Psychological Trauma: Theory, Research, Practice, and Policy
2012, Vol. 4, No. 4, 411–419


1942-9681/11/$12.00 DOI: 10.1037/a0024363

# Exploring Posttraumatic Growth in Japanese Youth

Kanako Taku
Oakland University

Ryan P. Kilmer, Arnie Cann, Richard G. Tedeschi and Lawrence G. Calhoun
UNC Charlotte

Despite a growing body of literature examining posttraumatic growth (PTG; positive change resulting from the struggle with trauma) in adult populations from various cultures, the emerging research base involving youth includes few studies exploring the construct in youth from Eastern cultures. This study examined PTG and perceived growth in the absence of trauma among Japanese youth. A total of 408 youth (215 boys, 193 girls), with a mean age of 13.38 years ($SD$ = .93), from one public junior high school in the suburbs of Tokyo were recruited. They reported whether they had experienced any trauma in the past year and completed measures assessing psychological growth using the Revised Posttraumatic Growth Inventory for Children, subjective severity, and cognitive processing using the adapted Rumination Scale. Results using one-way ANOVA showed that greater growth was reported by those who experienced trauma, and the objective severity of the adversity was reliably related to perceived growth. Chi-square tests revealed that those who did not experience adversity had more difficulty identifying growth. These results suggest that the youth-reported growth does not simply reflect normative maturation. Multiple regression analysis, using participants who reported at least one traumatic event, indicated that deliberate cognitive processing appears to play an important role in PTG. Cultural and developmental aspects of these findings, as well as implications for research and applied work are discussed.

*Keywords:* posttraumatic growth, development, cognitive processing, trauma severity, culture



A growing research literature has suggested that some people report personal growth as a result of the psychological struggle with highly challenging events or major life crises, a phenomenon known as posttraumatic growth (PTG; e.g., Tedeschi & Calhoun, 1996). Although the vast majority of research on PTG has examined the construct in various adult populations (see Helgeson, Reynolds, & Tomich, 2006, for a review), some have investigated PTG in children and youth. Despite the cognitive capacities assumed necessary to engage in the PTG process, emerging evidence supports that PTG can occur—at least in some form—in children and adolescents (e.g., Clay, Knibbs, & Joseph, 2009; Kilmer & Gil-Rivas, 2010a).

Researchers have documented PTG-like changes in diverse youth samples, including those experiencing traffic accidents (e.g., Salter & Stallard, 2004), natural disasters (e.g., Kilmer et al., 2009), and a range of traumatic events (e.g., Ickovics et al., 2006). Some recent work has described PTG in samples outside of North America, including Norway (Hafstad, Gil-Rivas, Kilmer, & Raeder, 2010; Hafstad, Kilmer, & Gil-Rivas, in press), the Netherlands (Alisic, van der Schoot, van Ginkel, & Kleber, 2008), and Israel (Laufer & Solomon, 2006). However, with only one known exception (Yu et al., 2010), no published research has examined PTG among youth in Eastern cultures. Given that several authors (Hafstad et al., in press; Kilmer et al., 2009; Tedeschi & Calhoun, 2004) have discussed the relevance of sociocultural elements for PTG, examining PTG in children from an Eastern culture (i.e., Japan) may yield information of relevance in assessing the degree to which the current conceptualization of the construct, theory about the PTG process, and the research base developed in Western cultures are consistent with observations from Eastern cultures. Moreover, although previous studies on PTG among Japanese undergraduate students (e.g., Taku et al., 2007) showed there were some culture-constant characteristics (e.g., the role of cognitive processing in the PTG process) and culture-specific characteristics (e.g., the relatively low level of PTG reported in a Japanese sample), there have been no attempts to evaluate whether these characteristics are observed in a nonadult sample. Thus, as a step toward addressing this gap, the present study explores the PTG construct among Japanese middle-school aged adolescents. Of relevance, youth this age typically have many of the developmental (e.g., cognitive, affective) capacities believed to be necessary to go through a PTG-like process (see Kilmer & Gil-Rivas, 2010a, for a discussion of developmental considerations).

PTG has been conceptualized as personal growth resulting from one's struggle in the aftermath of trauma. As such, the experience of truly challenging events—events that PTG models (Calhoun & Tedeschi, 2006; Kilmer, 2006) have described as sufficiently seismic to shake or threaten the individual's assumptive world (see also Janoff-Bulman, 1992), should produce the highest level of PTG (Helgeson et al., 2006). While research with adults has shown that the severity of the event is an important factor in PTG (e.g.,

This article was published Online First June 20, 2011.

Kanako Taku, Department of Psychology, Oakland University; Ryan P. Kilmer, Arnie Cann, Richard G. Tedeschi, and Lawrence G. Calhoun, Department of Psychology, UNC Charlotte.

The first two authors contributed equally to this paper.

Correspondence concerning this article should be addressed to Kanako Taku, Department of Psychology, Oakland University, Rochester, MI 48309-4401. E-mail: taku@oakland.edu

Bellizzi & Blank, 2006), among child and adolescent samples, results on the impact of severity on PTG have been mixed. For example, one study involving children who experienced Hurricane Floyd revealed that global ratings of the event's severity did not relate to PTG (Cryder, Kilmer, Tedeschi, & Calhoun, 2006). In other work, subjective and/or objective severity of the event did relate to growth. In one such study, youth who experienced a diverse range of traumatic events, as defined by the A1 criterion of the *DSM–IV* diagnosis for posttraumatic stress disorder (PTSD; the person experienced, witnessed, or was confronted with an event or events that involve actual or threatened death or serious injury; or threat to the physical integrity of himself or herself or others; American Psychiatric Association, 1994), evidenced greater levels of PTG than youth who experienced a stressful event that did not meet this *DSM–IV* criterion for trauma (Alisic et al., 2008), supporting the impact of objective severity on PTG. Other studies, in which all the youths experienced the same major traumatic events, such as direct exposure to Hurricane Katrina (e.g., Kilmer et al., 2009), have found that indicators of subjective severity, rather than the objective severity (i.e., trauma-related objective exposure scores), were most strongly associated with PTG. Thus, the relationships between subjective and objective severity and PTG among youth may depend, at least in part, on the nature of the adverse experience, as well as the means of operationalizing "objective" severity, "trauma," and other salient constructs.

Investigations of the importance of the severity of the event in PTG give rise to the question of whether it is possible to perceive PTG-like psychological growth without experiencing a severe trauma. Tedeschi and Calhoun (1996), for example, compared the scores on the PTG Inventory (PTGI) for university students who experienced at least one traumatic event and those who had not. They found that participants reporting severe trauma reported higher personal growth than those who had not, indicating those whose beliefs or assumptive world were possibly challenged by trauma were more likely to perceive growth. Notably, those who had not experienced any trauma still reported some psychological growth ($M = 69.75$; $SD = 20.47$ on a 0–105 scale). In fact, the PTGI has been used in other studies to measure growth that may not be directly related to trauma. One such study (Anderson & Lopez-Baez, 2008) revealed that growth can be observed for periods as brief as a single semester among college students who had not experienced any traumatic event. Thus, it appears that people do still perceive some level of psychological growth even in the absence of trauma per se.

Among children and youth, reports of PTG raise questions not only about the nature and level of the adverse event in question (i.e., what level of severity is necessary to initiate a PTG-like process? Does the nature of particular events, or specific characteristics of some events, preclude PTG?), but also about the ability of youth to perceive growth (i.e., are children and youth capable of perceiving their own psychological change without having a traumatic experience as a focal event?). In the child and youth literature, only Alisic and colleagues (2008) shed light on the latter question, with their finding that those exposed to trauma reported more PTG than those without trauma histories; however, all youth in that sample reported about adversity experiences, and levels of PTG were compared assuming all children were able to recognize changes in themselves whether they had experienced trauma or not.

This study aims to address more directly these issues and extend prior research by investigating PTG in a nonclinical sample of middle-school aged Japanese youth. It seeks to explore associations between the objective and subjective severity of the event and PTG and assess the differences in the reports of psychological growth between those experiencing trauma, those reporting adverse events that do not meet criteria for trauma, and those indicating that they had not experienced notable stressors. Given the trauma's potentially vital role as an anchor point that may facilitate individuals' comparison of themselves and their situations before and after the event, it is expected that those who had not experienced any event would have more difficulty in perceiving growth and, overall, would evidence lower levels of reported psychological growth.

A translated (from English) version of the revised PTGI for Children, a recently validated measure (Kilmer et al., 2009), was used to assess growth. Findings obtained with translated versions of the PTGI among adult samples suggest that the factor structure of the scale may differ across cultures (e.g., Weiss & Berger, 2006). For instance, four out of five original factors of the PTGI (i.e., "Relating to Others," "Personal Strength," "New Opportunities," "Spiritual Change," and "Appreciation of Life") emerged in work with a sample of Japanese undergraduate students, with the latter two extracted as one factor (Taku et al., 2007). In studies of youth, although one study attempted to examine levels of PTG across the factors (Ickovics et al., 2006), nearly all studies have used the total score of the child version of the PTGI. In that context, this study also explores the factor structure of the Japanese translation used here, to identify any cultural characteristics of PTG among youth.

Finally, it is likely that youth who experienced a traumatic event might engage in more event-related cognitive processing, a significant predictor of PTG (see, e.g., Kilmer & Gil-Rivas, 2010a), than those who did not experience any traumatic event. According to PTG models (Calhoun & Tedeschi, 2006; Tedeschi & Calhoun, 2004), children who experience a traumatic event might experience intrusive cognitive activity (i.e., they may think about what happened even when they do not mean to or try not to) or deliberate cognitive processing (i.e., they may try to identify some kind of good that might have emerged resulting from their struggle), which in turn may influence the eventual PTG. A recent study that assessed intrusive and deliberate cognitive processing (Kilmer & Gil-Rivas, 2010a) identified the significant impact of both types of cognitive processing on PTG in American children.

In summary, this study explores the factor structure of the Japanese version of the revised PTGI for Children and tests three hypotheses: (1) those not reporting trauma would evidence lower levels of self-reported psychological growth than those who had; (2) relative to youth reporting trauma, those not experiencing any traumatic event would have more difficulty recognizing their own growth, because of the lack of a specific event to serve as an anchor point for self-comparisons; and (3) among those reporting traumatic experience(s), the level of PTG would be predicted by subjective and objective severity, as well as intrusive and/or deliberate cognitive processing, as delineated by the PTG model (e.g., Calhoun & Tedeschi, 2006).

## Method

### Participants

A total of 440 7 to 9th graders (236 boys, 204 girls) in one public junior high school in the suburbs of Tokyo, were recruited, and 408 (215 boys, 193 girls) volunteered to participate (response rate = 92.7%) and provided consent. Among those participants, 31.4% were in 7th grade, 32.4% in 8th grade, and 36.3% in 9th grade, with an overall mean age of 13.38 years (*SD* = .93). All participants identified themselves as Japanese, which was also confirmed by school teachers.

### Procedure

The study was approved by institutional review boards at Oakland University and the UNC Charlotte. Everyone who attended school on the date of survey was recruited to participate in the survey. There were no exclusion criteria. Compensation was not provided. Each classroom teacher and a trained school counselor administered the questionnaire packets in classroom settings. Before completing the packet of study measures, participants were asked to provide demographic information such as sex and age. They then reported whether they had experienced any traumatic or stressful event within the last year. The youth participants were each given a list that included multiple categories of adverse events. Then, they received the following instruction: "You may have experienced one or more of the events on the list below, or you may have not experienced any. We would like to know if you have experienced any of the following events. Please check the box if you have experienced the event within the past year, then write down the details about the event if you would not mind. If you experienced more than one of these events, please tell us which one was the most stressful event for you." The list included natural disaster, accident, injury, serious illness, family issues, death, assault, bullying, move residence or change schools, break-up with friend, and other. The list also included 2 or 3 examples for each category of adverse event.

Those who reported experiencing two or more events were asked to choose the most traumatic event to serve as the focus when completing the remaining measures, including the revised PTGI for children (Kilmer et al., 2009) and the adapted Rumination Scale (Calhoun, Cann, Tedeschi, & McMillan, 2000), assessing event-related cognitive processing. They also provided a short written description of the trauma they had experienced and indicated the degree of perceived stressfulness and the time since the event. Those who had not experienced any trauma and those who did not remember any skipped the Rumination Scale and responded to the PTGI-C-R by comparing themselves to how they were a year ago.

### Measures

**PTG and growth without experiencing trauma.** To assess psychological growth with or without experiencing a traumatic event, the Japanese translated version of the revised PTGI for Children (PTGI-C-R; Kilmer et al., 2009) was used. The PTGI-C-R was developed from the PTGI-C (Cryder et al., 2006) and has satisfactory reliability for the total score ($\alpha$ = .77; Kilmer et al., 2009) and good construct validity (Kilmer & Gil-Rivas, 2010a). This 10-item scale assesses psychological growth in five PTG domains that have been identified with adult samples (e.g., Tedeschi & Calhoun, 1996): *New Possibilities*; *Relating to Others*; *Personal Strength*; *Appreciation of Life*; and *Spiritual Change.* The Japanese version was developed using standard methods of translation, back-translation, and revision. As a result, of the 10 items, 2 items for the domain of *Spiritual Change* (e.g., "My faith/belief in God is stronger than it was before") were changed to better reflect Japanese culture (e.g., "My faith/belief in a nonhuman power such as God, Buddha, or ancestors, etc. is stronger than it was before"). Using a 4-point scale (0 = *no change* to 3 = *changed a lot*), those who reported a traumatic event rated these 10 items based on the perceived changes resulting from the event; whereas those who did not report experiencing any trauma rated each item relative to the passage of time, by comparing themselves at the time of data collection with how they had been a year ago. Cronbach's $\alpha$ for the total score for those with and without an adverse event in our current sample were .89 and .88, respectively. For the Japanese version, an open-ended question was added to inquire about perceived psychological growth that might not have been captured by the existing 10 items. The instruction (roughly translated from the original Japanese) was, "If you have experienced any type of psychological growth in the last year (or as a result of the difficult experience you noted, if any) that were not included in the 10 items above, would you be willing to write them down?"

To assess the capability of perceiving one's own growth, an "*I don't know*" response option was added to the above-mentioned 4-point scale for each item on the PTGI-C-R. To facilitate examination of the youths' capacity for perceiving the possible presence of growth, the responses were recoded as a dichotomous variable, 0 for "*I don't know*" and 1 for all other choices from 0 "*no change*" to 3 "*changed a lot.*" Because those who reported "0" on the original metric were still able to recognize a sense of "*no change*," this was viewed as meaningfully different from those who reported "*I don't know* (about my own change)." For all other purposes (e.g., assessing the impact of severity and cognitive processing on PTG), the response of "*I don't know*" was coded as a missing value.

**Intrusive and deliberate cognitive processing.** For those who reported a traumatic event, event-related cognitive processing was assessed with the Rumination Scale (Calhoun et al., 2000; see Taku, Cann, Tedeschi, & Calhoun, 2009, for the adapted Japanese translated version). This study used eight of the original Calhoun et al. 14 items: 4-items assessed intrusive cognitive processing that might occur either soon after the event or over time (e.g., "Soon after the event, I thought about the event when I didn't mean to," "Recently, thoughts about the event came to my mind and I could not get rid of them"); and the other 4-items assessed deliberate cognitive processing (e.g., "Soon after the event, I reminded myself of some of the benefits that came from adjusting to the difficult experience," "Recently I have tried to make something good come out of my struggle"). Items were rated on a 4-point scale, ranging from 1 (*not at all*) to 4 (*often*). Because all of the events reported by the participants were experienced within the last year, this study uses only the total scores for intrusive and deliberate cognitive processing, without dividing them into the possible additional scores reflecting the timing (i.e., recently and

soon after the event). Cronbach's α for intrusive and deliberate cognitive processing scores in this sample were .87 and .84, respectively.

**Subjective severity of the traumatic event.** The subjective severity was assessed as the degree of perceived stressfulness when the event happened, ranging from 1 (*not at all stressful*) to 7 (*very much stressful*). The same scale was also used to assess the level of stressfulness associated with the event at the time of the survey.

**Objective severity of the traumatic event.** In line with prior research (e.g., Alisic et al., 2008), objective severity was assessed using the *DSM–IV* A1 criterion for PTSD (American Psychiatric Association, 1994). Participants' description(s) of their most stressful event(s) via an open-ended format were coded by two independent raters (one clinical psychologist and one child psychiatrist) as to whether or not they fulfilled the A1 criterion (interrater agreement, Kendall's $\tau$-$b$ = .84). Discrepancies between the raters were resolved by classifying them as not meeting the criterion. Events that met the A1 criterion in this sample (e.g., sudden death of a family member; severe natural disaster; traffic accident) were coded as high objective severity, whereas all other adversities that were reported as the most stressful but did not meet the A1 criterion (e.g., parental divorce; being bullied or attacked; injury or illness of a family member) were coded as low objective severity.

## Data Analysis

After summarizing descriptive findings and exploring the factor structure of the Japanese PTGI-C-R, as well as participants' open-ended descriptions of their psychological growth, one-way ANOVA was conducted to test the first hypothesis that those who had not experienced any traumatic event would evidence lower levels of psychological growth than those who had, considering separately the groups identified as high or low event severity. Second, chi-square analyses tested the hypothesis that those who had not experienced any traumatic event would have greater difficulty in recognizing their own growth because of the lack of a specific event that could serve as an anchor point of comparisons. Finally, the impact of subjective/objective severity as well as intrusive/deliberate cognitive processing on PTG was analyzed with multiple regression analyses involving only those who reported a traumatic event. All analyses were performed using SPSS (version 16.0 for Windows).

# Results

## Prevalence of Traumatic Life Events and Subjective/Objective Severity

Nearly 42% of participants ($n$ = 171; 84 boys and 87 girls) reported they had experienced at least one potentially traumatic event within the previous year ($M$ = 5.73 months before the survey point; $SD$ = 3.93). Of the remaining 237 youth, 52.74% ($n$ = 125) reported that they had not experienced any trauma, and 47.26% ($n$ = 112) reported that they did not remember whether they experienced any event. Of those reporting a trauma, just under 20% ($n$ = 34) of the adversities reported met the *DSM–IV* A1 criterion for PTSD (American Psychiatric Association, 1994), coded as high objective severity in this study. Severe injury or illness involving surgery ($n$ = 10); severe natural disaster ($n$ = 6); traffic accident ($n$ = 8); sudden death of a parent, sibling, or other loved one ($n$ = 5); and assault ($n$ = 5) were the experiences that met that criterion in this sample. The majority of those describing adverse events (80.12%; $n$ = 137) reported exposure to adversities that were not consistent with the A1 criterion (i.e., low objective severity), indicating that these events are better characterized as severe life stressors rather than trauma. The five most common events were being bullied or attacked ($n$ = 32); minor injury, accident, or illness ($n$ = 27); parental divorce or separation ($n$ = 19); death (not sudden) of a family member ($n$ = 18); and major injury or illness of a family member ($n$ = 11).

Table 1 shows the descriptive statistics and correlations for key study variables, including the mean subjective severity and the current perceived stress scores for those who experienced an event. Notwithstanding the difference in event classification for level of objective severity, there was no difference in subjectively per-

Table 1
*Means, SD, and Correlations for Key Study Variables*

| | High[a] | Low[a] | Correlations[b] | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean (*SD*) ($n$ = 34) | Mean (*SD*) ($n$ = 137) | 1 | 2 | 3 | 4 | 5 | 6 |
| 1. GG-PTG | 2.10 (0.72) | 1.77 (0.75) | | .34 | .08 | −.10 | −.03 | .12 |
| 2. SC-PTG | 1.87 (1.18) | 1.37 (1.00) | .52** | | −.14 | −.01 | −.16 | −.03 |
| 3. Severity | 4.79 (2.04) | 4.79 (1.79) | −.21* | −.13 | | .67** | .58** | .37 |
| 4. Stress | 3.00 (2.20) | 3.63 (1.80) | −.20* | −.08 | .68** | | .72** | .05 |
| 5. Intrusive | 2.65 (0.93) | 2.45 (0.92) | .04 | .14 | .30** | .48** | | .11 |
| 6. Deliberate | 2.28 (0.84) | 2.18 (0.93) | .30** | .29** | −.06 | .04 | .47** | |

*Note.* GG-PTG = General Growth factor of the PTGI-C-R; SC-PTG = Spiritual Change factor of the PTGI-C-R. Scores range from 0–3, with higher scores indicating more change/growth. Severity = subjective severity of the event (i.e., perceived stressfulness at the time of the event); Stress = perceived stressfulness at the survey point; scores range from 1–7, with higher scores indicating greater perceived stress. Intrusive = intrusive cognitive processing; Deliberate = deliberate cognitive processing; scores range from 1–4, with higher scores reflecting higher levels of recurrent cognitive activity.
[a] High refers to those who reported an event categorized as high in objective severity (i.e., the event met the *DSM–IV* A1 criterion); Low refers to those who reported a stressful event that was coded as the low objective severity. [b] Correlation coefficients for those with high objective severity are above the diagonal; correlations for those with low objective severity are below the diagonal.
* $p < .05$. ** $p < .01$.

ceived severity at the time of the event. Repeated measures ANOVA, with time since the event as a covariate, revealed that the stressfulness of the experience was perceived as higher at the time of the event than at the survey point, $F(1, 167) = 33.64$, $p < .001$, $\eta^2 = .17$. Moreover, there was a significant interaction effect, $F(1, 167) = 4.49$, $p < .05$, $\eta^2 = .03$, indicating that those who reported an event with low objective severity showed a less pronounced decrease in reported stress than those who reported an event with high objective severity. There was no significant impact of time since the event, $F(1, 167) = 1.64$.

## Factor Structure of the Japanese PTGI-C-R and Open-Ended Description of Growth

To examine whether the Japanese youth perceived distinct types of PTG, a principal components analysis with Varimax rotation was conducted separately for those with and without the experience of a designated event. Both analyses yielded the same two factors with eigenvalues greater than one, accounting for 62.66 and 61.75% of the common variance. The first factor (factor loadings ranged from .56 to .80 for those with trauma and from .68 to .79 for those without trauma) included eight items that reflect "General Growth," and the second factor (factor loadings were .87 and .90 for those with trauma and .85 and .87 for those without trauma) included the two items thought to capture "Spiritual Change." The individual/interpersonal characteristics of the items (i.e., "I can handle big problems better" "I learned how nice people can be") did not seem to affect the factor structure; rather, all of the items other than the spiritual change combined for one factor, labeled here "General Growth." The correlation between these two factors was .49 ($p < .001$) for those who experienced an event, and .46 ($p < .001$) for those who did not. The means of the items loading on each factor were used for subsequent analyses; "General Growth" (Cronbach's $\alpha = .89$ for those who reported an event, .89 for those who did not) and "Spiritual Change" ($\alpha = .80$ and .76, respectively).

Among the youth reporting a traumatic event, 58 provided responses to the open-ended question assessing the growth that might not be covered by the PTGI-C-R items. The most common responses included: the challenges involved in changing to be a "better" person ($n = 24$; e.g., "I learned that it was difficult to become a better person") or a "stronger" person ($n = 11$; e.g., "I learned that it was difficult to be stronger"); finding oneself oriented to others and their feelings more than before ($n = 6$; e.g., "I am kinder than before," "I am more caring," "I am less selfish") and the recognition of the value of education and hard work ($n = 6$, e.g., "I came to understand why we need to study . . . that way, we can learn how the world or society works").

## Comparisons Between PTG and Growth Without Experiencing Trauma

One-way ANOVA on the General Growth score of the PTGI-C-R showed that the effect of experiencing an event was significant, $F(2, 290) = 4.68$, $p < .05$, $\eta^2 = .03$. Post hoc analyses using the Scheffé test ($p < .05$) indicated that the level of General Growth in those who reported an event with high objective severity ($M = 2.10$, $SD = .72$) was higher than those who did not experience any event ($M = 1.66$, $SD = .70$) and marginally higher ($p = .078$) than those who reported an event with low objective severity ($M = 1.77$, $SD = .75$). Approximately 61% of those reporting an event with high objective severity, 48% of those with low objective severity, and 41% with no event obtained mean scores of 2.0 or higher on the General Growth composite of the Japanese PTGI-C-R, indicating an average response of "some" perceived change.

One-way ANOVA on the Spiritual Change score also showed that the effect of experiencing an event was significant, $F(2, 320) = 6.79$, $p < .01$, $\eta^2 = .04$. The post hoc comparisons using the Scheffé test ($p < .05$) showed that those who reported an event with high objective severity ($M = 1.87$, $SD = 1.18$) reported higher levels of Spiritual Change than those who did not experience any event ($M = 1.17$, $SD = .91$) and those who reported an event with low objective severity ($M = 1.37$, $SD = 1.00$). Thus, the hypothesis that those not experiencing any traumatic event would evidence lower levels of psychological growth than those who had was partially supported; however, the differences between those who reported an event with low objective severity and those who did not report any event were not significant.

## Assessing the Capability of Recognizing Personal Growth

Results from recoding the responses to the PTGI-C-R (0 for "*I don't know*" and 1 for all other choices including 0 "*no change*" to 3 "*changed a lot*") are shown in Table 2. Chi-square tests were conducted on each of the 10 PTGI-C-R items to examine the hypothesis that those who had not had any traumatic event would have greater difficulty in recognizing or considering their own growth. Results supported the hypotheses—those who had not reported an adverse event had more difficulty responding to each of the 10 items. In addition, of those who did not report any event, 43.6% were unable to perceive their own growth on at least one PTGI-C-R item, compared to 11.8% of those who reported an event. That is, as hypothesized, those who experienced a traumatic event were more likely able to assess and report about their own psychological growth (even if it was "no change") than those who did not.

## Impact of Severity and Cognitive Processing on PTG

Multiple regression analyses were conducted using only those participants who reported a trauma to examine the associations of subjective severity (perceived stressfulness at the time of the event), objective severity (dummy coded as "did not meet" or "did meet" A1 criterion for PTSD), intrusive/deliberate cognitive processing, and PTG. General Growth and Spiritual Change scores of the PTGI-C-R were examined separately as dependent variables. Because there were not meaningful differences in PTG related to the sex or age of the youth in the current sample, these variables were not included in the model. As shown in Table 3, the resulting model significantly predicted the General Growth score, $R^2 = .12$, adjusted $R^2 = .09$, $F(4, 119) = 4.01$, $p < .01$, and deliberate cognitive processing ($\beta = .30$, $t = 3.07$, $p < .01$) was the only individual variable to reach significance. The model predicting Spiritual Change also yielded significant results, $R^2 = .10$, adjusted $R^2 = .07$, $F(4, 122) = 3.42$, $p < .05$, and deliberate cognitive processing ($\beta = .21$, $t = 2.10$, $p < .05$) was significant,

Table 2
*Frequency and the Percentage of Responses Assessing Capacity to Recognize Growth in Those Who Experienced an Event and Those Who Did Not*

| | Those who reported a trauma ($n$ = 171) | | Those who did not report any trauma ($n$ = 237) | | |
|---|---|---|---|---|---|
| Japanese PTGI-C-R items | I don't know | All other choices[a] | I don't know | All other choices[a] | Results of $\chi^2$ test |
| I learned how nice and helpful people can be. | 12 (7.0%) | 159 (93.0%) | 52 (22.2%) | 182 (77.8%) | $\chi^2(1, N = 405) = 17.17^*$ |
| I can now handle big problems better. | 7 (4.1%) | 164 (95.9%) | 45 (19.0%) | 192 (81.0%) | $\chi^2(1, N = 408) = 19.81^*$ |
| I know what is important to me better. | 7 (4.1%) | 164 (95.9%) | 51 (21.5%) | 186 (78.5%) | $\chi^2(1, N = 408) = 24.73^*$ |
| I understand how nonhuman power (God, Buddha, or ancestors, etc.) works better. | 13 (7.6%) | 158 (92.4%) | 56 (23.6%) | 181 (76.4%) | $\chi^2(1, N = 408) = 18.16^*$ |
| I feel closer to other people. | 9 (5.3%) | 161 (94.7%) | 48 (20.3%) | 189 (79.7%) | $\chi^2(1, N = 407) = 18.39^*$ |
| I appreciate each day more. | 9 (5.3%) | 162 (94.7%) | 45 (19.0%) | 192 (81.0%) | $\chi^2(1, N = 408) = 16.29^*$ |
| I now have a chance to do things I couldn't do before. | 12 (7.0%) | 159 (93.0%) | 52 (21.9%) | 185 (78.1%) | $\chi^2(1, N = 408) = 16.73^*$ |
| My faith in nonhuman power (God, Buddha, or ancestors, etc.) is stronger. | 12 (7.0%) | 159 (93.0%) | 55 (23.2%) | 182 (76.8%) | $\chi^2(1, N = 408) = 18.97^*$ |
| I have learned that I can deal with more. | 12 (7.0%) | 159 (93.0%) | 65 (27.4%) | 172 (72.6%) | $\chi^2(1, N = 408) = 27.02^*$ |
| I have new ideas how I want things to be when I grow up. | 10 (5.8%) | 161 (94.2%) | 60 (25.4%) | 176 (74.6%) | $\chi^2(1, N = 407) = 26.68^*$ |

[a] All other choices include 0 (*no changes*) to 3 (*changed a lot*).
$^*$ $p < .001$.

though the objective severity of the event approached significance ($\beta = -.17$, $t = -1.91$, $p = .059$), indicating that higher levels of deliberate cognitive activity and objective severity were associated with greater Spiritual Change. These results partially support the hypothesis that deliberate cognitive processing would predict PTG, but did not support that subjective severity or intrusive cognitive processing would predict PTG.

## Discussion

PTG has been documented among adults and, more recently, in children and adolescents. Although previous research on PTG among youth experiencing the same specific event has yielded salient findings regarding PTG processes (e.g., Kilmer & Gil-Rivas, 2010a), this study addresses a prime question in the PTG literature involving nonadults: to what degree is perceived growth measured by the PTGI-C-R reported differently by those who experienced a trauma (i.e., PTG) and those who did not (i.e., growth not tied to a trauma)? Specifically, this study sought to examine differences in perceived growth among Japanese youth who experienced a trauma in the past year, those who had experienced stressful but not *DSM–IV*-defined traumatic events, and those who had not reported any adversity.

Analyses indicate that (1) the Japanese translated PTGI-C-R has good internal consistency and a two-factor structure; (2) those who experienced a trauma reported greater growth as measured by the PTGI-C-R than those who did not, and the objective severity of the adverse experience positively relates to the degree of growth experienced (see Table 1); (3) those who experienced a traumatic event were more able to perceive and report their own growth; and (4) deliberate rumination appears to play an important role in experiencing PTG among Japanese youth. The next paragraphs discuss these findings in turn. It bears highlighting that, while prospective longitudinal designs are necessary to conclude that the growth reported by youngsters is indeed PTG rather than change associated with normative maturation (see also Kilmer & Gil-Rivas, 2010a), the present findings suggest that the reports of PTG

Table 3
*Summary of Multiple Regression Analyses Examining Correlates of General Growth and Spiritual Change Among Participants Reporting Adverse Events*

| | General growth | | | Spiritual change | | |
|---|---|---|---|---|---|---|
| | B | *SE* | β | B | *SE* | β |
| Subjective severity[a] | −0.06 | .04 | −.14 | −0.09 | .06 | −.15 |
| Objective severity[b] | 0.23 | .17 | −.12 | −0.46 | .24 | −.17 |
| Intrusive cognitive processing | −0.02 | .02 | −.07 | 0.01 | .03 | .04 |
| Deliberate cognitive processing | 0.06 | .02 | .30$^{**}$ | 0.06 | .03 | .21$^*$ |
| $R^2$ | | | .12 | | | .10 |
| Adjusted $R^2$ | | | .09 | | | .07 |

[a] Subjective severity was assessed from the perceived stressfulness at the time of the event. [b] Objective severity was entered using dummy coding (0 = high objective severity; 1 = low objective severity).
$^*$ $p < .05$. $^{**}$ $p < .01$.

reflect change distinct from normative growth and development. Given that the PTG process is believed to be set in motion by the distress elicited in the context of one's struggle with a trauma and its aftermath, one would expect the significant difference observed here—specifically, those who perceived growth emerging from their experience of a trauma reported higher levels of positive personal change than those who did not report an adverse experience and, therefore, were reporting on self-perceived change over time (i.e., maturation). In the budding literature on PTG in children and youth, that constitutes the present work's most significant contribution.

Psychometric findings showed that the Japanese PTGI-C-R demonstrated a satisfactory internal consistency on par with that reported with the original, English version (Kilmer et al., 2009). Unlike the longer adult version (PTGI-J; Taku et al., 2007), the present factor analysis yielded a two-factor structure. The eight items developed to capture four of the five PTG domains were clustered as the current sample's General Growth factor, whereas Spiritual Change emerged as a second factor. Most of studies of PTG among children and youth have relied on the total score of the PTGI-C-R. Notably, a similar proportion of the present sample obtained General Growth scores indicating an average response of "some" to that reported among American youngsters impacted directly by Hurricane Katrina (Kilmer et al., 2009); however, that sample of American children also reported high Spiritual Change, whereas the Japanese children reported low levels, which is in accordance with studies on PTG among Japanese college students (Taku et al., 2007) as well as work with youth from other countries, such as Norway (e.g., Hafstad et al., in press). These findings suggest potential benefits of examining Spiritual Change separately depending upon the cultural or religious background of a given sample, reinforcing the merit of the factor analysis conducted on the PTGI-C-R items. It should be noted that the current results may reflect developmental or methodological issues, in addition to cultural differences. For example, factor analysis of responses from populations younger (e.g., under 10-years-old) or older (e.g., older than 16-years-old) than the present sample may yield different results. In addition, it is possible that interview methods or reports from third person observers could result in alternative findings than those obtained via self-report methods. Moreover, the two items associated with Spiritual Change were reworded to be more reflective of Japanese cultural and religious background, which may have contributed to their extraction as a separate factor.

Consistent with hypotheses, those who experienced *DSM–IV*-defined trauma exceeded those who did not report experiencing any adverse event and those who experienced an event with low objective severity on PTG. However, those who experienced an event with low objective severity and those who had not experienced an adverse event did not differ significantly. Overall, these results are consistent with previous findings (e.g., Alisic et al., 2008; Ickovics et al., 2006) and reinforce the notion that events reflecting trauma consistent with the *DSM–IV* A1 criterion seemingly contribute to greater levels of PTG. On the basis of prior work (e.g., Alisic et al., 2008) and the current results, it appears that the qualitative nature of the experience is indeed of relevance in that it must evoke sufficient "seismic" distress to catalyze a noteworthy perception of growth (e.g., Tedeschi & Calhoun, 2004).

The current study also showed that those who did not experience any trauma still reported some growth, a finding consistent with the results obtained with adults (Anderson & Lopez-Baez, 2008). To better understand factors that may be associated with event-related growth, this study tested the hypothesis that those not experiencing any traumatic event would have greater difficulty recognizing their own potential growth or nongrowth, whether it was not present or was a small or large change, because of the lack of a specific event to serve as an anchor point for comparisons. This hypothesis was supported; 43.6% of those who did not experience any event could not decide if they had grown on at least one item from the PTGI-C-R, whereas only 11.8% of those who reported an event could not decide. Perceiving one's own growth requires metacognition by comparing self "before" and "after." That the present sample could make the necessary temporal comparison is consistent with prior work (e.g., Harter, 2006; Kilmer et al., 2009), though the current results appear to support that experiencing a distinct life event facilitates this specific metacognitive ability. Consistent with reports among U.S. children (Cryder et al., 2006; Kilmer et al., 2009), there were not meaningful differences in PTG related to the sex or age of the youth in the current sample. Further work is necessary to understand the relationships among biological age, cognitive development, and PTG.

Finally, given that PTG models (e.g., Calhoun & Tedeschi, 2006; Kilmer, 2006; Tedeschi & Calhoun, 2004) emphasize the apparently catalytic roles of one's psychological struggle in trauma's aftermath, indicators of subjective/objective severity of the event as well as intrusive/deliberate cognitive processing directly related to what had happened are thought to be prime correlates of PTG. The present results yielded partial support for the hypothesis that deliberate cognitive processing and objective severity of the event would relate more strongly to PTG (though the contribution of objective severity to Spiritual Change was only marginally significant when it was analyzed with cognitive processing).

In contrast to previous findings (e.g., Kilmer et al., 2009), subjective severity was not significantly associated with PTG; however, when comparing across studies, it is necessary to take into account the nature of the adverse event(s) experienced and the means of operationalizing objective and subjective severity. For instance, the approach to classifying objective severity in the present study aligns with that of Alisic and colleagues (2008), rather than the objective exposure measures used in some other work (e.g., Kilmer et al., 2009; Kilmer & Gil-Rivas, 2010a). The present results also suggest that a more detailed measure of subjective severity (or the perceived seismicity of the experience) may be necessary to capture the impact of adverse experiences adequately. Put another way, more comprehensive assessment of objective and subjective severity of the event(s) may yield different results. As such, it would strengthen future research to investigate the degree to which the event has shaken one's beliefs, perhaps by using more clinical measures such as the UCLA-Posttraumatic Stress Disorder Reaction Index Revision 1 (Pynoos, Rodriguez, Steinberg, Stuber, & Frederick, 1998) or by adapting the Core Beliefs Inventory (Cann et al., 2010), developed to assess the level of disruption of adults' assumptive world, for youth samples.

Consistent with prior work involving U.S. youngsters (Kilmer & Gil-Rivas, 2010a), the present results highlight the critical contribution of deliberate cognitive processing to the PTG process. As

one study with Japanese and American undergraduates also showed that deliberate rumination was associated with greater PTG (Taku et al., 2009), deliberate rumination seems to play an important role in PTG process across cultures and developmental stages. That said, others have raised the possibility that the roles of such ruminative processes may vary by age; it is also possible that, at younger ages, supportive others play a more pronounced role in helping a youngster understand what has transpired, guiding his or her posttrauma coping and response, and fostering deliberate rumination (see, e.g., Kilmer & Gil-Rivas, 2010a). Although intrusive cognitive processing did not predict PTG in this sample, the dual types of cognitive processing have been the focus of considerable attention (see Watkins, 2008) and of PTG research (e.g., Cann, Calhoun, Tedeschi, Triplett, Vishnevsky, & Lindstrom, 2011). Thus, future work should examine the factors that foster deliberate cognitive processing following trauma and seek to elucidate the role of intrusive cognitive processing in the PTG process.

Consequently, although this study has some limitations, such as the small number of youth reporting trauma that met the A1 criterion, an exclusive reliance on youth self-reports, and the inclusion of a circumscribed set of constructs of potential relevance to the PTG process, this study extends PTG models for youth and existing findings by examining the role of event severity and cognitive processing in the PTG process and by distinguishing PTG and growth without experiencing an adverse event among Japanese youth. Specifically, the present investigation supports the notion that PTG does not simply reflect maturation and provides supportive results regarding the role of a specific trauma as a potential anchor point in youths' metacognitive ability to perceive personal growth. However, the quantitative comparisons we made in this study did not allow us to examine fully the range of potential qualitative differences between PTG and normative growth. Future research might examine these differences by adapting a phenomenological approach or qualitative study.

This study also lays important foundation for subsequent research, including the roles of proximate and distal cultural factors on PTG (Tedeschi & Calhoun, 2004). For instance, compared with children and youth in the United States (Ickovics et al., 2006; Kilmer et al., 2009), the overall level of PTG reported was rather low in the current sample. Relatively low average scores were also obtained in other research with non-U.S. children and youth (e.g., Hafstad et al., in press). It is possible that cultural factors may have contributed to this pattern of results. For example, as suggested by the potential influence of culture on PTG identified among Japanese college students (e.g., Taku et al., 2009), traditional Japanese cultural values may not encourage individuals to articulate positive change to the degree the U.S. culture does (e.g., Pals & McAdams, 2004). Furthermore, it bears mention that, because this study used a translation of a PTG measure originally developed within a Western cultural framework, items reflecting culture-specific growth might be missing. Indeed, responses to the open-ended question about psychological growth resulting from trauma included reports of realizing one's limitations (i.e., "I learned that it was difficult to become a stronger person"), which may point to a need to develop culturally sensitive measures of PTG, particularly for clinical application. Such findings lend support to others' conclusions that research must take culture and context into account when assessing PTG and the PTG process (Hafstad et al., in press; Kilmer et al., 2009). Future research is needed to better understand the differences in how PTG may manifest in youth across cultures.

Indeed, the process of adaption after trauma or the coping mechanisms related to each specific trauma might vary significantly from culture to culture, and PTG models (Calhoun & Tedeschi, 2006) suggest that culture can affect PTG in multiple interrelated ways, ranging from the type of trauma likely to be experienced to the content of PTG. Although research suggests the concept of PTG appears cross-culturally valid, the operationalization of the concept may serve to impose assumptions of a Western individualistic society (Splevins, Cohen, Bowley, & Joseph, 2010). In turn, Park, Chmielewski, and Blank (2010) suggest future research should examine the meaning of PTG in the broader contexts of the survivors' lives; thus, it will be critical to examine both cultural and contextual elements in PTG processes. Perhaps research would benefit from culture and context specific PTG models, rather than the singular PTG model that has been elaborated primarily within the United States or similar Western cultures.

Those working in clinical settings must also be sensitive and responsive to the unique backgrounds of those they serve. In work with youth who might have experienced trauma, clinicians must utilize culturally and developmentally appropriate interventions that are suitable to the context (e.g., Kilmer & Gil-Rivas, 2010b). Although the PTG research base needs further development and refinement, the current findings support the possible benefit of helping to guide productive event-related cognitive processing in youth as they reconstruct their narratives after trauma. Such steps may also facilitate PTG (Tedeschi & Kilmer, 2005).

## References

Alisic, E., van der Schoot, T. A. W., van Ginkel, J. R., & Kleber, R. J. (2008). Looking beyond posttraumatic stress disorder in children: Posttraumatic stress reactions, posttraumatic growth, and quality of life in a general population sample. *Journal of Clinical Psychiatry, 69,* 1455–1461.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Anderson, W. P., & Lopez-Baez, S. I. (2008). Measuring growth with the Posttraumatic Growth Inventory. *Measurement and Evaluation in Counseling and Development, 40,* 215–227.

Bellizzi, K. M., & Blank, T. O. (2006). Predicting posttraumatic growth in breast cancer survivors. *Health Psychology, 25,* 47–56.

Calhoun, L. G., Cann, A., Tedeschi, R. G., & McMillan, J. (2000). A correlational test of the relationship between posttraumatic growth, religion, and cognitive processing. *Journal of Traumatic Stress, 13,* 521–527.

Calhoun, L. G., & Tedeschi, R. G. (2006). The foundations of posttraumatic growth: An expanded framework. In L. G. Calhoun & R. G. Tedeschi (Eds.). *Handbook of posttraumatic growth: Research and practice* (pp. 3–23). Mahwah, NJ: Erlbaum.

Cann, A., Calhoun, L. G., Tedeschi, R. G., Kilmer, R. P., Gil-Rivas, V., Vishnevsky, T., & Danhauer, S. C. (2010). The Core Beliefs Inventory: A brief measure of disruption in the assumptive world. *Anxiety, Stress & Coping, 23,* 19–34.

Cann, A., Calhoun, L. G., Tedeschi, R. G., Triplett, K. N., Vishnevsky, T., & Lindstrom, C. M. (2011). Assessing posttraumatic cognitive processes: The event related rumination inventory. *Anxiety, Stress, & Coping, 24,* 137–156.

Clay, R., Knibbs, J., & Joseph, S. (2009). Measurement of posttraumatic growth in young people: A review. *Clinical Child Psychology and Psychiatry, 14,* 411–422.

Cryder, C. H., Kilmer, R. P., Tedeschi, R. G., & Calhoun, L. G. (2006). An exploratory study of posttraumatic growth in children following a natural disaster. *American Journal of Orthopsychiatry, 76,* 65–69.

Hafstad, G. S., Gil-Rivas, V., Kilmer, R. P., & Raeder, S. (2010). Assessing relationships between parental adjustment, family functioning, and posttraumatic growth in Norwegian children and adolescents following a natural disaster. *American Journal of Orthopsychiatry, 80,* 248–257.

Hafstad, G. S., Kilmer, R. P., & Gil-Rivas, V. (2011). Posttraumatic growth among Norwegian children and adolescents exposed to the 2004 tsunami. *Psychological Trauma: Theory, Research, Practice, and Policy.* doi:10.1037/a0023236

Harter, S. (2006). Self-processes and developmental psychopathology. In D. Cicchetti & D. J. Cohen (Eds.), *Developmental psychopathology, Vol. 1: Theory and method* (2nd ed., pp. 370–418). Hoboken, NJ: Wiley.

Helgeson, V. S., Reynolds, K. A., & Tomich, P. L. (2006). A meta-analytic review of benefit finding and growth. *Journal of Consulting and Clinical Psychology, 74,* 797–816.

Ickovics, J. R., Meade, C. S., Kershaw, T. S., Milan, S., Lewis, J. B., & Ethier, K. A. (2006). Urban teens: Trauma, posttraumatic growth, and emotional distress among female adolescents. *Journal of Consulting and Clinical Psychology, 74,* 841–850.

Janoff-Bulman, R. (1992). *Shattered assumptions.* New York: The Free Press.

Kilmer, R. P. (2006). Resilience and posttraumatic growth in children. In L. G. Calhoun & R. G. Tedeschi (Eds.), *Handbook of posttraumatic growth: Research and practice* (pp. 264–288). Mahwah, NJ: Erlbaum.

Kilmer, R. P., & Gil-Rivas, V. (2010a). Exploring posttraumatic growth in children impacted by Hurricane Katrina: Correlates of the phenomenon and developmental considerations. *Child Development, 81,* 1211–1227.

Kilmer, R. P., & Gil-Rivas, V. (2010b). Introduction: Attending to ecology. In R. P. Kilmer, V. Gil-Rivas, R. G. Tedeschi, & L. G. Calhoun (Eds.). *Helping families and communities recover from disaster: Lessons learned from Hurricane Katrina and its aftermath* (pp. 3–24). Washington, DC: American Psychological Association.

Kilmer, R. P., Gil-Rivas, V., Tedeschi, R. G., Cann, A., Calhoun, L. G., Buchanan, T., & Taku, K. (2009). Use of the revised Posttraumatic Growth Inventory for Children. *Journal of Traumatic Stress, 22,* 248–253.

Laufer, A., & Solomon, Z. (2006). Posttraumatic symptoms and posttraumatic growth among Israeli youth exposed to terror incidents. *Journal of Social and Clinical Psychology, 25,* 429–447.

Pals, J. L., & McAdams, D. P. (2004). The transformed self: A narrative understanding of posttraumatic growth. *Psychological Inquiry, 15,* 65–69.

Park, C. L., Chmielewski, J., & Blank, T. O. (2010). Post-traumatic growth: Finding positive meaning in cancer survivorship moderates the impact of intrusive thoughts on adjustment in younger adults. *Psycho-Oncology, 19,* 1139–1147.

Pynoos, R., Rodriguez, N., Steinberg, A., Stuber, M., & Frederick, C. (1998). *The University of California at Los Angeles Posttraumatic Stress Disorder Reaction Index (UCLA-PTSD RI) for DSM–IV (Revision 1).* Los Angeles: UCLA Trauma Psychiatry Program.

Salter, E., & Stallard, P. (2004). Posttraumatic growth in child survivors of a road traffic accident. *Journal of Traumatic Stress, 17,* 335–340.

Splevins, K., Cohen, K., Bowley, J., & Joseph, S. (2010). Theories of posttraumatic growth: Cross-cultural perspectives. *Journal of Loss and Trauma, 15,* 259–277.

Taku, K., Calhoun, L. G., Tedeschi, R. G., Gil-Rivas, V., Kilmer, R. P., & Cann, A. (2007). Examining posttraumatic growth among Japanese university students. *Anxiety, Stress, & Coping, 20,* 353–367.

Taku, K., Cann, A., Tedeschi, R. G., & Calhoun, L. G. (2009). Intrusive versus deliberate rumination in posttraumatic growth across US and Japanese samples. *Anxiety, Stress, & Coping, 22,* 129–136.

Tedeschi, R. G., & Calhoun, L. G. (1996). The Posttraumatic Growth Inventory: Measuring the positive legacy of trauma. *Journal of Traumatic Stress, 9,* 455–472.

Tedeschi, R. G., & Calhoun, L. G. (2004). Posttraumatic growth: Conceptual foundations and empirical evidence. *Psychological Inquiry, 15,* 1–18.

Tedeschi, R. G., & Kilmer, R. P. (2005). Assessing strengths, resilience, and growth to guide clinical interventions. *Professional Psychology: Research and Practice, 36,* 230–237.

Watkins, E. R. (2008). Constructive and unconstructive repetitive thought. *Psychological Bulletin, 134,* 163–206.

Weiss, T., & Berger, R. (2006). Reliability and validity of a Spanish version of the Posttraumatic Growth Inventory. *Research on Social Work Practice, 16,* 191–199.

Yu, X., Lau, J. T. F., Zhang, J., Mak, W. W. S., Choi, K. C., Lui, W. W. S., . . . Chan, E. Y. (2010). Posttraumatic growth and reduced suicidal ideation among adolescents at month 1 after the Sichuan earthquake. *Journal of Affective Disorders, 123*(1–3), 327–331.

Received July 13, 2010
Revision received April 25, 2011
Accepted May 6, 2011 ■