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Trajectories of Resilience, Depression, and Anxiety Following Spinal Cord Injury

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Purpose/Objective: To investigate longitudinal trajectories of depression and anxiety symptoms following spinal cord injury (SCI) as well as the predictors of those trajectories. ***Research Method/Design:*** A longitudinal study of 233 participants assessed at 4 time points: within 6 weeks, 3 months, 1 year, and 2 years from the point of injury. Data were analyzed using latent growth mixture modeling to determine the best-fitting model of depression and anxiety trajectories. Covariates assessed during hospitalization were explored as predictors of the trajectories. ***Results:*** Analyses for depression and anxiety symptoms revealed 3 similar latent classes: a resilient pattern of stable low symptoms, a pattern of high symptoms followed by improvement (recovery), and delayed symptom elevations. A chronic high depression pattern also emerged but not a chronic high anxiety pattern. Analyses of predictors indicated that compared with other groups, resilient patients had fewer SCI-related quality of life problems, more challenge appraisals and fewer threat appraisals, greater acceptance and fighting spirit, and less coping through social reliance and behavioral disengagement. ***Conclusion/Implications:*** Overall, the majority of SCI patients demonstrated considerable psychological resilience. Models for depression and anxiety evidenced a pattern of elevated symptoms followed by improvement and a pattern of delayed symptoms. Chronic high depression was also observed but not chronic high anxiety. Analyses of predictors were consistent with the hypothesis that resilient individuals view major stressors as challenges to be accepted and met with active coping efforts. These results are comparable to other recent studies of major health stressors.

Keywords: trauma, resilience, spinal cord injury, coping, depression

Impact and Implications

• This is the first study to document unique trajectories of mental health, including a resilient trajectory of consistently low symptom levels, following spinal cord injury (SCI). We examined data from continuous measures of depression and anxiety symptoms obtained from SCI patients in six European countries at four time points during the first 2 years after injury. To determine the trajectories of mental health that best explained the data, we used latent growth mixture modeling and included coping and appraisal scales as covariates within the model.

• We observed different patterns of trajectories for depression and anxiety symptoms. However, each model revealed a resilient trajectory of low symp-

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tom levels and a delayed trajectory of worsening symptoms. The resilient pattern was most common, observed in more than half of the patients in each analysis. The best-adjusted patients viewed major stressors as challenges to be accepted and met with active coping efforts.

• Results demonstrate that SCI patients are likely to show different but observable patterns of long-term outcome. Although many SCI patients adjust remarkably well, some will fail to recovery psychologically, and some (approximately 10%) will experience increased symptoms over time. Results on predictors suggest the potential usefulness of early psychological interventions that target how patients perceive and cope with their injury.

Introduction

During the course of a normal life span, most people are exposed to at least one and often several highly aversive or potentially traumatic life events (Norris, 1992). Although aversive life events are highly distressing and often potentially debilitating, it is well established that not everyone reacts the same way. Prospective and longitudinal research has repeatedly demonstrated clear trajectories of individual differences in psychological outcomes across time following such events (Bonanno, 2004; Bonanno, Westphal, & Mancini, 2011). Some people are overwhelmed and unable to function normally for years after the event, suggesting a pattern of *chronic dysfunction*, and others struggle for months but then gradually return to baseline levels of adjustment, suggesting a pattern of distress followed by improvement or *recovery*. Some people endure moderate levels of symptoms and distress but then gradually worsen, suggesting *delayed distress*, and still others and often a majority manage to continue functioning normally even soon after the event and thus appear to evidence psychological *resilience* (Bonanno, 2004).

Much of the research documenting trajectories of adjustment following aversive life events has focused on samples of individuals exposed to prototypical traumatic events, such as disaster (Bonanno, Rennicke, & Dekel, 2005; Norris, Tracy, & Galea, 2009), combat exposure (Bonanno et al., 2012), or bereavement (Bonanno et al., 2002). More recently, however, investigators have begun to report similar trajectory patterns in psychological outcome following health-related adversities, including emergency surgery for traumatic injury (deRoon-Cassini, Mancini, Rusch, & Bonanno, 2010; Le Brocque, Hendrikz, & Kenardy, 2010), disease epidemic (Bonanno et al., 2008), breast cancer (Deshields, Tibbs, Fan, & Taylor, 2006; Helgeson, Snyder, & Seltman, 2004; Lam et al., 2010; Lam, Shing, Bonanno, Mancini, & Fielding, 2012), and multiple physical trauma (Quale & Schanke, 2010).

In the current study, we extend this research by identifying trajectories of depression and anxiety in a community sample of spinal cord injury (SCI) patients obtained from four countries. The study was motivated by the assumption that identifying unique longitudinal trajectories of psychological adjustment in SCI survivors would greatly enhance understanding of the range of outcomes these patients experience. In addition, to enrich understanding of the factors that might contribute to each outcome pathway, we examined various appraisal and coping variables as possible predictors of class membership. This knowledge in turn will likely help inform and guide treatment decisions and potentially the development of new and more effective psychological interventions.

Spinal Cord Injury

SCI presents a particularly demanding coping challenge to survivors. Not only are the events leading up to SCI potentially traumatic, adaptation to SCI requires major changes in physical and functional independence, as well as an extended period of rehabilitation and readjustment. It is not surprising that, on average, SCI has been associated with reduced quality of life (QOL; Martz, Livneh, Priebe, Wuermser, & Ottomanelli, 2005), lower life satisfaction (Kemp & Krause, 1999), and elevations in depression and anxiety (Craig, Hancock, & Dickson, 1994; Kennedy & Rogers, 2000). These data suggest that significant numbers of SCI survivors could be expected to experience chronic psychological dysfunction. Despite the marked emotional strain of SCI, however, it appears that many SCI survivors nonetheless show healthy long-term psychological adjustment (Craig et al., 1994; Whiteneck et al., 1992).

Preliminary support for an explicit association between SCI and psychological resilience comes from Quale and Schanke's (2010) study of hospitalized survivors of serious injury. Using data from hospital admission and discharge, they defined a resilient outcome trajectory as the combination of consistently low levels of psychological symptoms and consistently high levels of state positive affect. Although the Quale and Schanke sample mixed SCI patients and patients with other types of serious injury, as in previous research, the resilient pattern was the most common outcome pattern observed in the study. Moreover, when they examined the trajectories in the smaller group of SCI patients, resilience was still highly prevalent.

Together, these data suggest that SCI samples may evidence longitudinal trajectories of both chronic dysfunction and psychological resilience at rates similar to those of other health-related adversities. It seems plausible as well that some SCI survivors would also evidence patterns of recovery and delayed distress. Previous studies also suggest that changes in psychological adjustment among SCI survivors are pronounced during the course of the first year after the injury but then change little from that period on (Craig et al., 1994; Pollard & Kennedy, 2007).

Growth Mixture Modeling

To identify the prototypical trajectories of adjustment following SCI, we employed recent advances in growth mixture modeling (GMM). Previous studies of outcome trajectories following aversive life events have employed a variety of nonparametric and semiparametric approaches (Bonanno et al., 2011). However, recent studies have taken advantage of new developments in the use of GMM, such as latent class growth analysis and latent growth mixture modeling (LGMM; Jung & Wickrama, 2008; Muthén, 2004; Muthén & Muthén, 2000). GMM methods identify homogeneous subpopulations within a heterogeneous sample for the purpose of demarcating meaningful groups or classes of individual variation across time (Jung & Wickrama, 2007). A critical distinction between GMM and traditional growth modeling techniques (e.g., hierarchical linear modeling) is that GMM approaches do not assume that participants belong to a single homogeneous population. In relaxing the assumption of a single population, GMM can identify heterogeneous patterns of responding (or trajectory classes) that represent, in effect, distinct populations (Muthén, 2004). The mean growth curves of these distinct populations can then be modeled separately, allowing for unusual flexibility and precision in identifying the various ways that people exhibit change across time. What permits this flexibility is the simultane-

ous modeling of latent continuous variables (e.g., intercept and slope) and latent categorical variables (trajectory class assignment).

A recent study, for example, used LGMM to identify outcome trajectories in a community sample of injured trauma survivors taken to a Level 1 trauma center for immediate medical attention (deRoon-Cassini et al., 2010). Using data gathered at four times across the first 6 months after surgery, this study identified four trajectories of posttraumatic stress symptoms and four trajectories of depression symptoms. Although the different sets of trajectories were similar, but not identical, they closely mapped onto the four prototypical patterns seen in other research. Moreover, as in many other studies of aversive life events, the most common pattern in each analysis was a stable trajectory of low symptoms or resilience (Bonanno, 2004).

Potential Predictors of SCI Outcome Trajectories

A key advantage of the GMM approach is that it can be extended to include theoretically relevant covariates that potentially improve model fit but also predict class membership. In the current study, we examined variables related to general dimensions of coping and appraisal as well as variables that described coping and appraisal dimensions specific to SCI.

Appraisal

Appraisals in response to a stressor, or the way that people interpret a stressful event, may have a strong influence on patterns of adaptation (Ferguson, Mathews, & Cox, 1999). Appraisals are influenced by various psychological characteristics such as personality, mood, values, and psychopathology, and they have been characterized as the "final common path" connecting these characteristics to behavioral and health outcomes (Monroe & Kelly, 1995). Two types of appraisals have been characterized in the literature, primary and secondary appraisals (Lazarus & Folkman, 1984). *Primary appraisals* are evaluations of the nature and meaning of specific transactions as they relate to well-being, and *secondary appraisals* draw on past experience and knowledge (Lazarus & Smith, 1988). Primary appraisals, in particular, have been shown to connect individual-level psychological characteristics and outcomes following a stressor (Cooper & Baglioni, 1988). Empirical investigation into primary appraisal patterns have found three common dimensions that emerge in response to a stressor: the appraisal of the potential for harm (*threat*); the appraisal of the potential for erosion of friendships, health, or self-esteem (*loss*); and the appraisal of the potential for growth, gain, and mastery (*challenge*; Ferguson et al., 1999).

In SCI populations, appraisals have been shown to impact long-term psychological adjustment as well as functional outcomes (Chevalier, Kennedy, & Sherlock, 2009). In one study, appraisals accounted for 49.4% of the variance in a measure of functional independence (Kennedy, Smithson, et al., 2010). In a longitudinal study of individuals followed from just after an SCI until 12 weeks postinjury, both threat and challenge appraisals after the event were shown to predict psychopathology outcomes, with greater threat predicting higher levels of anxiety and challenge predicting lower levels of depression (Kennedy, Lude, Elfström, & Smithson, 2010). Consistent with these findings, we predicted that people who demonstrate a resilient pattern of stable low symptoms following SCI would report lower threat appraisals and greater challenge appraisals following the injury.

Coping

There is long-standing evidence that situationally based coping responses, or coping strategies, impact psychological outcomes following a significant stressor (Cohen & Lazarus, 1973; Silver & Wortman, 1980). Coping strategies have been found to be particularly potent predictors of psychological responses to SCI. One of the first studies to examine this relationship demonstrated that certain coping strategies following SCI predicted depression and general distress, but time from the event did not (Frank et al., 1987). Similarly, Buckelew et al. (1990) found that coping strategies predicted psychological adjustment following SCI over and above age, time since injury, level of injury, and dispositional coping characteristics such as locus of control beliefs. Specific broad coping strategies including the development of strategies to deal with the stressor (*planning*), reducing one's effort to engage with the stressor (*behavioral disengagement*), and reconstrual of a stressful event in positive terms (*positive reinterpretation*) have been explored in relation to adaptation to SCI. Findings to date indicate no relationship between positive reinterpretation and depression and anxiety scores following an SCI, a significant but weak relationship between planning and anxiety following an SCI, and a strong positive relationship between behavioral disengagement and both depression and anxiety scores following an SCI. When examined in conjunction, behavioral disengagement remained a strong predictor of both depression and anxiety scores following an SCI, whereas planning and positive reinterpretation did not enter as significant predictors (Kennedy et al., 2000). Extending these findings, we predicted that behavioral disengagement would predict maladaptive longitudinal patterns of depression and anxiety following an SCI, whereas planning and positive reinterpretation would not be predictive of such patterns of response.

More recently, investigators have explored SCI-specific coping strategies. Coping with SCI presents a unique set of challenges including multisystem dysfunction, multiple disabilities, and risk for multiple ongoing and emergent health complications. As such, coping with an SCI requires adaptation to the initial event as well as ongoing secondary effects (El Masri & Short, 1997). Three distinct coping strategies have been found to be predictive of adaptation to SCI. These include the ability to integrate the injury and the physical consequences into one's life, or *acceptance*; the ability to make the best of life despite the SCI and working to find "tricks" to make life easier in relation to the injury, labeled *fighting spirit*; and the adoption of beliefs about one's self as dependant on others, or *social reliance* (Elfström, Rydén, Kreuter, Persson, & Sullivan, 2002). Acceptance and fighting spirit have been shown to contribute to positive psychological adjustment (Kennedy et al., 2000), with evidence that both have a stronger impact on depression following an SCI than on anxiety (Elfström, Kennedy, Lude, & Taylor, 2007). Social reliance has been shown to be maladaptive following an SCI (Kennedy, Lude, Elfström, & Smithson, 2011). Consistent with these findings, we predicted that acceptance and fighting spirit would predict resilience to depression and anxiety following an SCI, whereas social reliance would predict patterns of

poor psychological adjustment characterized by high depression and anxiety scores.

Method

Participants and Procedure

Our sample consisted of 233 participants (182 males, 51 females) who had data from at least two waves. All patients with newly acquired injuries were recruited from selected British, Swiss, Swedish, German, Austrian, and Irish spinal centers, with injuries representative of the SCI population. Individuals had sustained their injury between the ages of 16 and 83 years and were fluent in the language of the country from which they were recruited. Individuals with a known head injury or communication disorder were excluded from the study as such difficulties prevent the comprehension and completion of the questionnaires.

We used a longitudinal, multiple wave panel design. Questionnaires were administered four times: within 6 weeks of injury, and at 3 months, 1 year, and 2 years from the point of injury. Each country collected the data for that specific center and input those date in a standardized template. Participant data were entered using coded strings and stored in accordance with ethical guidelines. Ethical approval for this study was obtained from each center's local research ethics committee.

Participants were approached shortly after their admission to the rehabilitation centers and, once medically stabilized, provided with an information leaflet about the study. They were asked to consider their participation in the study for 24 hr before signing a consent form, and were given affirmation that any decision to take part or not would not affect their treatment in the hospital. Questionnaire booklets were translated to relevant languages using a back-translation procedure. Questionnaires of the appropriate language version were then distributed to consenting participants for self-completion. For the first two data points, questionnaires were administered face-to-face by a psychologist in the hospital. After discharge, follow-up reminders were sent to minimize attrition rates, and questionnaires at 1 year and 2 years were administered by mail.

Response rates for English-speaking patients were estimated from the U.K. sample: 113 patients were approached for initial recruitment, 100 (88.5%) completed the initial questionnaire booklet, and 95 (84.1%) completed the second questionnaire booklet. Response rates for German-speaking patients were 62.5% for Basel, 100% for both Bad Wildungen and Berlin, 52% for Hamburg, 60% for Kreischa, and 37.2% for Nottwil. The response rate from Lund-Orup was 62.5%.

Sample demographics at the time of injury were comparable to those reported in a previously published study on the acute phase of injury (Kennedy & Rogers, 2000). Sample demographics for the longitudinal sample were comparable to previously published studies using the same parent sample (Elfström et al., 2007; Kennedy & Rogers, 2000).

Measures

Demographic information. Questions were included to obtain personal details such as date of birth, gender, and marital status; injury characteristics, including cause, date, level and completeness of injury; and information on place of rehabilitation and employment status.

World Health Organization Quality of Life—Brief (WHOQOL-BREF; WHOQOL Group, 1998). This is a generic international, cross-culturally comparable QOL assessment instrument. It assesses individuals' perceptions of their position in life in the context of their culture and value systems and their personal goals, standards, and concerns. The WHOQOL-BREF instrument comprises 26 items, which measure the four following broad domains: physical health, psychological health, social relationships, and environment. A further two items measure overall QOL and general health. This version is available in approximately 20 language versions. The WHOQOL-BREF has been shown to display good discriminate validity, content validity, and test–retest reliability. Its sensitivity to change is currently being assessed. When examining the validity of this measure in the SCI population, Jang, Hsieh, Wang, and Wu (2004) found all domains to display good internal consistency (Cronbach's alpha range = .74–.78), with the exception of the social relationships domain (α = .54). The discriminate validity of the WHOQOL-BREF assessment in persons with SCI was satisfactory. Key strengths of the WHOQOL-BREF are that it places primary importance on the perception of the individual, and can be employed in a variety of cultural settings while allowing the results from different populations and countries to be compared.

Hospital Anxiety and Depression Scale (HADS-A and HADS-D; Zigmond & Snaith, 1983). This scale provides a brief state measure of anxiety and depression, enabling detection of clinical cases and assessment of severity without contamination of scores by reports of physical symptomatology. It has been found to perform well in somatic, psychiatric, and primary care patients, and in the general population and has previously been used with the SCI population (Glickman & Kamm, 1996). A review of papers assessing the validity and reliability of the HADS indicated that it has good psychometric properties, with internal consistency varying from .68 to .93 (M = .83) for the HADS-A, and from .67 to .90 (M = .82) for the HADS-D (Bjelland, Dahl, Haug, & Neckelmann, 2002). Possible scores for each subscale range from 0 to 21, with cutoffs for clinically relevant elevations set in most studies at 11 for each subscale (Zigmond & Snaith, 1983). However, a more recent investigation using a large clinical sample suggests a more conservative cutoff for both the Depression and Anxiety subscales of 8 or higher (Olssøn, Mykletun, & Dahl, 2005).

Functional Independence Measure (Hamilton & Granger, 1990). This disability measure assessed degree of independence in activities of daily living in each of seven areas of function: self-care, mobility, sphincter control, mobility, locomotion, communication, and social cognition. It has been widely used in the SCI population (Kennedy & Rogers, 2000) and has a good psychometric profile, with an internal consistency coefficient of .91 to .92 for the total scale and item-total correlations ranging from .33 to .81 when used with this group.

Appraisal of Life Events (Ferguson et al., 1999). This scale consists of a checklist of 16 adjectives designed to elicit respondents' cognitive appraisals of stressful life events in terms of threat (six adjectives), challenge (six adjectives), and loss (four adjectives). It has been shown to have a good factor structure, good

test–retest reliability (ranging from .48 to .90), good internal reliabilities (ranging from .75 to .91), and good construct validity.

Spinal Cord Lesion-Related Coping Strategies Questionnaire (Subscales 1–4; Elfström, Rydén, Kreuter, Persson, & Sullivan, 2002). This scale was developed specifically for use with individuals with SCI to explore coping processes. It consists of 12 items measuring the use of three coping strategies; acceptance (four items), fighting spirit (five items), and social reliance (three items). The scale has good psychometric properties, with item internal validity correlations ranging from .44 to .64 and internal reliability coefficients ranging from .72 to .79 for the three strategies.

COPE subscales (Carver, Scheier, & Weintraub, 1989). The COPE is a generic coping measure that measures coping styles as opposed to situation-specific coping strategies. This measure has been successfully used with an SCI population (Kennedy, Lowe, Gray, & Short, 1995). It contains 60 questions that relate to 15 coping strategies. Three subscales were used in the present study: Positive Reinterpretation, Behavioral Disengagement, and Planning.

Statistical Analysis

To model heterogeneity in the depression and anxiety data, we employed LGMM using Mplus 6.1 software as a means of identifying discrete growth trajectories (classes) and to test predictors of membership in these classes. LGMM assumes and treats error as independent (McArdle & Nesselroade, 2002), employs a robust full-information maximum-likelihood (FIML) estimation procedure for handling missing data, and assumes missing data are unrelated to the outcome variable (missing at random). The appropriateness of FIML is widely endorsed.

Because LGMM is flexible in modeling time (Muthén, 2004), we used factor loadings that corresponded directly to the time intervals for each wave of data collection. Although the first data collection occurred from 0 to 6 weeks of injury, we set this point at 0 for linear reference and then subsequent measurement intervals at 12 weeks, 1 year, and 2 years from the point of injury. To account for possible variation in initial assessment, we included time since injury as a covariate (see below). We examined unconditional models (i.e., no covariates) with an intercept parameter (no growth), intercept and slope parameters (linear growth), and intercept, slope, and quadratic parameters (nonlinear growth). Consistent with recommendations for model testing, we compared one- to five-class unconditional models. To determine the appropriate unconditional class solution, we examined the Bayesian (BIC), sample size-adjusted Bayesian (SSBIC), and Aikaike (AIC) information criterion indices; entropy values; the Lo–Mendell–Rubin likelihood ratio test (LRT; Lo, Mendell, & Rubin, 2001); and the bootstrap likelihood ratio test (BLRT). We sought a model with lower values for the criterion indices, higher entropy values, and significant p values for both the LRT and the BLRT. Selection of final class unconditional solutions was determined by the totality of these indices, in combination with interpretability. Next, consistent with recommendations for correct model specification, we extended the unconditional analyses to include theoretically relevant covariates (i.e., to create conditional models). This step is increasingly recommended (Muthén, 2003) as the absence of such relationships may indicate an incorrect local solution. We tested all demographic and questionnaire variables listed above, including time since injury, for possible inclusion in the conditional models as covariates. Only variables whose inclusion allowed for model convergence and improved model fit were retained. Finally, multinomial logistic regression analyses were nested within the LGMM to examine predictors of class membership.

Results

Depression

Unconditional model. Consistent with recommendations for model testing, we compared one- to five-class unconditional models (i.e., no covariates) for depression symptoms. In these models, a quadratic (nonlinear growth) model provided the best fit for depression symptoms with the intercept variances unconstrained and the slope and quadratic variances fixed.

As shown in Table 1, each of the information criterion indices (AIC, BIC, SSBIC) indicated lower values (improved fit) for each additional class from two- to four-class solutions. There was some variability in entropy values and the LRT. However, the BLRT, which stimulations have demonstrated to be a more robust indicator (Nylund, Asparouhov, & Muthén, 2007), consistently indicated improved fit up to the four-class solution. All six indices indicated declining fit for the five-class solution. Accordingly, we selected the four-class solution as optimal.

As can be seen in Figure 1A, the four-class solution identified four distinct trajectories of depressive symptoms across the 2 years following SCI. The most common class, capturing 66.1% of the sample, described a trajectory of *stable nondepressed*, with low initial depression scores and a flat and nonsignificant trajectory of growth across time. Another class (13.3%) described a trajectory of *depression improvement*, with initially high levels of depression, a pronounced drop in depression from 12 weeks to 1 year postinjury, and then a slight further decrease in depression from 1 to 2 years postinjury. The slope and quadratic parameters were significant for this class. A third class (10.7%) described a trajectory of *chronic high depression*, with initially high levels of depression and a flat and nonsignificant trajectory across time. Finally, a fourth class (9.8%) described a trajectory of *delayed depression,* with low initial levels of depression, a pronounced increase in depression from

Table 1
Fit Indices for One- to Five-Class Growth Mixture Models for Depression (Unconditional)

Fit index	Growth mixture model				
	1 class	2 classes	3 classes	4 classes	5 classes
AIC	3825.86	3777.52	3730.95	3712.68	3713.66
BIC	3853.47	3818.92	3786.17	3781.70	3796.49
SSBIC	3828.11	3780.89	3735.46	3718.31	3720.42
Entropy	—	.76	.72	.75	.74
LRT p value	—	<.01	.25	.03	.47
BLRT p value	—	<.001	<.001	<.001	.33

Note. AIC = Akaike information criterion; BIC = Bayesian information criterion; SSBIC = sample size-adjusted Bayesian information criterion; LRT = Lo–Mendell–Rubin test; BLRT = bootstrap likelihood ratio test.

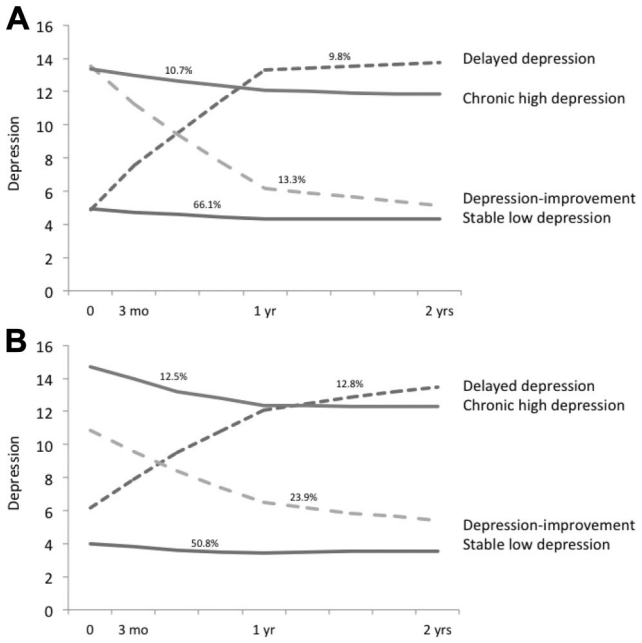

Figure 1. (A) Unconditional and (B) conditional models for depression symptoms. Unconditional model (no covariates), $n = 233$. Conditional model (covariates included), $n = 208$.

12 weeks to 1 year postinjury, and continued high levels of depression at 2 years postsurgery. The slope and quadratic parameters for this class were significant. Parameter estimates are summarized in Table 2.

Conditional model. We next conducted a series of nested analyses on the four-class solution to examine possible covariates that might improve model fit. We tested all possible covariates for inclusion. The following seven covariates improved model fit when included in the four-class solution: weeks from injury to first assessment; appraisals of challenge; general coping using behavioral disengagement; SCI-related coping using acceptance, fighting spirit, and social reliance; and SCI-related QOL problems. These covariates were also regressed as predictors of class membership. Because of missing data on the covariates, the sample size for the condition model was reduced modestly ($n = 208$). Comparison of participants evaluated in the conditional and unconditional models revealed no significant differences on any of the variables considered in these analyses. It is important to note that the structure of the four-class conditional (i.e., covariate) solution was also similar to the four-class unconditional (i.e., no covariates) solution. The most noteworthy changes in the conditional model, as can be seen in Figure 1B, were that the proportion of the stable nondepressed (resilience trajectory) was reduced to 50.8%, and the proportion of the depression improvement trajectory was increased to 23.9%. The depression improvement trajectory was also less steep in the conditional model, although the slope and quadratic parameters for this class remained significant. The chronic high depression (12.5%) and delayed depression (12.8%) trajectories were only slightly more prevalent than in the unconditional analysis.

Logistic regression analyses for predictors of class membership in the depression trajectories are summarized in Table 3. Using the stable low depression (resilient) class as the reference class revealed the most robust differences between the stable low depression group and the chronic depression group. These two groups differed on six of seven covariates that were entered into the model. Compared with the chronic depression class, the stable low depression group had fewer SCI-related QOL problems, and used more challenge appraisal, more SCI-related coping through acceptance and fighting spirit, and less coping through social reliance and behavioral disengagement. When compared with the depression improvement class, the stable low depression group had fewer SCI-related QOL problems and used greater challenge appraisal and greater SCI-related coping through fighting spirit. When compared with the delayed depression class, the stable low depression group had fewer SCI-related QOL problems and used greater SCI-related coping through fighting spirit.

In addition to the differences from the stable nondepressed class, the chronic depression group used less coping through acceptance and greater coping through social reliance, had a longer period from injury to first assessment than the depression recovery class, and used less challenge appraisal and greater coping through social relations than the delayed depression class. Finally, the delayed depression group used greater challenge appraisal compared with the depression recovery group.

Anxiety

We again compared one- to five-class unconditional models (i.e., no covariates) for anxiety symptoms, used the same fit

Table 2
Parameter Estimates for Each Class in Each Analysis

Class	Intercept		Slope		Quadratic	
	Est. (*SE*)	$p \leq$	Est. (*SE*)	$p \leq$	Est. (*SE*)	$p \leq$
Depression						
Stable low depressions	4.82 (0.31)	.001	−0.16 (0.12)	.17	0.01 (0.01)	.36
Depression improvement	13.54 (1.06)	.001	−1.99 (0.50)	.001	0.11 (0.04)	.01
Delayed depression	4.86 (0.65)	.001	2.33 (0.37)	.001	−0.14 (0.03)	.001
Chronic depression	13.44 (1.04)	.001	−0.42 (0.30	.17	0.02 (0.03	.41
Anxiety						
Stable low anxiety	4.30 (0.40)	.001	−0.01 (0.12)	.92	0.01 (0.01)	.64
Anxiety improvement	11.26 (0.51)	.001	−1.07 (0.21)	.001	0.07 (0.02)	.01
Delayed anxiety	5.09 (0.77)	.001	1.91 (0.33)	.001	−0.14 (0.04)	.001

Table 3
Multinomial Logistic Regression for Predictors of Depression Class Membership (n = *208*)

	Stable vs.						Chronic depression vs.				Delayed depression vs.	
	Depression improvement		Delayed depression		Chronic depression		Depression improvement		Delayed depression		Depression improvement	
Predictor	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*	Est.	*SE*
Weeks injured	−0.41	0.21	0.25	0.27	0.63	0.48	−1.04	0.49*	0.38	0.47	0.66	0.30
QOL problems	0.08	0.02***	0.08	0.03**	0.16	0.06**	−0.08	0.06	0.83	0.06	−0.01	0.03
Challenge appraisal	−0.19	0.07**	−0.03	0.07	−0.31	0.21**	0.13	0.11	−.28	0.12*	0.15	0.07*
SCL acceptance	−1.12	0.85	−.79	1.30	−3.06	1.44*	1.94	0.96*	−2.27	1.29	0.32	1.05
SCL fighting spirit	−3.16	1.21**	−2.78	1.36*	−5.76	1.99**	2.61	1.76	−2.98	1.79	0.38	1.29
Social relations coping	0.23	0.51	0.58	0.66	4.53	2.22*	−4.31	2.12*	5.11	2.19*	−0.80	0.71
Behavioral disengagement	2.01	2.62	3.94	2.99	11.38	5.59*	−8.47	4.58	7.44	5.93	1.03	3.64

Note. Weeks injured = number of weeks from injury to first assessment; QOL = quality of life; SCL = spinal cord lesion.
* $p < .05$. ** $p < .01$. *** $p < .001$.

indices as reported above, and again found that a quadratic (nonlinear) growth model provided the best fit for anxiety symptoms with the intercept variances unconstrained and the slope and quadratic variances fixed. As shown in Table 4, each of the information criterion indices (AIC, BIC, SSBIC) indicated lower values (improved fit), entropy increased, and both the LRT and BLRT indicated improved fit for each additional class up to the three-class solution. Three information criteria also supported a four-class solution. However, the LRT was nonsignificant and the BLRT indicated only a modest improvement in fit. The four-class solution also described a set of trajectories that was more difficult to interpret. Given that the four-class solution was both statistically and theoretically less compelling than the three-class solution, we selected the three-class solution as optimal for anxiety symptoms.

As can be seen in Figure 2A, the three-class solution identified three distinct trajectories of anxiety symptoms across the 2 years following SCI. Similar to depression, the most common class, capturing 57.5% of the sample, described a trajectory of *stable nonanxious*, with low initial levels of anxiety symptoms and a flat and nonsignificant slope of change across time. The next most common class, capturing slightly more than one quarter of the sample (29.6%), described a trajectory of *anxiety improvement*, with elevated initial levels of anxiety followed by a decrease in anxiety from 12 weeks to 1 year postinjury and then a stable level of anxiety from 1 to 2 years postinjury. Both the slope and quadratic parameters were significant for this pattern. A third class (12.8%) described a trajectory of *delayed anxiety*, with initially low levels of anxiety followed by a gradual increase in anxiety by 12 weeks and a stepper increase in anxiety from 12 weeks to 1 year postinjury. Both the slope and quadratic parameters for this class were significant. Parameter estimates are summarized in Table 2.

Conditional model. We tested all possible covariates for inclusion in the conditional model. Nested analyses on the three-class solution indicated that the following four covariates improved model fit: appraisals of threat, SCI-related coping using acceptance, SCI-related QOL problems, and general quality of life

Table 4
Fit Indices for One- to Five-Class Growth Mixture Models for Anxiety (Unconditional)

	Growth mixture model				
Fit index	1 class	2 classes	3 classes	4 classes	5 classes
AIC	3640.13	3622.18	3608.20	3602.34	3604.37
BIC	3667.74	3663.59	3663.42	3671.36	3687.19
SSBIC	3642.39	3625.56	3612.71	3607.97	3611.13
Entropy	—	.58	.60	.62	.66
LRT *p* value	—	.05	.05	.12	.63
BLRT *p* value	—	<.001	<.001	.04	.33

Note. AIC = Akaike information criterion; BIC = Bayesian information criterion; SSBIC = sample size-adjusted Bayesian information criterion; LRT = Lo–Mendell–Rubin test; BLRT = bootstrap likelihood ratio test.

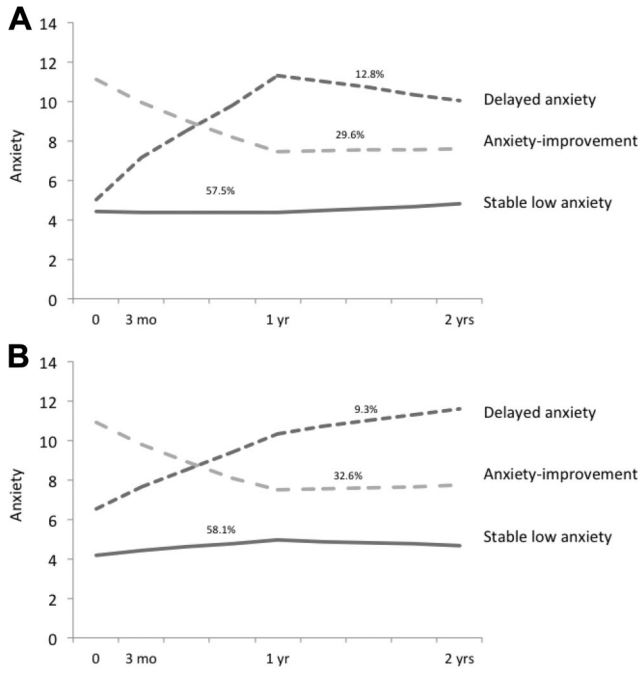

Figure 2. (A) Unconditional and (B) conditional models for anxiety symptoms. Unconditional model (no covariates), $n = 233$. Conditional model (covariates included), $n = 208$.

in the social domain. The slightly reduced sample for these analyses ($n = 208$) was the same used in the conditional model for depression, described above. In addition, and similar to the analyses for depression, the structure of the three-class conditional (i.e., covariate) solution for anxiety symptoms was similar to the three-class unconditional (i.e., no covariates) solution for anxiety symptoms. The proportions for the stable nonanxiety (58.1%), anxiety improvement (32.6%), and delayed anxiety (9.3%) trajectories were also similar to those observed in the unconditional model. The only noteworthy changes were that the delayed anxiety trajectory evidenced a higher initial level of anxiety and a less extreme increase in anxiety over time in the conditional model and that the intercept for the delayed class, which was nonsignificant in the unconditional model, was significant in the conditional model (see in Figure 2B).

Logistic regression analyses for predictors of class membership in the anxiety trajectories are summarized in Table 5. Using the stable nonanxious (resilient) class as the reference group indicated the most consistent differences with the delayed anxiety class. The stable low anxiety and delayed anxiety classes differed on all four covariates entered in the model. Compared with the delayed anxiety class, the stable nonanxious group had less appraisal of threat, greater SCI-related coping using acceptance, less functional impairment in problem solving, and greater quality of life in the social domain. Compared with the anxiety improvement class, the stable low anxiety group had less appraisal of threat, greater SCI-related coping using acceptance, and greater QOL in the social domain. The delayed anxiety and anxiety improvement classes did not differ significantly ($p < .05$) on any of the covariates.

Concordance in Classification of Depression and Anxiety Trajectories

Although the trajectory solutions for depression and anxiety described different numbers of classes, there were obvious similarities. Both analyses revealed a highly prevalent trajectory of stable low symptoms (resilience), a pattern of acute symptoms that improved over time (recovery), and a pattern of initially low symptoms that increased over time (delayed). A contingency analysis revealed that participants were significantly likely to be assigned to the same class in the final model solutions for depression and anxiety symptoms, $\chi^2(6) = 125.97$, $p < .001$. Analysis of individual cells indicated that among participants evidencing the resilient trajectory for depression, 76.0% also evidenced a resilient trajectory for anxiety symptoms, with 50.2% of the entire sample classified as resilient on both symptom measures. Among participants evidencing a recovery trajectory for depression, 83.9% also evidenced a recovery pattern for anxiety symptoms, with 11.2% of the entire sample classified as recovering on both symptom measures. Among participants exhibiting delayed elevations in depression, 65.2% also evidenced delayed elevations in anxiety symptoms, with 6.4% of the entire sample categorized in the delayed pattern on both measures. Among participants who were chronically depressed, 44% evidenced a recovery pattern for anxiety symptoms, 40% were stable nonanxious, and 16% evidenced delayed elevations in anxiety symptoms.

Table 5
*Multinomial Logistic Regression for Predictors of Anxiety Class Membership (*n = *208)*

	Stable low anxiety vs.			
	Anxiety improvement		Delayed anxiety	
Predictor	Est.	*SE*	Est.	*SE*
Threat appraisal	0.62	0.29*	0.60	0.29*
SCL acceptance	−1.90	0.73**	−2.23	0.91*
QOL social	−1.21	0.58*	−1.74	0.63**
Problem solving	0.37	0.32	1.33	0.62*

Note. SCL = spinal cord lesion; QOL = quality of life.
* $p < .05$. ** $p < .01$.

Discussion

SCI presents a particularly demanding coping challenge to survivors. Despite the fact that SCI has been associated with both reduced QOL and elevations in depression and anxiety, previous studies have shown that many SCI survivors nonetheless exhibit healthy long-term adjustment (Craig et al., 1994; Quale & Schanke, 2010; Whiteneck et al., 1992). The primary goal of the current investigation was to examine these divergent outcomes in greater detail by identifying unique trajectories of depression and anxiety symptoms across the first 2 years after SCI as well as the predictors of the trajectories within the same semiparametric model.

Our findings revealed that the best-fitting models were highly similar in terms of the shape and prevalence of trajectories they revealed but differed in the overall numbers of trajectories. In addition, the unconditional (no covariates) and condition models (covariates included) were only slightly different in each analysis. Both of the final conditional solutions for depression and anxiety symptoms included a trajectory of stable low symptoms or resilience, a trajectory of initial symptom elevations followed by improvement (recovery), and a trajectory of low initial symptoms that grew worse over time (delayed). The primary difference was that the best-fitting model for depression symptoms also included a chronic high depression trajectory, whereas the best-fitting model for anxiety did not include this trajectory.

By far the most common pattern observed in the current investigation was one of stable low symptoms beginning at hospitalization and continuing through 2 years posthospitalization. The consistently low symptom levels associated with this trajectory clearly suggest a resilient outcome (Bonanno, 2004). It is especially compelling to observe the prevalence of the resilient pattern in SCI patients because of the complex and demanding nature of such injuries. Not only is SCI associated with compromised physical functioning and independence, but also the period of rehabilitation and readjustment is typically extensive. Resilient individuals were those who endured these demands while still managing to maintain consistently stable positive psychological adjustment. A majority of patients were assigned to the resilient low symptom class in the analysis for depression and in the analysis for anxiety symptoms, and just over half the sample (50.2%) was assigned to this class in both analyses. Of note, the majority prevalence of the stable low

symptom trajectory in the current study is highly concordant with previous studies of resilience, following both potentially traumatic health events (e.g., deRoon-Cassini et al., 2010; Deshields et al., 2006; Helgeson et al., 2004; Lam et al., 2010, 2012; Quale & Schanke, 2010) and other types of potential trauma (Bonanno, 2004; Bonanno et al., 2011).

Both the depression and anxiety models also revealed two other patterns: a trajectory of initially elevated symptoms that decreased over time, suggesting a pattern of improvement or recovery; and a trajectory of low initial symptoms that increased over time, suggesting a delayed pattern. The prevalence of the improvement trajectory in the conditional models (23.9% for depression symptoms, 32.6% for anxiety symptoms) was at the higher end of the range observed in previous health- and injury-related studies (Bonanno et al., 2008; deRoon-Cassini et al., 2010; Helgeson et al., 2004; Lam et al., 2010; Le Brocque et al., 2010). Of interest, however, the shape of this trajectory suggested steady improvement only up to the 1-year posthospitalization mark and then only gradual improvement in depression symptoms and no further improvement in anxiety symptoms from 1 to 2 years. The lack of change in the second year after SCI has been noted in previous investigations (Kennedy et al., 2011) and may be indicative of a more settled health status and immunological adjustment.

The delayed pattern was characterized in both conditional analyses by a moderate initial level of symptoms followed by a dramatic increase in symptoms up to the 1-year point. Although depression increased slightly and anxiety decreased slightly from 1 to 2 years, in both models participants who exhibited this pattern still had elevated symptom levels at 2 years. Delayed symptoms have been identified in previous trauma studies at prevalence rates generally similar to those observed in the current investigation (Andrews, Brewin, Philpott, & Stewart, 2007; Bonanno, 2004). Recent trajectory studies of injury- and health-related adversities have also reported delayed reactions. Delayed trajectories have been observed, for example, following traumatic injury (deRoon-Cassini et al., 2010), breast cancer (Helgeson et al., 2004), and hospitalization for severe acute respiratory syndrome (Bonanno et al., 2008), in each case at a prevalence similar to that observed in the current investigation. A key feature of the delayed pattern observed in previous studies is that the participants who exhibit this pattern tend to show some signs of struggle even early on. This was true in the current investigation as well. For both depression and anxiety symptoms, SCI survivors who eventually exhibited delayed symptom increases had significantly greater initial symptom levels than the more resilient (stable low symptom) participants.

Finally, the model for depression symptoms revealed a trajectory of chronically elevated symptoms, but this pattern was not revealed in the best-fitting model for anxiety symptoms. Together, these findings suggest that although some SCI patients might experience chronic and enduring depression reactions to their injuries, anxiety reactions occur in a manner that is more responsive to situational variations. More specifically, elevated anxiety occurred soon after injury and then decreased around the 1-year postinjury mark. What is particularly striking about these patterns is that they are not apparent when either average-level data or percentages above a clinical cutoff are used but only revealed when individual latent trajectories are assessed.

Inclusion of Covariates as Predictors of the Trajectories

An advantage of the GMM approach is that it can be extended to include theoretically relevant covariates that potentially improve model fit and that illuminate predictors of class membership. In the current investigation, we tested the various covariates included in the study for possible inclusion in conditional models. The best-fitting conditional models included appraisal and coping variables as well as other relevant covariates. These models produced patterns of trajectories that differed only slightly from the unconditional models. It is of potential interest that, although the conditional analyses revealed different sets of covariates for models based on depression versus models based on anxiety symptoms, overall the findings were consistent with predictions for the appraisal and coping variables.

For the appraisal variables, as anticipated, participants exhibiting the resilient pattern of stable low symptoms were more likely to appraise SCI as a challenge rather than a threat. More specifically, the stable low depression group used significantly more challenge appraisals than the depression improvement and chronic depression groups, whereas the stable low anxiety group used significantly fewer threat appraisals than the anxiety improvement and delayed anxiety groups. For the coping variables, as anticipated, the stable low depression group was more likely to cope using acceptance and fighting spirit and less likely to cope more generally through social reliance and behavioral disengagement. Specifically, the stable low depression group had significantly higher SCI-related fighting spirit than all other groups and significantly higher SCI-related acceptance than the chronic depression group, whereas the stable low anxiety group had significantly higher SCI-related acceptance than both the anxiety improvement and delayed anxiety groups. In addition, the stable low depression group relied significantly less on coping through social reliance and behavioral disengagement than the chronic depression group. In addition to these findings, the stable low symptom or resilient groups also evidenced fewer QOL problems. Specifically, the stable low depression group had significantly fewer QOL problems than all other groups, and the stable low anxiety group had significantly fewer QOL social problems than all other groups.

Considering these same comparisons using the chronic depression pattern as the reference group, chronic depression SCI survivors had greater QOL problems, used greater behavioral disengagement and coping through social reliance, used less acceptance, fighting spirit, and challenge appraisals than the stable low depression group, and used less acceptance and greater social reliance coping than the depression improvement group. Although these findings clearly suggest a less adaptive pattern of coping and appraisal for the chronically depressed group, it is interesting that a somewhat opposite set of findings was observed when the chronic depression group was compared with the delayed depression group. In this comparison, chronically depressed individuals had greater challenge appraisal and less social reliance coping than the delayed depression group. Although both the chronic and delayed groups had elevated depression at the 2-year point postinjury, these findings suggest the intriguing possibility that the delayed depression group may actually be the more dysfunctional pattern of the two. Clearly, however, more data as well as more distal longitudinal analyses would be needed to support such a conclusion.

Limitations

A key advance of the current investigation was the identification of longitudinal trajectories of adjustment following SCI as well as the predictors of those trajectories using GMM. The GMM approach is especially well suited for field studies of highly aversive events because it employs a robust maximum-likelihood estimation procedure that accommodates missing data, allows parameters to vary as random effects across classes, and includes other variables that might influence the shape of the outcome patterns as covariates in the modeling procedures. It is important, however, to acknowledge the potential limitations of this approach.

One potential limitation is that although in unconditional analyses GMM can easily accommodate missing data, the conditional analyses that included covariates are necessarily limited to only those participants for whom data on the relevant covariates were available. In the current study, the sample size for the conditional models ($n = 208$) was only slightly reduced from the sample size used in the unconditional models ($n = 233$) and, importantly, there were no significant differences between the samples used in each analyses on any of the variables considered in our study.

Another potential limitation has to do with model selection. Although the identification of latent growth classes is largely empirically determined, the selection of a final model often requires conceptual adjudication. In the current study, the role of conceptual interpretation was asymmetric. More specifically, the empirical determination of the optimal trajectory solution for depression symptoms was unambiguous, informed by clear differences in fit statistics across models, whereas resolution of the final solution for anxiety symptoms depended to a greater extent on the conceptual interpretability of the models. Although this asymmetry might in part explain the fact that the analyses for depression and anxiety symptoms produced different numbers of trajectories, it is important to note that the patterns in these models were highly similar. Moreover, although the chief difference in the solutions was the lack of a chronic trajectory in the model for anxiety symptoms, decisions about model selection could not have been the source of this difference as none of the models in the analyses for anxiety symptoms produced a chronic pattern.

Finally, it is worth noting that resilience is more than the absence of psychopathology and that the assessment of resilience should also include the demonstration of healthy psychological functioning (Bonanno, 2004; Quale & Schanke, 2010). Although the LGMM in the current study was based on patterns of psychiatric symptoms, we did include measures of positive adjustment in the form of various aspects of QOL as covariates. These analyses revealed that participants evidencing a resilient pattern of stable low symptoms also reported fewer QOL problems and greater social relations. It will be important for future growth modeling studies on SCI to consider possible longitudinal patterns of these variables and other positive forms of adjustment so as to better illuminate resilient patterns of outcome. Assessing resilience and exploring psychological techniques to enhance resilience competence would be useful along with appraisal training and coping effectiveness training (Kennedy, Duff, Evans, & Beedie, 2003).

Conclusion

This study prospectively tracked possible trajectories of resilience and pathology exclusively among survivors of SCI. Consistent with previous studies of both potentially traumatic life events and health-related adversity, the majority of SCI survivors in the current study exhibited a stable pattern of low symptoms or resilience. Also consistent with previous studies, other patterns to emerge conformed to the prototypical trajectories of chronic symptom elevations, symptom elevation followed by improvement, and delayed symptom elevations. Extending previous studies of SCI, the LGMM analyses also demonstrated that individual differences in coping and appraisal measured soon after the injury informed the prevalence and shape of these trajectories as well as their membership.

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