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Empirical Article

The architecture of psychological well-being: A network analysis study of the Ryff Psychological Well-Being Scale

ANA BLASCO-BELLED[1] and CARLES ALSINET[2]

[1]*University of Girona, Girona, Spain*
[2]*University of Lleida, Lleida, Spain*

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The proliferation of mental health research is orienting its efforts towards the exploration of psychological well-being. One of the main burdens is the measurement challenges reported by the widely used Psychological Well-Being Scale (PWBS), which has often been criticized for inconsistencies between the theoretical and the empirical model. A potential alternative to understand the structure of psychological well-being is network models, which conceptualizes psychological phenomena as emerging systems of mutually connected variables. Employing exploratory graph analysis, we examined the network structure of the Spanish 29-item PWBS in a random sample of 1,404 adults. We estimated a regularized partial correlation network using the graphical LASSO algorithm in the item and dimension level. We tested the stability of both networks and identified the most important variables of the network. The PWBS network model revealed four dimensions, with self-acceptance, life purpose and environmental mastery clustering together. Node strength centrality suggested that self-acceptance is the most central dimension in the psychological well-being structure as measured by the PWBS. Despite the network model of psychological well-being did not replicate the theoretical structure of Ryff's model, it provides a novel conceptualization of psychological well-being and proposes target indicators for mental health interventions.

Key words: Measurement, mental health, network analysis, psychological well-being, quality of life.

Ana Blasco-Belled, University of Girona, Pujada de Sant Domènec, 9, 17004 Girona, spain; E-mail: ana.blasco@udg.edu

INTRODUCTION

The interest on the study of well-being has increased within the field of social sciences over the last decades. This advancement has been characterized by the proliferation of several measures that capture different aspects of well-being. One of the most well-known is the Psychological Well-Being Scale (PWBS; Ryff, 1989), which evaluates how individuals function psychologically in response to their life's demands premised on the eudaimonic notion that well-being comes from realizing human potential (Ryan & Deci, 2001). The PWBS is conceived as a multidimensional instrument composed of six dimensions: self-acceptance (being aware of and accept one's strength and weaknesses), positive relations (having deep, meaningful relationships with others), personal growth (experiencing progress as a result of developing one's strengths), autonomy (being self-determined and taking independent decisions), environmental mastery (managing one's circumstances to take advantage of opportunities), and purpose in life (establishing and being guide by goals). The conjunction of these dimensions resulted from converging previous models that described mental health, like the theories of Jahoda (1958), Maslow (1968), or Rogers (1961). The main goal was to offer a theory-driven basis to assess indicators of positive functioning (Ryff, 1989; Ryff & Keyes, 1995).

But despite its widespread application in research, psychological well-being has been surrounded by debates concerning the structure (e.g., validity and dimensionality) and therefore the applicability to the study of quality of life. Of note, *Social Science Research* held an academic discussion about the topic (see Ryff & Singer, 2006; Springer, Hauser & Freese, 2006). The conclusions opened a still ongoing academic discussion about the adequacy of using the PWBS, since the Ryff's theory model of six dimensions was often not supported by the PWBS measurement model. The divergences might stem from several factors; for example, it may depend on how the different samples (undergraduates, adults, older adults) understand the construct of PWB; on the number of items conforming each dimension of the scale; or on method effects (Tomas, Meléndez, Oliver, Navarro & Zaragoza, 2010). These measurement inconsistencies have been reported in other studies (e.g., Burns & Machin, 2009; Kafka, Kozma & Kafka, 2014; Triadó, Villar, Solé & Celdrán, 2007), so it is common to observe that the Ryff's six-factor model does not provide acceptable fit indices (Abbott, Ploubidis, Huppert, Kuh & Croudace, 2010; Díaz, Rodríguez-Carvajal, Blanco *et al*., 2006; Freire, Ferradás & Valle, 2017; Springer *et al*., 2006). A three-factor structure whereby self-acceptance, life purpose, personal growth and environmental mastery are combined to form a single dimension has been reported to explain the structure of psychological well-being (Abbott *et al*., 2010; Burns & Machin, 2009; Kafka *et al*., 2014), which resembles the self-determination theory of Ryan and Deci (2000). A four-factor model was found using the 29-item version of the PWBS (as in this study) composed of self-acceptance, environmental mastery, personal growth and life purpose, but the authors excluded the dimensions of positive relationships and autonomy (Freire *et al*., 2017). Other studies have supported the theoretical six-factor (Clarke, Marshall, Ryff & Wheaton, 2001; Díaz *et al*., 2006; Ryff & Keyes, 1995) or six-bifactor structure (Espinoza, Meyer, Anderson, Vaters & Politis, 2018).

Researchers generally agree that the PWBS appears as a good indicator of overall psychological well-being, but it fails to

identify the six intended specific dimensions. The empirical findings point to a refinement in the measurement of this construct, but a potential limitation is that these findings are based on different analytic strategies (e.g., exploratory factor analysis or exploratory structural equation modeling), with most of them rooting on factor analytic methods in which authors specify a measurement model based on the theoretical model (e.g., confirmatory factor analysis). Factor models are premised on the idea that an underlying cause explains the covariation between indicators (commonly referred to as symptoms in psychopathology), and thus these indicators may not be causally connected. According to this perspective, the co-occurrence between having a sense of purpose in life and feeling confident about oneself is *only* a cause of (the latent construct of) psychological well-being. However, to better represent the complexity of psychological phenomena it seems a good idea to incorporate and combine contributions from factor models and network models (Fried & Cramer, 2017).

What can the network approach offer to the study of psychological well-being?

A recent advance across several fields of psychology has been the introduction of the network approach (see Fried, van Borkulo, Cramer, Boschloo, Schoevers & Borsboom, 2017 for a review). In network research, psychological phenomena are represented as networks, a complex organization of psychological characteristics that emerge from the mutual connections between the observable indicators that define them (e.g., items or subscales) (Borsboom & Cramer, 2013). Rooting on the mutualism perspective, network models propose that psychological variables are mutually connected and reinforce one another, which forms a causally connected system (Borsboom, 2008). This offers an alternative approach to assess the dimensionality of constructs without necessarily detecting a common latent variable. In this case, the observable variables (i.e., items) do not assess directly the psychological phenomena (i.e., PWB) but are part of it. This approach offers the advantage of unveiling existing categories by depicting the associations present between variables in a graph (Epskamp, Waldorp, Mõttus & Borsboom, 2018). Networks are composed of psychological variables (nodes; PWBS items) that are associated through a set of relations (edges; total or partial correlations). In a network, nodes are visualized as circles and edges are the lines that connect these nodes. Exploratory Graph Analysis (EGA; Golino & Epskamp, 2017) is a technique used to statistically determine the number of dimensions and the allocation of each item within dimensions, providing a similar performance to exploratory techniques like parallel analysis or minimum average partial.

As a network model, psychological well-being is defined as a system that emerges from mutually interacting indicators that, together, form the construct. It is therefore assumed that indicators are not simply causes or by-products of psychological well-being, as represented by factor models, and the direct interactions between item responses conform the backbone of the network structure. More specifically, psychological well-being might not directly cause the emergence of self-acceptance, autonomy, life purpose, environmental mastery, positive relationships and personal growth. Rather, psychological well-being might emerge as a result of the mutual interactions between them (see Fig. 1). The indicators of this structure can be built under the domain- or item-level, implying that we can examine the network structure of the PWBS as represented by the six theoretical dimensions or the 29 items.

The network approach can add valuable knowledge to evaluate which of these indicators (dimensions and items) are more important to psychological well-being. At dimension level, this would inform about how the six theoretical dimensions are built within the structural organization of the PWBS. At item level, it is also possible to analyze if the network clusters into different communities, which would inform about how items conform separate dimensions and the importance of each dimension within the network structure. Maybe some indicators are more important to define psychological well-being and some others are more peripherical. For instance, at dimension level, self-acceptance, environmental mastery, personal growth and life purpose tend to appear as a one single dimension and might be more central (Abbot *et al*., 2010; Burns & Machin, 2009; Kafka *et al*., 2014). At item level, however, it becomes a convoluted task to predict which items would be more important to the network given the high heterogeneity of the PWBS measures used in prior research (e.g., 9-item, 39-item, 42-item, 52-item versions).

Despite the recent explosion of network models, to our knowledge only Kossakowski *et al*. (2016) advocated this perspective in the assessment of quality of life indicators, evidencing that the network approach has much to offer to the science of well-being. Given its novelty, our study can contribute to the ongoing investigation of psychological well-being by examining the network structure of one of the most expanded measures in the field. We seek to investigate the operationalization of psychological well-being by examining: first, the network structure of the PWBS at item level; second, the network structure of the PWBS at dimension level; and third, the importance of the empirically-driven dimensions in explaining psychological well-being by means of centrality test. We expect to find a multidimensional structure, with a potential dimension composed of self-acceptance, environmental mastery, personal growth and life purpose. Given the multiple disagreements in factor analytic studies, we anticipate that the theoretical model of six dimensions would not be identified in the network model.

METHODOLOGY

Participants and procedure

The data comprised 1,404 Spanish adults[1] (75.7% females; M = 21.65, SD = 7, age range = 18–69) who participated voluntarily in a project about personal development in the University of Lleida. Participants reported an "average" socio-economic level (60.5%), followed by "slightly higher than average" (15.1%) and "slightly lower than average" (13.5%). The rest of responses were split between "higher than average" and "lower than average." This study was part of a larger research project involving subjective and psychological well-being. For the present investigation, only measures of psychological well-being were considered, as the results of subjective well-being were used in prior studies (see Blasco-Belled, Rogoza, Torrelles-Nadal & Alsinet, 2019 for more details). Participants were informed the first day of college about the possibility of taking part in a research project aimed at assessing undergraduates' well-being.

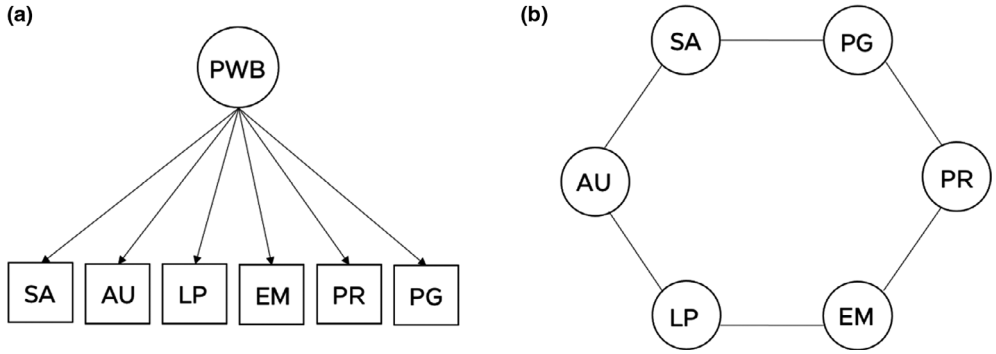

Fig. 1. Example of the Structure of Ryff's Psychological Well-being ppplied to a factor model (a) and a network model (b). SA = Self-acceptance, AU = Autonomy, LP = Life purpose, EM = Environmental mastery, PR = Positive relationships, PG = Personal growth

Although the participation was voluntary, the study registered a high rate of participation (83%). The only inclusion criterion to meet was to be an undergraduate enrolling in any degree of the university. After acceptance, we provided participants with access to an online platform through a Google forms link to complete a survey including all the measures. They completed the questions in around 15 min and obtained an individualized report with their results at the end. We provided an explanation of the study's aims in the survey, including the terms of confidentiality and anonymity. The participants were extensively informed about the procedure and the purpose of the project, and they signed an informed consent form prior to enrollment in the program. Only participants who completed the whole protocol were accepted into the study and their data were collected. As all the online questions were mandatory, we registered no missing data. The research project received approval by the Faculty of Psychology, Education and Social Work of the University of Lleida.

Instruments

Psychological Well-being Scale (Ryff, 1989; Spanish adaptation of Díaz *et al*., 2006). This 29-item scale evaluates psychological well-being through six dimensions: autonomy (six items; "My decisions are not usually influenced by what everyone else is doing"), environmental mastery (five items; "In general, I feel I am in charge of the situation in which I live"), personal growth (four items; "I have the sense that I have developed a lot as a person over time"), positive relationships (five items; "Most people see me as loving and affectionate"), purpose in life (five items; "I have a sense of direction and purpose in life"), and self-acceptance (four items; "In general, I feel confident and positive about myself"). It uses a seven-point Likert-type scale (1 = *strongly disagree* to 7 = *strongly agree*).

Analytic plan

We used the network analysis approach to assess the structure of psychological well-being. The analyses were carried out in *Rstudio* (RStudio Team, 2019) and the analytic plan, based on a quantitative, cross-sectional research design, consisted of the following steps; first, we estimated two networks and the centrality indices. Second, we assessed the accuracy of these inferences. Third, we scrutinized the dimensionality of the network, and fourth, we tested the stability of the structure. The data and R code are available at Open Science Framework: https://osf.io/mwpzq/?view_only=a4cc0d503970462b840d0f70ed81310d.

Network estimation. First, we estimated a Gaussian Graphical Model (GGM; Lauritzen, 1996), which assumes multivariate normal variables, to represent the structure of psychological well-being in the item and dimension level. In GGM networks, the connection (edges) between variables (nodes) are based on the partial correlation of two nodes after controlling for all other variables of the network. We estimated an undirected (no directionality between nodes; for example, whether item 4 is causally predicting the activation of item 9, or vice versa) and weighted network (edges represent the strength of the correlation). To clarify this, the width of edges represents the strength of the connection between two nodes and thus displays the unique associations between two variables. The edges are undirected (with no arrows), so the associations should not be interpreted as causal (Epskamp, Borsboom & Fried, 2018). To avoid overfitting due to the estimation of a large number of parameters, we used the graphical least absolute shrinkage and selection operator (glasso; Epskamp, Waldorp, Möttus *et al*., 2018), a regularization technique that shrinks all connections and sets small coefficients to zero (Tibshirani, 1996). This leads to a sparse network in which only a few edges are included to explain the associations. By this means, glasso preserves false positive edges and prevents erroneous conclusions about the presence of an edge in the model. To estimate the networks, we applied EGA (Golino & Epskamp, 2017) using the *EGA* function of the *EGAnet* R-package version 0.9.5 (Golino & Christensen, 2020). EGA estimates the correlation matrix of the observed variables before applying a graphical lasso estimation to obtain a sparse inverse covariance matrix in the form of a network (Friedman *et al*., 2008). To identify which nodes were more important to the network, we used the centrality metric of node strength (i.e., how strongly a node directly connects to other nodes, based on the absolute sum of edge weights connected to a node) using the *centralityPlot* function of the *qgraph* R-package version 1.6.9 (Epskamp, Cramer, Waldorp, Schmittmann & Borsboom, 2012). Recent work has suggested to rely on node strength, rather than on closeness or betweeness centralities, to interpret the relevance of a node in the network (Isvoranu & Epskamp, 2021).

Dimensionality. Highly connected nodes often cluster and form communities in the network, which are equivalent to latent factors (Golino & Epskamp, 2017). Here we analyzed the internal structure of psychological well-being by examining the number of communities (i.e., dimensions) within the network. Because we were interested in the clustering of items forming communities, dimensionality was only calculated in the item-level network. After identifying the allocation of the items in each dimension, we inspected the network loadings using the *net.loads* function of the EGAnet R-package version 0.9.5, which applies the walktrap algorithm to detect communities. Since the algorithm is deterministic, the resulting communities are not theory-driven, allowing researchers to discover the clustering of items based on the empirical data. Network loadings are equivalent to factor loadings and describe the extent to which a node contributes to a dimension in the network (Christensen & Golino, 2021). As network loadings represent partial correlations loadings, they are typically lower than factor scores. In the present study, we reported the standardized node strength for each node in each dimension of the network.

Network accuracy and structural consistency. After network estimation, it is recommended to test the accuracy in the inference of the network structure. First, we assessed the stability of the dimensions in the item-level network using the *bootEGA* function of the EGAnet R-package

version 0.9.5. We calculated dimension stability based on 1,000 bootstraps applying *parametric bootstrapping*. This procedure generates data from a multivariate normal distribution with the same number of cases as the original sample and repeatedly evaluates the model. Second, we assessed item stability to inspect the proportion of times that each item is replicated in each dimension. Finally, to ascertain the stability of centrality metrics, we assessed whether the order of strength centrality changed after re-estimating the network with less cases. If the correlation between the original centrality indices and the bootstrapped indices does not change, the interpretation of centralities is plausible (Epskamp, Borsboom *et al*., 2018). To that end, the *correlation stability coefficient* (*CS*-coefficient) tests the maximum proportion of cases that can be dropped. By default, the *CS*-coefficient computes a correlation of 0.70 with 95% CI. *CS-coefficients > 0.25 (and preferably >0.50) are recommended to interpret centrality differences* (Epskamp, Borsboom *et al*., 2018).

RESULTS

Network estimation

Descriptive statistics are available at the OSF site. EGA results showed that the network of psychological well-being included four different dimensions (Fig. 2).

Dimension 1 comprised the items of three dimensions from the Ryff's model: self-acceptance, purpose in life and environmental mastery; dimension 2 included the items of autonomy; dimension 3 included the items of personal growth and dimension 4 the items of positive relations. The allocation of items and the network loadings can be found in Table 1.

The centrality estimates (Fig. 3) in the item-level network indicated that items 24 (*Most of the time, I feel proud about who I am and the life I lead*) and 7 (*In general, I feel confident and positive about myself*) were more central to the network – both corresponding to the self-acceptance subscale[2] – suggesting that feeling proud, confident and positive about oneself exerts the largest influence on other variables of the network. By contrast, items 28 (*When I think about it, I have not really improved much as a person over the years*) and 14 (*In general, I feel I am in charge of the situation in which I live*) were the least central variables. In the dimension-level network, dimension 1 was the most important node in the network.

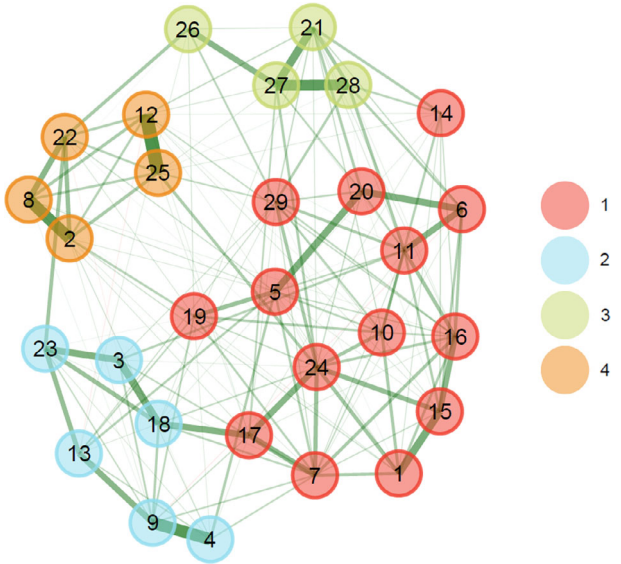

Fig. 2. Network of the Psychological Well-being Structure as represented by the PWBS items. *Note*: All correlations are positive.

Table 1. *Item allocation according to Ryff theoretical model and network empirical model*

Item	Ryff theoretical dimension	Network dimension
1	Self-acceptance	*Combination*
2	Positive relations	Positive relations
3	Autonomy	Autonomy
4	Autonomy	Autonomy
5	Environmental mastery	*Combination*
6	Life purpose	*Combination*
7	Self-acceptance	*Combination*
8	Positive relations	Positive relations
9	Autonomy	Autonomy
10	Environmental mastery	*Combination*
11	Life purpose	*Combination*
12	Positive relations	Positive relations
13	Autonomy	Autonomy
14	Environmental mastery	*Combination*
15	Life purpose	*Combination*
16	Life purpose	*Combination*
17	Self-acceptance	*Combination*
18	Autonomy	Autonomy
19	Environmental mastery	*Combination*
20	Life purpose	*Combination*
21	Personal growth	Personal growth
22	Positive relations	Positive relations
23	Autonomy	Autonomy
24	Self-acceptance	*Combination*
25	Positive relations	Positive relations
26	Personal growth	Personal growth
27	Personal growth	Personal growth
28	Personal growth	Personal growth
29	Environmental mastery	*Combination*

Note: Combination includes the Ryff theoretical dimensions of self-acceptance, life purpose and environmental mastery.

Dimensionality

Table 2 shows that dimension 4 had a perfect structural consistency, and dimensions 2 and 3 almost a perfect structural consistency. However, dimension 1 was less stable than the others. To inspect these results, we analyzed the stability of items in each dimension.

Figure 4 reveals that some items of dimension 1 were not consistently identified within the original dimension. After inspection of the network scores (Table 3), items 7 (*In general, I feel confident and positive about myself)* and 17 (*I like most aspects of my personality*) were also identified in the autonomy dimension, and item 14 (*In general, I feel I am in charge of the situation in which I live*) was also identified in the personal growth dimension. It is important to note that network loadings tend to be lower than factor loadings (Christensen & Golino, 2021), thus low values are not to be interpreted as weak loadings.

DISCUSSION

Substantial questions about the multidimensional nature of psychological well-being are often examined following empirical

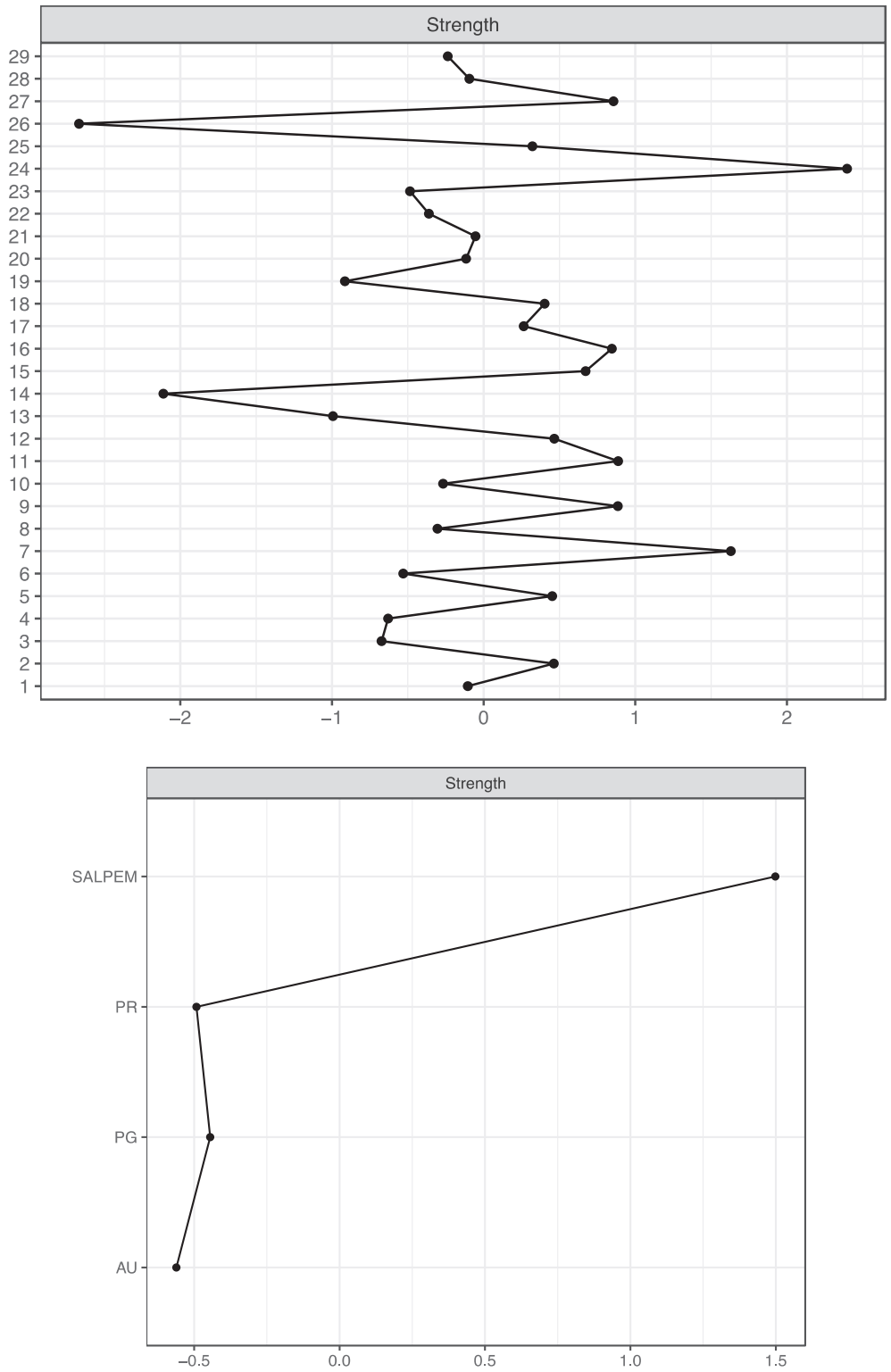

Fig. 3. Centrality indices of the PWBS Items (top panel) and empirical dimensions (bottom panel).*Note*: Centrality estimates are presented as standardized z-scores.

measurement models that, theoretically, derive from the conceptualization of psychological well-being. But the existing evidence relying on factor models, which assume that an underlying latent variable is *causing* psychological well-being, indicates that the resolution of these questions is far from clear. Network models conceptualize psychological well-being as *emerging from* mutual interactions between observable indicators, in which each interaction is based on the unique associations between indicators. In psychopathology and personality, network models have provided a different framework to understand the conceptualization, comorbidity and treatment alternatives of psychological phenomena (see Robinaugh, Hoekstra, Toner &

Table 2. *Structural consistency for the PWBS dimensions*

Dimension	Structural consistency
1. SALPEM	0.561
2. AU	0.980
3. PG	0.972
4. PR	1.000

Note: SALPEM = self-acceptance, life purpose and environmental mastery; AU = autonomy; PG = personal growth; PR = positive relationships.

Borsboom, 2020 for a review). Research on well-being seems a potential "client" to benefit from the network approach when it comes to clarifying inconsistencies about the composition of well-being measures.

We estimated the network model of psychological well-being as determined by the Spanish 29-item PWBS to examine its structure in the item and dimension level. Under this scope, the observable indicators measured by the PWBS items covary to generate the construct of psychological well-being. In accordance with prior research, our results showed that the item-level network does not replicate the six-factor model of Ryff (Abbott *et al*., 2010; Burns & Machin, 2009; Espinoza *et al*., 2018; Kafka *et al*., 2014; Triadó *et al*., 2007; Springer *et al*., 2006), and therefore our study did not support the empirical structure of the PWBS. The mutual interaction between the PWBS items yielded four dimensions; while dimensions 2, 3 and 4 successfully replicated the theoretical dimensions of autonomy, personal growth and positive relationships, dimension 1 comprised three of the theoretical dimensions (self-acceptance, life purpose and environmental mastery). From the network perspective, this suggests that self-acceptance, life purpose and environmental mastery may be highly enough interconnected and share similar features to form an individual dimension. This approach implies that the items in the scale do not measure psychological well-being, but are part of it; put differently, each variable does not directly assess psychological well-being, but parts of it (Borsboom, 2008).

Considering that psychological well-being articulates only a part of the assessment of eudaimonia that involves satisfaction within specific life contexts (e.g., satisfaction in relations or personal growth), it is important to note that our results specifically reflect the Ryff's scale and it is thus method-dependent – employing a different measure may reveal a different structure in the assessment of psychological well-being. That said, our findings suggest that the dimensions of self-acceptance, life purpose and environmental mastery, based on the Spanish 29-item PWBS, empirically reflect a single dimension as they all three share common elements that tie them together. In a tentative attempt to elaborate on our results, we hypothesize that the formulation of items regarding life purpose imply a positive self-view about one's accomplishments. Taken as an example, the item "I enjoy making plans for the future and working to make them a reality" evokes the respondent a sense of success in deciding and moving towards the future. Similarly, items corresponding to environmental mastery invoke confidence in the abilities to manage life situations. For instance, the item "In general, I feel I am in charge of the situation in which I live" implies a capacity to take responsibility of one's own situation to

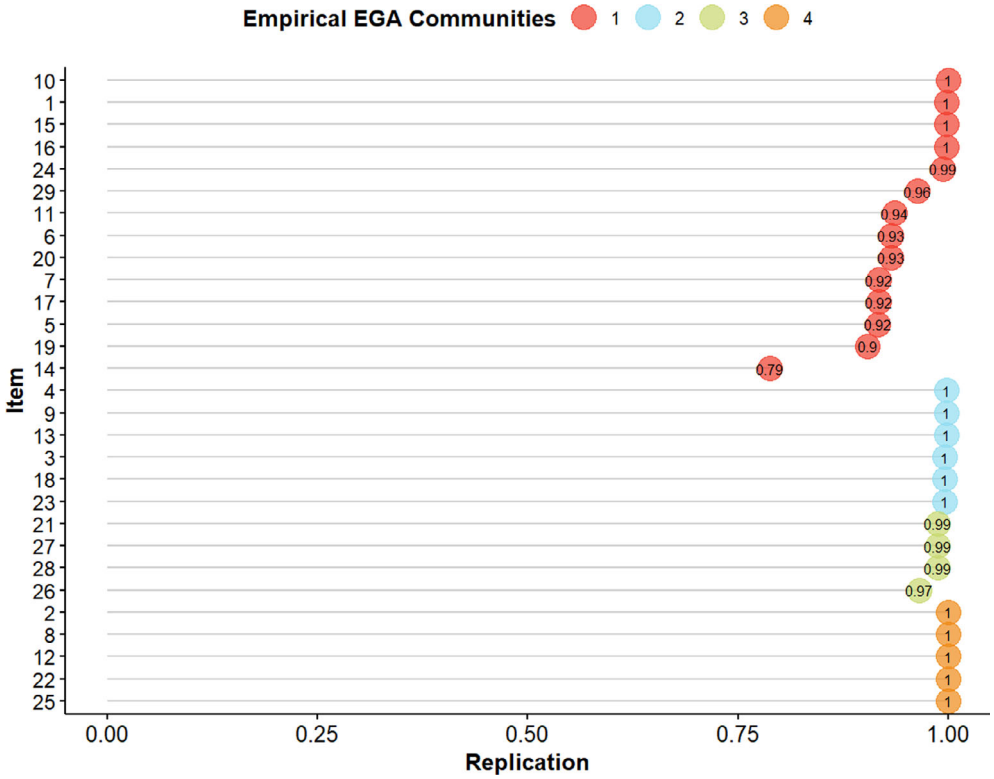

Fig. 4. Item stability of the PWBS. Nodes represent each item replication in the original dimension specified by EGA.

Table 3. *Network loadings of the PWBS Items on each dimension identified by EGA*

	Factor 1	Factor 2	Factor 3	Factor 4
Items				
1	**0.216**	0.000	0.000	0.022
5	**0.200**	0.075	0.000	0.046
6	**0.189**	−0.004	0.072	0.000
7	**0.254**	**0.112**	0.000	0.006
10	**0.206**	0.000	0.023	0.003
11	**0.225**	0.035	0.081	0.002
14	**0.059**	0.005	**0.088**	0.016
15	**0.267**	0.000	0.000	0.009
16	**0.265**	0.000	0.018	0.027
17	**0.135**	**0.128**	0.033	0.024
19	**0.106**	0.061	0.016	0.047
20	**0.188**	0.000	0.081	0.000
24	**0.313**	0.029	0.065	0.048
29	**0.140**	0.044	**0.108**	0.025
3	0.050	**0.262**	0.000	−0.002
4	0.049	**0.230**	0.000	0.016
9	0.048	**0.381**	0.000	0.009
13	0.048	**0.204**	0.008	−0.003
18	0.108	**0.242**	0.013	0.000
23	0.005	**0.286**	0.000	0.060
21	**0.113**	0.011	**0.239**	0.023
26	0.027	0.006	**0.130**	0.053
27	0.062	0.000	**0.474**	0.024
28	0.102	0.000	**0.273**	0.002
2	0.042	0.022	0.000	**0.353**
8	0.019	0.002	0.001	**0.378**
12	0.033	−0.003	0.043	**0.352**
22	0.019	0.060	0.061	**0.242**
25	0.053	0.000	0.014	**0.352**

Bold values indicate item loadings on the most preferential dimension.

either adapt to it or change it. The connection of self-acceptance with life purpose and environmental mastery seems, in light of our results, conceptually driven by the formulation of items. Despite the cultural and methodological measurement limitations of our study, the evidence warns about the conceptualization of the psychological well-being structure assessed by the PWBS, confronting the theoretical and the empirical models, and poses a challenge in the definition of the dimensions conforming psychological well-being.

A study that used the same Spanish version of the scale also found a four-factor structure (Freire *et al*., 2017) but the content of dimensions differed from our results. The authors removed the dimensions of positive relationships and autonomy, claiming that this final structure represented the core of eudaimonic well-being found in the literature. However, statistical decisions of items or scales removal without theoretical inferences are unadvisable because they can have substantial implications, especially if we consider psychological constructs as causal systems (Fried & Cramer, 2017). Besides the dimensional analysis, another fundamental finding concerns the identification of important variables (i.e., indicators) of the network structure as potential intervention targets.

If psychological well-being arises from the causal interaction between indicators, either at item or dimension level, it seems useful to determine the importance of each indicator. In network models we can identify important nodes by measuring centrality metrics. The item-level network revealed that feeling proud, confident and positive about oneself were the most central variables, which corresponded to self-acceptance. A sense of lack of progress in life and a feeling of responsibility for life situations were the least influential variables in the network, which corresponded to personal growth and environmental mastery. Of note, the item referring to progress in life reported the lowest structural consistency in the network. In the dimension-level network, dimension 1 was the most important, yet the least consistent; plausibly because it comprised three dimensions from the original Ryff model. Altogether, self-acceptance seems to exert a substantial influence over the rest of dimensions in the network of psychological well-being.

Activation of central nodes can produce and spread a flow of activation with other nodes in the whole network (Borsboom & Cramer, 2013). Echoing findings from psychopathology (McNally, 2016), by "turning on" central nodes it may be feasible to influence other nodes that help trigger, develop and maintain states of well-being. Therefore, positive interventions focused on enhancing mental health might be interested in targeting specific indicators of psychological well-being. Aspects relating to self-acceptance seems, according to the present results, potential targets to promote downstream benefits. To conclude, we do not claim to have a definite answer to the assessment of psychological well-being but provide evidence to encourage scholars to approach the issue with sophisticated research designs, and according to previous literature (Christensen, Golino & Silvia, 2020), these findings suggest that the validation of existing instruments should be reconsidered.

Limitations

Our study is not without limitations. Most importantly, we investigated the network structure of a single measure of psychological well-being, adapted to a single language, and applied to a single cross-sectional, nonclinical and women-overrepresented sample. These preclude generalization of findings and future studies should investigate cross-cultural variabilities. In identifying the network loadings, the Walktrap algorithm only allows nodes to load on a single community, which should be taken as a limitation in the estimation of dimensions. Of importance, complex psychological phenomena are not to be seen as a dualism between factor and network models (Fried & Cramer, 2017). For this reason, our study provides the first empirical attempt to understand psychological well-being as a system of interconnected variables. Further research using different samples, contexts and methodological approaches is needed to substantiate our findings. As stated previously, the PWBS has reported psychometric problems in terms of model fit (Springer *et al*., 2006). To ascertain the structure of psychological well-being, future research employing different measures may be needed.

CONCLUSIONS

In sum, our study was the first attempt to subject the PWBS to network analysis. The network architecture of the PWBS

provided four dimensions composing the structure of psychological well-being, with self-acceptance, life purpose and environmental mastery clustering together, which is partially in line with previous studies. The theoretical model of Ryff is not empirically supported from the network approach. Using a different perspective from previous research, our results tested the emergence of psychological well-being as resulting from mutually connected indicators rather than from a latent, underlying variable. These findings bring a novel perspective to evaluate the complex multicomponent nature of psychological well-being, and open new paths to inquiry into the promotion of psychological well-being interventions by targeting specific indicators that activate the network. Unfortunately, our findings supported previous assertions regarding the discrepancies between the theoretical claims and the empirical distinctions of the Ryff's model, which poses an academic challenge to the reconsideration of measurement scales of psychological well-being.

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ENDNOTES

[1] Network analysis are based on (partial) correlations, and despite power analysis techniques are not applied easily, samples >1,000 are considered large (see Isvoranu & Epskamp, 2021).

[2] The centrality measures are plausible to interpretation because network accuracy results (weight-accuracy and centrality stability) were non-significant and the *CS*-coefficient was .75. The plots of network accuracy can be found at the OSF site.

DATA AVAILABILITY STATEMENT

The data and R code are available at Open Science Framework: https://osf.io/mwpzq/?view_only=a4cc0d503970462b840d0f70ed81310d.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Figure S1 Stability of strength centrality. The line represents the mean of average correlations among strength centrality indices of sampled networks with case-dropping bootstrap.

Table S1 Item Descriptive Statistics of the 29-item Spanish PWBS.
Table S2. Dimension Descriptive Statistics of the 29-item Spanish PWBS.

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