manic rating scales were considered inadequate for this research question. Twenty signs and symptoms relevant to classic mania and to the mixed bipolar state were selected. Each feature was scored from 0 to 5, with defined anchor statements for scores of 1, 3, and 5. The 20 features entered in this factor analysis were increased motor activity, decreased sleep, pressured speech, racing thoughts, euphoric mood, grandiosity, hypersexuality, increased humor, unusual dress or grooming, psychosis (defined as any delusions or any hallucinations), paranoid ideation, lack of insight, intrusiveness, irritability, aggression, depressed mood, lability of mood, guilt feelings, suicidal thoughts or behavior, and anxiety.

RATING PROCEDURE

Ratings were completed by 1 or more of a group of 4 psychiatrists (F.C., K.F., E.M., and B.J.C.). All raters were clinicians familiar with the assessment and management of patients with mania. The ratings were based on direct interviews of at least 20 minutes duration. Additional information from the clinical record and from staff observations was incorporated in the rating process (eg, recent episodes of anger, inappropriate sexual behavior, or insomnia). Ratings related to a 3- to 4-day period to sample relatively uncommon events.

RELIABILITY AND CONCURRENT VALIDITY

Scale validity was determined by comparison with the Beigel-Murphy Manic-State Rating Scale and with a clinical global assessment of manic severity on a scale of 0 to 10. These concurrent ratings were performed by a single rater (F.C.) for 35 inpatients who had a DSM-III-R diagnosis of bipolar disorder, mixed, manic, or in remission. Pearson product moment correlation coefficients and confidence intervals were calculated, using total scores.

Joint interviews using the new scale were conducted for 11 patients by 3 of us (F.C., E.M., and B.J.C.). The subjects included patients meeting the DSM-III-R criteria for bipolar disorder, manic, mixed, or in remission. Intraclass correlation coefficients were determined. The other rater (K.F.) participated in reliability training exercises before her ratings were accepted. She was required to achieve a criterion of consistency with ratings by 2 of us (F.C. or B.J.C.) such that her scores on individual items did not differ by more than 1 point.

THE STUDY COHORT

The conditions of 237 patients admitted to John Umstead Hospital, Butner, NC, from November 1992 to August 1995 were evaluated; the patients met the DSM-III-R criteria for bipolar disorder, manic or mixed. Details of the individual DSM-III-R major depressive criteria used to meet a diagnosis of bipolar disorder, mixed, in this cohort are provided elsewhere. The patients were treated with medications as clinically appropriate. The conditions of more than 95% of the patients were evaluated between days 2 to 5 of hospitalization. Ratings were completed to assist with assessment and diagnosis during the screening and recruitment process of the affective disorders research program at the hospital. With Institutional Review Board approval of the process, all patients gave verbal consent to be interviewed. Some went on to participate in research protocols. No patient was rated in more than 1 episode.

FACTOR ANALYSIS

The symptom interrelationships were studied by principal components factor analysis using a correlation matrix and a VARIMAX rotation. The number of factors considered was taken as those with Eigen values greater than unity. A Scree plot was also inspected, and the number of factors was compared with those having Eigen values greater than 1.0. Item loadings with absolute values greater than 0.4 were used to describe the factors. The ratings of patients who met the criteria for bipolar disorder, manic (n=204), were also analyzed separately.

Factor scores for individual patients were calculated as described by Hamilton. Distributions were inspected for bimodal trends. The Kolmogorov-Smirnov statistic was used to test the normality of distributions of the total symptom scores and of the scores on each factor.

RESULTS

DEMOGRAPHIC DATA

The 237 patients included 109 men and 128 women. Two hundred four (86.1%) met the DSM-III-R criteria for bipolar disorder, manic, mixed, or in remission. Intraclass correlation coefficients were determined. The other rater (K.F.) participated in reliability training exercises before her ratings were accepted. She was required to achieve a criterion of consistency with ratings by 2 of us (F.C. or B.J.C.) such that her scores on individual items did not differ by more than 1 point.
polar disorder, manic, and 33 (13.9%) for bipolar disorder, mixed. The mean (±SD) age of the patients was 42.9 ± 14.9 years (range, 18-82 years). The sample included 132 whites, 104 blacks, and 1 American Indian. The mean (±SD) total symptom score was 33.9 ± 9.9 (range, 11-59). The distribution of total symptom scores was normal (Kolmogorov-Smirnov statistic, *P* = .22) (Figure 1).

**CONCURRENT VALIDITY AND RELIABILITY**

Thirty-five sets of concurrent ratings were obtained by one of us (F.C.) using the 20 selected features, the Beigel-Murphy Manic-State Rating Scale, and a clinical global rating. By DSM-III-R criteria, the episodes rated included bipolar disorder, manic (n=27), bipolar disorder, mixed (n=6), and bipolar disorder, in remission (n=2). The sample included 17 women and 18 men. The mean (±SD) age of these patients was 40.8 ± 13.3 years (range, 21-75 years). Correlations of the total symptom scores were significant with the Beigel-Murphy Manic-State Rating Scale, and a clinical global rating. By the Kolmogorov-Smirnov statistic, the distribution of weighted scores on factor 1 was bimodal (*P* = .09), and 5 (*P* = .61).

Eleven patients meeting the DSM-III-R criteria for bipolar disorder, manic (n=7), bipolar disorder, mixed (n=1), or bipolar disorder, in remission (n=3), were rated on the 20 selected features in 3-way joint interviews as previously described. The sample included 6 men and 4 women. One patient was rated during mania and in remission. The mean (±SD) age of the patients was 51.5 ± 17.0 years. The intraclass correlation coefficient for total symptom scores was 0.977.

**FACTOR ANALYSIS**

Five Eigen values were greater than unity, which determined the number of factors computed. The same number of factors was indicated by the Scree plot. The 5 factors captured 57% of the unrotated and rotated variances. Following rotation, the 5 factors were clinically interpretable. The 5 factors and their item loadings with absolute values greater than 0.4 are shown in the Table.

**Rotated Factor Loadings for Scale Items Greater Than 0.4 and Less Than 0.4**

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tr>
<td>Racing thoughts or disturbed concentration</td>
<td>. . . . .</td>
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<td>Pressured speech</td>
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<tr>
<td>Increased motor activity</td>
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<tr>
<td>Increased contact</td>
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<tr>
<td>Depressed mood</td>
<td>0.815</td>
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<tr>
<td>Anxiety</td>
<td>0.743</td>
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<tr>
<td>Guilt</td>
<td>0.713</td>
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<td>Mood lability</td>
<td>0.640</td>
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<td>Suicide</td>
<td>0.623</td>
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<tr>
<td>Euphoric mood</td>
<td>.</td>
<td>0.479</td>
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<td>Increased sexuality</td>
<td>. . . . .</td>
<td>0.687</td>
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<td>Humor</td>
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<td>Grandiosity</td>
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<td>0.637</td>
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<td>Psychosis</td>
<td>.</td>
<td>0.818</td>
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<td>Lack of insight</td>
<td>.</td>
<td>0.567</td>
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<tr>
<td>Paranoia</td>
<td>.</td>
<td>0.663</td>
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<td>Aggression</td>
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<tr>
<td>Irritability</td>
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<tr>
<td>Decreased sleep</td>
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<tr>
<td>Dress</td>
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<td>. .</td>
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<tr>
<td>Variance, %</td>
<td>15.6</td>
<td>10.7</td>
<td>10.2</td>
<td>9.8</td>
<td>10.7</td>
</tr>
</tbody>
</table>

*Ellipses indicate data not applicable.*

Fifteen of the 20 signs and symptoms loaded on only 1 factor each. Three loaded on 2 factors each. The items dress and sleep did not load on any factor.

The first and strongest factor is not a general factor denoting severity of mania. Rather, factor 1 has significant loadings for only 6 symptoms. Factor 1 is statistically bipolar. It represents mood, with euphoric and depressed moods on opposite poles. Anxiety, lability, guilt, and suicidal thoughts and behaviors also load on the dysphoric pole. The distribution of weighted scores on factor 1 was bimodal (Figure 2).

Factor 2 represents psychomotor acceleration, with loadings for motor activity, pressured speech, and racing thoughts. Increased contact, which includes descriptions of intrusiveness and inappropriately approaching others, was also included on this factor. Factor 3 comprises psychotic phenomena and includes the items paranoia, delusional grandiosity, delusional lack of insight, and psychosis (hallucinations and delusions). Factor 4 is a hedonia factor comprising euphoric mood, humor, and hypersexuality, as well as grandiosity. Factor 5 includes irritability, aggression, and paranoia.

The Kolmogorov-Smirnov statistic demonstrated that the distribution of weighted factor 1 scores was not normal (*P* = .001), with keeping the distribution's bimodal appearance (Figure 2). Kolmogorov-Smirnov statistics confirmed that the weighted score distributions of factors 2 (*P* = .40), 3 (*P* = .58), 4 (*P* = .09), and 5 (*P* = .61) were normal (Figure 3).

A separate analysis of the ratings of the 204 patients in whom bipolar disorder, manic, was diagnosed yielded the same factors with only minor differences in
The analysis generated 5 clinically interpretable factors. All 5 are unique in the research literature on mania, and each represents a major clinical dimension of manic illness. Factor 1 captured 15.6% of the rotated variance. It represents a dysphoric mood factor. It is not a general factor representing the overall severity of manic symptoms. It includes signs and symptoms, such as lability and anxiety, hypothesized but never demonstrated empirically to characterize dysphoric mania. It corresponds neither with the first general factor nor the second bipolar (euphoric-grandiose or paranoid-destructive) factor of Murphy and Beigel nor the analogous factors of Double. Factor 1 is unique. It represents a previously undetermined factor of depressed mood and associated dysphoric symptoms during mania. This statistical prominence of depressive signs and symptoms that we found during mania is in keeping with the clinical observations of numerous researchers.

The bimodal distribution of factor 1 (Figure 2) indicates statistically significant heterogeneity within the total population of patients with mania. This demonstrated heterogeneity can serve as a hypothesis-generating observation to suggest the existence of 2 distinct manic subgroups. The empirical bimodality of factor 1 scores also resembles the third factor of Double based on the Beigel-Murphy Manic-State Rating Scale. It differs from the report by Beigel and Murphy, but it is clearly a separate factor in our data. It also resembles the third factor of Double based on the Beigel-Murphy Manic-State Rating Scale. The items loading on factor 4 include 2 of the 4 classic defining features of mania (euphoric mood and grandiosity). The additional factor 4 items of humor and hypersexuality can be conceptualized as alternative expressions of elevated mood and self-esteem.

Factor 2 represents psychomotor acceleration. Its components (increased motor activity, racing thoughts or disturbed concentration, pressured speech, and increased contact) are all included among the “core items” of the first factors of Murphy and Beigel and Double. It is notable that decreased sleep, which is often regarded as an aspect of psychomotor acceleration, did not load on factor 2. Factor 2 represents 1 of the 4 classic defining features of mania.
“is suspicious,” did load with aggression in the report by Double. Inspection of the distribution of scores for factor 5 did not suggest bimodality (Figure 3). The unimodal distribution of this factor is also in keeping with the findings of Double. Factor 5, like factors 2 and 4, represents 1 of the 4 classic defining features of mania.

The 4 classic defining features of mania appeared as 3 factors in this analysis: factors 2 (psychomotor pressure), 4 (increased hedonic function comprising euphoric mood and grandiosity), and 5 (irritable aggression). This result tends to confirm the importance of these defining features but also suggests that euphoric mood and grandiosity are alternative expressions of 1 fundamental process (increased hedonic function). For that reason, euphoric mood and grandiosity may not appropriately be considered separately defining features of mania. The nosologic significance of the 2 additional factors, factors 1 (dysphoric mood) and 3 (psychosis), cannot be established from this factor analysis, which was restricted to patients with mania. However, the clinical salience of factors 1 and 3 in mania is self-evident.

Most signs or symptoms related to only 1 factor. Three did not: grandiosity, paranoia, and euphoric mood each loaded on 2 factors. Grandiosity loaded with the hedonia and psychosis factors. Qualitatively, it associates with hedonic drive, consistent with previous studies. At its extreme, it includes delusional grandiosity, which results in its appearance on factor 3 (psychosis). Paranoia, defined as hypervigilance at low levels and ranging up to paranoid delusions at the extreme, loaded on the paranoid-hostile factor, consistent with previous studies, and on the psychosis factor. Euphoric mood appeared on the hedonia factor as well as with a negative loading on factor 1. This establishes its position as inversely related to depressed mood and as associated with hedonic drive. Thus, all these instances of dual factor loadings are consistent with clinical observation in mania.

Factors 1, 2, and 4 provide some empirical support for theoretical formulations of the fundamental components of mood disorders. In 1974, Klein proposed 3 key processes in depression: a disinhibited central pain system, an inhibited reward system, and an impaired psychomotor facilitatory system. The classic symptoms of endogenous melancholic depression were linked by Klein to those 3 dysregulated neurobiological processes. In an extension of Klein’s model, Carroll provided a 3-component model of bipolar disorder. For mania, the Carroll-Klein model predicts a disinhibited reward system (factor 4 in our results) and an accelerated psychomotor facilitatory system (factor 2 in our results). The inhibited central pain system predicted by the Carroll-Klein model did not appear in our results because items relevant to the construct of central pain inhibition (eg, recklessness and risk taking) were not included in the 20 selected features. We did obtain a factor denoting disinhibited central pain features—factor 1—consistent with depressed mood in mania. The Carroll-Klein model also predicts that the central pain, reward, and psychomotor dimensions are orthogonal, which is confirmed in these data. Features of psychosis, aggression, and disturbed circadian rhythms (sleep) were excluded from the models of Carroll and Klein. In our data, the first 2 of these features appeared as separate factors in mania (factors 3 and 5, respectively), while sleep disturbance did not load on any factor.

To our knowledge, this study is the largest to date of manic signs and symptoms with a focus on mixed states. By including an adequate sampling of signs and symptoms relevant to mixed states, we identified a depressive mood factor in mania. By studying an adequate number of patients—more than 10 times as many patients as rated items—we also obtained stable factors that contradict the previous views of symptom clusters in mania, which were derived from limited earlier studies. In particular, we found that the factors denoting psychosis and aggression are quite separate from each other and from the factor representing dysphoria in mania.

The empirically observed bimodality of factor 1 gives some support to the view that mixed mania is a distinct state. This conclusion is in accordance with the clinically based DSM-III-R and DSM-IV view of bipolar disorder, mixed. It is yet to be determined whether this state represents the concurrent presence of mania and depression, a viewpoint in consonance with Kraepelin and Winokur et al, or a separate, independent state bearing features of mania and depression.

The factor structure did not change when the 33 patients with DSM-III-R–defined mixed bipolar episodes were removed from the analysis. This finding suggests that dysphoric features are salient even in “pure” manic episodes, as reported by Winokur et al. Our own analysis of symptom frequencies in pure and mixed manias is consistent with the data of Winokur et al. However, no good evidence exists to validate the DSM-III-R definition or the earlier definition of Winokur et al of mixed bipolar disorder. Thus, the retention of factor 1 with almost identical loadings in the pure manic group might simply reflect contamination of the pure manic group by patients who failed to meet the DSM-III-R criteria for the full major depression syndrome but who nevertheless displayed severely dysphoric features. Additional analyses of our data are planned to derive empirical criteria for dysphoric criteria for dysphoric mania (the second group in the distribution of factor 1) and to compare this group with the DSM-III-R–defined mixed bipolar group.

The factors generated in this study describe useful research and clinical dimensions for the study of mania. In addition to mood, they capture psychosis, hedonia, psychomotor acceleration, and irritable aggression. They allow the characterization of individual patients on these dimensions, which may extend our ability to study the relationship of features of mania to biological markers, prognosis, and treatment response.

Questions for future studies, which may be facilitated by the identification of these factors, include (1) the correspondence between factor 1 scores and DSM-IV criteria for bipolar disorder, mixed; (2) the stability of factor profiles across multiple episodes of mania; (3) the possibility that some treatments act selectively on specific factors; (4) the association of biological markers with specific factors; and
(5) differential factor profiles during mania as a function of genetic loading or of phenotypic variation during the depressed phase of bipolar disorder (eg, delusional, atypical, or melancholic subtypes of bipolar depression).

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