

Trajectories of Posttraumatic Growth and Depreciation After Two Major Earthquakes

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This study examined trajectories of posttraumatic growth or depreciation (i.e., positive or negative life change) in personal strength and relationships after 2 major earthquakes in Canterbury, New Zealand using group-based trajectory modeling. Participants completed questionnaires regarding posttraumatic growth or depreciation in personal strength and relationship domains 1 month after the first earthquake in September 2010 ($N = 185$) and 3 months ($n = 156$) and 12 months ($n = 144$) after the more severe February 2011 earthquake. Three classes of growth or depreciation patterns were found for both domains. For personal strength, most of the participants were grouped into a “no growth or depreciation” class and smaller proportions were grouped into either a “posttraumatic depreciation” or “posttraumatic growth” class. The 3 classes for relationships all reported posttraumatic growth, differing only in degree. None of the slopes were significant for any of the classes, indicating that levels of growth or depreciation reported after the first earthquake remained stable when assessed at 2 time points after the second earthquake. Multinomial logistic regression analyses examining pre- and postearthquake predictors of trajectory class membership revealed that those in the “posttraumatic growth” personal strength class were significantly younger and had significantly higher pre-earthquake mental health than those in the “posttraumatic depreciation” class. Sex was the only predictor of the relationship classes: No men were assigned to the “high posttraumatic growth” class. Implications and future directions are discussed.

Keywords: natural disaster, prospective, posttraumatic growth, posttraumatic depreciation, group-based trajectory modeling

In September 2010, a 7.1 magnitude earthquake struck 40 km west of Christchurch, New Zealand’s second biggest city. The earthquake caused significant damage, but remarkably no deaths. Then, in February 2011, a 6.3 magnitude earthquake struck Christchurch. The epicenter of this earthquake was much closer to the city and resulted in 185 deaths, numerous injuries, and months of aftershocks. In addition to significant damage to buildings and land, infrastructure, sewerage, and water supply were severely affected, causing major disruption to the daily lives of residents (see [McColl & Burkle, 2012](#), for a detailed account).

Before the first earthquake, we were in the midst of a longitudinal study on the health and well-being of residents in Christchurch and the surrounding regions (see [Kuijer, Marshall, & Bishop, 2014](#)). As a result, we were able to assess the short- and

long-term impact of the earthquake on our study sample. The second earthquake unfortunately provided the unique opportunity to prospectively assess the impact of repeated earthquake exposure. In this article we use these data to address questions about the temporal course of self-reported posttraumatic growth (and depreciation) after the first earthquake and how these reports were affected by the experience of the second earthquake using statistical techniques that allow for individual differences in trajectories over time. We also examine predictors of these trajectories as a secondary aim.

These questions are important for several reasons. First, it is relatively common for individuals to experience a natural disaster in their life time (e.g., [Briere & Elliott, 2000](#)). Second, repeated exposure to natural disasters is not unusual because many geographical locations are vulnerable to particular disasters such as flooding, hurricanes, tornados or earthquakes. Thus, understanding the psychological impact of experiencing a natural disaster, as well as repeated disasters, is crucial. Third, it is important to focus on posttraumatic growth because, although individuals are vulnerable to experiencing a range of negative psychological outcomes post-disaster (e.g., posttraumatic stress symptoms, depressive symptoms; [Bonanno, Brewin, Kaniasty, & La Greca, 2010](#); [Kuijer et al., 2014](#)), a growing body of research over the past few decades indicates that most individuals report positive psychological outcomes posttrauma, such as greater personal strength or closer

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relationships after disasters (e.g., McMillan, Smith, & Fisher, 1997; Xu & Liao, 2011) and other traumas (e.g., Affleck, Tennen, Croog, & Levine, 1987). We focus on posttraumatic depreciation (i.e., negative life changes) as well as growth given concerns in the literature about the exclusive focus on positive life changes in the posttraumatic growth literature. Finally, it is important to assess individual differences in trajectories of self-reported growth over time because not all individuals respond in the same manner to traumatic events. To provide the background for our study, prior theory and research on the temporal course of posttraumatic growth and depreciation, repeated trauma exposure, and predictors of posttraumatic growth are reviewed below.

Occurrence and Development of Posttraumatic Growth

Numerous studies have investigated the occurrence of posttraumatic growth after a range of traumas, including earthquakes (e.g., Xu & Liao, 2011). Most individuals report experiencing growth in personal strength (e.g., increased ability to cope with stress), relationships (e.g., increased closeness with friends and family), and other life domains. Less is known about how growth develops over time (Linley & Joseph, 2004). Key theorists (Tedeschi & Calhoun, 2004) have argued that traumatic events spark unconscious rumination, which is followed by deliberate rumination that then leads to the development of posttraumatic growth. An assumption of this theory is that posttraumatic growth should take time to develop and increase over time. In contrast, other theorists (e.g., Taylor & Armor, 1996) propose that posttraumatic growth is a coping strategy rather than an outcome and thus may occur soon after a trauma. According to this perspective, self-reported posttraumatic growth may not reflect actual change, but rather a “positive illusion” (Taylor & Armor, 1996). An associated assumption is that posttraumatic growth would remain stable or decrease over time as the traumatic event becomes less salient. Zoellner and Maercker (Maercker & Zoellner, 2004; Zoellner & Maercker, 2006) have argued in their two-component model (also called the Janus-Face Model) that both perspectives are valid and that posttraumatic growth has both illusory and constructive or functional components.

Fourteen longitudinal studies were found that have assessed posttraumatic growth over time. Of these studies, only two found a significant increase in average levels of self-reported posttraumatic growth over time (Frazier, Tashiro, Berman, Steger, & Long, 2004; Manne et al., 2004) and two found an increase over time only among individuals with high trauma severity (Thornton et al., 2012) or low initial levels of self-reported growth (Schwarzer, Luszczynska, Boehmer, Taubert, & Knoll, 2006). However, eight (Affleck et al., 1987; Frazier, Conlon, & Glaser, 2001; Davis & Novoa, 2013; Linley & Joseph, 2006; Llewellyn et al., 2013; McMillan et al., 1997; Silva, Crespo, & Canavarro, 2012; Thompson, 1985) found no significant changes over time. Only two studies (Butler et al., 2005; Dekel, Ein-Dor, & Solomon, 2012) found a significant decrease over time. Thus, despite some mixed results, it appears that self-reported posttraumatic growth generally remains stable over time. These findings are contrary to Tedeschi and Calhoun's (2004) theory of rumination leading to growth over time and in line with the coping theory of growth (e.g., Taylor & Armor, 1996).

Although these longitudinal studies shed some light on the temporal course of self-reported growth, they are limited in various respects. One important limitation is that all of these studies assessed average levels of self-reported posttraumatic growth. In research on posttraumatic distress, assessing only average responses has been found to mask meaningful patterns of individual variation in trajectories (e.g., Bonanno, 2004; Norris, Tracy, & Galea, 2009). Specific to natural disasters, Norris et al. (2009) found four distinct classes of distress postflood, including a resistance class (low stable symptoms across time), a resilience class (initially moderate symptoms that declined abruptly over time), a recovery class (initially moderate to severe symptoms that declined gradually), and a chronic class (moderate to severe symptoms that remained stable). Assessing individual differences in trajectories of growth, rather than average responses, would help resolve theoretical debates about the nature of posttraumatic growth. For instance, determining that some individuals experience an increase in growth whereas others experience stability or a decrease would support the two-component model (Maercker & Zoellner, 2004; Zoellner & Maercker, 2006).

There are other limitations of the existing longitudinal studies. First, only three of these longitudinal studies (Linley & Joseph, 2006; McMillan et al., 1997; Thompson, 1985) assessed the potentially unique impact of natural disasters on posttraumatic growth. Gathering information specific to the timing and course of self-reported growth after natural disasters is important because self-reports of growth have been found to differ across traumatic events. For example, McMillan et al. found that individuals exposed to a tornado were more likely to report closer relationships posttrauma than were individuals exposed to a shooting or plane crash. Unlike other traumas (e.g., sexual assault, health-related trauma), disasters are a collective or community-wide trauma. Prosocial behaviors (e.g., increases in unity, altruism, mutual helping, and empathy) may be more common after *natural* disasters, as these behaviors occur when the community responds to the damage postdisaster (see Bonanno et al., 2010; Kaniasty & Norris, 2009, for reviews). Second, only half of the studies clearly assessed self-reported growth less than 6 months after the traumatic event (Affleck et al., 1987; Butler et al., 2005; Davis & Novoa, 2013; Frazier et al., 2001; Frazier et al., 2004; McMillan et al., 1997; Thornton et al., 2012; Thompson, 1985). Assessing growth soon after the event is important to understand when posttraumatic growth begins developing (i.e., immediately posttrauma or after a period of rumination). Third, although most studies combined posttraumatic growth across different life domains such as relationships and personal strength (e.g., Frazier et al., 2004; Llewellyn et al., 2013; Manne et al., 2004; Schwarzer et al., 2006; Thornton et al., 2012), studies that have examined them separately have all found that different domains not only have differing prevalence rates but also develop differently over time (e.g., Affleck et al., 1987; Butler et al., 2005). Finally, the measurement of self-reported posttraumatic growth (e.g., via the Posttraumatic Growth Inventory [PTGI]; Tedeschi & Calhoun, 1996) has been criticized for only assessing positive outcomes, ignoring the possibility that negative (i.e., depreciation) or no life change can also occur (e.g., Linley & Joseph, 2004).

Repeated Exposure

Theory and research on the development of posttraumatic growth have generally focused on exposure to isolated traumatic events and generally have not addressed the phenomenon of repeated exposure. However, as discussed, repeated exposure to natural disasters, and other traumas, is not uncommon. For example, in the current study, participants living in Canterbury, New Zealand experienced *two* significant earthquakes over a 6 month period. Given that we generally do not know when another trauma or disaster is going to occur, it is not surprising that no other prospective studies have examined the occurrence and development of posttraumatic growth after repeated exposure.

A few studies have included retrospective accounts of repeated exposure in their models examining predictors of posttraumatic growth. Of these studies, most have found no significant relation between reports of growth and prior exposure to an identical (Arikan & Karanci, 2012; Frazier et al., 2004) or a similar (Aldwin, Sutton, & Lachman, 1996) trauma. Only one study found that prior exposure to the traumatic event (an emergency situation) was related to less posttraumatic growth after a subsequent trauma (Saccinto, Prati, Pietrantonio, & Perez-Testor, 2013). Thus, despite mixed results it appears that repeated exposure is not significantly related to posttraumatic growth. However, all of these studies assessed self-reported growth only after the second trauma. In contrast, we were in the unique position of being able to assess self-reported growth (and depreciation) after the first earthquake and both before and after the second earthquake.

Predictors of Posttraumatic Growth

Across studies, the prevalence rates of posttraumatic growth differ markedly. For example, Linley and Joseph (2004) reported prevalence rates ranging from 3% to 98% across 39 studies. Theories that attempt to explain this variation agree that pretrauma personal resources and trauma-related factors are important predictors (see Zoellner & Maercker, 2006, for a review). Personality and demographic variables are the most commonly studied pretrauma factors and, of these, optimism, female gender, being an ethnic minority, and younger age are most consistently related to self-reported posttraumatic growth (Helgeson, Reynolds, & Tomich, 2006). Trauma-related factors are often separated into objective trauma severity and subjective threat or stress. Greater trauma impact is associated with more posttraumatic growth, with subjective appraisals having stronger relations than objective measures (Helgeson et al., 2006).

Despite the wealth of research on predictors of posttraumatic growth, one factor that has not been given much attention is pretrauma mental health. Because pretrauma mental health is significantly related to optimism (e.g., Glaesmer et al., 2012), and optimism is related to growth, one would expect individuals with better mental health pretrauma to report more growth posttrauma. However, in the two prospective studies that have assessed pretrauma mental health, it was either unrelated (Davis, Nolen-Hoeksema, & Larson, 1998) or *negatively* related (Tartaro et al., 2006) to self-reported growth. One limitation of these studies is that mental health was not actually measured pretrauma. Specifically, Davis and colleagues recruited participants through a hospice who were already preparing for the approaching death of their loved one and Tartaro and colleagues studied individuals who had

already been diagnosed with malignant or benign breast cancer. In addition, neither assessed predictors of different growth trajectories.

Current Study

The first aim of our study was to assess the occurrence and development of self-reported posttraumatic growth or depreciation using our unique data set. Addressing limitations of previous research, we assessed both self-reported posttraumatic growth and depreciation soon after both earthquakes and 1 year after the second earthquake using group-based trajectory modeling (GBTM; also referred to as latent class growth analysis), which can identify distinct trajectories (or classes) of posttraumatic growth or depreciation. We examined two life domains in which individuals most often report change postdisaster—personal strength and relationships (e.g., McMillan et al., 1997; Xu & Liao, 2011). These domains were analyzed separately.

Our research questions and hypotheses were as follows. First, based on research on trajectories of posttrauma distress (e.g., Bonanno, 2004), we expected different trajectories of posttraumatic growth and depreciation to emerge, with classes reflecting growth, depreciation, and neither growth nor depreciation. In other words, we expected some individuals to report significant growth posttrauma, others to report depreciation or negative life change, and others to essentially report no change. Given the lack of research on trajectories of growth, and the relative dearth of research on depreciation, it was difficult to make specific predictions about the relative size of these groups. However, given prior research on natural disasters (e.g., Bonanno et al., 2010; Kaniasty & Norris, 2009; McMillan et al., 1997) we expected more self-reported growth in relationships than in personal strength. With regard to the shape of the trajectories (e.g., whether individuals would report increasing levels of growth over time), we expected participants in the no change and growth classes to report comparable levels of growth or no change after the second earthquake and 1 year post. This predicted stability would be reflected in nonsignificant linear slope coefficients. Once again, because of the relative dearth of research on posttraumatic depreciation, we did not have a specific hypothesis regarding the depreciation trajectories.

Finally, we investigated whether important pretrauma factors (i.e., sex, age, or pre-earthquake mental health) and trauma impact (i.e., immediate material loss and trauma exposure, ongoing earthquake-related hassles) predicted trajectory patterns. We predicted that female gender, younger age, better pretrauma mental health (measured before the first earthquake), and greater trauma impact would predict membership in trajectories characterized by more posttraumatic growth. We did not have enough variation in ethnicity to include that variable as a pretrauma predictor.

Method

Participants and Procedure

Participants were originally recruited to participate in a cross-sectional study on health and well-being in 2007. Recruitment was done through random delivery of letters about the study to 3,500 homes in the Canterbury region (90% in Christchurch, 10% in

surrounding towns) inviting adults (18 years and older) to complete a questionnaire on health and well-being. There were 354 individuals who completed the questionnaire (T1). In 2008, we recontacted participants who at T1 had indicated willingness to participate in future research ($N = 307$). These participants completed assessments 20 months (T2; $N = 242$) and 2 months (T3; $N = 167$) before the first earthquake. We surveyed them again approximately 1 month after the September 2010 earthquake (T4; $N = 185$), and approximately 3 months (T5; $N = 156$) and 12 months (T6; $N = 144$) after the February 2011 earthquake (see Kuijer et al., 2014). The study was approved by the university human ethics committee and all participants gave informed consent.

The current study used information provided from T3 to T6. Participants who completed at least two postearthquake assessments ($N = 156$) comprised the study sample. Those who dropped out between T1 and T4 (first postearthquake assessment) were younger and more likely to be male and of non-European descent but did not differ on other demographics (e.g., education; Kuijer et al., 2014). Participants who dropped out between T4 and T5 ($n = 29$) or T5 and T6 ($n = 12$) did not differ on any of the demographic variables from those who remained in the study, nor did they differ on T4 or T5 earthquake measures. Because participants who dropped out before T4 (the first postearthquake assessment) did not complete measures of earthquake impact, they were compared with completers on residential land damage; no significant between-groups differences were found (Kuijer et al., 2014).

The sample for these analyses ($N = 156$) was predominantly female (75%), of NZ European descent (91%), in a married or committed relationship (63% married or committed, 29% widowed, divorced, or separated; and 8% single or never married), middle aged (age at first earthquake: $M = 56.80$, $SD = 15.98$) and had obtained a posthigh school qualification (12% had no formal qualification, 28% had a secondary or high school qualification and 60% had a posthigh school qualification). Most resided in Christchurch (92%) as opposed to surrounding areas.

Measures

Pre-earthquake mental health (T3). The Short-Form 12-item Health Survey (SF-12) is a reliable and valid brief measure of functional health status, well-being, and quality of life that produces two scores; a physical health component summary score (PCS) and a mental health component summary score (MCS) (Ware, Kosinski, & Keller, 1995, 1996). The component scores are created by first weighting and then summing the SF-12 item responses. The resulting scores are then standardized to have a mean of 50 and a SD of 10 using general United States population norms, with higher scores reflecting better health (Ware et al., 1995). In the current study, only the mental health component score was used ($\alpha = .82$).

Immediate earthquake impact (T4 & T5). Earthquake impact was assessed at T4 and T5 using a conventional check list formula for the two major categories of immediate disaster impact: loss of material resources and traumatic exposure. Loss of material resources was assessed with six items (Kuijer et al., 2014). Participants rated whether their house/contents sustained *no damage* (0), *minor damage* (1), *moderate damage* (2), or *major damage* (3). Other items in a yes or no format assessed whether their

current residence was livable (*no* = 1), they had working sewerage (*no* = 1), they had returned home (*no* = 1), they had lost income (*yes* = 1), and they had lost their job or business (*yes* = 1). To assess traumatic exposure, the following three items were included in the same yes or no format: fear of life during the event, injuries they themselves sustained, or injuries family members sustained (*yes* = 1). At T5, participants also indicated whether they knew anybody who had died as a result of the earthquake and to indicate the relationship if applicable (family member, friend, coworker, or neighbor). None of the participants lost a family member or a neighbor. Death of a coworker ($n = 9$) was coded as a 1 and death of friend ($n = 16$) was coded as a 2. All items were summed to create a composite measure of earthquake impact at T4 and at T5 (possible range = 0 to 13).

Ongoing earthquake impact (T6). To assess ongoing earthquake impact, an earthquake-related hassles measure was created, which was modeled after the Hassles Scale (Kanner, Coyne, Schaefer, & Lazarus, 1981; see Kuijer et al., 2014). Forty items were written using information in the local media, the investigators' knowledge of earthquakes and prior participants' comments, and were rated on a yes or no scale (e.g., "living in a damaged house" and "damage to road or infrastructure"). Participants could add three further hassles for a total possible score of 0 to 43 current hassles.

Posttraumatic growth or depreciation (T4, T5, and T6). Posttraumatic growth or depreciation was assessed using a 16-item scale adapted from a scale developed for a study of sexual assault survivors (Frazier et al., 2001). Items reflected four common domains of posttraumatic growth including personal strength, relationships, life philosophy or spirituality, and empathy. Responses were made on a 5-point scale ($-2 = \text{Much worse now}$, $-1 = \text{A little worse now}$, $0 = \text{No change}$, $1 = \text{A little better now}$, and $2 = \text{Much better now}$). Because the scale was used after earthquakes as opposed to sexual assault, a principal component analysis (oblimin with Kaiser Normalization rotations) was conducted using T4 (post-September 2010 earthquake) ratings. Both Kaiser-Meyer-Olkin value (.80) and Bartlett's test of sphericity, $\chi^2(120) = 999.34$, $p < .001$, supported the factorability of the correlation matrix. The analysis revealed four factors with eigenvalues above 1.0 explaining 65% of the variance. The scree plot also had a clear break after the fourth component. Based on the eigenvalues and the factor loadings there appeared to be two main factors, personal strength (eigenvalue = 4.97, 6 items, e.g., "my confidence in my own ability to handle difficulties," "my sense of control over life") and relationships (eigenvalue = 2.74, 5 items, "my sense of closeness with friends," "the knowledge that I can count on people in times of trouble"). Because only two items loaded on Factors 3 and 4 and these factors had eigenvalues close to 1.0 they were not included in the analyses. In addition, one item was excluded because it loaded on two factors. Alpha coefficients in the current sample ranged from .87 to .91 for personal strength and .80 to .87 for relationships across time.

Data Analysis

To identify subgroups of individuals with distinct classes of posttraumatic growth or depreciation after the earthquakes, we used group-based trajectory modeling (GBTM; Nagin, 2005) in Mplus v 7.0 (Muthén & Muthén, 2012). Growth/depreciation in

relationships and personal strength were analyzed separately because prior research suggests that they may develop differently over time. We used full information maximum likelihood estimation (FIML), which enabled participants with missing data to be included (which ranged from 0% for T5 relationship growth or depreciation and sex to 22% for pre-earthquake mental health). Supporting the FIML assumption, Little's MCAR test was not significant, $\chi^2(133) = 126.24, p = .65$. A significant value indicates that the data are not missing completely at random. As in Kuijer et al. (2014), the sampling method was specified as complex to take into account dependency of observations (i.e., in some cases more than one person per household participated in the study).

A 1 class linear model was first run without fixing the variance around the intercepts and slopes to zero. The results showed significant variance around the intercepts ($b = 9.20, SE = 2.88, p = .001$; $b = 4.34, SE = 1.92, p < .0001$ for personal strength and relationships, respectively) but not for the slopes ($b = 0.02, SE = 0.02, p = .38$; $b = 0.01, SE = 0.01, p = .52$ for personal strength and relationships, respectively). The significant variability around the intercepts suggests that individuals significantly differ in their responses, and supports the decision to disaggregate the sample into multiple classes. Thus, we next tested 1–6 class linear and quadratic GBTM models. The final model was chosen based on the sample size adjusted Bayesian Information Criterion (ssBIC) and entropy; lower ssBIC scores and higher entropy indicate better fit. We placed greater importance on ssBIC, which is the most accurate fit statistic for small samples (Henson, Reise, & Kim, 2007). We used Raftery's (1995) suggestion that a 10-point difference in ssBIC between models reflects a significant improvement in fit. Based on Nagin's (2005) recommendation not to rely

solely on fit statistics, we chose the most parsimonious models that captured the distinct and substantive features of the data. A model was considered distinct if it had conceptually different classes; thus, models with similar classes (e.g., that had similar intercepts and slopes) were not considered to capture distinct features of the data. Given our sample size, a substantive class was a total count of at least 10% ($n = 15$) per class.

After determining the best fitting model for both domains, participants were assigned to a class (i.e., keeping the classes constant) and multinomial logistic regressions were conducted in Mplus (again specifying the sampling method as complex to account for dependency in the data) to test whether covariates significantly predicted membership in the different trajectory classes. The covariates were pre-earthquake mental health, sex, age, and three measures of earthquake impact (i.e., 2010 earthquake (T4), 2011 earthquake (T5), and ongoing (T6) earthquake impact). The "growth" class for personal strength and the "high growth" class for relationships were used as the reference groups.

Results

Classes of Posttraumatic Growth or Depreciation

Linear and quadratic models with 1 to 6 trajectory classes were estimated in the posttraumatic growth domains of both personal strength and relationships (see Table 1). For both domains, the three-class linear models had the best fit, and captured the distinct and substantive features of the data. For both domains, all the models with more than three classes had at least one very small class (less than 10% of the sample) and were rejected. Furthermore, for both outcomes, the 3-class

Table 1
Model Fit Indices of 1–6 Class GBTM Models for Personal Strength and Relationships

	Personal strength		Relationships	
	Linear	Quadratic	Linear	Quadratic
Class 1				
ssBIC	2561.65	2557.48	2271.93	2273.42
Class 2				
ssBIC	2499.48	2494.21	2189.27	2191.05
Entropy	.75	.75	.68	.69
Smallest class size	23% ($n = 35$)	23% ($n = 36$)	47% ($n = 73$)	48% ($n = 75$)
Class 3				
ssBIC	2449.31	2440.69	2164.69	2160.88
Entropy	.83	.84	.74	.78
Smallest class size	13% ($n = 20$)	12% ($n = 19$)	11% ($n = 17$)	11% ($n = 16$)
Class 4				
ssBIC	2449.90	2434.69	2152.30	2150.43
Entropy	.84	.87	.80	.82
Smallest class size	1% ($n = 2$)	3% ($n = 5$)	1% ($n = 2$)	6% ($n = 10$)
Class 5				
ssBIC	2449.66	2433.72	2152.71	2150.84
Entropy	.87	.87	.83	.85
Smallest class size	0.6% ($n = 1$)	3% ($n = 4$)	1% ($n = 2$)	1% ($n = 2$)
Class 6				
ssBIC	2446.43	2430.38	2133.41	2128.40
Entropy	.87	.87	.87	.88
Smallest class size	2% ($n = 3$)	3% ($n = 4$)	1% ($n = 2$)	1% ($n = 2$)

Note. $N = 155$ for personal strength and $N = 156$ for relationships. GBTM = group-based trajectory model; ssBIC = sample size adjusted BIC.

quadratic models did not fit better than the 3-class linear models, based on the ssBIC, and were not chosen over the more parsimonious linear models.

The three classes of personal strength are shown in Figure 1. The average trajectory obtained from the 1 class linear model is also reported to illustrate differences between the average trajectory and the GBTM analysis. The largest class in the 3 class linear model in the GBTM analyses ($n = 106$, 68%)—labeled the “no growth or depreciation” class—had an intercept that was not significantly different from 0 ($b = 0.54$, $SE = 0.33$, $p = .10$), where 0 indicates a self-report of no growth or depreciation. The slope was not significant, indicating no significant change over time ($b = 0.00$, $SE = 0.03$, $p = .99$). A smaller proportion of the sample ($n = 29$, 19%) had an intercept significantly greater than 0 ($b = 5.23$, $SE = 0.94$, $p < .001$) that also remained stable ($b = 0.07$, $SE = 0.09$, $p = .41$). This is the “posttraumatic growth” class who reported positive personal changes as a result of the earthquakes. The smallest class ($n = 20$, 13%) had an intercept that was significantly lower than 0 ($b = -4.25$, $SE = 0.91$, $p < .001$), which also remained stable over time ($b = -0.09$, $SE = 0.08$, $p = .24$). This “posttraumatic depreciation” class reported that their personal strength decreased as a result of the earthquakes. Thus, most participants reported no posttraumatic growth (or posttraumatic depreciation) in personal strength as a result of the earthquakes. None of the slopes were significant indicating that initial levels of life change reported soon after the 2010 earthquake remained stable through 1 year after the second and more severe 2011 earthquake. The average trajectory suggested that individuals reported low (but significantly different from zero) levels of growth after the September 2010 earthquake ($b = 0.76$, $SE = 0.30$, $p = .01$) that remained stable over time ($b = 0.01$, $SE = 0.02$, $p = .83$). This class was very similar to the no growth or depreciation class but the average trajectory failed to identify the one-third of the sample that reported either significant depreciation or significant growth.

The three classes and the average trajectory obtained from the 1 class linear model, for relationships are shown in Figure 2. The largest class ($n = 76$, 49%) in the GBTM analysis had an intercept that was significantly greater than 0 ($b = 3.95$, $SE = 0.29$, $p < .001$), and their scores remained stable over time ($b = 0.01$, $SE = 0.03$, $p = .69$). This “moderate posttrau-

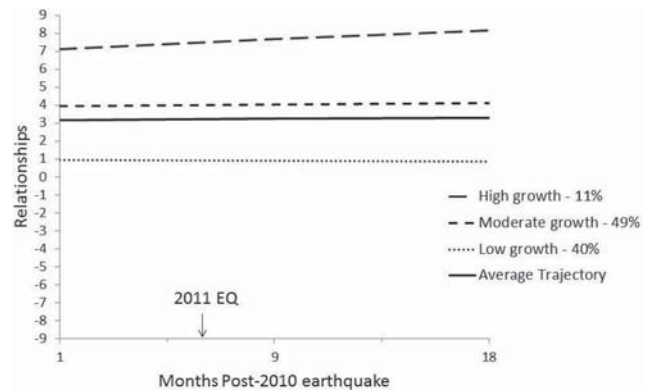


Figure 2. Three-class linear model for total posttraumatic growth and depreciation in the relationships domain, as a function of time post-2010 earthquake.

matic growth” class reported a moderate level of posttraumatic growth in the relationship domain as a result of the earthquakes. The “low posttraumatic growth” class ($n = 63$, 40%) reported a small degree of posttraumatic growth ($b = 0.96$, $SE = 0.34$, $p < .01$) that remained stable over time ($b = -0.01$, $SE = 0.03$, $p = .81$). A small proportion of the sample, referred to as the “high posttraumatic growth” class ($n = 17$, 11%), reported high levels of posttraumatic growth ($b = 7.13$, $SE = 0.50$, $p < .001$), that marginally increased over time ($b = 0.06$, $SE = 0.03$, $p = .06$). Thus, unlike personal strength, all classes reported posttraumatic growth in the relationships domain, differing only in degree of change. As with personal strength, no slopes were significant; initial change reported (at the 2010 earthquake) remained stable across the second earthquake and 1-year post. The average trajectory suggested that individuals reported moderate levels of growth after the September 2010 earthquake ($b = 3.18$, $SE = 0.22$, $p < .001$) that remained stable over time ($b = 0.01$, $SE = 0.02$, $p = .62$). The average trajectory was similar to the moderate growth group who represented 49% of the sample. Thus, this average trajectory did not identify those who in the high or low growth groups who represented 51% of the sample.

Predictors of Class Membership

Multinomial logistic regression analyses were conducted to identify whether the posttraumatic growth groups differed from the other classes in terms of demographics (sex and age), pre-earthquake mental health and earthquake impact (2010 earthquake, 2011 earthquake, and ongoing hassles). The posttraumatic growth group for personal strength and the high posttraumatic growth group for relationships were designated as the reference groups as they were conceptually the most relevant to our hypotheses. See Table 2 for descriptive statistics and bivariate correlations and Table 3 for multinomial logistic regression results.

With regard to personal strength, those who were older and who had lower pre-earthquake mental health were more likely to be in the posttraumatic depreciation class in comparison to the posttraumatic growth class. There were no significant differences in de-

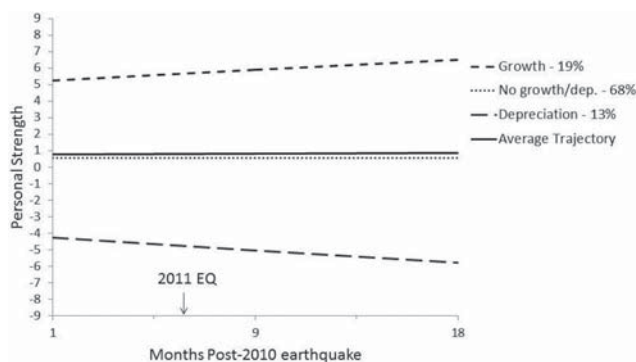


Figure 1. Three-class linear model for total posttraumatic growth and depreciation in the personal strength domain, as a function of time post-2010 earthquake.

Table 2
Predictor and Outcome Descriptives and Bivariate Correlations

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9	10	11
Demographics													
1. Age ^a	56.80	15.98											
2. Sex ^b	1.75	0.43	-.18*										
3. Pre-EQ mental health	53.38	7.55	.27**	-.13									
4. EQ impact: 2010 EQ	1.54	1.13	-.22**	.04	-.15								
5. EQ impact: 2011 EQ	2.43	1.73	-.21*	.09	-.09	.43***							
6. EQ impact: Ongoing	8.28	6.44	-.21*	.07	-.14	.40***	.50***						
7. P strength: 2010 EQ	1.01	3.80	-.05	.00	.28**	-.05	-.02	-.09					
8. Relationships: 2010 EQ	3.13	2.77	.03	.12	.02	.18*	.04	.12	.23**				
9. P strength: 2011 EQ	0.12	4.25	-.21**	.01	.08	-.02	-.12	-.15	.56***	.14			
10. Relationships: 2011 EQ	3.37	3.09	-.08	.14	.15	.05	.11	.23**	.19*	.54***	.28***		
11. P strength: 1 year post	1.30	4.59	-.24**	.10	.15	.15	-.01	.01	.47***	.36***	.57***	.35***	
12. Relationships: 1 year post	3.22	3.21	-.08	.22**	-.01	.14	.22*	.19*	.16	.51***	.24**	.58***	.53***

Note. *N* = 116–156 for all variables (lower *N*s attributed to T6 variables and pre-earthquake mental health). EQ = earthquake; P strength = personal strength.

^a Age at the time of the first earthquake. ^b 1 = male, 2 = female.

* $p < .05$. ** $p < .01$. *** $p < .001$.

mographics, pre-earthquake mental health, and either immediate or ongoing earthquake impact between the no growth or depreciation class and the posttraumatic growth class.

With regard to relationships, males were more likely to be in either the low posttraumatic growth class or moderate posttraumatic growth class than in the high posttraumatic growth class. In fact, no men were classified into the high posttraumatic growth class. Age, pre-earthquake mental health, and immediate and ongoing earthquake impact did not significantly distinguish the high posttraumatic growth class from the other two classes.

Discussion

The primary purpose of this study was to further knowledge about the development of self-reported posttraumatic growth or

depreciation using a prospective study design. We followed a sample of individuals after two major earthquakes and used group-based trajectory modeling to identify different patterns of change over time in growth and depreciation (i.e., self-reported positive and negative life changes). This unique data set also allowed us to assess trajectories of growth and depreciation after repeated trauma exposure (i.e., two major earthquakes). Our study answered calls for more longitudinal studies (e.g., Helgeson et al., 2006) and improved on previous research by assessing both posttraumatic growth and depreciation, and by examining the trajectories of two separate and major domains of life change—personal strength and relationships. Finally, we assessed personal resources and trauma impact as predictors of membership in the identified trajectories using both pretrauma and posttrauma data.

Table 3
Multinomial Logistic Regression Assessing Predictors of Trajectories of Posttraumatic Growth or Depreciation

Personal strength	Posttraumatic depreciation (<i>n</i> = 20)					No posttraumatic growth or depreciation (<i>n</i> = 106)				
	OR	<i>b</i>	<i>SE</i>	<i>p</i>	95% CI	OR	<i>b</i>	<i>SE</i>	<i>p</i>	95% CI
Sex	1.20	0.18	0.84	.83	[−1.20, 1.56]	0.58	−0.60	0.55	.31	[−1.45, 3.44]
Age	1.06	0.05	0.02	<.01	[0.02, 0.09]	1.02	0.02	0.02	.15	[−0.00, 0.05]
Pre-EQ mental health	0.90	−0.11	0.05	.03	[−0.18, −0.03]	1.01	0.01	0.04	.85	[−0.05, 0.07]
EQ impact (T4)	1.04	0.04	0.38	.92	[−0.58, 0.65]	0.76	−0.27	0.20	.18	[−0.60, 0.06]
EQ impact (T5)	1.18	0.17	0.24	.48	[−0.22, 0.55]	1.20	0.18	0.17	.27	[−0.09, 0.46]
Ongoing EQ impact	1.07	0.06	0.06	.29	[−0.04, 0.16]	0.98	−0.02	0.04	.62	[−0.09, 0.05]
Relationships	Low posttraumatic growth (<i>n</i> = 63)					Moderate posttraumatic growth (<i>n</i> = 76)				
	OR	<i>b</i>	<i>SE</i>	<i>p</i>	95% CI	OR	<i>b</i>	<i>SE</i>	<i>p</i>	95% CI
Sex	0.00	−9.36	0.41	<.001	[−10.03, −8.70]	0.00	−9.50	0.40	<.001	[−10.15, −8.85]
Age	0.97	−0.03	0.02	.22	[−0.06, 0.01]	0.97	−0.03	0.02	.17	[−0.07, 0.01]
Pre-EQ mental health	0.99	−0.01	0.05	.80	[−0.09, 0.06]	0.99	−0.01	0.04	.68	[−0.07, 0.04]
EQ impact (T4)	0.76	−0.27	0.26	.30	[−0.70, 0.16]	0.97	−0.04	0.22	.86	[−0.39, 0.31]
EQ impact (T5)	0.90	−0.10	0.18	.57	[−0.41, 0.19]	0.76	−0.28	0.17	.10	[−0.56, 0.00]
Ongoing EQ impact	0.94	−0.07	0.06	.25	[−0.16, 0.03]	0.99	−0.02	0.06	.78	[−0.12, 0.08]

Note. *N* = 155–156. The highest positive change groups (high positive change for relationships [*n* = 17] and positive change for personal strength [*n* = 29]) were used as the reference group. EQ = earthquake.

As hypothesized, the GBTM analyses identified distinct classes (or trajectories) that differed significantly in the amount of self-reported posttraumatic growth or depreciation after the first major earthquake (September 2010 earthquake). For the domain of personal strength, most of the participants were grouped into a no (*significant*) growth or depreciation class and relatively small proportions of the sample (less than 20%) were grouped into the depreciation and posttraumatic growth classes. In contrast, all three classes reported posttraumatic growth in relationships, differing only in the *amount* of posttraumatic growth reported. Approximately equal proportions of the sample were classified into low or moderate growth, and a smaller proportion was classified into a high growth class in the relationships domain. Overall, the average trajectories approximated the levels of growth reported by most participants, but they did not identify the trajectories that differed from the normative trajectories (e.g., participants who reported depreciation in personal strength).

All participants reported some degree of growth postdisaster in relationships; however, only a minority reported significant posttraumatic growth in personal strength. This finding supports previous research that participants reported more posttraumatic growth in the relationships domain than in terms of personal strength postdisaster (e.g., [McMillan et al., 1997](#); [Xu & Liao, 2011](#)), perhaps because postdisaster communities feel greater unity, altruism, and empathy. In the context of the Canterbury, New Zealand earthquakes, socializing with neighbors, friends, and family increased postearthquakes ([McColl & Burkle, 2012](#)) and was frequently reported on in the weeks and months postdisaster (e.g., [Ensor, 2011](#)). In contrast, growth in personal strength is more subjective and less overt postdisaster.

No classes reported significant changes in how much positive (growth) or negative (depreciation) life changes they reported after the two earthquakes. These findings suggest that posttraumatic growth is stable even after repeated subsequent traumas. The current study builds on previous results showing longitudinal stability in reports of posttraumatic growth (e.g., [Frazier et al., 2001](#); [Llewellyn et al., 2013](#); [McMillan et al., 1997](#)). These findings also contradict an assumption of one of the key theories of posttraumatic growth, which is that growth should increase over time ([Tedeschi & Calhoun, 2004](#)). Instead, self-reported growth may represent a coping strategy for dealing with the trauma. That is, given that the same amount of change was reported after two events (and at two time points after the second event) self-reported growth or depreciation may illustrate how people generally cope with traumatic events rather than actual life changes after those events ([Frazier et al., 2009](#)). Similarly, [Jayawickreme and Blackie \(2014\)](#) have recently argued that self-reported posttraumatic growth may be best understood as an individual difference trait associated with how individuals generally respond to life challenges.

The final aim was to determine whether the trajectory classes differed in terms of pretrauma personal characteristics (pre-earthquake mental health, sex, and age) and trauma-related factors (immediate material loss and trauma exposure and ongoing hassles). For personal strength, the posttraumatic depreciation class had lower pre-earthquake mental health than the posttraumatic growth class, consistent with the hypothesis that pretrauma mental health, like optimism, is a personal resource that predicts posttraumatic growth ([Helgeson et al., 2006](#)). The posttraumatic depreci-

ation class also was older than the posttraumatic growth class. Older individuals may have reported less growth (and more depreciation) in personal strength because the earthquakes and aftermath were a stark reminder that they are older and weaker (e.g., more prone to injury or illness, no longer able to do certain activities or tasks, and/or able to fully care for themselves). This was reflected by a comment made by an 81-year-old after the first earthquake “I have been in hospital twice since [the earthquake] with lung infection and have been feeling a little more stress with this happening and the quake has made me a little nervous being in a building on my own at night.”

For relationships, the only characteristic that differentiated the groups was gender, whereby the high posttraumatic growth class had significantly more females than the moderate and low posttraumatic growth classes. These results partially support previous literature suggesting that women tend to report more posttraumatic growth ([Helgeson et al., 2006](#)) perhaps because women engage in more affiliative behaviors ([Taylor et al., 2000](#)). Future research would benefit from understanding the mechanisms behind these predictors that lead to greater posttraumatic growth. For example, *why* do women experience more growth in relationships than men after a natural disaster such as this?

Trauma impact was not a predictor of trajectory class membership. These findings are contrary to the theoretical assumption that more severe events are more likely to serve as catalysts for growth ([Tedeschi & Calhoun, 2004](#)). However, the relation between trauma impact and self-reported posttraumatic growth is small and variable, especially for objective ratings ([Helgeson et al., 2006](#)). It is important to note that this sample was a general population sample recruited before the earthquakes. In contrast, most disaster research uses convenience samples, typically recruited in high damage areas (see [Bonanno et al., 2010](#)). Therefore, the current sample may have lower impact scores than other samples, which may have contributed to the lack of relation between trauma impact and posttraumatic growth.

After the Canterbury earthquakes, developing and implementing effective psychosocial services was important in the recovery process to ensure that negative psychological posttrauma reactions in individuals and the wider community were minimized (see [Mooney et al., 2011](#) for a review). As outlined by Mooney et al., a strength-based approach to psychosocial recovery was advised that draws upon existing resources and focuses on resilience and empowerment. The first phase in this approach was to identify available resources (or strengths) and vulnerabilities. Our findings provide further empirical support for an available posttrauma resource that could be used in psychosocial recovery efforts—self-reported growth in existing social connections and empathy. With regard to vulnerabilities, our findings provided further evidence that older individuals and individuals with lower pretrauma mental health were more vulnerable to experiencing negative psychological outcomes (see also [Kuijer et al., 2014](#)). Thus, psychosocial recovery efforts could target these individuals in particular.

Despite the contributions, this study had several limitations and suggests areas for future research. First, because the sample was predominately female, European and educated, generalizability is limited. In terms of the measurement of posttraumatic growth and depreciation, there is controversy regarding whether it is appropriate to assess negative and positive change on the same continuum because participants may have experienced different types of

change in the same domains (Park & Lechner, 2006). On a related note, self-reports of change are controversial because they may not be an accurate reflection of actual change experienced (e.g., Frazier et al., 2009). Third, with regard to measurement timing, although this is one of the few studies to measure immediate and longer-term posttraumatic growth or depreciation, future research should investigate additional time points beyond 1-year post-trauma as it is possible that the proposed increases could take longer to emerge. Fourth, although we investigated the major life domains in which growth typically occurs postdisaster, there are other domains (e.g., spirituality, appreciation of life, empathy, and life priorities) that we did not investigate. Future research would benefit from examining these other life domains in which change is reported. Finally, because some of the classes could not be differentiated from each other, future research would benefit from including additional pretrauma and posttrauma predictors of trajectories.

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