Title

Posttraumatic growth and its measurement: A closer look at the PTGI's psychometric properties and structure

Author list

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Data Accessibility

The data are available upon request. The analytic code (including covariance matrices) is freely available at <https://osf.io/ucd7n/>.

Conflict of interest

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Author contribution

The authors collectively conceived the main idea and the design of the study. BJ wrote the theoretical framework and discussion with input from NK and MA. MA performed statistical analyses. JH, PT and NK supervised the study. All authors have revised the manuscript, made a substantial contribution to this work, and approved it for publication.

Abstract

Despite its negative connotation, surviving trauma can result in improvements in some of the domains of one's life. This phenomenon is known as posttraumatic growth and is usually measured using the Posttraumatic Growth Inventory (PTGI). Given the ambiguous results of the existing validation studies, the present study aimed to verify the psychometric properties of the Slovak version of the (PTGI) in a representative sample of Slovak citizens. Although the results suggest that a modified one-factor structure fitted the data best, other issues such as extremely high correlations between the latent factors, related to the PTGI's factor structure were observed. It is likely that the application of the latent variable model does not represent the essence of PTG adequately and the network approach thus appears to be a far more suitable conceptualization of PTG. More detailed information on between-person differences and within-person changes in PTG could help to tailor more effective interventions or preventative programs.

Key words: posttraumatic growth, posttraumatic growth inventory, PTGI, validation, network analysis

Introduction

Approximately 70% of people experience at least one potentially traumatic event in their lifetime (Benjet et al., 2016; Knipscheer et al., 2020). Based on the criteria stated in the DSM-5, trauma is defined as an event in which a person is exposed to actual or imminent death, severe injury, or sexual violence (American Psychiatric Association, 2013). The word trauma is usually perceived negatively and the majority of research on this topic is focused on its negative consequences on mental health. How a person responds to the survival of a traumatic event is conditional on multiple factors (biological, psychosocial, etc.). PTSD is just one of many possible types of reactions (Yehuda et al., 2015), and it develops in about 5% of people who survived a traumatic event (Atwoli et al., 2015). The prevalence rates stem from a combination of historical circumstances (e.g., war/conflicts, high criminality rates, natural disasters, etc.; see Asnakew et al., 2019) and mental health care infrastructure within individual countries, which determines the practices related to the PTSD diagnosing and treatment.

However, in the last 25 years, research has started to focus also on the positive consequences of surviving a traumatic event. Different terms have been used to describe positive psychological changes after surviving a potentially traumatic event, for instance, positive psychological changes (Yalom & Lieberman, 1991), stress-related growth (Park et al., 1996), or flourishing (Ryff & Singer, 1998). The most cited and the most elaborate is the theory of posttraumatic growth (PTG; Tedeschi & Calhoun, 1996). PTG is defined as a positive change in certain areas of life. The positive psychological change can happen in (at least) one of the following domains: (1) interpersonal relationships, (2) new possibilities, (3) personal strength, (4) spiritual change, and (5) appreciation of life (Tedeschi & Calhoun, 1996). PTG has been mostly studied in samples of war veterans (Mark et al., 2018), people who survived a natural disaster (García et al., 2015), victims of sexual violence (Bakaityté et al., 2020), oncological patients, or people diagnosed with other serious diseases (Hamama-Raz et al., 2019). Currently, research is focusing on COVID-19 pandemic and its relationship with PTG (Hamam et al., 2021). Working with such specific groups could have narrowed the focus of research on traumatic events to the most extreme ones (e.g., war, natural disaster) despite the fact that people are experiencing a wider range of traumatic events throughout their lives (Brooks et al., 2016). According to Kessler et al. (2017), the three most burdensome traumatic events are sexual violence (15.1%), rape (13.1%), and unexpected death of a loved one (11.9%). Mills et al. (2011) found that the most frequently experienced traumatic events are the sudden death of a loved one or witnessing other forms of violence. It is, therefore, important to focus trauma-related research also on the general population (Brooks et

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al., 2016). According to a meta-analysis (Wu et al., 2018), about 53% of people exposed to some form of a traumatic event (chronically ill people, war veterans, firefighters, rescuers, etc.) consequently experience at least medium posttraumatic growth. A better understanding of posttraumatic growth could significantly improve not only therapeutic work with trauma survivors but also prevention of dysfunctional processing of such events. However, to do so, a valid measure of PTG adapted to different cultural settings is needed first.

With more than 6 000 citations, the Posttraumatic Growth Inventory (PTGI) is the most frequently used method for measuring PTG. The items in the original version of the questionnaire were mainly based on the authors' interviews with people who had severe physical difficulties or experienced the death of a loved one (husband/wife) and the questionnaire was validated on a sample of students (Tedeschi & Calhoun, 1996). There are currently three other versions of the original questionnaire: its shortened form (PTGI-SF; Cann et al., 2010), a version for children (PTGI-C; Cryder et al., 2006), and a version with an expanded spiritual-existential change scale (Tedeschi & Calhoun, 2017). According to the authors of the original version, the questionnaire consists of five subscales that represent the five PTG domains depicted above. Besides calculating a score for each subscale, a summary score can be elicited (Tedeschi & Calhoun, 1996). The questionnaire has been validated by several research teams from different countries (e.g., Arandia et al., 2018; Jaarsma et al., 2006; Joseph et al., 2004; Linley et al., 2007; Mack et al., 2015; Osei - Bonsu et al., 2012; Silverstein et al., 2018). The results of these validation studies pointed to the inconsistencies in the factor structure of the PTGI questionnaire. Besides the natural variations caused by language/culture adaptation and sampling, the results may differ due to the use of different statistical procedures to verify the factor structure of the PTGI. In practice, however, either the initial five-factor model or the general one-factor structure (i.e., a simple summary score) is being widely used (Steffens & Andrykowski, 2015).

Because of (1) the unclear factor structure of the PTGI and (2) the fact that validity of the original version of a measure does not guarantee that its adaptation to other languages will be valid as well (see, e.g., Byrne, 2016), the main aim of this study was to verify the psychometric properties of the Slovak version of the Posttraumatic growth inventory (PTGI) on a representative sample of Slovaks. Additional goals of this study were to examine the invariance of the instrument across gender and to examine its relations with external variables (spirituality and resilience) and also with the type of traumatic or stressful event. Ultimately, the structure of the PTGI was explored using the network analysis.

Method

Participants and procedure

Data were collected in April 2019. Based on quota characteristics (gender, age, education, size of the place of residence, and region of residence), a total of 1018 respondents were selected. Quota characteristics were calculated based on the data from the Statistical Office of the Slovak Republic. More descriptive data about the sample are available in Table 1. Using the Life stressor checklist (LSC-R), we identified that 71% ($N = 721$) of people in the sample survived a traumatic or stressful life event. Those participants were then administered the Posttraumatic growth inventory (PTGI). The study was reviewed and approved by the ethics board of the Olomouc University Social Health Institute (OUSHI).

Measures

Posttraumatic growth inventory (PTGI)

The posttraumatic growth inventory (PTGI) measures the level of posttraumatic growth in persons who have survived a traumatic event (Tedeschi & Calhoun, 1996). It consists of 21 items. Each of them falls under one of the five factors: (1) relating to others, (2) new opportunities, (3) personal strength, (4) spiritual change, and (5) understanding of life. The participants are asked to indicate the degree to which they have or have not experienced a particular change using the scale ranging from 0 to 5. A higher score indicates a higher level of posttraumatic growth. Examples of items: (1) I'm more aware that I can handle difficulties, (2) I'm putting more effort into my relationships, or (3) I've found out how great people are.

Brief resilience scale (BRS)

Resilience was measured using the Brief resilience scale (BRS; Smith et al., 2008). The BRS consists of six items and measures resilience as the ability to recover from a stressful event. Examples of items: (1) It is difficult for me to go through a stressful situation or (2) I tend to recover quickly from difficult situations. The reliability of the scale was $\omega_{\text{total}} = .87$.

Spiritual well-being scale (SWBS)

The Spiritual well-being scale (SWBS; Paloutzian and Ellison, 1982) is a self-report questionnaire that measures spiritual and life well-being. The SWBS consists of 20 items, from which either a

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summary score can be calculated or two subscales (religious well - being and existential well-being) could be elicited. In this sample, the scale showed high reliability with $\omega_{\text{total}} = .87$.

Functional assessment of chronic illness therapy (FACIT)

FACIT is a 12-item self-report questionnaire designed to measure spiritual well-being and quality of life for people diagnosed with serious diseases (Peterman et al., 2002). Four items of the questionnaire focus on meaning and purpose of life, four items on inner peace, and four items on faith. The reliability of the whole scale was high with $\omega_{\text{total}} = .88$.

Life stressor checklist (LSC)

The prevalence of exposure to life stressors was assessed by the Life stressor checklist (Wolfe et al., 1996). The LSC is a 30-item questionnaire; 19 items assess psychological trauma, and nine items focus on stressful life events. Additional questions provide insights into the age of the person at the time of surviving the event and how much this situation affects them in later life (Kaščáková et al., 2018).

Table 1. Demographic characteristics of the sample

	N	%
Gender		
Male	496	48,7
Female	522	51,3
Age		
18-24 y.	110	10,8
25-34 y.	187	18,4
35-44 y.	199	19,5
45-54 y.	166	16,3
55-64 y.	168	16,5
65 or more	188	18,5
Living with		
A partner	671	65,9
Alone	162	15,9
Parents	185	18,2
Level of education		
Primary	137	13,5
Secondary vocational school	272	26,7
High school	382	37,5
University degree	227	22,3

Data analysis

In the initial screening, descriptive statistics were calculated, and the data were screened for missings and improbable value. Given the online administration, the particular variables did not contain any missing values or values that were unlikely to occur (e.g., typos) - all the observed values were within the range of the response scales. As such, no observations were considered as outliers and no transformation of data had been applied. The initial screening also included inspection of the correlation matrix of the PTGI items.

Afterwards, the dataset was randomly split into two parts - exploratory ($N_E = 360$) and confirmatory ($N_C = 361$). A priori analysis of statistical power based on the RMSEA coefficient ($\alpha = .05$; H_A RMSEA = .08; H_0 RMSEA = .04) indicated that for a combination of a sample of $N = 360$ and a model with $df = 179$ (the Five-factor model), statistical power to detect model's misspecification converges to 100%. Although both PTGI models were constructed in accordance with the conventions in PTG research (Tedeschi & Calhoun, 1996; Silverstein et al., 2018), the here-employed form of cross-validation was preferred as the occurrence of some misspecifications was expected. The exploratory dataset served for addressing these misspecifications (all the potential modifications had to be, first and foremost, theoretically justifiable). The confirmatory dataset was hence used to cross-validate the results and to select the most optimal PTGI structure. Consequent invariance testing (with gender as a potential source of invariance), and examination of convergent validity was performed only for the best-fitting model. When examining convergent validity, external variables (BRS, SWBS, and FACIT) were modelled together in one general model (which, obviously, included also PTGI) and correlations between the latent variables were calculated. From the technical perspective, the models were initially estimated using the WLSMV method, with the items being treated as ordinal. The models were also fitted using the ML estimator due to the technical problems with fitting the Five-factor model using the WLSMV (see Results), as well as for the purpose of comparison of competing models using the chi-square difference test. The models were considered disconfirmed had the value of chi-square (note, chi-square is the only statistical test of model-data fit in SEM; see Ropovik, 2015) been significant. The potential sources of models' misfit were inspected (factor loadings, covariances between latent factors, residual matrix, and modification indices were checked). Apart from calculating chi-square values, fit of the models was diagnosed using the (scaled) conventional approximate fit indices (AFI), namely, CFI, TLI, RMSEA, and SRMR (see Hu & Bentler, 1999). Given the nested structure of the tested models (expect the modified One-factor model), a formal chi-square difference test was calculated to determine which of the models fit the data best. To

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examine the reliability of the respective factors, McDonald's omega (utilizing polychoric correlations) was computed.

With regard to the problematic and hardly interpretable results of the performed CFAs (see Results below), a network analysis was calculated (as an exploratory part of this study) on the whole dataset. The traditional, more or less implicit assumption of a latent variable which causally determines the observed (measured) behaviors is, in fact, only hardly justifiable for the conceptualization of psychological constructs (e.g., Borsboom, 2008). To the contrary, PTG (or, eventually, any other psychological construct; see, e.g., Borsboom & Cramer, 2013) is composed of a set of indicators that are mutually connected and have an inner structure. As, in respect to the goals of this paper, computing a network of the PTGI items had not been initially intended, the below-presented network has more of a demonstrative (rather than technically rigorous) purpose. The network was estimated using the EBICglasso estimator (the tuning parameters were set to prefer sparser network). Centrality/connectivity parameters, as well as indices of network stability and replicability, were calculated. The analyses were performed in R (R Core Team, 2020), with *psych* (Revelle, 2020), *lavaan* (Rosseel, 2012), *qgraph* (Epskamp et al., 2012), and *bootnet* (Epskamp et al., 2018) serving as the main packages.

Results

A correlation matrix, as well as means and standard deviations of the PTGI items, is available in Table 2.

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Table 2. Correlation matrix, means and standard deviations of the PTGI items

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	-																				
2	.81	-																			
3	.70	.73	-																		
4	.65	.68	.76	-																	
5	.57	.61	.55	.57	-																
6	.61	.68	.64	.68	.65	-															
7	.70	.70	.76	.72	.62	.67	-														
8	.62	.67	.65	.69	.63	.76	.74	-													
9	.60	.63	.62	.68	.59	.68	.68	.78	-												
10	.66	.68	.65	.71	.59	.71	.70	.71	.72	-											
11	.71	.74	.69	.72	.61	.72	.73	.72	.70	.86	-										
12	.68	.73	.67	.71	.61	.73	.70	.73	.70	.82	.86	-									
13	.69	.74	.65	.67	.59	.68	.68	.69	.67	.78	.82	.81	-								
14	.64	.66	.70	.70	.56	.66	.73	.69	.67	.72	.75	.73	.72	-							
15	.63	.69	.64	.64	.62	.70	.64	.76	.70	.73	.76	.74	.76	.74	-						
16	.62	.66	.64	.67	.52	.66	.68	.73	.73	.70	.74	.72	.73	.68	.73	-					
17	.65	.69	.66	.69	.56	.67	.70	.70	.70	.74	.76	.76	.75	.74	.75	.80	-				
18	.47	.48	.44	.45	.73	.51	.48	.53	.50	.46	.49	.49	.51	.48	.55	.45	.49	-			
19	.68	.71	.65	.71	.60	.67	.70	.68	.67	.78	.79	.77	.74	.72	.72	.68	.75	.57	-		
20	.60	.63	.63	.68	.57	.71	.66	.72	.67	.69	.73	.72	.70	.70	.73	.70	.73	.54	.76	-	
21	.64	.68	.64	.66	.64	.74	.68	.75	.71	.75	.77	.77	.75	.72	.81	.74	.78	.57	.77	.84	-
M	2.22	2.54	2.14	2.19	1.91	2.22	2.11	2.09	2.02	2.31	2.41	2.35	2.61	2.02	2.30	2.22	2.15	1.66	2.32	2.21	2.20
SD	1.58	1.58	1.52	1.48	1.54	1.49	1.57	1.45	1.46	1.51	1.54	1.48	1.58	1.55	1.45	1.45	1.48	1.59	1.57	1.50	1.44

Confirmatory factor analyses

Exploratory dataset

The original One-factor model ($\chi^2(47) = 686.96$; $p < .001$), as well as the original Five-factor model ($\chi^2(48) = 481.55$; $p < .001$) have shown significant deviations from data. The mean value of the factor loadings was very high - $\lambda = .86$ (ranging from .68 - .94) for the One-factor model and $\lambda = .89$ (ranging from .79 - .96) for the Five-factor model, respectively. In the One-factor model, there were observed high residual covariances ($cov > .10$) between the items no.: 1 and 2, 3 and 4, and 5 and 18. Modification indices ($MI > .10$) suggested to include a covariance term between 14 pairs of the items, with the absolute values of the standardized expected parameter change ranging from 0.25 to 0.78. After adding a covariance term between the theoretically justifiable pairs of the items (items no. 5 and 18, 20 and 21, 1 and 2, 10 and 11, 11 and 12, 3 and 4, and 16 and 17), the value of chi-square statistics dropped substantially. The model was, however, still deemed disconfirmed. Five-factor model, despite it has shown much better fit compared to the One-factor model, had flagged problems with the convergence – correlations between the five latent factors were extremely high (mean correlation was .89), and the estimated correlation between the factor 2 and the factor 3 exceeded the value of 1. Estimation of the model using ML had still produced similar problems with its convergence. Although there were no visible problems with residual covariation in this case, the values of modification indices had been erroneous. Due to high collinearity between the factors, the factors correlating above .8 were merged, creating a model with two latent factors (items no. 5 and 18 loaded on one factor and all the other items loaded on the second factor). Even though the Two-factor model converged, sources of its misspecifications were similar to those observed in the One-factor model. The comparison of the nested model using the likelihood ratio test has shown that, out of the candidate models, the Five-factor model fitted the data best. When compared with the non-nested modified One-factor model (probabilistic model selection), the Five-factor model had shown worse values of information criteria AIC and BIC. Parameters of models' fit are summarized in Table 3. The reliabilities of the respective subscales (both in the One-factor, the Two-factor, and the Five-factor model) were extremely high $\omega_{Total} = .90 - .98$, except for the reliability of the fourth factor in the Five-factor model, which was still very high ($\omega_{Total} .86$).

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Table 3. Model fit parameters (scaled) for both the exploratory and the confirmatory dataset

Model	χ^2	df	p	CFI	TLI	RMSEA [95% CI]	SRMR
Exploratory dataset							
One-factor	686.96	47	< .001	.87	.99	.20 [.18, .21]	.04
Five-factor	481.55	48	< .001	.91	.99	.16 [.15, .17]	.03
Modified One-factor	381.62	50	< .001	.93	.99	.14 [.12, .15]	.03
Two-factor	603.53	47	< .001	.89	.99	.18 [.17, .19]	.04
Confirmatory dataset							
One-factor	713.25	37	< .001	.87	.98	.23 [.21, .24]	.05
Five-factor	438.70	37	< .001	.92	.99	.17 [.16, .19]	.04
Mod. One-factor	379.60	38	< .001	.94	.99	.16 [.15, .17]	.04
Two-factor	536.81	37	< .001	.91	.99	.19 [.18, .21]	.04

Confirmatory dataset

All the models tested in the exploratory dataset were fitted again in the confirmatory dataset. Similar to the previous results, the Five-factor model had had troubles with convergence regardless of the estimation method, as there was extremely high collinearity between the latent factors. Given the fact that the modified One-factor model had fitted the data best, it was used for further analysis of convergent validity and measurement invariance across gender. Models' fit parameters for all the models are presented in Table 3.

Assuming potential gender differences in the PTGI structure, measurement invariance was calculated on the modified One-factor model. The results indicate that the PTGI structure is invariant across gender in term of metric ($\Delta\chi^2 = 20.92$, $\Delta df = 20$, $p = .402$) and scalar ($\Delta\chi^2 = 28.34$, $\Delta df = 20$, $p = .102$) invariance. Significant non-invariance was observed in terms of latent means of PTG ($\Delta\chi^2 = 10.12$, $\Delta df = 1$, $p = .001$), with women scoring 0.35 SD (converted to the PTGI scale = 9.1 points) higher than men.

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The modified One-factor model was then correlated with the BRS ($r = -.05$), SWBS ($r = .29$), and FACIT ($r = .32$) within one general model. The reported coefficients thus represent correlations between the latent variables. It is worth noting that the item no. 18 has shown very high cross-loadings on both SWBS and FACIT. For descriptive purposes, the One-factor model was correlated with the Life Stressor Checklist (LSC-R), which serves as a screening for stressful (traumatic) experiences. The results of LSC-R were then divided into five scores: (1) interpersonal violence, (2) indirect trauma, (3) traumatic events experienced before 16 years old, (4) summary score of traumatic exposure, and (5) other forms of trauma (see Schumacher et al., 2010; Kaščáková et al., 2018). The observed correlations between the PTGI score and the above-described scores were $r = .10$, $r = .22$, $r = .15$, $r = .22$, and $r = .23$ for interpersonal violence, indirect trauma, traumatic events experienced before 16 years old, summary score of traumatic exposure, and other forms of trauma, respectively.

PTG as a network

The performed analyses point out to five main facts: (1) there was a strong correlation (average $r = .68$) between the PTGI items; (2) all the PTGI items loaded very well on the latent factor/factors; (3) if PTGI was modelled with more than one latent factor, there were extremely high correlations between the factors; (4) the modified One-factor model fitted the data best; (5) none of the PTGI items was problematic per se. The combination of these facts suggests that it is next to impossible to find an optimal factor structure of PTGI (note: this assumes that all the PTGI items are important for the operationalization of PTG – in other words, the items in PTGI capture all the theoretically relevant aspects of PTG). It is, therefore, possible that the inability to find the optimal factor structure stems from the way PTG is statistically modelled in the validation studies, including this one. Applying reflective latent models to psychological constructs rests on several assumptions which are usually not tenable. For example, in reality, it is unlikely that there exists an underlying latent variable (or, say, five latent variables) representing PTG that causes its observable indicators. Rather on the contrary, mutual relationships between the specific behavioral aspects (indicators) and their dynamics cause a system which is conventionally labelled as PTG. This radical shift in the perspective and understanding of a phenomenon (from latent models to network approach) subsequently changes the nature of the research questions being asked, for instance: (1) how are the indicators of PTG related? (2) Which PTG indicators play a core, or on the other hand, a peripheral role in the system? To provide an insight into these emerging questions, a network consisting of PTG indicators had been estimated. A visualization of this (conservative – small edges were shrunk to zero) network is presented in Figure 1a.

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Figure 1. A network of PTG indicators and their centrality indices

Figure 1a. A visualization of a regularized network of the PTG indicators. Thicker edges depict stronger relationships. Dashed edges indicate negative relationships. The numbers in the nodes correspond with the numbers of the PTGI items.

Figure 1b. Centrality and connectivity indices of the PTG indicators.

As can be seen from Figure 1b, the highest degree of centrality (strength of a direct association between an indicator and other indicators; strength and expected influence) were found for the

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items no. 11, 21, and 8. The highest connectivity, in terms of how strongly a node is indirectly connected with other nodes (closeness), was found for the items no. 8, 6, 7, 9, and 15, while the items no. 7 and 8 were the most important for connecting other nodes (betweenness).

The estimated network is relatively robust. Bootstrapped estimates suggest that the above-described parameters are rather stable although the stability is not ideal (for all the parameters, the point estimate of average correlation with the original sample is above $r = .50$ even when 50% of cases are dropped; see <https://osf.io/ucd7n/>). The presented network is also fairly replicable. Estimates obtained from replicating and simulating the network highly correlate ($r \approx .70$ and higher) with the original values (except for Jaccard index) even when 250 cases are sampled. Altogether, the network performs well enough to make some initial inferences, nonetheless, future replication studies are very much needed.

Discussion

The aim of this study was to verify the factor structure of the Slovak version of the Posttraumatic growth inventory (PTGI) on a representative sample of the Slovak population. The analyses revealed strong correlations between the PTGI items, and also extremely strong correlations between the latent factors (had the PTG model included more than one latent factor). The results suggested that a modified one-factor model overperformed the competing models. While the structure of the one-factor model was invariant across gender, a difference in latent means was observed (women scored higher compared to men). The questionnaire is thus applicable to both men and women (Mordeno et al., 2015). The convergent validity of the modified One-factor modified model of the PTGI was examined by correlating the factor with external criteria (FACIT, SWBS, BRS). A weak to moderate positive relationship with spirituality and a weak to a moderate negative relationship with resilience were observed. Similar findings were found in other studies (Danahauer et al., 2013; Paredes & Pereira, 2017; Shaw et al., 2005).

Although the modified One-factor model fitted the data best, altogether, the observed results (e.g., even the best-fitting model significantly deviated from the data; very high correlations between the items; extremely high correlations between the PTGI subscales if the model consists of more than one latent factor), suggest that the main issue might lie elsewhere. Given the observed results, but also the conceptual basis for measuring psychological constructs, applying the latent variable model (a latent factor is a single cause of the observed/reported indicators) to PTG might

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not be appropriate. Instead, a network approach in which PTG is regarded as a set of mutually interacting indicators that form a structure consensually labelled as PTG is a more appropriate representation (for a similar argumentation in PTSD research see Armour et al., 2017)

The existing evidence (e.g., Silverstein et al., 2018), as well as the present results (high correlations between latent factors), suggest that although posttraumatic growth as a construct can be observed in different domains of life (Tedeschi & Calhoun, 1996), it is probably the same variable. Dividing the PTGI into factors could potentially help to better capture the nature of this phenomenon from the theoretical perspective. The empirical evidence, however, suggests that this distinction is rather didactical. If a researcher aims to study PTG, a reduction in the number of administered items (e.g., administering a short form of the PTGI, see Cann et al., 2010; Lamela et al., 2014) could save their resources as well as the participants' time and effort, subsequently leading to a higher quality of the obtained data. Therefore, if an item is not essential with respect to the constitutive definition of PTG, it might be worth considering to remove it from the measure. In other words, it might be useful to take a step back and look at the constitutive definition of PTG and utilize the corresponding operationalizations in the questionnaire.

Shifting the perspective from a latent variable model to the more structured network approach would allow detecting the central/peripheral indicators, consequently leading to better-tailored interventions/facilitation strategies. For dynamic systems, suggesting interventions solely from cross-sectional data could be tricky (see Henry et al., 2020) and more longitudinal research and studies using experience sampling will be needed. Based on the performed calculations, the items no. 6, 7, 8, 9, 11, 15, and 21 appear to be the most central ones. These items correspond to the first (relating to others) and the second (new possibilities) factor from the original five-factor structure. Based on this, we can consider that the most important in posttraumatic growth could be the quality of relationships and the social environment a person has, how they can communicate their difficulties and how a view of life and confidence in their own coping skills will change. A network structure of PTG was already examined by Bellet et al. (2018). The authors, however, used the short form of the PTGI (PTGI-SF) and were primarily focusing on the co-occurrence of PTG and complicated grief. According to their findings, the core indicators (based on the expected influence measure) of PTG were the items no. 6 and 9 (these correspond to the items no. 7 and 19 in the original, full version of the PTGI questionnaire) These items fall under the new possibilities (II) and personal strength (III) factors. Contrary to the present analysis, the authors did not find sufficient evidence for depicting the relating to others (I) factor as a core aspect of PTG. The authors highlight the importance of the ability to imagine a new way forward

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and, at the same time, their results suggest that greater personal strength might be more important for PTG than relationships with others. The least influential items appeared to be the items no. 1 ("My priorities about what is important in life") and 2 ("An appreciation for the value of my life"), which partially corresponds with the findings from the presented analysis.

Based on the results of invariance testing, women had a higher average score of PTG, which may be related to their higher emotionality and openness to communicate about their own experiences (First et al., 2017). Another possible explanation is that women cope with the situation using more deliberative and reflective rumination, which might lead to higher posttraumatic growth (Vishnevsky et al., 2010). In general, emotion-focused coping strategies (positive reaction, acceptance, denial) are positively related to PTG (Butler et al., 2005; Helgeson et al., 2006; Prati & Pientrantoni, 2009).

Positive moderate correlations were observed between spirituality, religiosity and posttraumatic growth. This result is in line with the theory of posttraumatic growth process as described by Tedeschi and Calhoun (1996; spiritual change is one of the main aspects of PTG) and is also supported by other studies (e.g., Prati & Pientrantoni, 2009). Furthermore, weak positive correlations were observed between PTG and the different types of stressful events as measured by the Life Stressor Checklist. The type of traumatic event is related to posttraumatic growth only marginally and it appears that subjective evaluation of the traumatic situation (i.e., subjectively perceived burden and stress) play a more important role compared to its objective attributes (Karanci et al., 2012). A weak negative correlation was also observed between PTG and resilience. At the first glance, it may seem that these concepts are very similar, even synonymic, and such finding is counterintuitive. The evidence on this topic is, however, inconsistent. While some authors found a positive relationship between these two variables (Bensimon, 2012), others detected a negative relationship (Levine et al., 2009). The inverse correlation between resilience and PTG could be explained by the fact that a more resilient person may not cognitively evaluate (cognitive processing plays a key role in PTG development; Tedeschi & Calhoun, 1996) a traumatic event as sufficiently threatening or disruptive and, as such, PTG may not develop (Levine et al., 2009). The results may also vary due to a very pragmatic reason - the fact that different operationalizations of a construct could lead to different findings (see, e.g., Adamkovič et al., 2020; Bensimon, 2012).

Limits and perspectives of further research

The present study has several limitations. The first one regards the research sample. As the data comes from a representative sample of the adult Slovak population, the generalizability of the results to other cultural settings might be, obviously, limited. Second, the study was not focused on discussing the theoretical justification of the constitutive definition of PTG nor it was focused on qualitative analysis of items operationalization. Third, even though the study presented also a network analysis of PTG, it is important to acknowledge that this was not the original purpose of the study (the main aim of the study was to verify the psychometric properties and the factor structure of the PTGI) and, as such, the here-presented network has rather a demonstrative character. To learn more about the structure of PTG from a network perspective, more exclusive research on this topic would be needed. Ideally, such research would combine cross-sectional, longitudinal, and experiential sampling design, while putting sufficient effort into having the study designs reasonably powered. The combination of between-person differences and within-person changes could help to determine which aspects of PTG are more efficient to address by potential interventions or prevention programs. Having a succinct PTG measure with a clear structure which produces a valid score across different cultures is, therefore, a necessity.

Conclusion

The PTGI (Tedeschi & Calhoun, 1996) is the most commonly used method for measuring posttraumatic growth. The questionnaire was validated on different samples (e.g., general population, students population, people diagnosed with serious diseases) and cultural settings. Its factor structure and psychometric properties vary across these validations. One of the main reasons for this ambiguity might be the fact that the application of the latent variable model does not represent the essence of PTG adequately and the network approach thus appears to be a more suitable conceptualization. Shifting the perspective could significantly help to grasp the construct and consequently to target more effective interventions. A better understanding of PTG could significantly help both prevention and intervention in psychotraumatology. Having a succinct PTG measure with a clear structure which produces a valid score across different cultures would substantially help in pursuing this goal. A collaborative and transparent approach could greatly advance this ambition.

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