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Mapping Relationships of Nonordinary Experiences and Mental Health: A Network Analysis in a Representative Brazilian Sample

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Nonordinary experiences (NOEs), such as hearing voices or dissolution of the self, are more common than typically assumed yet poorly understood, and their effect on mental health underexplored. We present the topological structure of a range of NOEs and their differential relationship with mental health in a representative sample of Brazilian adults for race, sex, region, and age ($N = 878$). A network analysis revealed three coherent clusters, indicating that specific NOEs tend to cooccur, hinting at possible biological or cultural underlying mechanisms. This advances previous research that typically treated experiences in isolation and instead suggests a coherent experience structure. Individual experiences within clusters showed both positive and negative associations with depression scores in particular challenging simplistic explanations of NOEs as either pathological or spiritually enriching. Our findings highlight the need for research regarding the structure and nature of NOEs to help researchers and clinicians better understand their implications for mental health.

Keywords: psychometric network analysis, mental health, nonordinary experiences, anxiety, depression

Supplemental materials: https://doi.org/10.1037/cns0000387.supp

Nonordinary Experiences

Nonordinary experiences (NOEs), such as hearing voices or altered states of consciousness, are part of the human condition (Barlev et al., 2021; Fischer & Tasananukorn, 2018; Krippner, 2008; Powell & Moseley, 2020), yet an understanding of their relative structure (e.g., the topological structure of the elements in a network of symptoms) and health implications remain controversial. These experiences are common in general population samples (Barlev et al.,

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continued

2021; Maraldi & Krippner, 2019; Monteiro de Barros et al., 2022; Pechey & Halligan, 2012) but remain poorly understood. Such experiences have been classified using a variety of labels, including paranormal (Brugger & Mohr, 2008), spiritual (Highland et al., 2021), extraordinary (Wahbeh et al., 2019), religious (Kapogiannis et al., 2009), supernatural (Rossano, 2020), anomalous (Moreira-Almeida & Lotufo-Neto, 2017) and nonordinary (Taves et al., 2019), with the associated interpretations of these experiences indicating mental disorders, extraordinary abilities, and talents or reflecting religious or spiritual states (Luhrmann, 2017; McCauley & Graham, 2020; Schmidt, 2014, 2015). What is unclear is how these experiences may be organized (which experiences are more likely to occur together with others) and how experiences and possible experience clusters relate to mental health. One possible reason for the relative incoherence and variability of results regarding the link between NOEs and mental health in the literature to date (Maraldi et al., 2023) is the lack of information on the coassociation and possible interactions between these phenomena when looked at as a system (Maraldi et al., 2023). Using recent advances in psychometric network modeling, we aim to contribute to a better understanding of which and how such NOEs correlate with each other and with mental health. These insights are particularly timely and important given the relative widespread distribution of these experiences in general population samples and the lack of understanding whether (or which) such experiences may be detrimental for mental health. We also need more evidence from non-Western populations to develop a truly global psychology of human functioning and well-being (Henrich et al., 2010).

We focus on the organization of various experiences that may stand out from day-to-day experiences. In doing so, we follow Taves (2020) recommendations and use the label of NOEs to avoid any specific interpretation or evaluative labeling of those experiences. This term also provides a more inclusive treatment of the topic by encompassing experiences considered nonordinary from a researcher's point of view, which may feel relatively ordinary for the person experiencing them (Taves & Barlev, 2022). Although the term "non-ordinary" would indicate they are uncommon or deviate from day-to-day experience, emerging evidence suggests that actually almost half of the population in representative samples around the world have experienced something that would be classified as NOEs by researchers (e.g., hearing voices, feeling the presence of others) at least once in a lifetime (Barlev et al., 2021; Maraldi & Krippner, 2019; Monteiro de Barros et al., 2022; Pechey & Halligan, 2012).

When considering possible linkages between such experiences and mental health, a first challenge is the relatively diverse nature of such experiences, including hearing voices, seeing individuals who have died, feeling that one's self dissolves, feeling one with nature or a larger force, distortions in time or space as well as cognitive phenomena like deja-vus. Despite their diversity, some authors have argued that there is some common cognitive architecture underlying some of these experiences. Cohen and Barrett (2008), for example, showed cross-culturally common cognitive features of experiences of spirit possession. Despite differences in the explanation of possession across religions, followers across cultures agree on a displacement of agency as an explanation. Winkelman (2021) analyzed magico-religious behaviors (e.g., being a medium and receiving messages from the dead) and identified common features across societies, including experiencing alterations of consciousness and shared strategies to control experiences

publication of this article

The material, the anonymized data, and analysis scripts are available in the Open Science Framework link https://osf.io/5js8k/.

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viewed as spirit communication. In line with these observations, a number of researchers have suggested the possibility of identifying common structures underlying beliefs or experiences in general population samples, which may be driven by biological mechanisms across cultures (Barrett et al., 2021; Cohen, 2008; Cohen & Barrett, 2008; McCauley & Cohen, 2010).

We decided to focus on Brazil, which provides an interesting study context for mapping possible structures and mental health implications, as well as explore possible intersections between cultural and biological interpretations. First of all, NOEs are socially accepted and inserted into widely shared belief systems influenced by a mixture of African, Indigenous, and traditional Abrahamic religions (Cohen & Barrett, 2008; Krippner, 2008). Available evidence suggests that the frequency of NOEs tends to be higher in places where such experiences are socially accepted or part of the culture (Luhrmann et al., 2021). Second, in Brazil, a number of experiences are an integral part of the religious and spiritual belief systems and are explicitly encouraged in ritual practice (Cohen & Barrett, 2008). For example, some religious groups can be classified within a broader ancestor-worship category, which highly values interactions with deceased ancestors or ancestorial spirits (Krippner, 2008). Other religious practices (e.g., Kardecists or Umbanda followers, accounting for at least 5% of the population according to census data) regularly use spirit mediums for ritual healing or divination purposes. Third, previous research has taken a relatively undifferentiated approach to NOEs and mental health. However, our observation of the Brazilian context suggests that specific NOEs may have positive mental health implications to the extent that such experiences are integrated into cultural narratives (G. Lucchetti et al., 2021). Given these social and cultural conditions, Brazil provides a fertile context for studying the frequency and topological organization of experiences and their relationship with mental health.

We use data in which a sample of Brazilian adults from all regions of the country reported a number of experiences and answered a number of mental health questions (Monteiro de Barros et al., 2022). Some of these experiences are typically interpreted as having religious or spiritual meaning (e.g., hearing God's voice or feeling the presence of a higher power), whereas other experiences are relatively neutral (e.g., feeling connected to nature), and a final group are unrelated to cultural or religious doctrines but are often interpreted as indicating psychiatric problems (dissolution of self, intuition, or suspension of time or place). Including these diverse experiences may provide us with some insights into the possible organizing principles vis-a-vis cultural dynamics. We explore these structures using a network approach which has been shown to provide additional insights into the structure of mental health phenomena relative to more common approaches such as factor models or other latent variable techniques (Borsboom & Cramer, 2013; Boyette et al., 2020; Cramer et al., 2020; Fischer & Karl, 2020; Fried et al., 2016; Mullen & Jones, 2021; Peters et al., 2021).

NOEs and Mental Health

One of the central challenges in studying these experiences is examining how they might be related to mental health. Historically, these experiences have been interpreted as demonstrating special religious or spiritual giftedness or as symptoms of clinical conditions, especially if they interfere with normal activities (Pechey & Halligan, 2012. For example, being able to make contact with deceased people can be phenomenologically strikingly similar to auditory and visual hallucinations. Loch et al. (2019) hypothesized that religion might serve as a coping mechanism for people with subclinical symptoms of psychiatric conditions such as schizophrenia and bipolar disorder. Although psychiatric diagnostic criteria acknowledge the importance of social and cultural attributions when classifying experiences as potentially pathological or not, these discussions typically do not consider how clusters of experiences may be organized phenomenologically and how these clusters may relate to mental health. For example, are some experiences included across different diagnostic criteria likely to cooccur in a general population? Furthermore, how are potentially clinically relevant criteria related to other experiences that are nonordinary but do not appear in diagnostic manuals? One of the important questions is whether such clustering of experiences may help to differentiate between a pathological and a nonpathological experience, a concern already raised by the literature (Delmonte et al., 2016).

At a broader level, more research is needed that explores how NOEs may relate to anxiety and depression as core concerns of mental health professionals. Although there has been some progress in recent research exploring the experience of nonordinary states and mental health, the evidence suggests a more complex picture of how NOEs are linked to well-being or distress. While some studies identified higher levels of anxiety and depression in groups reporting NOEs (Maraldi, 2014), others suggest NOEs are related to happiness (Newberg & Waldman, 2018). Contributing to these mixed findings is the undifferentiated treatment of NOEs—different experiences are often clustered under the same label, or individual experiences are treated in isolation from others. A network approach could give new insights to the issue. Therefore, one of the central questions is whether there are common structures (i.e., clusters) or associations between experiences. The identification of such clusters may be of great importance for both researchers and clinicians, particularly when considering the broader exploration of experiences that are considered in diagnostic manuals together with experiences that are typically not explored in clinical settings. Once a possible structure has been identified, the second question can be explored, which is how any such clusters or individual experiences might be associated with mental health symptoms.

A Network Perspective on NOEs

Current research has suggested that some NOEs may share a common structure (Barrett et al., 2021; McCauley & Cohen, 2010; Taves, 2020). From a clinical perspective, NOEs do not occur randomly but are often thought to express some underlying cause. Because psychological constructs are generally not directly accessible, researchers have used conceptual models and statistical techniques, which explore the association between experiences and presume some underlying latent variable that phenomenologically causes these experiences (Borsboom & Cramer, 2013). Presumed latent psychological constructs are inferred via multiple observed indicators, which are typically responses to survey items. The latent variable is the hypothesized causal variable that underlies the responses and offers a convenient and seemingly parsimonious explanation of the association between observed indicators. In other words, in the medical disease model, a latent construct is assumed causally responsible for covariation among observed and measured symptoms (Borsboom et al., 2019). However, the relative ontological status of such a latent variable is often unclear (Borsboom et al., 2003). Furthermore, there is typically little attention devoted to interpreting the relative pattern of correlations between items both within and across latent variables. Using depression as an example, lack of sleep, lack of appetite, and loss of interest might be all related to each other, but the relative strength of these associations may reveal something meaningful about plausible causal mechanisms: Lack of sleep may decrease both one's feeling of hunger and interest and loss of interest may then also further decrease interest in food. Such an underlying causal structure would result in differential strengths of correlations. If we were to treat all these phenomena as indicators of depression, we may create an overall index which nevertheless ignores any meaningful differences in associations between these indicators. Furthermore, such a latent variable approach assumes that the three indicators are interchangeable, of equal importance, and all being necessary for diagnosing depression. Such assumptions are not tenable given the complexity of depression (Fried et al., 2022). Depression is clinically diagnosed if five of nine symptoms are present, two of which are mandatory, over 2 weeks (American Psychiatric Association, 2013). From a latent variable perspective, all criteria should be present to at least some degree. A number of researchers have suggested that it may be more fruitful to consider these symptoms as parts of a system that can be represented as a network (Borsboom et al., 2021) Conceptualizing experiences or symptoms as a network allows us to understand patterns of associations that facilitate the development of descriptive models of cooccurring mental states, which can then be further queried and explanatory causal models can be proposed that may account for these associations (Hochstein, 2016; Ward & Fischer, 2019).

The first step is therefore to explore the patterning of experiences. Individual experiences may cooccur due to mutual interactions of these experiences themselves, as the clinical experience clearly has demonstrated that depressive symptoms can occur in different combinations and result in the same diagnosis (Fried et al.,

2016). Of clinical relevance, the interaction between individual symptoms may actually be more important for understanding the progression of clinical states (Fried & Robinaugh, 2020). Therefore, the connection and interaction of symptoms may be of importance to explore. Considering NOEs, we could presume similar interactive dynamics that have been discussed in recent clinical network models. For example, an individual may feel the presence of a higher force, which may sensitize the individual to pay more attention to other experiences, such as the suspension of time or space. Alternatively, an individual may have heard some voice, which now sensitizes the individual to other sensory experiences.

When such interacting symptoms are conceptualized as network structures, new information can arise even from the same data set. Network approaches do not necessarily presuppose a latent construct as an explanation for the structure, although it may be interpretable from a latent variable perspective if further evidence suggests so (Golino & Epskamp, 2017; Kruis & Maris, 2016; Marsman et al., 2018; Robinaugh et al., 2020). Network analyses can help to achieve new insights into topological structures between different phenomena and processes of the mind. This approach started gaining ground in recent years because it allows researchers to investigate psychological and behavioral phenomena as complex systems, considering, for example, clinical symptoms in their interaction with each other and through each other, which opens new avenues for clinical diagnoses and treatment (Borsboom & Cramer, 2013; Fried & Robinaugh, 2020). Some types of NOEs in the context of specific disorders have already been studied as networks (e.g., aberrant perceptual experiences in psychosis; Boyette et al., 2020; dissociative experiences in posttraumatic stress disorder; Cramer et al., 2020), but to our knowledge, there are no studies investigating the network structure of occurrence of several NOEs outside of a pathological context. We, therefore, provide the first network investigation of a set of NOEs in a general population sample.

As we highlighted above, identifying possible clusters among NOEs will also open new avenues for linking them with mental health. Specifically, we want to understand if and how distinct groups of NOEs are related to mental health problems. Are some clusters of experiences more likely to be associated with anxiety or depressive mood than others? Are there specific experiences within such clusters that are more central to understanding associations with mental health problems? These two questions are complementary in that it requires both an exploration of the overall structures of NOEs (i.e., the cooccurrence of experiences) and their link to mental health problems overall, as well as an exploration of the specific individual experiences that are more likely to be associated with specific mental health symptoms. The explorations of these associations will provide new insights for researchers across disciplines interested in NOEs and mental health.

The Present Study

To summarize, we report an analysis of a data set on the frequency of various NOEs in a large Brazilian sample. Previous research has often interpreted individual experiences as religious, paranormal, spiritual, mystical, or even an altered consciousness state. Here, we take a neutral stance and explore the relative association of these experiences with each other. To do so, we adopt a network analysis framework. After exploring the clustering, we relate NOEs to mental health, specifically anxiety and depression, and explore whether different types of experiences are differentially related to mental health problems. We focus on anxiety and depression because these two states have received significant attention recently due to the increases in the general population with and after the pandemic, being the leading causes of the global health-related burden (Feter et al., 2021; Fischer & Hartle, 2022; Goularte et al., 2021; Salari et al., 2020; Santomauro et al., 2021; Weich, 2022). We believe that by (a) examining the network structure of a set of NOEs and (b) understanding possible links between experience clusters and mental health, we can help researchers and clinicians to better understand NOEs and mental health associations and therefore point toward potential implications of reported NOEs on mental health.

Materials and Method

Study Design and Participants

The study consisted of a nationwide observational cross-sectional study carried out in Brazil.

Participants signed an online informed consent. To be included, participants had to be Brazilian residents, ≥18 years old, and should have online access (see Monteiro de Barros et al., 2022 for a description of the sample). Data were collected through a self-administered online survey coordinated by Qualtrics panels (Brandon et al., 2014). Qualtrics sent invitations to our target population through its partner organizations, offering monetary incentives for survey completion. Response patterns were monitored to meet established quotas, ensuring the surveyed population matched the demographic profile of the general adult population in Brazil according to the 2010 Demographic Census. Our study included all individuals who reported complete data on variables of interest. From a total of 1,254 participants that completed the survey, 376 were excluded due to missing values for at least one item from the experiences or mental health questionnaires, resulting in a final sample of 878 participants. The final selected sample reflects the census distribution of sex, race, age, and geographic regions, although there are minor deviations with a higher representation of Afro-descendants in the sample compared to the census data and a relatively smaller representation of the white population. Our sample differs from census data in having higher levels of education than the general population. Descriptive statistics of demographic variables for the final sample used in the analysis are presented in Table 1.

Survey

NOEs were assessed using the "Spiritual and religious experiences" questionnaire (Monteiro de Barros et al., 2022). Participants indicated whether they had any of the experiences listed on a 4-point Likert scale, with possible responses: "Never happened in my life," "Happened once in my life," "More than once in my life," and "Frequently happens in my life."

Depressive symptoms were assessed using the Patient Health Questionnaire−9 (PHQ-9), validated in Brazilian Portuguese for the general

Table 1
Sample Descriptive Statistics

Variable	$N = 875$	IBGE data[a]
Mean age (missing = 2)	41 (±16)	41 (±16)
Women	38 (±14)	41 (±17)
Men	44 (±17)	40 (±16)
Region (missing = 2)		
Central-West	69 (7.9%)	8.02%
Northeast	266 (30%)	26.92%
North	71 (8.1%)	8.54%
Southeast	343 (39%)	41.79%
South	126 (14%)	14.74%
Sex (missing = 2)		
Women	429 (49%)	51.68%
Men	446 (51%)	48.32%
Education (missing = 2)		
No instruction/elementary school incomplete		34%
Elementary school complete/secondary school incomplete	38 (4.4%)	12.8%
Secondary school complete/undergraduate course incomplete	331 (37%)	34%
Undergraduate course complete	506 (58%)	19.2%
Race (missing = 2)		
Asian	21 (2.4%)	1.16%
White	544 (62%)	48.56%
Indigenous	5 (0.6%)	0.36%
Afro-descendent	305 (35%)	49.92%
GAD score (missing = 0)	5.0	
PHQ score (missing = 0)	6.0	

Note. IBGE = Brazilian Institute of Geography and Statistics; GAD = General Anxiety Disorder; PHQ = Patient Health Questionnaire.
[a] Brazilian Institute of Geography and Statistics, Demographic Census 2010 and 2020, considering adults over 18 years old.

population (Santos et al., 2013), and with its accuracy comparable to semistructured diagnostic interviews (Levis et al., 2019). Internal reliability in our sample was $\alpha = .92$ [0.91;0.93].

Anxiety symptoms were assessed using the General Anxiety Disorder–7 (GAD-7), validated in Brazilian Portuguese for the general population (Moreno et al., 2016), and with accuracy comparable to semistructured diagnostic interviews (Spitzer et al., 2006). Our sample's internal consistency was $\alpha = .93$ [0.93;0.94].

The distribution of the experiences can be seen in the Supplemental Material. Other measures were part of the questionnaire, and results are reported elsewhere (Monteiro de Barros et al., 2022). The full questionnaire is available in the Open Science Framework link (https://osf.io/5js8k/; Hartle et al., 2023).

Data Analysis

Network Estimation and Network Parameters

In network analysis, each variable is represented as a node—for example, each questionnaire item will be represented as a node in the psychometric network. Links between nodes are called edges. A psychometric network represents the pairwise conditional dependencies present in the data, which show the probabilistic relationship between each pair of variables, controlling for all other variables in the data (conceptually similar to partial correlations). The psychometric network solution makes it possible to analyze network structure (e.g., edges between nodes), properties of nodes (e.g., the importance of nodes to the network in terms of their strength and centrality of associations with other nodes), and node clustering (how nodes can be arranged into communities that show stronger links within communities compared to across communities). By representing this information using statistical and visual formats, psychometric network approaches allow us to explore the overall topological structure of NOEs and the relationship between NOEs and mental health as measured by self-report questionnaires.

Our analysis progressed in two major stages. In the first stage, we estimated a network model for the NOEs, calculated the centrality parameters of each node in this network, and explored the community structure. In the second stage, we then related the communities we had identified in the first stage to the mental health indicators. In this step, we also explored specific nodes in each community that showed particularly strong associations with mental health. We conducted a power analysis to determine the minimal sample size for our study with the powerly package in R (Constantin et al., 2021). Based on a sensitivity of 0.8 and a power of 0.8, we would need a sample size of at least 540 respondents. The upper confidence interval in 97.5% is 563. Hence, our sample size of 878 respondents is above the threshold. A graph with sensitivity values for all sample sizes can be seen in the Supplemental Methods.

Within the first stage of the analysis, we examined the structure of the NOEs. We evaluated the relationships between nodes through regularized partial correlation networks (Epskamp & Fried, 2018), using Gaussian Markov random field estimation via graphical LASSO (least absolute shrinkage and selection operator) and extended Bayesian information criterion. To select the optimal regularization parameter, we utilized the qgraph package (function "bootnet_EBICglasso"; Epskamp et al., 2012) in R (R Core Team, 2022) and a lasso (L1) penalty to compute a sparse inverse covariance matrix. With this penalty, the edges between nodes with small partial correlations are excluded so that a network is created with only those edges included that are unlikely to occur by chance. The networks were all undirected and weighted. Undirected networks do not indicate causality, and no conclusions can be drawn about whether one experience causally influences another experience.

To identify the importance of an individual item in a network, we computed the expected influence (EI) of each node, a centrality measure developed with psychological networks in mind (Robinaugh et al., 2016). The EI measure considers positive and negative associations between nodes and is computed as the summed weight of edges (connections) that a node shares with the remaining nodes in the network (Robinaugh et al., 2016). Hence, the EI measures the influence of a node within a network by considering the type of its relationship (positive or negative) with other nodes. Although the EI and other centrality measures indicate relevant interactions within the nodes of a network, similar to the overall network structure associations, they are purely correlational and do not imply any causality. The EI of each node was calculated with the function implemented in the "networktools" R package (P. Jones, 2022).

We then explored possible communities or clusters of experiences. The community structure was examined using exploratory graphical analysis (EGA; Golino & Epskamp, 2017). EGA has been shown to provide more accurate estimates of clustering within empirical data (Golino et al., 2020). To evaluate network stability, we used the BootEGA algorithm (Christensen & Golino, 2021b), using 1,000 bootstrap samples. Drawing 1,000 random subsamples with replacement, the algorithm estimates the most common number of dimensions and the "typical network," which is the median of all pairwise correlations over the 1,000 bootstraps. This bootstrap procedure also allows the calculation of the proportion of times different numbers of dimensions were identified (i.e., structural consistency), as well as the dimension to which each item is assigned (i.e., item stability; Christensen et al., 2020).

In the second stage of our analysis, we investigated the relationship between experience clusters and mental health by examining the connections of each experience community node identified in the first stage with the communities formed by the PHQ-9 and GAD-7 items. We estimated a joint network taking into account the communities of experiences identified by the EGA, together with items from the PHQ-9 and GAD-7 assigned a priori into two distinct communities. We then computed the "Bridge EI (1-step)" metric (BEI; P. J. Jones et al., 2021), which focuses on the EI metric between the focal node within a cluster and any node in any other cluster. Hence, nodes with high values of BEI can be seen as bridge nodes across the communities. We computed BEI values for each experience node according to the clusters identified in stage 1 of our analysis and their connection with the a priori defined PHQ-9 and GAD-7 communities. While positive values indicate that a node in an experience cluster is associated with greater mental health problems, negative values indicate that more frequent NOEs are associated with lower mental health problems.

Exploratory Analyses: Loadings Comparison Test

The interpretation of network structures is open to discussion. However, it is possible to make educated guesses on plausible data-generating structures consistent with theoretical models implying an underlying latent variable or sparse network structures that do not presuppose a common causal factor. We explored whether our empirical data are more consistent with a latent variable perspective or whether the topological structure of NOEs is better conceptualized as a sparse network structure (van Bork et al., 2021). We used the Loadings Comparison Test algorithm, which estimates whether the data structure is closer to a network or factorial pattern by comparing factor and network loadings (Christensen & Golino, 2021a).

Fully connected networks are statistically equivalent to latent variable models (Kruis & Maris, 2016). However, sparse networks in which some edges are absent cannot be reduced to latent variable models. For example, a latent variable perspective assumes that all observed variables load on a latent factor, implying that partial correlations between variables should not be zero but should not exceed their zero-order correlation. In contrast, in a network structure, some associations between observed nodes can be absent (e.g., a linking structure of $a \geq b \geq c$ in which there is no direct link between a and c), resulting in a so-called sparse network structure. Such a network structure can have partial correlations of a value of zero or partial correlations that exceed the zero-order correlation. Therefore, these empirically observable conditions can provide data-driven insight into possible data-generating processes, which can be used for theory-building exercises and guide more focused studies.

Transparency and Openness

Our analyses were not preregistered and are exploratory. The material, the anonymized data, and analysis scripts are available in the Open Science Framework link (https://osf.io/5js8k/; Hartle et al., 2023). We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study. The research has been approved by the Ethics Research Committee of the Institute of Psychiatry of the Hospital das Clínicas of the Faculty of Medicine of the University of São Paulo (CAAE 64956717.4.0000.0065).

Results

Network Structure and Stability

The estimated network showed a relatively sparse structure featuring 58.33% of possible

edges between all nodes. The vast majority of these edges were positive (95.71%), with only three negative edges (out of 70 edges included in the estimated network). Overall, these indicators point toward a clustered network structure with primarily positively connected dense network communities. We tested several stability indices via bootstrapping, all indicating that the network structure was stable (see Supplemental Materials).

Network Centrality Parameters

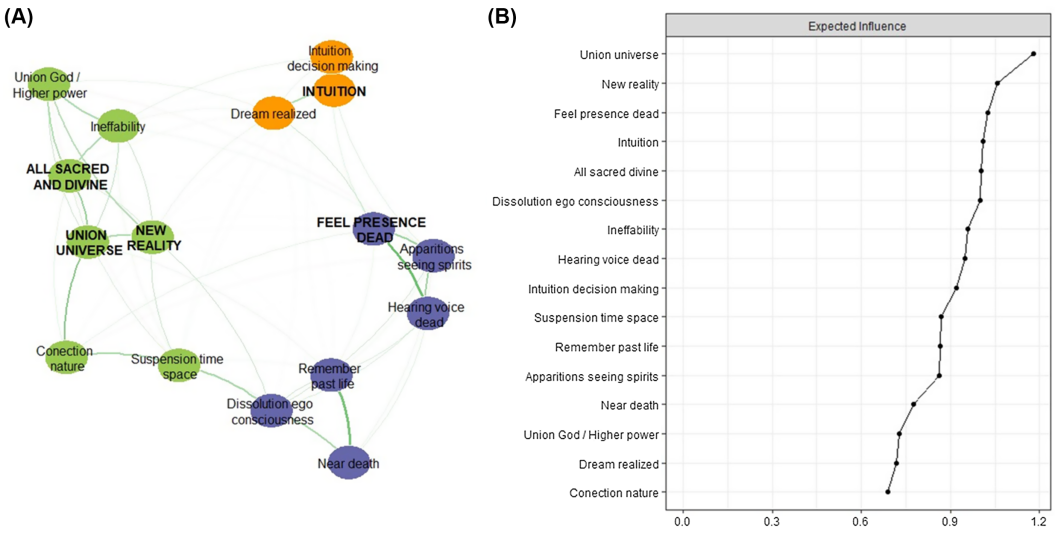
We next examined the most central nodes within the network. The most central nodes using standardized EI were "Experiencing union with the universe," "New reality," "Everything is sacred and divine," "Feeling the presence of dead," and "Intuition" (Figure 1B). One important question is whether the relative frequency of the experiences influences the position within the network. To address this, we computed the correlation between the median frequency of each experience and the EI centrality. Overall, the correlation was small and not statistically significant: $r(14) = -.072$, $p = .79$. This indicates that the centrality of the item within the observed network structure was not driven by the differential frequency of the nodes.

Topological Structure of NOEs

A primary question for our study was the relative clustering or topological structure of the experiences. Using exploratory graph analysis and across 1,000 bootstrap samples, the most common solution contained three communities (67.4% of samples). 32.2% of the bootstrap samples showed a four communities' solution, and 0.4% of the bootstrap samples indicated a five communities' solution.

A detailed analysis of the network properties, including structural and item consistency parameters per cluster, is presented in the Supplemental Material. Summarizing the major results, the three communities' solution showed good consistency. This "typical structure" of the network is displayed in Figure 1A. Clearly distinguishable is a community including experiences related to

Figure 1
NOEs Network and Nodes Expected Influence



Note. (A) Experiences network with communities indicated by BootEGA function. edge thickness represents the magnitude of the pseudocorrelation between two nodes. green edges indicate that most relationships between nodes were positive in this network. the top five centrality nodes are highlighted by capitalized bold text (experiencing union with the universe, a new reality, feeling the presence of the dead, intuition, and that everything is sacred and divine). in order to interpret the position of the nodes, the network is plotted in an multidimensional scaling layout. (B) Standardized expected influence centrality for each item in the experiences network. NOEs = nonordinary experiences; EGA = exploratory graphical analysis. See the online article for the color version of this figure.

death (e.g., experiences with spirits, hearing or seeing dead relatives; Community 1), a second community capturing experiences of intuition and dreams that apparently were fulfilled or realized in real life (Community 2), and finally, a community grouping experiences related to connections to God, nature, and the universe (Community 3).

Focusing on each community's relative stability and consistency, Community 1, encompassing items related to the experience of interaction with spirits and dead relatives, showed less internal consistency but was still above commonly accepted thresholds. Nevertheless, the items of this cluster asking about experiences of remembering a past life, near-death experiences, and the feeling of ego dissolution emerged in a separate fourth cluster in a small fraction of bootstrap samples (see Supplemental Table S1). These items were at the suggested threshold limit of cluster consistency (∼.75% of bootstrap samples in Community 1; Supplemental Figure S3) and showed associations above the suggested cutoff of ≥0.15 with other clusters (Christensen & Golino, 2021a on the equivalency of factor and network loading; Supplemental Table S2). This suggests the possibility of additional subclusters and greater complexity for Community 1 and explains the items' lower stability. Here, we adopted the more parsimonious three-community structure since the consistency parameters were above the suggested thresholds and higher network loadings occurred within the same communities. However, more complex configurations could be explored in future studies.

Relationship Between NOEs and Mental Health

Focusing on our second major question, we investigated the relationship between the different communities in the NOEs network and the two mental health communities. We separated depression (PHQ-9) and anxiety (GAD-7) communities a priori. We used bridge centrality metrics to identify those nodes that link communities, calculating first-order (direct) BEI values for every experience node with nodes in the anxiety and depression clusters. Hence, each BEI value indicates the relationship of a node with either PHQ or GAD items while controlling for the influence of all other nodes. To display the main findings, we adapted the graphs used by (Peters et al., 2021).

Focusing on anxiety first, some experiences showed positive but very low EI values with the GAD cluster, while others showed no influence. Across all experiences, "hearing voices of dead individuals" had the highest positive value, followed by other experiences with lower positive values (i.e., "suspension of time and space," "remember past life," and "dream realized"). Therefore, individuals reporting these experiences also reported higher anxiety scores.

In comparison, the bridge strength between NOEs and depression was stronger in absolute terms and more variable. The highest positive association with the PHQ cluster was with "near-death" experiences, followed by "ego dissolution" and "seeing apparitions/spirits." This indicates that individuals reporting these experiences also experienced higher depressive moods, controlling for all other experiences. In contrast, the experience of "connection with nature" had a marked negative bridge strength with the PHQ cluster, followed by the experience of "union with the universe" (Figure 2). Therefore, these two experiences are associated with less depressive mood symptoms, controlling for all other nodes.

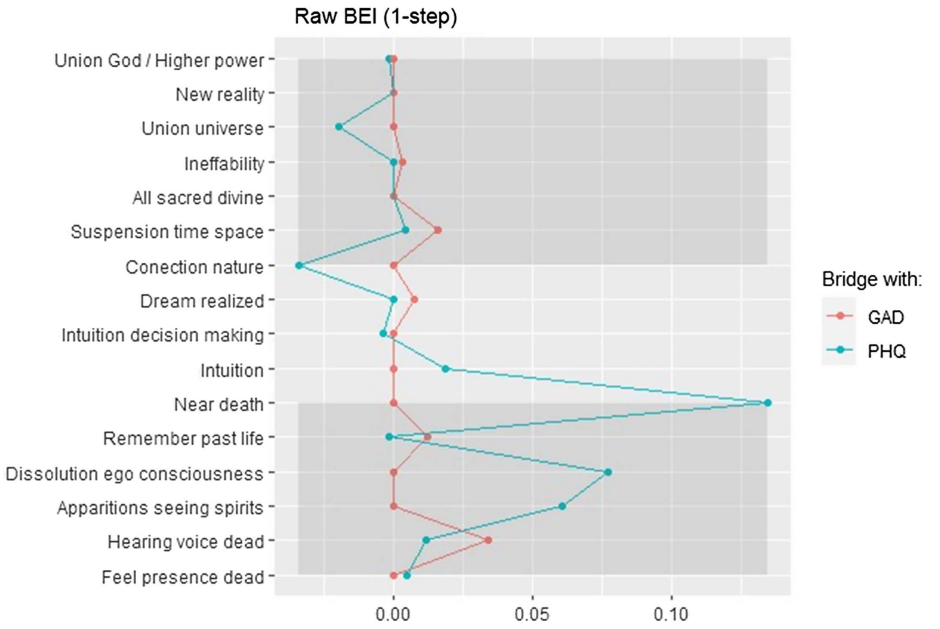
The previous analysis was computed on the whole network, but it is also possible to run more focused analyses comparing associations with out-of-community nodes. The results were practically identical, and the relevant statistics are included in the Supplemental Material.

Factorial Versus Network Data Structure: Loadings Comparison Test

The loading comparison test with 1,000 bootstrap samples indicated that 74% of the models identified a network structure across bootstraps, and 26% identified a common factor structure. This suggests that the data are best interpreted as causally independent observations that do not share a common underlying causal structure. Using commonly used techniques such as exploratory or confirmatory factor analysis may not be appropriate for capturing the relationships between distinct NOEs, and future research may benefit of comparing both approaches and its results.

Figure 2

Bridge Expected Influence (BEI 1-Step) Values for Each Experience Node With Depression and Anxiety Clusters



Note. Normalized data according to cluster size. Shaded areas indicate experience clusters from EGA. EGA = exploratory graphical analysis; GAD = General Anxiety Disorder; PHQ = Patient Health Questionnaire. See the online article for the color version of this figure.

Discussion

We report the topological structure of nonordinary experiences in a large-scale community sample in Brazil and relate these experiences to anxiety and depression scores as indicators of mental health. Most importantly, we identified a small number of relatively coherent experience clusters, which implies that certain types of NOEs tend to cooccur within this sample. An investigation of the plausible underlying mechanisms suggested that these associations are better interpreted as mutually connected networks and not as reflecting underlying latent variables. Focusing on mental health, each cluster's individual experiences showed positive and negative associations, primarily with depression scores. Therefore, some experiences are clearly associated with better mental health responses, whereas other NOEs may contribute to a possible mental health burden. Our analysis also suggested that depression responses were more strongly linked to NOEs than anxiety. We explore these points in more detail next.

Structure of NOEs Network

Our exploration of the relative association between a selected set of NOEs showed a three-cluster structure. To briefly recap the clustering of experiences, the first cluster featured experiences related to death—such as having different interactions with deceased people or remembering a past life, the second cluster included experiences regarding intuition and premonition, and the third cluster consisted of experiences of transcendence with different ontological explanations—such as connection with nature or God. Overall, the clustering was stable, except for three items within the first community, which may form a fourth cluster. In the following, we provide some theoretical interpretation of the observed clusters, focusing specifically on plausible biological constraints on perception and sensory input or biased cognitive functioning. Our theorizing here can be best seen as an effort of hypothesis generation that need to be further tested and validated in future studies.

Our network-based approach does not share the same underlying assumptions about latent variables as factor analysis, focusing instead on the (bi)directional relationships between observed variables, conditioned on all other variables (Cramer et al., 2012). Therefore, these models are more statistically likely to identify the most probable clustering of empirical data, but at the same time, they are theoretically neutral about the ontological nature of the identified clusters. Based on the currently available evidence, it is unlikely that these patterns we observed are compatible with latent variables. Instead, we believe that having one experience may sensitize individuals toward other experiences, which leads to reinforcing interactions over time that can be detected as relatively stable experience clusters. Therefore, the clusters are unlikely to be driven by a single common underlying biological mechanism, as could be expected within a latent variable perspective. We strongly encourage future studies that examine the possible data generation mechanisms empirically and explore the conceptual validity of network versus latent or common effect models.

Ontological Nature of Experiences Network Communities

First Cluster (Experiences Related to Death)

Experiences of contact with the dead are usually studied in the literature as either hallucinations or religious experiences (Loch et al., 2019; Luhrmann et al., 2021). Although it is possible to isolate phenomenologically abnormal sensory perception processes (e.g., hearing, seeing, or feeling something that cannot be perceived by other people around), current evidence suggests that an experience of hallucinations of dead (e.g., dead relatives) cannot be reduced to a misfunctioning of sensory mechanisms. For example, in hallucinations induced by drugs, the knowledge that the abnormal sensory stimulus is a hallucination is almost always preserved (Fortier, 2018). At the same time, within specific cultural or social knowledge systems, preexisting beliefs can give specific meanings to the experience and lead to both differentiation and unification of sensory experiences. Luhrmann et al. (2015) has extensively studied voice-hearing experiences and argued that the content of auditory hallucinations is shaped by culturally driven expectations.

Our study was conducted in Brazil, where widespread religious beliefs stimulate and value communication with the dead. Loch et al. (2019) suggested that individuals with NOEs can use religion to explain their subclinical hallucinations in a way that makes them socially functional. Therefore, we would argue that hallucinations of the dead across different sensory modalities align with the explicit valuation of these experiences within the cultural context. The other items clustering within this community may further enhance and complement the status of these experiences. For example, being able to perceive or interact with dead people may be enhanced if one has felt close to death or appears to have some memories of a past life. Remembering past-life and near-death experiences are related to death, and the belief of life after death may have clustered here due to an interpretation of experiences through this belief. Individuals that interpret thoughts as past-life memories may be the same people that interpret sensations as feeling the presence of a dead one—leading to a more frequent cooccurrence.

Finally, ego dissolution has been reported to accompany induced near-death experiences (Martial et al., 2019), although ego dissolution happens as well in other contexts such as transcendent states and drug-induced states (Taves, 2020). With all of this in mind, these items might have clustered together because they are related to (a) altered perceptions across multiple sensory systems and (b) the content of the hallucinations has high cultural value within the local community.

Even though these experiences may be culturally valued, the first cluster contained the items most strongly related to negative mental health outcomes. Remembering past life was related to anxiety only; seeing spirits, ego dissolution, and near-death experiences were related to depressive symptoms only; and hearing voices was related to both anxiety and depression. On one hand, these associations are compatible with the usual treatment of visual and auditory hallucinations in psychiatric manuals as pathological and implying psychiatric conditions (Delmonte et al., 2016). Nevertheless, at the same time, experiencing NOEs may not be the same as experiencing psychosis. For example, mystical experiences cannot be reduced to psychotic symptoms in general (such as delusions, hallucinations, and disorganized speech, thought, or behavior), even

though such experiences may be present in some of these individuals (Bitēna & Martinsone, 2021). Moreover, cultural expectations can influence the phenomenology and enhance the occurrence of reporting these kinds of experiences in, for example, religious contexts, which may increase their prevalence in a general population (Luhrmann et al., 2015). Nevertheless, these experiences can be subjectively stressful and be associated with mood disturbances, particularly when this experience is out of a religious and/or cultural context (A. L. Lucchetti et al., 2016).

This is compatible with studies that reported depressive symptoms after near-death experiences, especially when the experience was not well-integrated into the individual's belief system (Greyson, 2001). At the same time, near-death experiences have also been related to posttraumatic growth in a study with burn survivors if the significance and meaning of the experience are developed (Royse & Badger, 2017), showing the importance of other factors posterior and besides the experience itself to the mental health consequences. A specific study with out-of-body experiences leading to ego dissolution also found higher anxiety in those individuals compared to people who did not experience ego loss (de Boer, 2020). This highlights the complex interplay of cultural valuations of these experiences, which may be positive for community members in general, while the subjective experience can have a negative mental health implication for some of the individuals reporting them.

Second Cluster (Intuition and Premonition)

The second cluster involved the most frequent experiences in our sample, with less than 30% of participants indicating that it never happened in their lives. This cluster is linked to the first cluster through the item "feeling the presence of the dead," also the most common experience within that cluster.

One process that might be particularly relevant for the coassociation of these experiences is related to analytic reasoning. Scientifically, intuition is automatic information processing based on personal experience and differs from a deliberate thought process associated with analytical processing of relevant information (Kahneman, 2003). The nodes in this cluster could be thought of as results of more automatic information processing. Although intuitive decision making and analytic reasoning are not necessarily conflicting, especially if the intuitions are based on broad life experiences (Inbar et al., 2010), the tendency to accept intuitions and assign meaning to coincidences while rejecting other explanations that come to mind is common in some psychiatric disorders (Coltheart et al., 2011). Nonclinical delusions do not seem to be predicted by analytic cognitive style, although analytical reasoning seems to predict paranormal explanations (Ross et al., 2017).

Similar to the first cluster, this second cluster also appears strongly influenced by beliefs and expectations, although these expectations may be less culture-specific compared to the first cluster. Intuitions might be based on an adaptive system that generates and maintains cognitive schema while also acting automatically on information that violates cognitive schema without these violations being processed consciously. As a result, coincidences are assigned strong meaning and significance (Bressan et al., 2008). These mechanisms seem to be common to these three experiences that form this cluster.

What is interesting from a theoretical perspective is the relatively strong link of this second cluster to the first cluster via the feeling of the presence of the dead. In our view, this suggests similar processes: something elicits a memory or a feeling related to a deceased one (below a conscious awareness threshold), and the automatic interpretation is that the deceased one is present in spirit because the initial triggering mechanisms remain below conscious awareness. Therefore, the strong bridge associations with this second cluster may show that similar cognitive processes can affect different items across the network that do not necessarily cluster together due to other processes involved. Again, this suggests that there are common cognitive or biological mechanisms but the absence of a distinct latent variable that exclusively "causes" the cooccurrence of the nodes within a community cluster.

An important observation is that this second cluster did not have strong bridges with mental health scores. Together with the high frequency of these experiences, these cognitively oriented experiences show no consistent association with anxious and depressive symptoms.

Third Cluster (Experiences of Transcendence)

The last cluster involves experiences that have been studied under a variety of names, including self-transcendent (Yaden et al., 2017) and mystical experiences, or altered states of consciousness (Taves, 2020). The terms religious or spiritual are often used to refer to experiences with these same characteristics, that is, a decreased self-salience and an increased feeling of connectedness (Yaden et al., 2017). Experiences in this cluster are also in line with the current definitions of spirituality. Feelings of connectedness to nature, for example, are usually related to spirituality (Puchalski et al., 2014).

Biologically, Lifshitz et al. (2019) hypothesized that trait absorption might be a relevant factor for the explanation of self-transcendence. Luhrmann (2005) and Lurhmann et al. (2010, 2021) proposed that those with a proclivity for absorption are more likely to report NOEs. Absorption can be defined as a trait that varies between people and is associated with vivid mental imagery, openness to experience, and a tendency to be absorbed by sensory stimuli (Roche & McConkey, 1990). Taves (2020) noted that absorption might make ego dissolution experiences more acute. In line with this reasoning, ego dissolution, which formed part of the first cluster, showed the strongest bridge with the third cluster, with which it shares more common phenomenological characteristics, such as timelessness, a sense of union with others or the universe, and dissolution of body boundaries. Therefore, trait absorption can be one element that is present not only in this cluster but also in experiences of other clusters—again advocating for a network organization of experiences.

Focusing on mental health, experiences in this cluster had stronger relationships with positive mental health, even though suspension of time and space was linked to anxiety. Self-transcendent experiences may be beneficial for mental health by building connections to others (Yaden et al., 2017). Experiences related to nature can also be protective factors. Connection to nature, for example, has shown relatively consistent benefits to mental health (Bratman et al., 2019). Spirituality can also play a role, but although cross-sectional data show associations between religiousness and spirituality and lower levels of depression, substance use and suicidality, findings are mixed regarding anxiety, psychotic, and other disorders (G. Lucchetti et al., 2021). Longitudinal data suggest that only participation in public religious activities and the importance of religion are related to mental health, with small effects (Garssen et al., 2021). Indeed, factors other than the experience itself may be important when considering its impact. Spontaneous transcendent experiences among atheists, for example, were related to enhanced well-being only when integrated into the person's worldview (van der Tempel & Moodley, 2020).

Clinical Implications

Our work has a number of interesting implications for clinicians. First, the clustering of NOEs that may be included in diagnostic criteria together with other experiences that may not be routinely explored by clinicians suggests that a broader canvasing of NOEs may be beneficial for a better understanding of possible mental health risks and protection factors. What is important for mental health is the interpretation and embedding of experiences into meaning systems. Exploring meaning systems around cooccurring experiences may be an important step for clinicians.

Second, anxiety and depression scores showed the strongest links with experiences in Community 1 (especially experiences involving death/deceased). The literature on bereavement certainly suggests that remembrance and dealing with lost loved ones can have strong negative mental health implications. As discussed above, the subjective experience of hallucinations may be distressing and associated with higher mood disorders, even though the experience is positively valenced within the cultural context. This dissociation between a relative positive valence within the community combined with subjectively experienced stress certainly needs careful attention.

At the same time, our study clearly shows that NOEs are not, by default, detrimental to mental health. Experiences in the transcendent cluster (Cluster 3) had the strongest negative links with depression in particular, indicating that transcendental experiences can be associated with improved mood. It is important to highlight that the exploration of NOEs can be helpful to both identify possible risk factors but also to explore possible protective factors. As we had noted, a number of experiences function

as bridges across network communities, which implies that for specific individuals the boundaries between clusters can be quite fluid.

Focusing on the research–clinical intersection, it will be important for future research to identify possible biological, social, or life experience triggers for specific NOEs within each community network, which may result in person-specific topological structures with mental health implications. One option for clinical exploration might be to start with the most central nodes within the network and examine the etiology of the specific node and how it may contribute to other experiences within the community and the wider network. (Golino & Epskamp, 2017; Kruis & Maris, 2016; Marsman et al., 2018)

Limitations

The first limitation of our data is the retrospective data collection method. Although there are obvious limitations to the analysis of NOEs in near-real time, the recall of specific experiences may have already influenced the recall and interpretation of other experiences. Future research may use more naturalistic assessments, including momentary assessment or experience sampling methods, to capture experiences in situ or as closely as possible to the occurrence. Such an approach also provides advances for possible clinical applications by exploring the situational characteristics of the experiences and associated mood effects. A second limitation is the cross-sectional nature: we measured the NOEs retrospectively, but mental health was measured with a more restricted temporal time frame (2 weeks). The influence of any specific NOE may be more temporally specific and may not be relevant for understanding mental health reports within the time frame set by these two instruments. This limitation applies to most cross-sectional explorations of risk factors or demographic profiles, but it is important to highlight this when interpreting the results. The most appropriate interpretation of our associations is in terms of possible long-term effects on NOEs on mental health. It may also be plausible that individuals with more mental health problems may be more sensitized to report and remember specific experiences that appear unusual or out of the ordinary from a normative perspective. However, because of the cross-sectional nature of the study, no causality can be implied. The specific clinical pathways that connect a specific experience with either reduced or improved mental health are therefore unknown. An important further area of research related to the previous points is to examine the ontological nature of these experiences, specifically focusing on possible mechanistic explanations that may elucidate how each of these experiences may emerge in interaction between situational and biological variables and how these processes then influence mental health. Our statistical analyses suggested that a network model is more plausible given our data compared to a latent variable model. Additional sets of models exploring these experiences in situ are needed to advance our insights into the meaning and impact of these clusters. Furthermore, we have not assessed psychotic symptoms or diagnoses, which are more often associated with the NOEs that were measured in our study. Future studies should add these variables to understand further relationships between broad NOEs and specific diagnostic criteria with mental health outcomes.

Conclusion

There has been renewed interest in so-called NOEs in recent years, in particular with a focus on differentiating possible mental health impacts. Our study advances our current understanding by highlighting the topological structure of NOEs in a large nonclinical population sample and demonstrates that specific experiences can have positive and negative mental health implications. Future research clearly needs to pay more attention to the differential structure and nature of experiences.

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