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Core Beliefs Shaken by an Earthquake Correlate With Posttraumatic Growth

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Posttraumatic growth (PTG), psychological growth as a result of personal struggle with trauma, is hypothesized to occur when a highly stressful life event, such as a natural disaster, forces people to reexamine their core beliefs. To the authors' knoweldge, the present study is the first investigation in Japanese people examining the role of core beliefs, intrusive rumination, and deliberate rumination in PTG. Hypotheses that the level of reexamination of core beliefs, intrusive rumination, and deliberate rumination correlate with the seismicity of an earthquake and that the challenge to core beliefs is the major determinant of PTG were tested. Japanese undergraduate students who experienced the Great East Japan Earthquake on March 11, 2011 (N = 314) participated in this study and completed the Japanese version of the Core Beliefs Inventory (CBI), the Event-Related Rumination Inventory (ERRI), and the Posttraumatic Growth Inventory (PTGI). Results indicated that core beliefs were less likely to be challenged and that ruminations were less likely to be activated in Japanese people who were in the southern area with an approximate Richter magnitude of 4 or lower. PTG was more likely to occur when core beliefs were reexamined following the earthquake. Also, younger participants and those who recalled having engaged in both deliberate and intrusive rumination reported more PTG. Future studies should investigate which aspects of trauma can trigger or suppress the reexamination of one's core beliefs, for they are likely to be the major determinants of PTG, and should look at change longitudinally.

Keywords: posttraumatic growth, core beliefs, earthquake, rumination, culture

In the literature on posttraumatic growth (PTG), the metaphor of an "earthquake" has been used to describe the severity of a traumatic event. Like an earthquake, a trauma can be a psychologically seismic experience that can shake and challenge our core beliefs and force an examination of these beliefs (e.g., Calhoun & Tedeschi, 1998). Core beliefs are defined as a "general set of beliefs a person has about the universe, how it works, and the individual's place in it" (Calhoun & Tedeschi, 2013, p. 16). They include, for example, "how we believe people will behave, how events should unfold, and our ability to influence events" (Cann et al., 2010, p. 19). In the process of rebuilding their core beliefs after a trauma, people often come to realize positive changes in their worldview and connections with others (i.e., PTG) that would not have existed otherwise.

One comprehensive theoretical model of PTG processes (Calhoun, Cann, & Tedeschi, 2010; Calhoun & Tedeschi, 2006; Tedeschi & Calhoun, 2004) describes the cognitive, emotional, and social processes that should facilitate PTG. The model incorporates multiple factors, such as characteristics of the person pretrauma, managing the emotional distress caused by a triggering event, intrusive and deliberate rumination processes associated with rebuilding core beliefs, self-disclosure, and sociocultural elements that could be important components of the PTG process. One critical factor that has been theorized to initiate the PTG process is a challenge to core beliefs. PTG is not likely to occur automatically as a result of a traumatic event. Rather, it is the individual's psychological struggle initiated by the disruption of core beliefs that facilitates the identification of positive changes and explains the variations in PTG (Cann et al., 2010). Empirical studies using both cross-sectional and longitudinal designs have supported this assumption; the degree of reexamination of core beliefs is positively correlated with PTG, at least among North Americans (e.g., Cann et al., 2010; Danhauer et al., 2013; Lindstrom, Cann, Calhoun, & Tedeschi, 2013).

One feature of the process that is worthy of note is that the degree to which core beliefs are examined is not necessarily equivalent to the perceived stressfulness or severity of the triggering event. A weak to moderate correlation has been reported between the disruption of core beliefs and perceived stressfulness of the event (e.g., Lindstrom et al., 2013), but "even tremors, lower on a 'psychological' Richter scale, could lead to an examination of one's core beliefs" (Cann et al., 2010, p. 31), and some highly stressful events may not lead to questioning of core beliefs. Tests of this proposal may have been limited because most available research has focused on people who identified a personally "most severe and traumatic" life event, such as being diagnosed with cancer or losing a loved one, as the focal event, which may be reducing the range of experienced distress. A study targeting daily negative life events, for example, has revealed that core beliefs

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were not severely disrupted as a result of daily negative life events, such as taking an exam and having done poorly (LoSavio et al., 2011). Thus, individual differences in the disruption of core beliefs may be restricted when the research focuses on either those who identified the "personally most traumatic" life event or those who identified daily negative life events but not necessarily traumatic life events.

Natural disasters such as earthquakes may provide widely shared experiences that also show considerable variation in the subjective severity. Even though a large number of people physically and concurrently experience the event, large individual differences have been observed in their psychological reactions (e.g., Başoğlu, Kiliç, Şalcioğlu, & Livanou, 2004; McMillen, North, & Smith, 2000). Previous research with a sample of earthquake survivors reported widely varying prevalence rates of PTSD symptoms (e.g., Ahmad et al., 2010; Carmassi et al., 2013), and a few studies have reported the possibilities of PTG among earthquake survivors (e.g., Xu & Liao, 2011; Yu et al., 2010). Research has not examined how the disruption of core beliefs may occur in conjunction with exposure to an actual earthquake and how core beliefs shaken by an earthquake might be related to subsequent PTG. The present study was designed to investigate the disruption of core beliefs and its relationships with PTG among people in Japan, where a large-scale earthquake, the Great East Japan Earthquake, happened on March 11, 2011. As the earthquake metaphor suggests, core beliefs are not likely to be challenged and reexamined when the psychological seismicity of the event is at a lower level. However, little is known about whether closer proximity to the epicenter of the earthquake can result in greater challenge to core beliefs. Because the theoretical model of PTG predicts that the challenge to one's core beliefs is likely to set the stage for subsequent PTG (Calhoun et al., 2010; Calhoun & Tedeschi, 2006; Tedeschi & Calhoun, 2004), it is important to investigate if the level on the psychological Richter scale (i.e., disruption of core beliefs) will be correlated with that on the objective Richter scale (i.e., degree of actual exposure to an earthquake).

A few studies have reported that people who experienced an earthquake reported positive changes or PTG (e.g., Xu & Liao, 2011; Yu et al., 2010). One study conducted following the 2008 Sichuan Earthquake in China showed that people who experienced a higher degree of earthquake exposure reported greater PTG (Xu & Liao, 2011). It is, however, unknown why greater exposure to the earthquake was associated with higher PTG. The relationship could be due to the examination of core beliefs precipitated by closer exposure to the threat. Under these conditions, there may be more destruction, loss of life, and general disruption of people's world and futures. It is possible that greater exposure to the earthquake leads people to reexamine their core beliefs and to activate more cognitive processing, which in turn may lead to PTG. Two major types of rumination have been identified to understand the cognitive processing that leads to PTG (Cann et al., 2011; Tedeschi & Calhoun, 2004). Intrusive ruminations are "unsolicited invasions of one's cognitive world—thoughts about an experience that one does not choose to bring to mind" (Cann et al., 2011, p. 138), and deliberate ruminations are constructive thoughts that are "engaged in voluntarily and can be focused purposefully on trying to understand events and their implications" (Cann et al., 2011, p. 138). According to the theoretical PTG model outlined by Calhoun and Tedeschi (Calhoun et al., 2010; Calhoun & Tedeschi, 2006; Tedeschi & Calhoun, 2004), this deliberate rumination plays a significant role in PTG; however, intrusive rumination is also necessary to initiate the PTG processes, as it indicates that the triggering event had a significant psychological impact. In accordance with this model, positive associations between both types of rumination and PTG, as well as core belief reexamination, have been identified in several studies (Danhauer et al., 2013; Groleau, Calhoun, Cann, & Tedeschi, 2013; Lindstrom et al., 2013; Triplett, Tedeschi, Cann, Calhoun, & Reeve, 2012; Wilson, Morris, & Chambers, 2014). In sum, challenge to core beliefs and ruminative thoughts will better explain the variability of PTG over and above the effects based on the physical Richter scale (i.e., direct exposure to the earthquake such as proximity to the epicenter). Thus far, these findings have been replicated mainly in Western cultures. If this PTG model is not exclusively applicable to Western cultures, these theory-driven relationships among challenges to core beliefs, rumination, and PTG should be replicated with a Japanese sample.

Cross-cultural studies of PTG, especially the ones focusing on comparisons of Japanese and American groups, have suggested that Japanese people report significantly lower levels of PTG than Americans (e.g., Shigemoto & Poyrazli, 2013; Taku & Cann, 2014). Relatively high levels of PTG among Americans could be due to the social pressure of getting positives out of negative events (Zoellner, Rabe, Karl, & Maercker, 2008) or self-enhancing tendencies (e.g., Kitayama, Markus, Matsumoto, & Norasakkunkit, 1997). However, given that the disruption of core beliefs has been found to be a key catalyst for subsequent PTG (e.g., Cann et al., 2010; Danhauer et al., 2013; Lindstrom et al., 2013), the relatively lower PTG among Japanese people might indicate that their core beliefs are not challenged as much as those of Americans, because of Japanese cultural norms that value being modest and ordinary (Ohashi & Yamaguchi, 2004), coupled with a general pessimistic bias in the culture (Chang, Asakawa, & Sanna, 2001). That is, instead of holding such beliefs as "good things will happen to people if they engage in good behaviors" or "most misfortune should be able to be avoided since we all have a certain amount of control," people in certain cultures such as Japan may be more likely to think "bad things are likely to happen, just the same as good things" or "we cannot really control what happens in this world," leading to core beliefs that are not as likely to be challenged by highly stressful events. Thus far, most studies addressing the role of disruption of core beliefs in PTG have been conducted in the West; thus, we do not know if Japanese people also experience a certain level of reexamination of core beliefs as a result of stressful life events.

In the current study, we examine the relationships among core belief reexamination, the two types of rumination, and PTG by testing the following two hypotheses.

> *Hypothesis 1:* People who experienced an earthquake at closer physical proximity to the epicenter (i.e., objective Richter scale) are likely to report a higher level of examination of core beliefs (i.e., psychological Richter scale), intrusive rumination, and deliberate rumination.

> *Hypothesis 2:* Consistent with the findings among Americans (e.g., Cann et al., 2011; Lindstrom et al., 2013), challenges to core beliefs will be the strongest predictor of PTG and will explain more variance of PTG than the perceived stressfulness

of the earthquake at the time of the event. Both intrusive and deliberate rumination will also be significant predictors of PTG; however, deliberate rumination will have a stronger relationship with PTG than intrusive rumination.

Method

Participants

The participants were recruited from introductory psychology courses in the Kanto region of Japan, approximately 180 to 210 miles from the epicenter of the Great East Japan Earthquake. A total of 320 undergraduate students participated 2 years and 3 months after the earthquake. Six were excluded from the analyses, either because their first language was not Japanese ($n = 4$) or because they did not provide demographic information such as gender ($n = 2$). The final sample of 314 participants included 158 men and 156 women, with ages ranging from 18 to 36 years ($M = 19.40$, $SD = 1.60$). More than 99% of this sample was single.

Measures

Sociodemographic information. The participants provided demographic information, such as gender, age, and marital status, and indicated whether their first language was Japanese. The participants also reported how they were affected by the earthquake in an open-ended format, including where they were when the earthquake happened. In addition, two questions were used to assess their experiences of psychological distress due to the earthquake: how stressful it was during the time it occurred and how stressful it felt at the time of the participation in the survey, on a scale of 1 (*not at all*) to 7 (*extremely stressful*). The correlation between these two questions was $r = .46$, $p < .001$. Only one item, the perceived stressfulness at the time of the earthquake, was used to test Hypothesis 2.

Posttraumatic growth. The degree of PTG experienced in the aftermath of the Great East Japan Earthquake was assessed using the Japanese version of the 21-item Posttraumatic Growth Inventory (PTGI; Tedeschi & Calhoun, 1996; PTGI-J; Taku et al., 2007). Each item was rated using a 6-point scale, with values ranging from 0 (*I did not experience this change as a result of the earthquake*) to 5 (*I experienced this change to a very great degree as a result of the earthquake*). The PTGI has good internal reliability, test–retest reliability, and validity (e.g., Shakespeare-Finch & Barrington, 2012; Shakespeare-Finch & Enders, 2008; Tedeschi & Calhoun, 1996). The PTGI assesses change in five domains: Relating to Others, New Possibilities, Personal Strength, Spiritual Change, and Appreciation of Life; however, the current study only uses the total 21-item score. Cronbach's alpha in the current sample was .94.

Challenge to core beliefs. Perceived challenge to core beliefs was assessed using a Japanese translated version of the nine-item Core Beliefs Inventory (CBI; Cann et al., 2010). For this study, with the permission of the original authors, the Japanese version was developed by using the standard back-translation approach. As with the English version, the participants were asked to indicate the extent to which the event (i.e., earthquake) led them to seriously examine their core beliefs using a 6-point scale, with values ranging from 0 (*not at all*) to 5 (*a very great degree*). The CBI has been used frequently to measure the disruption of core beliefs and has satisfactory internal consistency and test–retest reliability (e.g., Cann et al., 2010; Lindstrom et al., 2013). Cronbach's alpha for the total score in the current Japanese sample was .87.

Cognitive processing. Cognitive processing such as intrusive and deliberate rumination in the aftermath of experiencing the Great East Japan Earthquake was assessed using a Japanese translated version of the 20-item Event-Related Rumination Inventory (ERRI; Cann et al., 2011). The Japanese version was developed for this study using the standard back-translation approach, and it was confirmed by the authors of the scale. Of 20 items, 10 items measure intrusive, mostly automatic and often undesired, ruminative thoughts. The remaining 10 items measure deliberate and more constructive ruminative thoughts. The original ERRI is designed to measure these two types of rumination at two different times ("during the weeks immediately after the event" and/or "in the last few weeks" at the time of the survey point); however, the current study only used the first option; that is, "during the weeks immediately after the earthquake." The participants rated the degree to which the thoughts occurred using a 4-point scale, with values ranging from 0 (*not at all*) to 3 (*often*). The ERRI has been used in several studies to measure intrusive and deliberate rumination, and it has good reliability and good construct validity (e.g., Cann et al., 2011; Groleau et al., 2013). Cronbach's alpha in the current Japanese sample was .93 for intrusive rumination and .93 for deliberate rumination.

Procedure

Participants were recruited in general psychology classes at two universities in Japan. The measures were administered in a group setting. Participants were first asked to read the informed consent form. After signing the consent form, the participants were given the package of inventories described above. Completion of the measures took approximately 30 min. The study was approved by the institutional review board.

Results

Descriptive Statistics and Item Analyses of the CBI and ERRI

Since this is the first study using the CBI and ERRI in a Japanese sample, descriptive statistics for each item and internal consistency (i.e., item-total analysis) were first examined. Of nine items (ranging from 0 to 5) of the CBI, only one item ("Because of the event, I seriously examined my spiritual or religious beliefs") showed a markedly low score ($M = 0.76$, $SD = 1.25$), suggesting that Japanese people are not likely to experience this type of core beliefs challenge. The other eight items had means ranging from 1.52 to 2.23, indicating that core beliefs were challenged, at least to a small degree, as a result of the earthquake. Cronbach's alpha for the total ($\alpha = .87$) did not increase by deleting any of the nine items. The mean rating of the total CBI was 1.73 ($SD = 1.03$). Similarly, Cronbach's alpha coefficients for the total of 10 items measuring intrusive rumination ($\alpha = .93$) and deliberate rumination ($\alpha = .93$) were not improved by deleting any of the 10 items for each scale (Cronbach's alpha, if items were deleted, was lower than .92), indicating that these two scales are

internally consistent. The mean rating of the total intrusive rumination was 1.09 (SD = .69), and that of deliberate rumination was 1.26 (SD = .72).

Hypothesis 1: Relationships Between Seismicity of the Earthquake and the CBI and ERRI

The first hypothesis—that experiencing the earthquake at closer proximity to the epicenter would correlate with the level of examination of core beliefs, intrusive rumination, and deliberate rumination—was tested using a multivariate analysis of variance (MANOVA) since positive correlations were expected among these three variables. The MANOVA was conducted with three exposure groups: those who were in the Tohoku area with an approximate Richter magnitude of 6 to 8 (n = 76, 24.2%—high exposure group); those who were in the Kanto area, including Tokyo, with an approximate magnitude of 5 (n = 158, 50.3%—moderate exposure group); and those who were in the southern area with a magnitude of 4 or lower (n = 73, 23.2%—low exposure group) at the time of the earthquake. Seven people who did not specify where they were at the time of the earthquake were excluded from the following analyses.

The results of the MANOVA, using Pillai's trace criterion, indicated that there was a significant effect of earthquake exposure on the level of core beliefs examination, intrusive rumination, and deliberate rumination, V = .14, $F(6, 582) = 7.36$, $p < .001$. The follow-up univariate analysis of variance (ANOVA) for the CBI was significant, $F(2, 292) = 4.67$, $p < .05$. Post hoc comparison using Scheffé's method showed that those in the moderate exposure group (M = 1.88, SE = .08, 95% confidence interval [CI] = [1.72, 2.05]) reported a higher CBI score than those in the low exposure group (M = 1.43, SE = .12, 95% CI = [1.19, 1.68]) at $p < .05$; however, there were no significant differences between those in the high exposure group (M = 1.70, SE = .12, 95% CI = [1.46, 1.93]) and those in the moderate exposure group or low exposure group. The follow-up univariate ANOVA for the intrusive rumination was also significant, $F(2, 292) = 17.58$, $p < .001$. Those in the high exposure group (M = 1.31, SE = .08, 95% CI = [1.17, 1.46]) and those in the moderate exposure group (M = 1.16, SE = .05, 95% CI = [1.06, 1.26]) reported a higher degree of intrusive rumination than those in the low exposure group (M = .71, SE = .08, 95% CI = [.55, .86]) at $p < .001$. There were no significant differences between those in the high exposure group and those in the moderate exposure group. The follow-up univariate ANOVA for the deliberate rumination was also significant, $F(2, 292) = 14.00$, $p < .001$. As with the results of intrusive rumination, those in the high exposure group (M = 1.40, SE = .08, 95% CI = [1.25, 1.56]) and those in the moderate exposure group (M = 1.36, SE = .06, 95% CI = [1.26, 1.47]) reported a higher degree of deliberate rumination than those in the low exposure group (M = .88, SE = .08, 95% CI = [.72, 1.04]) at $p < .001$.

Thus, Hypothesis 1 was not fully supported in that proximity to the epicenter (i.e., objective Richter scale) was not directly correlated with the CBI (i.e., psychological Richter scale), nor with intrusive or deliberate rumination. That is, although the current data supported the expectation that core beliefs were less likely to be challenged among those farther from the epicenter, there were no significant differences between those who were in the Tohoku area (magnitude of 6 to 8) and those who were in the Tokyo area (approximate magnitude of 5).

Hypothesis 2: Perceived Stressfulness, Cognitive Processing, CBI, and PTG

To test Hypothesis 2, hierarchical regression analysis was conducted with the PTGI total score as the outcome variable. All predictors were linearly transformed to reduce the multicollinearity problems. Correlations among the study variables are presented in Table 1. Demographic variables (gender and age) were entered first, perceived stressfulness at the time of the earthquake and the CBI were entered second, and intrusive and deliberate rumination were entered third. Results showed that the first model explained only 1.4% of the variance for the PTGI total score, $F(2, 294) = 2.02$, *ns*. Addition of the perceived stressfulness at the time of the earthquake and the CBI score improved the prediction, R^2 change = .37, $p < .001$, $F(4, 292) = 46.20$, $p < .001$. Examination of beta coefficients (see Table 2) indicated that the CBI was the strongest predictor and that the perceived stressfulness was not a significant predictor for PTG, supporting the hypothesis. Age was also a significant predictor, suggesting that younger people are likely to report higher levels of PTG. In the final model, addition of the cognitive processing factors, intrusive and deliberate rumination, also improved the prediction, R^2 change = .05, $p < .001$, with the CBI (β = .46, $p < .001$) as the strongest predictor,

Table 1
Zero-Order Correlations Among the Study Variables

	Gender[a]	Age	Stressfulness	CBI	Intrusive rumination	Deliberate rumination
Age	−.02					
Stressfulness[b]	.31***	.18**				
CBI[c]	.12*	.05	.25***			
Intrusive[d]	.23***	.20***	.50***	.50***		
Deliberate[e]	.15**	.13*	.39***	.62***	.69***	
PTGI total	.04	−.11*	.15**	.60***	.42***	.51***

Note. PTGI = Posttraumatic Growth Inventory.
[a] Gender was coded with 0 = male, 1 = female. [b] Stressfulness = perceived stressfulness at the time of the event. [c] CBI = Core Beliefs Inventory. [d] Intrusive = intrusive rumination. [e] Deliberate = deliberate rumination.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2
Hierarchical Regression Analyses Predicting the Total Posttraumatic Growth Inventory (PTGI) Score

Model	Predictor	*B*	β	*F*	Adjusted R^2	ΔR^2
1	Gender	.04	.02	2.02	.01	
	Age	−.07	−.11			
2	Gender	−.12	−.07	46.20***	.38	.37***
	Age	−.09	−.15**			
	Stressfulness	.02	.03			
	CBI	.55	.61***			
3	Gender	−.15	−.08	36.90***	.42	.05***
	Age	−.10	−.18***			
	Stressfulness	−.04	−.06			
	CBI	.41	.46***			
	Intrusive rumination	.20	.15*			
	Deliberate rumination	.23	.18*			

Note. CBI = Core Beliefs Inventory.
* $p < .05$. ** $p < .01$. *** $p < .001$.

followed by age (β = −.18, $p < .001$), deliberate rumination (β = .18, $p < .05$), and intrusive rumination (β = .15, $p < .05$). Pairwise parameter comparisons showed that the role of the CBI was larger than age, gender, perceived stress at the time of the event, or intrusive rumination; however, there were no significant differences between the role of the CBI and deliberate rumination (the critical ratio was 1.83 and thus did not exceed the cutoff of 1.96). In this final model, the overall model explained 43.3% of the variance for the PTGI total score, $F(6, 290) = 36.90$, $p < .001$.

In sum, greater disruption of core beliefs was the strongest predictor of PTG, more so than perceived stressfulness at the time of the event, supporting Hypothesis 2. Although both intrusive rumination and deliberate rumination were significant predictors, there were no differences between their betas. Taken together, being younger, deliberately and intrusively ruminating about the earthquake, and challenges to core beliefs were all positively associated with higher levels of PTG. Retrospective perceptions of stressfulness at the time of the earthquake and participants' gender did not significantly contribute to the total score of the PTGI.

Discussion

This was the first study examining the characteristics of, and the role of challenge to, core beliefs, intrusive rumination, and deliberate rumination in PTG with a Japanese population. The results of this study indicated that core beliefs among Japanese people were challenged by the earthquake, although at a relatively low level. Reports of core belief challenge with American samples have tended to focus on people who personally identified their "most severe and traumatic" life event (e.g., Cann et al., 2010; Lindstrom et al., 2013; Triplett et al., 2012), whereas the current study asked participants to focus on the shared event (i.e., the earthquake) when they completed the CBI, making direct comparisons problematic. However, even among people in the high exposure group (those who were in the Tohoku area with an approximate Richter magnitude of 6 to 8), CBI scores were low. Since Japanese people tend to be less optimistic (e.g., Fischer & Chalmers, 2008; Rose, Endo, Windschitl, & Suls, 2008), they may expect life to include more negatives, so that negative events are less likely to challenge their core beliefs. In addition, people in Japan, because of the prevalence of the Buddhist and Shinto belief systems, may be more likely to assume that life is unpredictable and that tragedy can occur randomly, which also makes it less likely that these core beliefs would be challenged (Calhoun & Tedeschi, 2013) by unpredictable and tragic circumstances.

To explain the variability of the CBI and ERRI scores, we hypothesized that core beliefs were more likely to be examined and that intrusive and deliberate rumination were more likely to be activated if people experienced the earthquake at closer proximity to the epicenter. This hypothesis was not fully supported in that there were no differences between those who were in the moderate exposure group and those who were in the high exposure group. However, we found that those in the low exposure group reported significantly lower levels of CBI and ERRI than the other two groups. Consistent with the literature showing the relatively low level of CBI found in those who experienced daily negative events (e.g., LoSavio et al., 2011), it is not surprising that core beliefs were less challenged and that intrusive or deliberate rumination was not as likely to be experienced when people were not strongly affected by the earthquake (i.e., low exposure group). However, contrary to our hypothesis, there were no differences between those in the high exposure group and those in the moderate exposure group in the level of core belief examination, intrusive rumination, or deliberate rumination. One possible reason that the physical Richter scale of the earthquake was not linearly related with the psychological impact (i.e., level of reexamination of core beliefs) in our sample may be that this 3.11 earthquake also involved a nuclear accident. Unlike the damage directly caused by the earthquake, the nuclear accident may have caused psychological distress in a broader area, including the Tokyo suburban area (i.e., moderate exposure group). Perhaps the experiences of those in the moderate exposure group were no less stressful than those in the high exposure group. One limitation of this study was the lack of assessment of the objective consequences of the earthquake for the participants. There should be considerable variability in the specific physical consequences of the earthquake within the same level of exposure groups. Future studies should investigate more details about specific life experiences caused by events such as earthquakes, tsunamis, and nuclear accidents.

The current study indicated that core belief reexamination and PTG were highly correlated, consistent with studies done in Western countries. As we hypothesized, the disruption of core beliefs played a major role in predicting the level of PTG, suggesting that "the process of reviewing and examining core beliefs is a key catalyst for the subsequent possibility of PTG" (Calhoun & Tedeschi, 2013, p.16). Several studies have also shown the significant role of cognitive processing, especially deliberate rumination, in laying the foundation for PTG (Cann et al., 2011; Stockton, Hunt, & Joseph, 2011). Similar to previous studies, the current study indicated that deliberate rumination and intrusive rumination had positive relationships with PTG. We hypothesized that deliberate rumination would have a larger impact than intrusive rumination; however, this hypothesis was not supported. One possibility is that, as described in the PTG theoretical model, both intrusive and deliberate rumination should play critical roles; however, the timing should matter. Ideally, as the aftermath of a traumatic event unfolds, intrusive ruminations are replaced by deliberate rumina-

tions, which in turn should influence PTG. One limitation of the current study is that rumination was assessed at one time, more than 2 years after the earthquake. Further research will be needed to assess the time-sensitive role of core beliefs, intrusive rumination, and deliberate rumination in PTG.

Although there were no statistical differences in the size of the beta of the CBI ($\beta = .46$, $p < .001$) and deliberate rumination ($\beta = .18$, $p < .05$), the absolute level of beta showed that the CBI had a larger association with PTG. One possibility is that, unlike deliberate rumination, which requires active cognitive engagement that is specific to the event (e.g., "I thought about whether I could find meaning from my experience"; "I thought about the event and tried to understand what had happened"), the CBI is designed to assess a more neutral and yet thoughtful examination of one's core beliefs that are beyond a specific triggering event (e.g., "Because of the event, I seriously examined the degree to which I believe things that happen to people are fair"). Thus, this examination of core beliefs may itself represent personal growth for some people. Uchida, Takahashi, and Kawahara (2014) reported that approximately 60% of their Japanese sample reported that their attitudes toward life had changed "somewhat" after the Great East Japan Earthquake, and "reevaluation" of life and connectedness was the one factor that predicted well-being after the earthquake.

Similar to the present findings, some studies conducted with American populations (e.g., Danhauer et al., 2013; Triplett et al., 2012) have also demonstrated an almost equal contribution of deliberate rumination and core belief reexamination to PTG. It is possible, then, that due to Eastern cultural influences, where self-effacement and self-criticism are regarded as virtues (e.g., Takata, 2003), reexamining core beliefs might provide a foundation for personal growth in a humble but primitive form (e.g., "I cannot find meaning from my experience, but at least I have seriously examined my assumptions"). Additionally, it is possible that because the CBI assesses the degree to which people reexamine their core beliefs, it may reflect some individual differences in the openness toward self-reflection. The current findings also indicated that perceived stressfulness when the earthquake happened was not a significant predictor of PTG, supporting the theoretical model of PTG (Calhoun et al., 2010; Calhoun & Tedeschi, 2006, 2013; Tedeschi & Calhoun, 2004). Not everyone who experiences a highly stressful life event reports PTG; rather, those whose core beliefs are examined are more likely to experience PTG. Finally, our findings showed that age played a significant role in PTG; younger people reported higher PTG, consistent with the previous findings (e.g., Pietrzak et al., 2010; Xu & Liao, 2011).

In sum, this study suggests that the examination of core beliefs, as well as cognitive processing, not the perceived stressfulness or objective severity of an event, is a major determinant of PTG, providing additional support for the theoretical model of PTG. What factors, then, led people to examine their core beliefs and activate cognitive processing? One study found that greater optimism and self-efficacious thoughts are positively associated with reexamination of core beliefs and deliberate rumination (Wilson et al., 2014); thus, individual difference factors (e.g., personality, psychological preparedness) and situational factors (i.e., physical severity of the event) might play a role in determining whether one's core beliefs are likely to be challenged and how one's cognitive processing is shaped. Future studies should examine what aspects of traumatic experiences are likely to force people to reexamine their core beliefs, as well as what individual characteristics are likely to elicit the tendency to reexamine their core beliefs. In addition, longitudinal work that allows tracking of the process of PTG from the event, to intrusive rumination, to deliberate rumination, to core belief examination, and to PTG would be a valuable test of the PTG model.

In considering these findings, it is important to address some limitations of this study. First, it was cross-sectional. Although CBI and ERRI scores were found to be reliable predictors of PTG in our hierarchical regression model, we cannot determine the direction of effect. Bias might occur when relying exclusively on retrospective assessments, as the current study did. Second, at the time of participation, those who were in the high exposure group in this study were attending a university located in the Kanto area, where the level of earthquake severity was different from that of their hometown area. The results might be different if data were collected from those who experienced the earthquake in the Tohoku area and continued to live in the area, where the earthquake directly hit and where the risk of nuclear exposure is more ongoing.

Because the current study used a single common event (i.e., the Great East Japan Earthquake) as a focus for all participants rather than asking participants to describe their "most traumatic life event," this study was able to investigate wider individual differences in the level of reexamination of core beliefs and cognitive processing, as well as PTG. Additional research is needed to explain the variability of the level of reexamination of core beliefs, since most studies begin with the CBI as a predictor variable for PTG. Thus, it will be important to know more about the process of core belief reexamination itself.

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