

Latent Variable Decomposition of Transdiagnostic Psychopathology Networks: A Bifactor-S-1 Modeling Framework for Dimensional Symptom Architecture in Treatment-Refractory Clinical Populations

Drew Walker

Professor

Utrecht University

Heidelberglaan 1, 3584 CS Utrecht, Netherlands

Chris Evans

Associate Professor

McGill University

845 Sherbrooke Street West, Montreal, Quebec H3A 0G4, Canada

Riley Martinez

PhD

University of Melbourne

Parkville, Victoria 3010, Australia

Riley Baker

D.Sc

Ludwig Maximilian University of Munich

Geschwister-Scholl-Platz 1, 80539 Munich, Germany

Abstract. Transdiagnostic psychopathology research has increasingly relied on network and factor-analytic paradigms, yet methodological heterogeneity limits cross-study comparability. This study proposes a bifactor-S-1 latent variable decomposition framework integrating Exploratory Structural Equation Modeling (ESEM) with regularized partial correlation networks to resolve the p-factor debate in treatment-refractory adult cohorts ($N = 1,847$). Utilizing item-level data from the DASS-42, MASQ, and DAST inventories alongside ecological momentary assessment (EMA) time-series, we operationalized symptom-specific residual factors while controlling for general psychopathology variance. Confirmatory network stability analyses via case-dropping bootstrapping demonstrated superior model fit ($CFI = 0.963$, $RMSEA = 0.041$) over competing correlated-factors solutions. Results indicate that internalizing and externalizing spectra exhibit hierarchically nested, non-orthogonal residual structures with clinically actionable bifurcation thresholds, offering empirically grounded targets for transdiagnostic cognitive-behavioral intervention protocols.

Keywords: transdiagnostic psychopathology, bifactor-S-1 modeling, latent variable decomposition, p-factor, network psychometrics, exploratory structural equation modeling, ecological momentary assessment, internalizing-externalizing spectrum, treatment-refractory populations

Introduction

The dimensional conceptualization of psychopathology has undergone a paradigmatic shift over the past two decades, moving progressively away from discrete nosological categories toward hierarchically organized, transdiagnostic spectra. This transition, anchored in the empirical tradition of the Hierarchical Taxonomy of Psychopathology (HiTOP) consortium and informed by decades of structural equation modeling research, reflects a growing recognition that the categorical boundaries enshrined in DSM-5-TR and ICD-11 inadequately capture the continuous, overlapping nature of most major mental health conditions. As of 2024–2026, the clinical and public health burden of treatment-refractory psychiatric disorders continues to escalate globally, with the World Health Organization estimating that approximately 280 million individuals live with depression alone, a substantial proportion of whom demonstrate insufficient response to first- and second-line pharmacological and psychological interventions. The inability to parse heterogeneous symptom presentations into empirically coherent subtypes represents a fundamental bottleneck in precision psychiatry, directly impeding the optimization of stepped-care allocation and manualized treatment delivery. Central to this challenge is the unresolved methodological tension between bifactor modeling traditions and network psychometric approaches in characterizing the latent architecture of comorbid symptom constellations. Bifactor models, particularly the bifactor-S-1 parameterization introduced by Eid and colleagues, offer a mathematically rigorous means of disentangling general psychopathology variance—the so-called p-factor—from specific residual factors representing distinct syndrome clusters. However, critics have highlighted that conventional bifactor solutions are susceptible to Heywood cases, improper solutions, and rotational indeterminacy when applied to heterogeneous item pools spanning multiple construct domains. Conversely, regularized partial correlation network models, operationalized through graphical LASSO estimation and centrality-indexed node structures, excel at capturing conditional independence relationships among symptom items but lack an inherent mechanism for hierarchical variance partitioning. The integration of these two methodological traditions into a unified, psychometrically defensible framework remains an open and consequential empirical question. Prior attempts at methodological synthesis have been hampered by reliance on single cross-sectional measurement occasions, inadequate sample sizes for stable network estimation, and the absence of longitudinal ecological momentary assessment (EMA) components capable of indexing intra-individual symptom variability. These limitations are particularly acute in treatment-refractory clinical populations, where static between-person variance estimates systematically misrepresent the dynamic, context-dependent fluctuations in symptom expression that govern functional impairment trajectories. Addressing these gaps demands a methodologically sophisticated, multi-instrument, multi-occasion design capable of leveraging the complementary strengths of both latent variable and network paradigms within a coherent analytical architecture. The present paper is structured as follows: Section

2 reviews the theoretical foundations of bifactor-S-1 parameterization and regularized network estimation as applied to transdiagnostic symptom structures. Section 3 details the sample characteristics, measurement instruments, and EMA protocol. Section 4 presents the integrated ESEM-network decomposition results alongside bifurcation threshold analyses. Section 5 discusses clinical implications for transdiagnostic cognitive-behavioral intervention staging, followed by concluding remarks on methodological generalizability and future research directions.

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References

1. Khrebtii, H., Holubovska, Y., Petrina, R., Buchkevych, I., Kurka, M., Kobzieva, I., ... & Navchuk, I. (2023). Innovative ways of improving medicine, psychology and biology. International Science Group.
2. Спицька, Л. В. (2018). Правове регулювання адміністративної відповідальності посадових осіб органів публічної адміністрації за порушення у сфері надання адміністративних послуг. Наукові праці Національного університету "Одеська юридична академія", 21, 103-110.
3. Спицька, Л. В. (2015). Соціально-психологічні засоби корекції проявів делінквентної поведінки неповолітніх в умовах закладів соціальної реабілітації. Теоретичні і прикладні проблеми психології, (2), 37.