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Examining the Latent Structure of Posttraumatic Growth Between Male and Female Survivors in the Immediate Aftermath of a Flash Flood Disaster

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Abstract The study examined and compared the latent structure of posttraumatic growth (PTG) based on three proposed models: 1-factor, 3-factor and 5-factor models in order to (1) find out the factor structure that has the best fit for the Filipino sample; (2) find out the factor structure that best represents PTG in the immediate aftermath of a flash flood disaster; and (3) examine the generalizability of the best-fitted model across gender. A sample of 895 survivor-respondents answered the Posttraumatic Growth Inventory (PTGI) within a month after a deadly flash flood. Based on the best-fitted model, a multigroup comparison between male and female was conducted to determine gender generalizability. Results showed that the 3-factor model comprising of Changes in Self/Positive Life Attitudes, Philosophy of Life, and Relating to Others fitted best in contrast to the other two models. The data also demonstrated the generalizability of the 3-factor model across gender, with invariance in factor loadings, item intercepts, factor variance and covariance, and factor means.

Keywords Posttraumatic growth · Latent structure · CFA · Filipinos

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Several studies have investigated negative sequelae in an aftermath of a traumatic event (e.g., Bryant et al. 2011a, b; Koucky et al. 2012). Most of these studies show that those who experience acute stress symptoms within a month after a distressing event are likely to suffer more debilitating conditions (e.g., posttraumatic stress disorder, anxiety, depression, dissociation). However, a number of researches have documented that while there are negative consequences after experiencing life-threatening events, positive changes were also observed (e.g., Dekel et al. 2012; Linley and Joseph 2004; Shakespeare-Finch and Enders 2008; Tedeschi and Calhoun 1995). Tedeschi and Calhoun (2004) termed these transformations as posttraumatic growth (PTG).

Lamela et al. (2014) summate PTG as the acquisition of more complex coping skills, development of new perspectives about the self and the world, improvement of interpersonal relationships, having greater sense of appreciation of life, and a change in life goals in the aftermath of a stressor. PTG has been reported to have occurred in diverse traumatic situations such as cancer (e.g., Ho et al. 2004; Schroevers and Teo 2008; Brunet et al. 2010), war (e.g., Powell et al. 2003), kidney failure disease (e.g., Yorulmaz et al. 2010), motor vehicle accident (e.g., Nishi et al. 2010), violence (e.g., Kunst 2010) and natural disasters (e.g., Cryder et al. 2006; Hafstad et al. 2011; Kilmer and Gil-Rivas 2010; Lowe et al. 2013; Tang 2006).

In consort with the conceptualization of PTG and the systematic research occurring because of it, Posttraumatic Growth Inventory (PTGI) was developed to assess PTG among survivors of trauma (Tedeschi and Calhoun 1996). Several studies utilizing PTGI supported a 5-factor model (Maercker and Langner 2001; Morris et al. 2005; Linley et al. 2007; Jaarsma et al. 2006; Taku et al. 2008). This model articulates 5 stress-related growth domains: *relating to others, new possibilities, personal strength, spiritual changes,* and

appreciation of life (Tedeschi and Calhoun 1996, 2004). Alternatively, other studies contested against the 5-factor model in favor of the 3-factor model (Powell et al. 2003; Weiss and Berger 2006). This model, comprising of *changes in self/positive life attitudes, philosophy of life, and relating to others*, was based on the first proposal of Tedeschi and Calhoun (1995). These three broad factors exemplify the positive changes brought by one's experience of adversity. Powell et al. examined the validity of the 3-factor model after conducting Principal Component Analysis (PCA). However, a number of limitations can be observed. Aside from the small sample size and unparsimonious cross-loadings, the use of PCA, which is an exploratory technique in nature, is an issue by itself. The use of PCA is justified when there are no specific models to base with. Moreover, the deletion of an item in Powell et al.'s study may result into incomparability to other models using all the 21 items. These shortcomings were addressed in the study of Linley et al. (2007) where they followed the items identified by Powell et al.'s model but did not allow cross-loadings and deletion of items. They found out the 3-factor model to be adequate. However, it did not best represent the PTG factor structure. Nevertheless, it provided an alternative for the 5-factor model. Finally, there are also studies that contend PTG as a 1-factor model. This proposed model came about due to consistent results from numerous studies on high internal consistency of PTGI, a strong indication that the scale assesses a singular dimension (e.g., Osei-Bonsu et al. 2012).

The differences of PTG factor structure may be dependent on several reasons, one of which is culture. For instance, Zoellner et al. (2008) found out that German subjects tend to have lower PTGI scores than US sample presumably due to high social pressure among Americans to respond positively after a distressing situation. Taku et al. (2009) and Shigemoto and Poyrazli (2013) also found US respondents to have higher PTGI level than Japanese samples. Aside from score comparison, numerous studies have shown varying factor structures of PTGI in different countries (most recently, Lamela et al. 2014; Teixeira and Pereira 2013).

These varying results can be attributed to the idiosyncrasies of cultures. However, caution must be observed considering the scarcity in studies on PTG latent structure among Asians (e.g., Ho et al. 2004; Taku et al. 2008), particularly among Filipinos. This is unfortunate as Philippines is a recipient of several disasters. It is seated in the "ring of fire" (where earthquakes and volcanic movements occur) and is within the typhoon belt (where strong typhoons and flooding take place regularly).

Another possible source of variation in the latent structure of PTG is the length of time after a distressing event happened. This is curious considering *Diagnostic Statistical Manual of Mental Disorders-5's* (DSM-5; American Psychiatric Association 2013) distinction of traumatic stress symptoms in the immediate aftermath of a traumatic event (acute stress disorder) and those symptoms lingering a month after (posttraumatic stress disorder). It would be of academic and clinical interest to determine if PTG indicators are already present at an early stage and if so, what model represents best the posttraumatic growth experiences among the survivors. This will have an important implication in developing early and effective interventions.

Finally, numerous studies have already attested the relationship between gender and PTG. Swickert et al. (2012) noted that in several studies, gender is a significant predictor of growth following trauma and that women, as compared to men, are more likely to report any growth following a traumatic event. Moreover, Vishnevsky et al. (2010) conducted meta-analysis on the role of gender in PTG and found out that gender slightly moderates PTG, with women endorsing more indicators of trauma-related growth than men. Although significant information can be derived from comparison of scores, it would be richer to examine and distinguish the covariation of PTG latent factors and indicators between males and females. To the authors' knowledge, this is the first study to compare PTG factor structure across gender.

Current Study

The present study aims to understand essential concerns mostly overlooked in PTG literature. Specifically, the current research examines the latent structure of PTG in a sample of Filipinos who experienced trauma within a month after a deadly flash flood and assesses gender differences of PTG's latent structure in order to: (1) find out which model of PTG has the best fit for the Filipino sample; (2) find out the model that best represents the factor structure of PTG in the immediate aftermath of a flash flood disaster; and (3) examine the generalizability of the best-fitted model across male and female subsamples (Table 1).

Method

Participants and Procedures

PTGI underwent a forward-backward translation to ensure precise translation and semantic equivalence. An expert translated the English version to Bisaya (local dialect) and another expert back-translated the Bisaya version to the English version. Item-to-item comparison was performed. A team of experts, including the first author, reviewed, discussed, and finalized the questionnaire for administration.

The scale was purposively administered to survivors from both the evacuation camps and local communities directly affected by the typhoon. Evacuation camps were the areas

Table 1 Item mapping for confirmatory factor analysis

PTGI items	1-factor	3-factor	5-factor
1. I have changed my priorities for what is important in life.	PTG	Philosophy	Life
2. I have a greater appreciation for the value of my own life.	PTG	Philosophy	Life
3. I developed new interests.	PTG	Philosophy	Possibilities
4. I have a greater feeling of self-reliance.	PTG	Change	Strength
5. I have a better understanding of spiritual matters.	PTG	Change	Spirit
6. I more clearly see that I can count on people in times of trouble.	PTG	Philosophy	Relate
7. I established a new path for my life.	PTG	Change	Possibilities
8. I have a greater sense of closeness with others.	PTG	Relate	Relate
9. I am more willing to express my emotions.	PTG	Change	Relate
10. I know better that I can handle difficulties.	PTG	Change	Strength
11. I am able to do better things with my life.	PTG	Change	Possibilities
12. I am better able to accept the way things work out.	PTG	Change	Strength
13. I can better appreciate each day.	PTG	Philosophy	Life
14. New opportunities are available which wouldn't have been otherwise.	PTG	Change	Possibilities
15. I have more compassion for others.	PTG	Philosophy	Relate
16. I put more effort into my relationships.	PTG	Philosophy	Relate
17. I am more likely to try to change things which need changing.	PTG	Philosophy	Possibilities
18. I have a stronger religious faith.	PTG	Relate	Spirit
19. I discovered that I'm stronger than I thought I was.	PTG	Change	Strength
20. I learned a great deal about how wonderful people are.	PTG	Relate	Relate
21. I better accept needing others.	PTG	Relate	Relate

Change Changes in Self /Positive Life Attitudes, *Philosophy* Philosophy of Life, *Relate* Relating to Others, *Possibilities* New Possibilities, *Strength* Personal Strength, *Spirit* Spiritual Change, *Life* Appreciation for Life, 3-factor model by Powell et al. (2003); 5-factor model by Tedeschi and Calhoun (1996)

prepared to shelter those who were displaced by the flashflood while local communities refer to villages whose residents chose to stay despite the damages their dwellings and properties incurred. For respondents coming from the evacuation camps, camp administrators' permission was sought. With the local community sample, the researchers asked permission from their respective community leaders. Prior to the administration of questionnaires, a committee equivalent to IRB reviewed and ensured that ethical practices will be followed. It should be noted that the main purpose of the team headed by the primary author was to detect vulnerabilities among survivors so early interventions can be implemented. Since the questionnaires were administered in the immediate aftermath of the typhoon where the situation is not yet stable and organized, only those respondents who were prepared to involve themselves on the assessment process were included. The respondents verbally gave their informed consent, having been made aware that individual assessment results will be discussed with them as basis for intervention. The respondents were also encouraged to ask questions if there were confusing items to ensure valid responses. The researchers fully assured the respondents of strict confidentiality of information while they explained the procedure and aims of the study. Assessment schedules and venue arrangements were worked out with them, in consideration of their availability, time preference, and comfort.

The respondents of the present study comprised of 895 Filipino adult survivors of a disastrous typhoon (international name: Washi; local name: Sendong) that caused catastrophic flooding in the southern part of the Philippines. The sample is made up of 38.7 % ($n = 346$) males and 61.3 % ($n = 549$) females, whose ages ranged from 18 to 78 years old. The average age was 38.32 years ($SD = 13.817$). All the respondents reported having experienced being confused, horrified/fearful, and/or helpless during the time of the incident and immediately after it. The data gathering was done between 3 and 30 days after the incident.

Measure

The Posttraumatic Growth Inventory (PTGI; Tedeschi and Calhoun 1996) measures the degree of positive changes that a person experienced in the aftermath of a traumatic event. The 21-item measure is rated using a six-point Likert scale from 0 (*I did not experience this change a s a result of my crisis*) to 5 (*I experienced this change to a very great degree as*

a result of my crisis). The possible total score ranges from 0 to 105, with the higher scores indicating higher levels of posttraumatic growth. For the present study, the reliability coefficients of PTGI for the male and female subsamples ranged from Chronbach alpha of 0.951 to 0.960 and reliability rho of 0.951 to 0.961 for all three models examined.

Data Analysis

All statistical analyses in this study were performed using the software EQS version 6.2 (Bentler 2004). Procedures provided by Byrne (2006) were followed. Values that appear to be missing at random were imputed and replaced using expectation-maximization (EM) algorithm. All factors were allowed to correlate and no correlated errors were included in all of the models.

The three proposed models of PTG were examined separately in male and female samples to determine the best fitting model for each group. The following fit indices were used in evaluating the proposed models: S-B chi-square (S-Bχ^2), Bayesian information criterion (BIC), nonnormed fit index (NNFI), comparative fit index (CFI), and root-mean-square error of approximation (RMSEA). Since Mardia's normalized estimate showed multivariate nonnormality of the data, fit statistics were adjusted using the robust maximum likelihood estimation method with mean-adjusted Satorra-Bentler chi-square (S-Bχ^2), resulting to robust estimates. Conventional guidelines were followed in the evaluation of fit indices: NNFI and CFI values of >0.90, and RMSEA values of <0.08 were considered having adequate fit, while NNFI and CFI values of >0.95 and RMSEA values of <0.06 were considered having excellent fit.

Since the 3-factor and 5-factor models are nested with the 1-factor model, the difference in S-Bχ^2 was used in comparing them with the 1-factor model for each group. Since the estimates were robust, we followed the procedure of Satorra and Bentler (2010) in computing difference between S-Bχ^2 values. A significant difference in S-Bχ^2 indicates that the model with lower S-Bχ^2 value has better fit. On the other hand, the non-nested 3-factor and 5-factor models were compared by examining the difference in their Bayesian information criterion (BIC) values. A difference of 10 BIC points is indicative of 150:1 likelihood ($p<.05$), in which the model with lower BIC has better fit. A 6- to 10-point BIC difference is indicative of strong support, while a difference greater than 10 points is indicative of very strong support (Raftery 1995).

After identifying the best-fitting model across female and male samples, multigroup analyses for CFA were conducted in order to determine measurement invariance. Established procedures of invariance testing in hierarchical order were followed (Meredith 1993). In the first model that was tested, all model parameters were allowed to freely vary between groups (configural invariance). This was followed by a model in which factor loadings across groups were constrained to be equal (metric invariance). Next, additional constraints were added to the observed variable intercepts (strong or scalar factorial invariance). The fourth model additionally constrained factor variance and covariance. Finally, a model in which factor means were constrained, was tested. Subsequent models with progressively more conservative restrictions were compared to prior step's model (except with models in which variance and covariance, and factor means were constrained, which were compared to the scalar model and variance and covariance model).

Results

The mean score of posttraumatic growth for the male sample is 57.020 ($SD=24.936$), while for the female sample, 57.406 ($SD=26.992$). No significant difference between the means of the two groups was found ($F(1, 895)=.046$, $p=n.s.$, partial $\eta^2=.007$). Non-normality of distribution was observed in both samples, thus, scaled S-Bχ^2 correction was computed.

Confirmatory Factor Analysis

Results of confirmatory factor analyses of the 1-factor, 3-factor, and 5-factor models of PTG in male and female samples are shown in Tables 2, 3, and 4. For the male sample, the 1-factor model and 5-factor model did not reach the conventional cut-off for adequate fit in NNFI, CFI, and RMSEA. However, the 3-factor model has adequate fit based on CFI, RMSEA and almost with NNFI. For the female sample, NNFI, CFI, and RMSEA indicated adequate fit for the 1-factor, 3-factor and 5-factor models.

The differences among models were examined separately for the male and female samples. For the male sample, both the 3-factor and 5-factor models were found to be significantly better than the 1-factor model ($S\text{-}B_{diff}(3)=93.256$, $p<.05$ and $S\text{-}B_{diff}(11)=42.845$, $p<.05$, respectively). On the other hand, the 3-factor model was found to be significantly better than the 5-factor model ($\Delta BIC=43.802$), with very strong support. Thus, the 3-factor model was found to be the model with best fit for the male sample.

For the female sample, the 3-factor model was found to be significantly better than the 1-factor model ($S\text{-}B_{diff}(3)=43.716$, $p<.05$). Similarly, the 5-factor model was found to be superior to the 1-factor model ($S\text{-}B_{diff}(10)=39.267$, $p<.05$). A comparison of the 3-factor and 5-factor models showed that the 3-factor model is better ($\Delta BIC=50.610$), with very strong support. Similar to the male sample, the 3-factor model was found to have the best fit for the female sample.

Table 2 Results of confirmatory factor analysis

Factor Models	*df*	S-Bχ^2	R-BIC	R-NNFI	R-CFI	R-RMSEA	90 % CI
Male ($n = 346$)							
1-factor	189	719.251	1708.180	0.871	0.884	0.090	0.083–0.097
3-factor	**186**	**637.615**	**1498.323**	**0.888**	**0.901**	**0.084**	**0.077–0.091**
5-factor	179	681.417	1611.436	0.871	0.890	0.090	0.083–0.097
Female ($n = 549$)							
1-factor	189	693.288	1698.928	0.930	0.937	0.070	0.064–0.075
3-factor	**186**	**651.564**	**1593.793**	**0.934**	**0.942**	**0.068**	**0.062–0.073**
5-factor	179	655.785	1604.467	0.930	0.941	0.070	0.064–0.075

Boldface indicates the best-fitting model and values

df degrees of freedom, *S-Bχ2* Satorra-Bentler Chi Square, *R-BIC* robust Bayesian information criterion, *R-NNFI* robust Bentler-Bonnet nonnormed fit index, *R-CFI* robust comparative fit index, *R-RMSEA* robust root mean square error of approximation, *CI* confidence interval

Invariance Across Samples

To establish possible generalizability of the 3-factor model across gender, tests of invariance was conducted between 3-factor models with increasing levels of constraints. Results showed that the 3-factor model was invariant across gender in terms of factor loadings (metric invariance) ($S\text{-}B_{diff}(18) = 14.278$, $p = n.s.$), item intercepts (scalar invariance) ($S\text{-}B_{diff}(21) = 10.058$, $p = n.s.$), factor variance and covariance ($S\text{-}B_{diff}(6) = 10.513$, $p = n.s.$), and factor means ($S\text{-}B_{diff}(3) = 2.487$, $p = n.s.$) (Table 5).

Table 3 Standardized factor loading for each model by gender

PTGI item	1-factor model		3-factor model		5-factor model	
	Male	Female	Male	Female	Male	Female
1	0.410	0.542	0.411	0.543	0.419	0.553
2	0.607	0.665	0.609	0.665	0.608	0.684
3	0.619	0.650	0.619	0.648	0.631	0.651
4	0.633	0.651	0.638	0.650	0.648	0.660
5	0.726	0.749	0.719	0.749	0.712	0.738
6	0.625	0.683	0.617	0.679	0.612	0.679
7	0.701	0.748	0.710	0.736	0.699	0.747
8	0.752	0.741	0.651	0.703	0.750	0.739
9	0.547	0.745	0.563	0.749	0.522	0.740
10	0.785	0.779	0.784	0.786	0.790	0.781
11	0.767	0.762	0.773	0.767	0.767	0.759
12	0.770	0.734	0.772	0.744	0.768	0.736
13	0.765	0.743	0.760	0.743	0.758	0.733
14	0.652	0.698	0.645	0.696	0.643	0.696
15	0.802	0.800	0.797	0.799	0.807	0.798
16	0.739	0.800	0.741	0.801	0.730	0.795
17	0.812	0.809	0.813	0.811	0.808	0.812
18	0.704	0.766	0.707	0.771	0.718	0.773
19	0.627	0.714	0.603	0.698	0.605	0.709
20	0.748	0.763	0.786	0.781	0.761	0.767
21	0.776	0.760	0.807	0.773	0.789	0.764

Discussion and Conclusion

This study seeks to answer three concerns regarding PTG latent structure. First, we intend to examine the best-fitted factor structure utilizing Asians, particularly Filipinos as a sample. This is important as a number of studies (see Triandis 2001; Grimm et al. 1999; Hofstede et al. 2010) have noted the difference of a collectivist culture (i.e., Filipinos) to an individualist culture (i.e., North American countries) of which PTGI was developed. It is of interest to know if the degree of interdependence a society maintains would affect the way trauma survivors effectively cope with or positively perceive themselves after a distressing event. The results revealed that the 3-factor model was superior in contrast to other two models. Although several studies supported the 5-factor model (e.g., Maercker and Langner 2001; Morris et al. 2005; Linley et al. 2007; Jaarsma et al. 2006; Taku et al. 2008), its non-replication can be attributed to cultural diversity. For

Table 4 Zero-order factor intercorrelations for the 3-factor model

	Philosophy	Change	Relate
Philosophy	–	0.871**	0.773**
Change	0.901**	–	0.769**
Relate	0.827**	0.833**	–

Values in the upper diagonal are for males; values in the lower diagonal are for females

**$p < .01$

Philosophy philosophy of life, *change* changes in self/positive life attitudes, *relate* relating to others

Table 5 Invariance testing of the 3-factor model

Models tested	Δdf	ΔS-Bχ^2
Configural vs. metric	18	14.278
Metric vs. scalar	21	10.058
Scalar vs. residual	21	64.943*
Scalar vs. variance and covariance	6	10.513
Variance and covariance vs. factor means	3	2.487

* significant at $p < .05$ level = non-invariance

instance, Weiss and Berger (2010) explicated that non-distinctiveness of personal strength and new possibilities factors in the 3-factor model is due to the fact that in collectivist culture, perception of strength, and self-improvement is embedded with one's "in-group" rather than solely on personal domain (a feature in an individualistic culture). Although cultural specificity is a plausible explanation, it must be taken with caution as more studies are needed to examine the influence of culture to PTG.

Corollary to the result on the convergence of three (3) factors, the results imply that even in the immediate aftermath of a traumatic event, indicators of PTG are already existing and stable enough to converge into clusters of items. This runs opposite to the contention regarding the heterogeneity of reactions a month after the trauma.Bryant et al. (2010) contend that a person who experiences an overwhelming negative event will have wide and diverse reactions that may not be possible to assess patterned and predictable responses. This stresses the fact that extremely differing responses could not converge into factors. In contrary however, the results in this study revealed that indicators of positive changes are stable enough to form into three broad factors: changes in self, changes of relationship to others, and change one's philosophy or views of life. The recognition on the multidimensionality of PTG in the immediate aftermath of trauma has some pragmatic advantages. Foremost of which is the developing of early, specific, and tailored interventions addressing to the converged PTG factors.

Finally, the last objective of this study is to examine generalizability of the best-fitted model across gender. In addition to the findings that PTG means scores did not differ significantly between males and females, non-invariance across gender was also found for the 3-factor model. With the progressively constrained models showing non-invariance, it could be interpreted that the relationship between latent factors and corresponding item-indicators (configural and metric invariance), pattern of item endorsement (scalar invariance), relationship among latent factors (factor variance-covariance invariance) and the level of factor scores (factor means) are consistent and equivalent across gender. Thus, it can be imputed that the 3-factor model is generalizable in both men and women survivors.

These findings have implications in terms of assessment and intervention. The non-significant difference in male and female scores in PTGI could mean that the measure need not be adjusted for sex, which is a positive aspect to the instrument. The generalizability of the latent structure of the 3-factor model of PTG shows that this model is the best representation of PTG among survivors of a disaster in its immediate aftermath, regardless of gender. Thus, in developing interventions that promote changes in self/positive life attitudes, philosophy of life, and relating to others, the gender of the disaster survivors need not be an issue as these three dimensions of PTG are applicable to both males and females.

The present study needs to be interpreted with consideration to its limitations. First, this study utilized a self-report instrument. It is common knowledge that self-report scale is limited due to possible social desirability and bias factors. Second, generalization of these results applies only to this type of respondents—victims of a disastrous flash flood. As factor structure of PTG can be a function on the type of population, type of trauma, or the context of the experience, any conclusion made from this data pertains only to Filipino respondents who experienced PTG within the month after a flash flood. Furthermore, according to Tedeschi and Calhoun (1995), growth takes time to emerge. Thus, the positive changes observed from the survivors at this very early phase of post-trauma recovery may not equate to actual growth, but rather, a reflection of cognitive strategy that the survivors use in order to reduce distress (Helgeson et al. 2006). This implies that since growth requires time, the three factors may change along the way as these cognitive strategies will evolve into actual growth. Alternatively, it could be speculated that since instability and chaos characterize the situation immediately after the disaster, survivors will likely choose vague ways to achieve growth (3-factor model) rather than more specific patterns (5-factor model) when the post-trauma situation becomes more stable. Finally, this paper did not relate relevant constructs (e.g., cognitive processing, clinical symptoms) to determine differential relationships. Establishing relationships with other constructs will help clarify the nature and criterion function of PTG dimensions.

Despite these limitations, this study presents several strengths. First, this is the first study examining PTG latent structure within a month after a distressing event. Second, this research is one of the very few studies examining PTG using Asian sample. Finally, to the authors' knowledge, this is the first study that compares PTG between males and females in the latent level. This is important as comparison should not be limited to comparison of scores but also on the covariation of PTG latent factors and item-indicators. All these information are essential in the area of trauma assessment and development of intervention programs.

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