Thriving After Trauma: Posttraumatic Growth Following the Canterbury Earthquake Sequence

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Abstract

Existing theoretical models of posttraumatic growth hold that distress and struggle are necessary, to produce the challenges to world views believed essential for psychological growth. Such models do not incorporate the construct of psychological resilience, and existing research has not examined posttraumatic growth among resilient individuals. The current study explores the association of resilience and posttraumatic growth in a group of individuals coping well after moderate-to-high exposure to earthquake-related events in Canterbury, New Zealand, following an extended earthquake sequence, including four earthquakes of magnitude greater than 6.0 Mw that caused 185 deaths, thousands of injuries, and substantial damage to residential and commercial buildings and infrastructure. Posttraumatic growth, severity of trauma exposure, distress in response to earthquake-related events, and stressful life events were assessed in 101 Canterbury residents, aged 18 to 72 years of both genders, who were coping well after moderate-to-high exposure to earthquake-related events. Higher levels of posttraumatic growth were associated with higher levels of ongoing earthquake-related distress, and greater difficulty with life events over the previous five years. Women reported greater posttraumatic growth than men, particularly in the posttraumatic growth domains of appreciation of life, personal strength, and relating to others. Women reported higher levels of distress related to their earthquake experiences and more difficulty with stressful life events than men. Both distress and difficulty with life events appeared to mediate the association between gender and posttraumatic growth. Results indicate that higher levels of resilience were not associated with posttraumatic growth, and posttraumatic growth may therefore not be an aspect of resilience. Such findings are important for extricating the constructs of resilience and posttraumatic growth after trauma, and understanding that posttraumatic growth can exist in resilient individuals. This is because resilience does not appear to prevent an individual from processing an event to find positive significance in a traumatic event and to develop posttraumatic growth.

Keywords: *posttraumatic growth, resilience, gender, earthquake*

Good can come from bad. The concept of struggle producing strength is millennia old. Confucius is reputed to have said, “The gem cannot be polished without friction, nor man perfected without trials” (cited in Ji, 2008, p. 614). In the last three decades social science has broadened its focus from the negative aftermath of trauma to explore positive changes that individuals report as a result of their experiences with adversity (Joseph & Linley, 2005; Park, Cohen, & Murch, 1996; Tedeschi & Calhoun, 1996). Such positive change has been termed posttraumatic growth (Tedeschi & Calhoun, 1996).

Models of posttraumatic growth posit that a traumatic experience produces a distress response and challenges prior assumptive worldviews, thereby triggering coping strategies such as rumination, seeking social support, and taking action (Calhoun, Cann, & Tedeschi, 2010; Janoff-Bulman, 2004). An individual may then reflect on the experience, making sense of that experience

and finding positive outcomes as a result. It follows that trauma can lead to posttraumatic growth.

The psychological construct of resilience has been conceptualised in various ways, including a response to adversity in childhood (Masten & Tellegen, 2012), a character trait (Funder & Block, 1989), a function of biology (Kim-Cohen, Moffitt, Caspi, & Taylor, 2004), a process of positive coping after trauma (Mancini & Bonanno, 2010), and an ability to cope with stress in the face of adversity (Connor, 2006). It has also been debated whether posttraumatic growth is related to these understandings of resilience, is separate from resilience (Westphal & Bonanno, 2007), or whether it reflects one facet of resilience, such as the absence of pathology after high-risk circumstances (Lepore & Revenson, 2006). The current paper defines resilience as the subjective experience of coping well after moderate to high exposure to earthquake-related events, such as physical injury or illness, death of a loved one, witnessing falling buildings, seeing bodies, property loss, income loss, problems with housing caused by earthquake related events, not having sought treatment for earthquake-related distress, and assessed to be without psychiatric diagnoses, including posttraumatic stress disorder, major depression, or other anxiety disorders.

Little research has examined the association between such characteristics of psychological resilience and posttraumatic growth, including the effect of resilience on the posttraumatic growth process. Theories of posttraumatic growth imply that those with higher resilience may have less cause to reflect, and are less therefore likely to exhibit posttraumatic growth (Westphal & Bonanno, 2007). A psychologically resilient individual may be less disrupted or distressed by a traumatic event than a less resilient individual. Existing research has included those with varying levels of distress after traumatic events and has typically not measured resilience. This means it is not known whether resilient individuals may have different correlates of posttraumatic growth compared to those with trauma-related psychopathology.

Existing research has shown that posttraumatic growth can co-exist with symptoms of posttraumatic stress disorder and negative affect, including anxiety. Higher levels of peritraumatic distress and more posttraumatic stress disorder symptoms have been found to relate to greater posttraumatic growth in varied populations (Cadell, Regehr, & Hemsworth, 2003; Wild & Paivio, 2004). In these contexts, *peritraumatic distress* has referred to distress experienced at the time of and immediately after the potentially traumatic events. Some studies have found a curvilinear association between posttraumatic stress disorder symptoms and posttraumatic growth, with posttraumatic growth correlating positively with posttraumatic stress disorder symptoms up to a certain level of symptom severity, after which posttraumatic growth declines (Kunst, 2010). It has therefore been concluded that distress may produce posttraumatic growth until the level of distress becomes less manageable, after which stage an individual is less likely to exhibit posttraumatic growth.

Women have often been found to have higher levels of posttraumatic growth than men (Jin, Xu, & Liu, 2014; Vishnevsky, Cann, Calhoun, Tedeschi, & Demakis, 2010) although it is unclear exactly why this may be. Women are more likely to engage in some coping strategies than men (Tamres, Janicki, & Helgeson, 2002), specifically using positive self-talk, seeking emotional social support (Vingerhoets & Vanheck, 1990), and religious coping (Prati & Pietrantoni, 2009), all of which are associated with posttraumatic growth (Helgeson, Reynolds, & Tomich, 2006) and which may provide a framework for understanding trauma and the world surrounding it. Some posit that women may show more growth because they ruminate more than men, both deliberately, in the form of reflection, and negatively, in the form of brooding (Treynor, Gonzalez, & Nolen-Hoeksema, 2003). Higher levels of rumination, which has largely been conceptualised neutrally in posttraumatic growth research and is therefore similar to reflection, appear associated with greater posttraumatic growth (Calhoun et al., 2000; Cann et al., 2011; Taku et al., 2008). Posttraumatic growth has also been found to relate to personality traits such as extraversion, optimism, openness to experience, conscientiousness, and religiosity (Linley & Joseph, 2004). Women report more distress in response to traumatic events (Fergusson, Boden, Horwood, & Mulder, 2014) while some associations may exist among gender, aspects of distress, and posttraumatic growth.

The current research examined postraumatic growth among resilient individuals exposed to a major disaster in the Canterbury region of New Zealand. Four major (Mw > 6.0), and thousands of more minor, earthquakes occurred in this region over the years 2010-2011. They resulted in 185 deaths, thousands of injuries, major property and infrastructure damage throughout the city,

and loss of the majority of the central business district. Considering the severity of related trauma, associations among posttraumatic growth and resilience, severity of trauma exposure, peritraumatic distress, ongoing earthquake-related distress, stressful life events, gender, and age were explored among an identifiably resilient sample of individuals exposed to the 2010-2011 Canterbury earthquake sequence.

The following hypotheses were proposed: 1. That posttraumatic growth will show a negative association with resilience, such that higher resilience will relate to lower levels of posttraumatic growth; 2. That moderate levels of distress will be associated with more posttraumatic growth than low or high levels of distress; 3. That objective severity of threat exposure will relate positively to posttraumatic growth; 4. That women will score more highly than men on the Posttraumatic Growth Inventory, particularly on the subscales of relating to others, new possibilities, personal strength, and spiritual change; 5. That women will score more highly than men on measures of distress, specifically reporting higher levels of peritraumatic distress, distress associated with exposure to earthquake events and difficulty with life events; and 6. That gender and age will interact, such that age will not influence posttraumatic growth in men, but older women will show higher levels of posttraumatic growth.

Given the previously mixed findings concerning associations between prior life stressors and posttraumatic growth, a further exploratory question was included: Whether the number of life stressors in the 5 years and 6 months prior to assessment will relate to levels of posttraumatic growth.

Method

Participants

Participants were Canterbury residents, who were resilient in spite of moderate to high exposure to earthquake-related events such as physical injury or illness, death of a loved one, witnessing falling buildings, seeing bodies, property loss, income loss, or problems with housing caused by earthquake related events. Resilience was defined as: the subjective experience of coping well, not having sought treatment for earthquake-related distress, and assessed to be without psychiatric diagnoses, including posttraumatic stress disorder, major depression, or other anxiety disorders. Participants were recruited in response to articles, opinion pieces and community notices in local newspapers, and via word of mouth.

Procedure

Potential participants were screened by telephone to determine that they had moderate to high exposure to earthquake-related events, and were coping well. Screened participants then attended the Clinical Research Unit of the University of Otago, Christchurch, where it was confirmed that inclusion criteria were met and, once the project was explained, written consent was obtained. Assessments were conducted by assessors trained in all aspects of the research protocol. Each participant completed the full assessment protocol with one assessor, usually on a single occasion, with the structured diagnostic interview followed by the self-report questionnaires. Recruitment occurred over the course of 13 months, from January 2013 to February 2014, which was two to three years after the September 2010 and February 2011 earthquakes.

Posttraumatic growth. The Posttraumatic Growth Inventory (PTGI) (Tedeschi & Calhoun, 1996) is a 21-item self-report scale that measures aspects of positive psychological consequences after potentially traumatic or stressful experiences, including motor vehicle accidents, assault, terrorism, and disasters including earthquakes. Responses are on a 0-5 Likert-type scale with scores ranging from 0-105 for the total scale. Domains of growth and subscale ranges include: relating to others (0-35), new possibilities (0-25), personal strength (0-20), spiritual change (0-10), and appreciation of life (0-15).

Resilience. The Connor-Davidson Resilience Scale (CD-RISC) (Connor & Davidson, 2003) assesses characteristics of resilient individuals such as commitment, viewing change as a challenge, strong self-confidence, adaptability to change, stress having a strengthening effect, social problem-solving skills, sense of humour in the face of adversity, patience, ability to withstand stress or pain, responding to tasks using action, having a realistic sense of control and recognising the limits to one's control, and developing goals to meet difficulties (Kobasa, 1979; Lyons, 1991; Rutter, 1985). Respondents rate the 25 items on a five-point Likert-type scale, with total scores ranging from 25 to 95, higher scores indicating greater resilience.

Severity of trauma exposure. The Traumatic Exposure Severity Scale (TESS) (Elal & Slade, 2005) is a 24-item self-report scale measuring potentially traumatic events

and distress in response to earthquakes. It has two parts, the first measuring the occurrence of a range of potentially traumatic events or experiences, yielding an occurrence score from 0 to 24. Types of trauma assessed fall under five subscales: Resource loss/ being in need, damage to home and goods, personal harm, concern for significant others, and exposure to the grotesque. The second part measures distress associated with these experiences on a five-point Likert-type scale, with 1 signifying no distress at all, and 5 signifying extreme distress, producing a distress score from 0 to 120.

Level of peritraumatic distress. The Peritraumatic Distress Inventory (PDI) (Brunet et al., 2001) is a 13-item questionnaire that uses a 5-point Likert-type scale to assess the level of distress during and immediately after a potentially traumatic event. Focusing particularly on the experience of distress in response to an event, items tap two factors, negative feelings, and perceived life threat and bodily arousal. In the current study the total scale score is the mean of all items, with the score range from 0 to 5. A score of 1.77 or more predicts likelihood of developing post-traumatic stress disorder (PTSD) (Guardia et al., 2013).

Stressful life events. The Crisis in Family Systems Scale (CRISYS) (Shalowitz, Berry, Rasinski, & Dannhausen-Brun, 1998) is a 63-item self-report scale, modified for the current study with three additional items, that measures the number of life events experienced in the six months prior to assessment and the difficulty perceived from experiencing each of these events. All items are rated on a 5-point Likert-type scale. For the purposes of the current study, participants were also asked whether they had experienced these stressful life events in the previous five years. Stressful event response options included: financial events, legal events, career events, relationship events, medical events pertaining to self, medical events pertaining to others, safety in the community, safety at home, home issues, difficulty with authority, and prejudice. Scores for occurrence of current life events and for the past five years can range from 0 to 63. Difficulty scores were given for each life event, ranging from 1 to 5 where 1 represents no difficulty at all and 5 represents extreme difficulty. The mean difficulty score was calculated by dividing the sum of the ratings by the number of stressors reported.

Psychiatric comorbidity. Participants were assessed for the presence of psychiatric disorders using the Mini International Neuropsychiatric Interview (MINI) (Sheehan et al., 1998). This interview yields diagnoses for PTSD, other anxiety disorders, mood and other disorders corresponding to DSM diagnoses.

Data analyses

Pearson's correlation coefficients tested the association of posttraumatic growth scores and measures of resilience, distress, and the number of potentially traumatic events experienced during the earthquakes. Student's t-tests compared the scores of males and females for normally distributed subscales of the PTGI, measures of distress, and severity of earthquake exposure, and Mann-Whitney tests were applied to non-normally distributed subscales. General linear models were constructed to test for an interaction between age and gender to ascertain whether age affected posttraumatic growth for males and females, respectively.

Hierarchical regression analysis tested for linear and curvilinear associations between posttraumatic growth and distress during and since the earthquakes, and due to stressful life events in the previous five years. To test for the possibility of a curvilinear association between each distress measure and posttraumatic growth, a hierarchical regression was conducted with posttraumatic growth as the dependent variable. A new predictor variable was generated to test for a curvilinear association by mean-centring and squaring distress scores (Cohen, Cohen, West, & Aiken, 2013). The original distress score was entered in step one of the hierarchical regression, and the squared distress score was entered in step two. The linear regression and curvilinear regression were compared to ascertain goodness of fit for each regression model. Hierarchical regression was also used, to examine the mediating effect of gender on the association between earthquake-related distress and posttraumatic growth.

Power analysis: The final sample of 101 provided sufficient power (80%): to detect statistically significant ($p < .05$) correlation coefficients greater than 0.27. Sufficient power was also predicted for a 2:1 gender ratio, to detect statistically significant ($p < .05$), moderate effect sizes (> 0.6) between genders. All power analyses assumed a two-tailed test for statistical significance.

Results

The sample comprised 101 residents, 34 males and 67 females, of Canterbury, New Zealand, aged 18 to 72 years, with an average age of 50.1 years (SD = 11.02 years). Seventy-nine participants were of New Zealand European descent, with one participant of Māori descent, one of Cook Island Māori descent, one Indian, and others from German, Chinese, Irish, Celtic, and other European descent. Median education level was a university degree (bachelor's degree or diploma).

Posttraumatic growth, resilience, distress, and events

Means and standard deviations for scores on PTGI, CD-RISC, TESS, PDI and CRISYS scales are reported in table 1. PTGI scores were normally distributed, with a mean score of 37.44 (*SD* = 22.58), ranging from 0 to 93, of a maximum possible score of 105. Mean subscale scores were converted to percentages in order to compare a percentage of endorsement for each subscale. These calculations produced average endorsements of 43 percent for personal strength, 42 percent for appreciation of life, 37 percent for relating to others, 31 percent for new possibilities, and 16 percent for spiritual change. Resilience scores from the CD-RISC were also normally distributed, with a mean score of 75.92 (*SD* = 12.01) of a possible 100. The mean resilience score for the current study is comparable to means from USA-based research (*M* = 75.7, *SD* = 13.0, to *M* = 83.0, *SD* = 13.4) and from Australia-based research (*M* = 71.3, *SD* = 10.8, to *M* = 73.4, *SD* = 13.6) (Connor & Davidson, 2015).

Table 1. *Means and Standard Deviations for Posttraumatic Growth, Resilience, Distress, and Stressful Life Events Measures*

Scale or subscale	Scale Range	Mean	SD
Posttraumatic Growth Inventory total score	0-105	37.44	22.58
Subscales			
Relating to Others	0-35	12.99	8.40
New Possibilities	0-25	7.75	6.08
Personal Strength	0-20	8.65	5.21
Spiritual Change	0-10	1.60	2.56
Appreciation of Life	0-15	6.34	3.78
Connor Davidson Resilience Scale	25-95	75.92	12.05
Traumatic Exposure Severity Scale			
Subscales			
Occurrence (number of stressful elements of earthquake experiences)	0-24	5.15	2.56
Distress (distress related to stressful elements of earthquake experiences)	0-120	15.42	10.80
Peritraumatic Distress Inventory total score	0-5	1.03	.63
Crisis in Family Systems Scale			
Subscales			
Life events in last 5 years	0-63	8.47	4.90
Life events in last 6 months	0-63	3.56	2.81
Difficulty with life events in last 5 years	1-5	2.05	.69

Scores on the CD-RISC resilience scale and the PTGI posttraumatic growth inventory were not significantly correlated ($r(99) = .10$, $p = .35$). A linear association was identified between the level of distress experienced during the earthquakes, as measured by the PDI, and posttraumatic growth, as measured by the PTGI. Greater distress predicted higher levels of reported posttraumatic growth. Peritraumatic distress explained 18% of the variance in post-traumatic growth ($R^2 = .18$, $F(1, 97) = 21.7$, $p < .001$; $\beta = .43$, $p < .001$). Curvilinear regression was not associated with a significant improvement in model fit compared to the linear model ($R^2 = .00$, $F(1, 91) = .02$, $p = .90$). This indicated that there was no significant reduction in posttraumatic growth, for participants experiencing higher levels of distress during the earthquakes. Instead as reported distress levels increased, so did reported levels of posttraumatic growth.

There was a significant positive correlation of medium magnitude between scores on the TESS distress subscale and scores on the PTGI inventory for posttraumatic growth ($r(100) = .44$, $p < .001$) with higher levels of posttraumatic growth associated with higher reported distress during and since the earthquakes. A linear association was found between difficulty with life events and posttraumatic growth, such that greater difficulty predicted higher levels of reported posttraumatic growth. Difficulty explained 20 percent of the variance in post-traumatic growth ($R^2 = .20$, $F(1, 98) = 24.91$, $p < .001$). Curvilinear regression showed no significant improvement in model fit from the linear model ($R^2 = .02$, $F(1, 97) = 2.68$, $p = .11$). This indicated that as difficulty with life events increased, so did posttraumatic growth.

A significant positive correlation of medium magnitude ($r = .33$, $p < .01$) was found between the number of earthquake-related traumatic events experienced and the level of posttraumatic growth. This indicated that a higher number of traumatic events experienced by

participants related to greater posttraumatic growth. No association was found between posttraumatic growth and stressful general life events.

Gender differences

Females had higher PTGI posttraumatic growth scores than males ($t(98) = -2.18$, $p = .03$). Females had higher scores than males on the appreciation of life subscale ($t(99) = -2.00$, $p = .05$) and relating to others subscale ($t(98) = -2.16$, $p = .03$) and personal strength subscale ($t(99) = -2.45$, $p = .02$). A Mann-Whitney test found no significant difference between males and females for the Spiritual Change subscale ($U = -0.87$, $n_1 = 34$, $n_2 = 67$, $p = .39$). Age and gender were entered into a general linear model and an interaction between age and gender was tested to ascertain whether older women showed more posttraumatic growth than younger women. This also tested whether age was related to posttraumatic growth in men. However, no significant interaction was found between gender and age for posttraumatic growth ($R^2 = .07$, $F(1, 96) = .56$, $p = .46$).

A significant difference was found between men and women in the level of distress reported during the earthquake sequence on the PDI ($t(98) = -2.07$, $p = .04$), with males' mean score ($M = .85$, $SD = .60$) lower than that of females ($M = 1.12$, $SD = .64$). However the magnitude of the difference between means ($M = -.27$, 95% CI: -.53 to -.01) was small to moderate ($\eta_2 = -0.045$). No significant difference was found between genders on distress related to the severity of trauma exposure ($t(96) = -.73$, $p = .47$). Nor was there a significant difference between genders in the incidence of trauma exposure ($t(99) = -.09$, $p = .93$). This indicated that male and female participants reported comparable numbers of stressful events during and since the earthquakes, and reported comparable distress about traumatic earthquake-related events, but that women had higher distress at the time of the earthquakes.

No difference was found between men and women in the number of stressful life events reported over the last five years ($t(99) = .05$, $p = .96$), however women reported significantly more difficulty associated with stressful life events ($M = 2.17$, $SD = .67$) than men ($M = 1.84$, $SD = .70$) ($t(99) = -2.3$, $p < .05$). The magnitude of the difference between the means (95% CI [-.61 -.05]) was small to moderate ($\eta_2 = -0.05$).

Given the associations between gender and distress, distress and posttraumatic growth, and gender and posttraumatic growth, a mediation analysis (hierarchical regression) was conducted to examine the possibility that distress during the earthquakes mediated the association of gender and posttraumatic growth. Gender was entered at step one, explaining five percent of the variance in posttraumatic growth. After the distress variable was entered at step two, the total variance of posttraumatic growth explained by gender and distress was 20 percent ($R^2 = .20$, $F(2, 96) = 11.97$, $p < .001$). Distress explained an additional 16% of the variance in posttraumatic growth change ($R^2 = .16$, $F(1,96) = 18.55$, $p < .001$). The Sobel test examined the significance of the mediation effect, indicating that the mediation was almost statistically significant ($p = .052$). As illustrated in figure 1, the sum of these results suggest that the association of gender and posttraumatic growth may be mediated by peritraumatic distress.

A second hierarchical regression was conducted to ascertain whether the reported difficulty of life events in the last five years mediated the association between gender and posttraumatic growth. Gender was entered at Step one, explaining five percent of the variance in posttraumatic growth. After difficulty with life events was entered at step two, the total variance of posttraumatic growth explained by gender and life event difficulty was 22 percent ($R^2 = .22$, $F(2,97) = 13.5$, $p < .001$). Life event difficulty explained an additional 17 percent of the variance in posttraumatic growth change ($R^2 = .17$, $F(1,97) = 21.25$, $p < .001$). A Sobel test indicated that

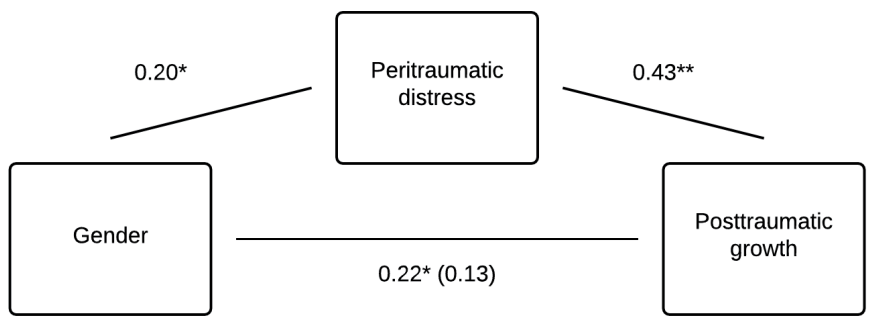

Figure 1. Mediating effect of peritraumatic distress on the association between gender and posttraumatic growth.

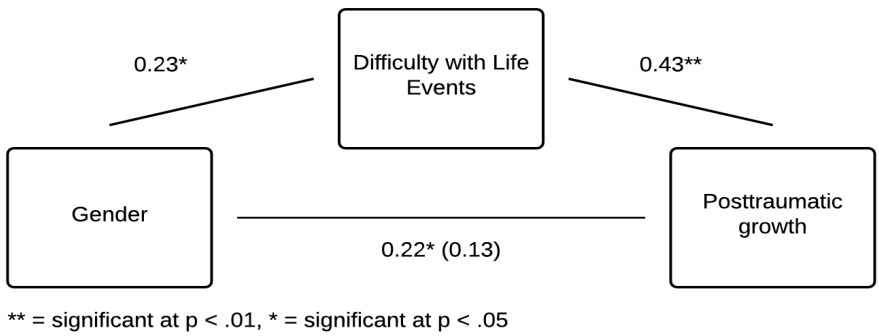

Figure 2. Mediating effect of difficulty with life events on the association between gender and posttraumatic growth.

the mediation was significant (p = .049). The association between gender and posttraumatic growth was mediated by reported difficulty with life events, as shown in figure 2.

Discussion

Results of the current study did not support hypothesis 1, that posttraumatic growth would be negatively associated with resilience, such that higher resilience would relate to lower levels of posttraumatic growth. In the current sample of individuals coping well, the level of resilience was not associated with levels of posttraumatic growth. Hypothesis 2 was not supported: Contrary to the hypothesis, moderate levels of distress were not associated with more posttraumatic growth than low or high levels of distress. In the current study, a linear association was found, with higher levels of distress related to higher levels of posttraumatic growth. Hypothesis 3 was supported: Objective severity of threat exposure was related positively to posttraumatic growth, with exposure to more earthquake-related traumatic events associated with greater posttraumatic growth. Hypothesis 4 was partially supported: Women scored more highly than men on the Posttraumatic Growth Inventory, and on the subscales of relating to others and personal strength. In addition women scored more highly on the subscale of appreciation of life. However, contrary to this hypothesis, women did not score significantly differently than men on the subscales of new possibilities and spiritual change. Results partially supported Hypothesis 5: Women reported higher levels of peritraumatic distress, and more difficulty with life events. However women reported levels of distress about traumatic earthquake-related events, such as damage to housing, loss of services, injury, concern about others and needing to relocate due to unsafe homes comparable to those reported by men. Hypothesis 6 was not supported: Gender and age did not interact; age did not influence levels of posttraumatic growth for women or men. The number of life stressors in the 5 years and 6 months prior to assessment did not relate to levels of posttraumatic growth.

Conclusion

Results from the current study indicate that variations in levels of resilience in a sample coping well after trauma are not associated with levels of posttraumatic growth. This finding is important for extricating the constructs of resilience and posttraumatic growth after trauma, and understanding that posttraumatic growth can occur for resilient individuals. Resilience does not appear to prevent an individual from processing and finding positive significance in a traumatic event and thereby developing posttraumatic growth. This resilient sample reported peritraumatic distress and difficulty with earthquake-related events, but did not exhibit psychopathology, indicating that these individuals experienced distress and managed it, contributing to the process of posttraumatic growth. It has been assumed that not experiencing distress prevents the erosion of assumptive worldviews, and the triggering of coping strategies, and thereby the reconstruction of revised worldviews and the posttraumatic growth that ensues (Calhoun et al., 2010; Janoff-Bulman, 2004). The current study's findings suggest that resilient individuals, in addition to coping with adversity and maintaining equilibrium, experience and manage distress that contributes to posttraumatic growth.

Among individuals coping well, higher levels of posttraumatic growth were associated with higher levels of peritraumatic distress, higher ongoing earthquake-related exposure, and greater difficulty with life events over the five years prior to assessment, which included events up to three years before the Canterbury earthquake sequence. The associations were linear in the current study, not curvilinear with growth declining above a certain level of posttraumatic stress, as previously reported by Kunst (2010). It is possible that

levels of peritraumatic distress were not sufficiently high for this curvilinear association to be demonstrated, or that the growth-distress association is linear in this population. Further, whereas the number of potentially traumatic earthquake-related events was related to levels of posttraumatic growth, with higher posttraumatic growth occurring for individuals with more earthquake related exposure, number of life events was not related to posttraumatic growth.

Further, Janoff-Bulman (2004) suggested that some domains of posttraumatic growth, such as viewing the self as stronger, can emerge when worldviews are challenged without the distress or psychological dysfunction following trauma. This may partially account for a finding from the current study, that resilient individuals experienced posttraumatic growth. However, resilient participants in the current study showed growth in domains of posttraumatic growth other than personal strength, such as relationships with others, seeing new possibilities, and greater appreciation of life.

These findings may indicate that worldviews were challenged for resilient individuals in the current study, and that this triggered a rebuilding of perspectives to bring about posttraumatic growth. Alternatively, they may indicate that posttraumatic growth can happen without worldviews being challenged. Future research is needed with resilient populations to explore the extent that the challenge to worldviews contributes to posttraumatic growth. Relatively high resilience scores observed in the current study nonetheless support the recruitment process for participants, which aimed to encompass the subjective experience of coping well in the post-earthquake period after moderate to high earthquake exposure.

Women reported higher levels of posttraumatic growth than men, particularly in appreciation of life, personal strength, and relating to others. Women experienced higher peritraumatic distress than men and more difficulty with stressful life events than men. It also appears that distress concerning earthquake-related events and difficulty with life events in general may have mediated the association between gender and posttraumatic growth. Fergusson et al. (2014) found the same positive linear association between recalled distress associated with the Christchurch earthquakes and positive changes after the earthquakes, using a different methodology and a sample representative of the general Christchurch population. Considered alongside Fergusson et al. (2014), the current study's findings suggest that the distress and difficulty of dealing with trauma-related or general life events may be an important influence on the development of posttraumatic growth. For resilient individuals in the current study, degree of resilience did not relate to posttraumatic growth, whereas degree of distress and difficulty did relate to posttraumatic growth. This is comparable to previous studies, by Cadell et al. (2003) and Wild and Paivio (2004), which found the severity of distress and posttraumatic symptoms was related to posttraumatic growth.

Limitations of the current study include its cross-sectional design, which does not allow the observation of causal associations across various stages of a longitudinal timeframe. Future research could use longitudinal designs to clarify associations among traumatic exposure, peritraumatic distress, life events, gender, and posttraumatic growth. The current participants were resilient by definition and this has not allowed a full exploration of the association between resilience and other constructs of interest. The current sample also had a higher level of educational attainment than the general population. This means that results may not generalise to the wider earthquake-affected population.

The current study also has a number of strengths. It appears to be the first study to provide a focused examination of posttraumatic growth in a group of individuals coping well after a major community-wide trauma. The current findings contribute to understanding growth in resilient individuals after earthquakes in Western populations. They are also likely to contribute to understanding responses to other trauma and in other populations. The current findings have also highlighted a potential for further research to explore the associations among gender, distress, and posttraumatic growth in more detail. Most importantly, associations between posttraumatic growth and different types of distress and difficulty, identified by the current research, lend support and add to pre-existing models of how emotional distress can lead to posttraumatic growth.

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