Perceived Growth and Decline Post-Spinal Cord Injury: Reality or Illusion?

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Abstract

Objective: This study examined whether retrospective reports of posttraumatic growth (PTG) and depreciation (PTD) of individuals recently diagnosed with a spinal cord injury (SCI) coincide with prospectively measured changes in the conceptually close domains of general self-efficacy (SE) and purpose in life (PIL). The study also tested whether PTG/D and changes in SE and PIL independently predict psychological adjustment to the injury (depressive symptoms, anxiety, life satisfaction). ***Methods***: Adopting a longitudinal design, a sample of 206 newly-injured patients admitted to one of the four Swiss SCI rehabilitation centers was analyzed. SE and PIL were assessed one month after injury diagnosis and at rehabilitation discharge, PTG/D and the adjustment indicators only at discharge. Structural equation modelling was used to calculate latent change scores for SE and PIL, to correlate these scores to PTG/D scores, and to regress the adjustment indicators on both of them. ***Results***: PTG/D scores were weakly (r_{max}=.20, p=.033) correlated to changes in SE and PIL. In the multivariate analyses, positive changes in SE and PIL and PTG scores were all associated with better adjustment (e.g., fewer depressive symptoms). In contrast, PTD scores were related to lower adjustment. ***Conclusions***: These results suggest that PTG/D in the initial time after a potentially traumatic medical event seem to be illusory to some degree, as indicated by their weak association with "actual" (i.e., longitudinally measured) changes. Nevertheless, both, PTG/D and actual changes, need to be considered by researchers and clinicians, as they seem to be independently related to psychological adjustment.

Keywords: *spinal cord injuries, posttraumatic growth, depression, anxiety, self efficacy*

A spinal cord injury (SCI) is a health condition which is often characterized by a permanent, complete or incomplete loss of sensory, motor, and autonomic functions in body areas below the level of the spinal cord at which the injury occurred (World Health Organization, 2013). As a consequence, social participation can be restricted and a substantial minority of the population is at risk for clinically significant symptoms of depression or posttraumatic stress disorder (World Health Organization, 2013).

Nevertheless, individuals with SCI also experience posttraumatic growth (PTG; e.g., Kunz, Joseph, Geyh, & Peter, 2017). PTG is a term used to describe positive psychological changes in the aftermath of potentially traumatic events, such as a greater sense of personal strength, greater appreciation of life, or better relationships with others (Tedeschi & Calhoun, 2004). Typically, researchers have assessed PTG using the Posttraumatic Growth Inventory (PTGI; Tedeschi & Calhoun, 1996). The PTGI asks respondents at a time after the event to indicate whether they perceive themselves to have changed positively in different domains as a result of a critical life event such as SCI onset. Following previous research (e.g., Frazier et al., 2009), self-reports of positive changes that are based on such retrospective, subjective perceptions are referred to as *perceived PTG*.

However, assessing personal changes by retrospective self-reports is subject to several methodological limitations (see e.g., Tennen & Affleck, 2009, for a review). For example, recalling personal change requires complex mental operations and is in particular subject to recall bias. However, prospective research does not need to rely on retrospective accounts of change. The difference in state measures taken at two time points can be calculated to give a measure of change (see, Tennen & Affleck, 2009). Although still relying on self-perceptions, the latter procedure is not affected by the same limitations as retrospective accounts. As such, previous research (e.g., Frazier et al., 2009) refers to prospectively measured changes as *actual changes* in typical PTG domains.

So far, only a few of studies have attempted to compare perceived PTG and actual changes in PTG domains. In one of these studies, Frazier et al. (2009) followed a sample of students across eight weeks. In those who experienced a potentially traumatic event during that time, pre- to post-event changes in measures identified as corresponding to PTGI domains were only weakly related to perceived changes assessed with the PTGI. Importantly, perceived PTG was found to be positively, and actual changes to be negatively, related to psychological distress. Following another student sample, Yanez, Stanton, Hoyt, Tennen, and Lechner (2011) showed that the positive association between perceived PTG and distress was partially mediated by denial coping, whereas actual changes had a direct, negative effect on distress. Together, these results suggest that perceived PTG may not reflect actual positive changes and that both may be independently, but differently related to psychological adjustment.

Such findings fuel a theoretical debate about the conceptualization of perceived PTG and whether it is a counterfactual positive illusion (e.g., Taylor, 1983), and if so, whether this is an adaptive coping strategy or a defensive, denial-like strategy that interferes with psychological adjustment (e.g., Ford, Tennen, & Albert, 2008; Zoellner & Maercker, 2006). Thus, a clarification of whether perceived PTG represents actual changes is of high clinical significance.

However, it is uncertain whether results from student samples can be transferred to individuals coping with health-related potentially traumatic events. Responses could differ depending on the type of event and students are not at the peak age for the onset of a chronic health condition (Aspinwall & Tedeschi, 2010). Studies testing the association of perceived PTG with adjustment to chronic health conditions revealed positive or non-significant results (Barskova & Oesterreich, 2009), but to date no study examined whether the association is independent of the effects of actual changes. As initial evidence from a sample of individuals with cancer indicates that perceived PTG is weakly related to actual changes in such a population too (Ransom, Sheldon, & Jacobsen, 2008), this is an important research gap.

Moreover, more research on the association between perceived PTG and actual changes is warranted because the usual measurement of changes in previous research raises several issues: First, the studies that examined actual changes have typically relied on raw change scores, that is, subtracting the baseline score from the one of a second measurement of the same construct later on, to operationalize actual changes. Yet, the reliability of such change scores is questionable because measurement error of the two combined measures may accumulate (e.g., Gollwitzer, Christ, & Lemmer, 2014; McArdle & Nesselroade, 2014).

Second, none of the studies tested for longitudinal measurement invariance of the constructs across time. This means that they did not test whether the measure of the same construct at the two measurement occasions had equivalent properties (see e.g., Little, Preacher, Selig, & Card, 2007). In this case, changes in self-reports cannot be unambiguously interpreted as quantitative differences in the construct itself. They may also reflect a change in the reference point of the respondent or even a change in his or her subjective definition of the underlying construct (i.e., response shift; Gollwitzer et al., 2014; Tennen & Affleck, 2009).

Third, whereas measures of actual changes can show positive and negative changes over time, questionnaires such as the PTGI allow respondents to report only positive changes. This might have led to a positivity bias explaining the difference between perceived and actual changes (Park & Lechner, 2006). Perceived negative changes in the typical PTG domains are termed posttraumatic depreciation (PTD) and were shown to co-occur with PTG (e.g., Baker, Kelly, Calhoun, Cann, & Tedeschi, 2008; Kunz et al., 2017). As such, it is necessary to assess both, perceived PTG and PTD, and their associations with actual changes.

The Present Study

In order to fill the identified research gaps, the present study had two aims. The first aim was to compare perceived PTG and PTD in individuals with SCI at discharge from their clinical rehabilitation assessed with an expanded version of the short form of the PTGI (Kunz et al., 2017) with actual changes in general self-efficacy (SE) and purpose in life (PIL) across rehabilitation. The reasoning to focus on changes in SE and PIL for such a comparison was that they reflect two broader domains which Janoff-Bulman (2006) distinguished within the original five PTGI domains. She argued that as a result of the coping process, individuals in the aftermath of potentially traumatic events may discover a sense of competence in managing difficult situations based on which new choices in life are made (representing the PTGI domains sense of personal strength and new possibilities in life). This broader domain of the PTGI, referred to as *strength through suffering*, corresponds to positive changes in SE, that is, the strength of one's belief to be able to manage difficult or novel situations (Schwartzer & Jerusalem, 1995). The second broader domain Janoff-Bulman (2006) identified within the PTGI is that due to the uncontrollable nature of trauma, individuals may find new meaning in life by valuing more the preciousness of human existence in different life domains (representing the PTGI domains appreciation of life, relationships with others, and spiritual change). This second broader domain, termed *existential reevaluation*, corresponds to positive changes in meaning or PIL. Based on research outlined above, we expected a weak association between perceived PTG and positive changes in SE and PIL.

Because perceived PTD covers the same domains as perceived PTG, the same reasoning was applied to relate it to negative changes in SE and PIL. Previous research (Blackie, Jayawickreme, Helzer, Forgeard, & Roepke, 2015; Helgeson, 2010) suggested that perceived PTD may be reported more accurately compared to perceived PTG, as indicated by a stronger corroboration by significant others. Hence, we expected a moderate to strong association of perceived PTD with actual changes in SE and PIL.

The second aim of the study was to examine whether perceived PTG and PTD predict psychological adjustment (i.e., fewer symptoms of depression and anxiety, and greater life satisfaction) to SCI at discharge from clinical rehabilitation independent of actual changes in the conceptually close domains of SE and PIL. Both, actual positive changes in SE and PIL, were shown to be related to improved mental health in a previous study examining individuals with SCI (van Leeuwen, Edelaar-Peeters, Peter, Stiggelbout, & Post, 2015). Accordingly, we expected actual changes in SE and PIL to be positively related to psychological adjustment. Regarding perceived changes, analyses of a smaller subsample of the same cohort (see method section) indicated that perceived PTG was negatively related to symptoms of depression, positively related to life satisfaction and unrelated to anxiety, while perceived PTD was generally related to lower adjustment scores (Kunz et al., 2017). We expected these associations of perceived PTG to remain even when controlling for actual changes. As we expected perceived PTD to represent actual changes more accurately than perceived PTG, we hypothesized that perceived PTD does not independently predict psychological adjustment.

Method

Participants and Design

The present study used data from Pathway 3 of the Swiss Spinal Cord Injury Cohort Study (SwiSCI PW3; see Post et al., 2011). SwiSCI PW3 is an extensive inception cohort study following individuals recently diagnosed with an SCI across their clinical rehabilitation and beyond. Data is collected by clinical assessments and self-report surveys. Included are all Swiss residents newly diagnosed with an SCI, aged 16 years or older, and admitted for clinical rehabilitation to one of the four Swiss rehabilitation centers (Spinal Cord Injury Center of the Balgrist University Hospital, Zürich; Centre for Spinal Cord Injury and Severe Head Injury, REHAB Basel; Clinique Romande de Réadaptation, Sion; and the Swiss Paraplegic Centre, Nottwil). Exclusion criteria are: congenital conditions leading to paraplegia or tetraplegia, new SCI in the context of palliative care, and neurodegenerative disorders such as multiple sclerosis. In addition, trained research assistants invite the eligible patients to participate in the study only upon approval of the responsible physician. The SwiSCI study was approved by the principal ethics committee on research involving humans of Northwest and Central Switzerland (covering the collaboration centers in Nottwil and Basel), the Ethics Committee Vaud (covering the center in Sion), and the Ethics Committee Zürich (covering the center in Zürich). All participants gave written informed consent.

During clinical rehabilitation, data collection in SwiSCI PW3 takes place at one, three, and six months after SCI diagnosis, and at rehabilitation discharge (Post et al., 2011). The present study focused only on data collected at one month post injury (T1; baseline measurement of SE and PIL) and at rehabilitation discharge (T2; follow up measurement of SE and PIL, measurement of perceived PTG, PTD, and the adjustment indicators).

As SwiSCI PW3 data collection is ongoing, the 371 participants who completed rehabilitation until July 1, 2017, were considered for the study. Of these, 123 participants were excluded because they did not complete T1, because complete scales of interest were missing at T1, or because they had a very short rehabilitation duration leading to collapsed measurement occasions. Of the remaining participants, 42 did not complete T2 or did not answer complete scales at T2 and were excluded (see Supplemental Figure S1). Thus, the attrition rate is 16.9%. In terms of selection effects, participants who completed T1 and T2 (continuers: n = 206) and participants who completed only T1 (dropouts: n = 42) did not differ significantly regarding language of the questionnaire, age at injury, duration of clinical rehabilitation, type of injury, SE at T1, and PIL at T1. However, continuers were more likely to be male, χ^2 (1) = 4.18, p = .029, V = .14, and married or widowed, χ^2 (4) = 14.04, p = .007, V = .24. Furthermore, continuers did also not differ significantly from those participants who did not complete T1 (n = 100) regarding sex, language of the questionnaire, and age at injury. However, participants who did not complete T1 (M = 166.28, SD = 95.65) had on average a longer duration of clinical rehabilitation compared to continuers (M = 134.46, SD = 95.65), t (304) = 3.31, p < .001, d = .40, and were more likely to have an incomplete or complete tetraplegia, χ^2 (5) = 18.67, p = .002, V = .27). In sum, these differences indicate a slight selection bias in the analyzed sample (n = 206). The reporting of the study is based on the

STROBE statement (von Elm et al., 2007).

Measures

Perceived PTG and PTD (T2). Perceived PTG was assessed with the short form of the Posttraumatic Growth Inventory, a 10 item scale (PTGI-SF; Cann et al., 2010). Two items each measure positive changes in the five PTGI domains (Personal Strength, New Possibilities, Appreciation of Life, Relationships with Others, and Spiritual Development). In each item, participants rated the degree to which they perceived positive change as a result from SCI on a scale from 0 (*I did not experience this change*) to 5 (*I experienced this change to a very great degree*). To measure perceived PTD, 10 corresponding but negatively worded items were selected from the Paired Format Posttraumatic Growth Inventory (PTGI-42; Baker et al., 2008). PTG and PTD Total scores (possible range of 0 to 50) are calculated separately with higher scores indicating greater perceived PTG or PTD. The PTGI-SF and the PTGI-42 are both reliable instruments (Baker et al., 2008; Cann et al., 2010). Following the reasoning based on Janoff-Bulman's (2006) typology of how the five PTGI domains are related to actual changes in SE and PIL, for both, PTG and PTD, a Strength Through Suffering (possible range of 0 to 20) and an Existential Reevaluation score (possible range of 0 to 30) was created too.

General Self-Efficacy (T1, T2). SE was measured with a modified version of the General Self-efficacy Scale (GSES; Peter, Cieza, & Geyh, 2014). The GSES assesses the strength of the belief in one's ability to manage novel or difficult situations (Schwartzer & Jerusalem, 1995). Its modified version consists of five Likert-type items ranging from 1 (*not at all*) to 4 (*exactly true*). Higher sum scores (possible range of 5 to 20) indicate higher SE. The scale demonstrated satisfactory reliability (person reliability index = .82) in an SCI sample (Peter et al., 2014). In terms of validity, GSES scores and the ones of similar measures of general self-efficacy have been shown to be moderately to strongly associated with a broad range of psycho-social outcomes (e.g., symptoms of depression) in the SCI context (Peter, Müller, Cieza, & Geyh, 2012; van Diemen, Crul, van Nes, Geertzen, & Post, 2017). These effects are comparable to the ones observed when SCI- or other context-specific measures of self-efficacy were used (Peter et al., 2012; van Diemen et al., 2017).

Purpose in Life (T1, T2). PIL was assessed with the Purpose in Life Test-Short Form (PIL-SF; Schulenberg, Schnetzer, & Buchanan, 2011). The PIL-SF consists of four items on a Likert scale ranging from 1 to 7. Higher sum scores (possible range of 4 to 28) indicate more meaning and PIL. Good internal consistency (α of .84-.86) and validity as indicated by high correlations with other measures of meaning in life and with well-being was demonstrated (Peter, Schulenberg, Buchanan, Prodinger, & Geyh, 2016; Schulenberg et al., 2011).

Psychological adjustment (T2). Three indicators of psychological adjustment were used: symptoms of depression, anxiety and life satisfaction. Symptoms of Depression and Anxiety were measured with the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). The HADS is a self-assessment scale designed to detect clinically significant levels of symptoms of Depression and Anxiety in patients in a medical clinic. Seven items each assess symptoms of Depression and Anxiety during the past week on a Likert scale ranging from 0 to 3. The HADS typically demonstrated good reliability (α ranging between .67 and .90 regarding the Depression and between .68 and .93 regarding the Anxiety subscale) and validity in the form of strong associations with other measures of depressive symptoms and anxiety in various clinical populations (Bjelland, Dahl, Haug, & Neckelmann, 2002). Life Satisfaction was measured with the International Spinal Cord Injury Quality of Life Basic Data Set (SCI QoL Basic Data Set; Charlifue et al., 2012). The SCI QoL Basic Data Set assesses satisfaction with physical and psychological health and the overall life satisfaction. The response scale of the corresponding three items ranges from 0 (*completely dissatisfied*) to 10 (*completely satisfied*) and the values are aggregated into a mean score. The SCI QoL Basic Data Set demonstrated to be a reliable (α = .81) and valid measure as indicated by strong correlations with mental health and general measures of life satisfaction (Post, Adriaansen, Charlifue, Biering-Sorensen, & van Asbeck, 2016).

Data Analyses

Stata, version 14, was used to clean the data set and to calculate descriptive statistics. The amount of participants having missing values varied between 0% and 12.6% per variable (Table 1). To deal with the missing data, multiple imputation with chained equations (MICE) was conducted using the mice package in R (van Buuren & Groothuis-Oudshoorn, 2011). As recommended by Enders (2010), data was imputed at the item level and 20 imputed data sets were created. Besides all variables used in subsequent analyses, three auxiliary variables (sex, marital status, rehabilitation duration) were included in the imputation model.

To examine the research questions, latent change score models (McArdle & Nesselroade, 2014) were used to estimate changes in SE and PIL from T1 to T2. These latent change score models were then integrated into broader structural equation models in which changes in SE and PIL were correlated to the different PTG and PTD scores and in which the psychological adjustment indicators measured at T2 were regressed on changes in SE and PIL and the PTG and PTD scores, while controlling for T1 levels in SE and PIL. Separate models were tested for each combination of the latent change score model of SE or PIL with one of the three psychological adjustment indicators. All of these six models included PTG and PTD Total scores. In another six models, the PTG and PTD Strength Through Suffering scores combined with the latent change score model of SE and the PTG and PTD Existential Reevaluation scores combined with the latent change score model of PIL were included instead of the PTG and PTD Total scores. As an illustrative example, a simplified version of the model analyzing the associations between changes in SE, PTG and PTD Total scores, and symptoms of Depression is depicted in Supplemental Figure S2. All of these analyses were performed in the R software package lavaan (Rosseel, 2012).

In building these models, a stepwise approach was followed (see McArdle &

Nesselroade, 2014; Weston & Gore, 2006). First, longitudinal measurement invariance of the measures of SE and PIL was tested to ensure that corresponding changes can be meaningfully interpreted (e.g., Gollwitzer et al., 2014). To do so, configural, loading, and intercept invariance was tested (e.g., Gollwitzer et al., 2014; Little et al., 2007). Regarding both SE and PIL, a first model representing a longitudinal confirmatory factor analysis without any constraints besides those for scale setting of the latent factor at T1 and T2 (configural invariance) was fitted. In the second and third model, equality constraints on the factor loadings of corresponding items (loading invariance) and additionally on the intercepts (intercept invariance) were imposed. The loading and the intercept invariant model were both compared to the less restrictive one by using a Chi-square (χ^2) difference test. A non-significant difference indicates that the corresponding level of measurement invariance holds.

Second, the latent change score models of SE and PIL were created by adding a latent change score factor to the T1 and the T2 intercept invariant measurement models. The T2 factor was regressed on the T1 factor and the latent change score factor using structural weights set equal to 1.0. Together with fixing the variance of the T2 factor at 0, this mimics a subtraction. In these latent change score models, mean changes (i.e., intercept of the latent change score factor, μ_Δ) and interindividual differences in changes in SE and PIL over time (i.e., variance of the latent change score factor, σ_Δ^2) are included as model parameters. The main advantage of this way to calculate change is that it is measured without measurement error (Gollwitzer et al., 2014; McArdle & Nesselroade, 2014).

Third, the latent change score models were expanded by adding the PTG and PTD scores and the adjustment indicators to the models. Although guidelines consider a sample size of 200 to be sufficient for structural equation models, each of them was included as single indicator construct (i.e., observed variable) to ensure parsimony and an adequate ratio of the number of variables included in a model and the sample size (see e.g., Weston & Gore, 2006).

All models were estimated using robust maximum likelihood to adjust for non-normal distribution (Finney & DiStefano, 2006). Goodness of fit was judged by χ^2, comparative fit index (CFI), and root mean square error of approximation (RMSEA) including the 90% confidence interval (CI). Good model fit is indicated by a nonsignificant χ^2, a CFI value above .95, and an RMSEA value below .06 (Hu & Bentler, 1998).

Results

Participant Characteristics and Descriptive Statistics

Demographic and injury-related characteristics of the sample (n = 206) are shown in Table 2. Descriptive statistics of all study variables are depicted in Table 1.

Measurement Invariance and Actual Changes in SE and PIL

Model fit and χ^2 comparisons of the nested models testing longitudinal measurement invariance of the measures of SE and PIL are presented in Table 3. For both constructs, the configural invariant model demonstrated good fit statistics. Standardized factor loadings (p < .05) ranged between .58 and .82 and between .68 and .87 for the measure of SE or PIL, respectively. The equality constraints in the loading invariant models and in the intercept invariant models did not result in a significant increase in χ^2 (Table 3). Hence, intercept invariance was adopted as a basis for the latent change score models of SE and PIL.

The fit of both latent change score models exactly mirrored the one in the corresponding intercept invariant model. In the latent change score model of SE, there was no significant mean change from T1 to T2 ($\mu_\Delta = 0.01$, $p = .746$). However, there were significant interindividual differences in intraindividual change ($\sigma_\Delta^2 = 0.25$, $p < .001$). In the latent change score model of PIL, there was a significant decrease in the latent mean from T1 to T2 ($\mu_\Delta = -0.21$, $p = .005$). Again, there was also significant interindividual variability in intraindividual changes ($\sigma_\Delta^2 = 0.94$, $p < .001$). Altogether, the significant variability of individual patterns of change from T1 to T2 regarding both, SE and PIL, allowed for probing associations of these changes with other constructs.

Correlations of Actual Changes in SE and PIL with PTG and PTD Scores

All twelve models still achieved good fit (i.e., CFI > .95 and RMSEA < .06) when the different PTG and PTD scores and the adjustment indicators were added to the latent change score models, except that the χ^2 value was significant ($p < .05$) for most of them. In these models, PTG ($r = .15$, $p = .079$) and PTD Total scores ($r = .09$, $p = .298$) were both not significantly correlated to changes in SE[1] nor changes in PIL[1] ($r = .08$, $p = .282$; $r = .03$, $p = .731$, respectively).

Similarly, the PTG ($r = .20$, $p = .033$) and the PTD ($r = .12$, $p = .155$) Strength Through Suffering scores were weakly or not significantly correlated to changes in SE[1] and the PTG ($r = .03$, $p = .714$) and PTD ($r = .00$, $p = .975$) Existential Reevaluation scores were not significantly correlated to changes in PIL[1]. In sum, perceived PTG and PTD scores were at best weakly related to actual changes in the conceptually close domains of SE and PIL.

Predicting Psychological Adjustment from Actual and Perceived Changes

Analyses with PTG/PTD Total scores. The standardized beta coefficients of interest in the six models in which changes in SE or PIL and the PTG and PTD Total scores were regressed on the adjustment indicators are presented in Table 4. Positive changes in SE and PIL from T1 to T2 were related to better psychological adjustment (i.e., lower symptoms of Depression, lower Anxiety, and higher Life Satisfaction) at T2. Except for the association between changes in SE and Anxiety ($\beta = -.15$, $p = .071$), which only approached borderline

[1] The correlation of each type of PTG and PTD score with the two latent change score factors was estimated three times (i.e., once in each model combining the latent change score model of SE or PIL with one of the three adjustment indicators). We only report the correlations estimated in the model combining the latent change score model of SE or PIL with symptoms of Depression as these correlations were virtually the same when Anxiety or Life Satisfaction was included instead (i.e., $\Delta r < .01$).

statistical significance, all of these associations were statistically significant. Effect sizes were stronger for changes in PIL (β ranging between -.45 with symptoms of depression and -.30 with anxiety) than for changes in SE (β ranging between -.15 with Anxiety and .24 with Life Satisfaction).

In the models including changes in SE, higher PTG Total scores were significantly related to fewer symptoms of Depression (β = -.26, $p < .001$) and to higher Life Satisfaction (β = .15, $p = .032$). These effect sizes are weaker than those of changes in SE and PIL. Higher PTD Total scores were related to more symptoms of Depression (β = .48), higher Anxiety (β = .37), and lower Life Satisfaction (β = -.33) . In the three models in which changes in PIL were controlled for, the effects of both PTG and PTD Total scores were slightly weaker, but followed the same pattern (Table 4).

Analyses with PTG/PTD Strength Through Suffering and Existential Reevaluation scores. Most notably, the PTG Strength Through suffering scores were not significantly related to any of the adjustment indicators (Table 5). Although still significant, also the effects of the PTD Strength Through Suffering scores (β ranging between .29 with symptoms of Depression and -.20 with Life Satisfaction) were substantially weaker than the ones of the corresponding Total scores. In contrast, the effects of PTG and PTD Existential Reevaluation scores did not differ substantially from the ones of the Total scores (Table 5).

Sensitivity Analysis

Multiple imputation is based on an iterative process that can go wrong. Thus, the fit of the imputation model needs to be checked by comparing distributional properties of the imputed and observed data as well as the parameter estimates that result in complete and imputed data sets (Lee, Roberts, Doyle, Anderson, & Carlin, 2016; van Buuren & Groothuis-Oudshoorn, 2011). In the present study, graphical analyses yielded no remarkable distributional differences between imputed and observed data which indicates a good fit of the imputation model. This was further supported as no discrepancies in parameter estimates (i.e., Δ in relevant coefficients was on average .03) were detected when the main analyses were rerun with complete cases only (n = 162)..

Furthermore, to test the power of the significant regression paths in all 12 models (Tables 4 and 5), post hoc Monte Carlo power analyses were performed using the simsem package in R (Pornprasertmanit, Miller, & Schoemann, 2013). Average effect power was .82.

Discussion

The present study examined the association of perceived PTG and PTD at discharge from clinical rehabilitation with actual (i.e., longitudinally measured) changes in the conceptually close domains of SE and PIL across rehabilitation in individuals with SCI. Our hypotheses were partially supported. First, perceived PTG, but unexpectedly also PTD scores, were at best weakly related to actual changes in SE and PIL. This can be interpreted as suggesting that both perceived PTG and PTD are illusory to some degree. Second, the study also investigated whether actual and perceived changes independently predict psychological adjustment to the injury at discharge from rehabilitation. As expected, individuals showing more increases in SE and PIL reported fewer symptoms of depression and anxiety and higher life satisfaction. Partially supporting our hypothesis, perceived PTG in domains covering PIL (i.e., existential reevaluation) was related to fewer symptoms of depression and higher life satisfaction, whereas perceived PTG in domains covering SE (i.e., strength through suffering) was unrelated to the adjustment indicators. Contrary to our expectations, perceived PTD was negatively related to all adjustment indicators in these multivariate analyses.

Perceived PTG, Actual Changes, and Psychological Adjustment

The finding that perceived PTG may be illusory to some degree, as indicated by weak associations with actual positive changes, was also observed in studies focusing on individuals coping with cancer (Ransom et al., 2008) or other types of potentially traumatic events (e.g., Frazier et al., 2009). In contrast to these studies, longitudinal measurement invariance for the measures of actual changes was established and latent change score models were used to calculate actual changes in the present study. In doing so, confidence was increased that unreliability in the measures of actual changes or response shift cannot serve as alternative explanations for this finding (Gollwitzer et al., 2014). Moreover, the present study used an expanded version of the PTGI allowing respondents not only to report perceived PTG, but also PTD. Thus, it seems unlikely that positivity bias, which may result in PTG measures allowing respondents to report only positive changes, can explain these results.

Even so, perceived PTG and actual changes may both be relevant in the psychological adjustment process to SCI, as indicated by their independent associations with the adjustment indicators. The result that positive changes in SE and PIL were related to better adjustment scores confirms and expands the mostly cross-sectional previous research showing that SE and PIL are important resources in the adjustment process to SCI (Peter et al., 2012; van Diemen et al., 2017). This result also conforms to the longitudinal study in individuals with SCI showing that increases in SE and PIL were related to improved mental health (van Leeuwen et al., 2015).

Perceived PTG in domains covering meaning in life (i.e., existential reevaluation) was related to better psychological adjustment to the injury even though we controlled for actual changes in PIL. Although these effects were weaker than those of the actual changes, this result supports the idea that perceived PTG could represent a positive illusion which has an adaptive function in the adjustment process (Taylor, 1983). At the same time, this finding contrasts with studies showing that perceived, potentially illusory PTG is related to more psychological distress in students coping with other types of potentially traumatic events (Frazier et al., 2009; Yanez et al., 2011). There are several possible explanations for this discrepancy. First, it may be explained by the different populations examined or by the different methods used in the other studies. Second, perceived PTG was assessed considerably earlier after the event in these studies (i.e., maximally two months compared to five months on average in the present study). In this respect, the Janus face model of perceived PTG (Zoellner & Maercker, 2006) posits that perceived PTG undergoes a process in which one of two co-existing components dominates at different points in time. A dysfunctional component (e.g., denial), which is associated with lower adjustment, is predominant in the very initial time after the event. However, with time, a constructive component (e.g., positive reappraisal, cognitive processing), which is associated with better adjustment, prevails. Taken together, the results of the present study and those of Frazier et al. (2009) or Yanez et al. (2011) could be seen as support for this model.

However, it may be that not all positive illusions are equally powerful. Perceived PTG in the domains covering SE (i.e., strength through suffering) was unrelated to psychological adjustment in the multivariate analyses. Thus, positive illusions in SE domains may play a less important role in the adjustment process to SCI than those in domains covering PIL.

Perceived PTD, Actual Changes, and Psychological Adjustment

The present study is the first to test how perceived PTD is related to actual negative changes after a potentially traumatic event such as SCI. Hence, we based our hypothesis on previous studies (Blackie et al., 2015; Helgeson, 2010) showing that perceived PTD received stronger corroboration by close others than perceived PTG. The result that perceived PTD was unrelated to actual negative changes may seem contradictory. Yet, it has been argued that corroboration could either indicate that actual changes took place or simply that individuals informed close others about perceived changes (Park & Lechner, 2006). As perceived negative changes are likely to attract more attention than positive ones (Helgeson, 2010), they may be more often reported to close others. Thus, an individual’s perceived negative changes may resemble more the ones of his or her close others than perceived positive changes, albeit both may not represent actual changes, as suggested by the results of the present study.

Similar to perceived PTG, perceived PTD was also significantly related to lower adjustment scores, although actual negative changes in SE and PIL were controlled for. Therefore, perceived PTD may represent an illusory, that is, an overly pessimistic view on posttraumatic life changes that generally signals maladjustment to SCI.

Limitations and Future Research

The present study is subject to several limitations. First, the baseline measurement of SE and PIL was scheduled one month after injury diagnosis. As a result, the time span for actual changes in these constructs does not cover the complete time span (i.e., time since SCI) asked for in the measures of perceived PTG and PTD. It is possible that actual changes occurring in the first month after the injury affected the comparisons of perceived and actual changes. Moreover, we were not able to include pre SCI measures of SE and PIL. Hence, actual changes in these constructs cannot be unambiguously interpreted as actual PTG or PTD (see e.g., Ford et al., 2008). Panel studies, which repeatedly assess SE and PIL and whether there was an onset of a chronic health condition like SCI, are needed to better understand the impact of such an event on SE and PIL. This type of study design would allow for determining pre- to post-event change in these constructs (i.e., actual PTG and PTD).

Second, the associations of perceived PTG and PTD with actual changes in SE and PIL and psychological adjustment were examined only at one point after SCI onset. However, perceived PTG may reflect a process in which its function differs depending on time since the event (Zoellner & Maercker, 2006). Accordingly, an important avenue for future research is to assess perceived and actual changes and their independent association with adjustment at various points after SCI or other potentially traumatic events.

Third, perceived PTG and PTD as well as the adjustment indicators were included as observed variables in the structural equation models to ensure an adequate ratio of variables included in the models and the sample size. However, this means that measurement error affects correlations with these constructs. Thus, future studies having larger sample sizes could replicate the present findings by integrating all variables as latent constructs.

Conclusion and Clinical Implication

The present study contributes to a better understanding of perceived PTG and PTD and their role in the psychological adjustment process to health-related potentially traumatic events such as SCI. In sum, the results indicate that both seem to represent a distorted or illusory view on personal changes, at least in the initial time after the event. Nonetheless, the present results suggest that researchers and clinicians should consider perceived PTG and PTD *besides* actual changes as both were independently related to adjustment.

As such, perceived PTG and actual positive changes in the conceptually close domains of SE and PIL seem to be both suitable, but distinct targets for intervention to improve psychological adjustment to SCI in the clinical rehabilitation context. Regarding perceived PTG, although research in the SCI context is lacking, results of randomized controlled trials examining individuals with cancer or after other types of potentially traumatic events suggest that, for example, mindfulness exercises and written or spoken self-disclosure can effectively increase levels of perceived PTG (Roepke, 2015; Shiyko, Hallinan, & Naito, 2017). With respect to actual changes in SE and PIL across time, several cognitive-behavioral interventions have been shown to effectively increase levels of SE and PIL in individuals with SCI or after other health-related potentially traumatic events (e.g., Dorstyn, Mathias, & Denson, 2011; Hart, Fonareva, Merluzzi, & Mohr, 2005; Jonkers, Lamers, Bosma, Metsemakers, & van Eijk, 2012). Future research is now needed to examine the independent long term effects of perceived and actual changes in typical PTG domains on adjustment, and for clinicians to consider the use of the PTG construct in assessing patients with SCI and developing therapeutic interventions to promote their psychological adjustment.

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Tables

Table 1

Descriptive Characteristics of the Study Variables at T1 and at T2 (n = 206)

	T1					T2				
Construct	*n* (%) missing[a]	α	*M* (*SD*)	Skewness	Kurtosis	*n* (%) missing[a]	α	*M* (*SD*)	Skewness	Kurtosis
PTG Total						19 (9.2)	.87	19.78 (11.57)	0.11	2.01
PTG Strength Through Suffering						14 (6.8)	.82	8.25 (5.68)	0.20	2.04
PTG Existential Reevaluation						15 (7.3)	.74	11.53 (6.61)	0.18	2.20
PTD Total						26 (12.6)	.86	9.54 (9.51)	1.24	4.13
PTD Strength Through Suffering						19 (9.2)	.79	3.64 (4.26)	1.16	3.51
PTD Existential Reevaluation						19 (9.2)	.77	5.90 (6.06)	1.23	4.12
Self-Efficacy	7 (3.4)	.81	15.73 (2.75)	-0.56	3.24	6 (2.9)	.85	15.76 (2.78)	-0.84	4.56
Purpose in Life	4 (1.9)	.86	22.64 (4.38)	-1.15	4.24	4 (1.9)	.85	21.94 (4.22)	-1.03	4.60
Depression						2 (1.0)	.84	4.84 (3.86)	0.91	3.47
Anxiety						0	.86	4.80 (4.16)	1.00	3.60
Life Satisfaction						2 (1.0)	.91	6.55 (2.21)	-0.60	2.82

Note. Except *n* (%) missing, all values rely on imputed data. PTG = posttraumatic growth. PTD = posttraumatic depreciation.

[a] *n* (%) participants with missing values in at least one of the items composing a scale. Participants with all items of a scale missing were excluded.

Table 2

Demographic and Injury-related Characteristics of the Sample at T1 (n = 206)

Characteristic	*n* (%)	*M* (*SD*)	*n* (%) missing
Age at injury in years		53.82 (16.57)	0
Sex			0
Male	148 (71.8)		
Female	58 (28.2)		
Marital status			0
Single (never married)	60 (29.1)		
Married	109 (52.9)		
Widowed	14 (6.8)		
Divorced	23 (11.2)		
Language of questionnaire			0
German	170 (83.0)		
French	32 (15.5)		
Italian	3 (1.5)		
Cause of injury			
Traumatic	123 (59.7)		
Nontraumatic	83 (40.3)		
Type of injury			14 (6.8)
Incomplete paraplegia	100 (48.5)		
Complete paraplegia	32 (15.5)		
Incomplete tetraplegia	50 (24.3)		
Complete tetraplegia	8 (3.9)		
Intact	2 (1.0)		
Duration of first rehabilitation in days		134.46 (69.24)	0
Time between SCI and T2 in days		149.06 (70.63)	0
Time between T1 and T2 in days		105.75 (65.03)	0

Note. Time between T1 and T2 = Time between baseline assessment (T1) and assessment at discharge from first rehabilitation (T2).

Table 3

Longitudinal Measurement Invariance of Self-Efficacy and Purpose in Life (n = 206)

Model	χ^2 (*df*)	CFI	RMSEA [90% CI]	$\Delta\chi^2$ (*df*)	ΔModels
Self-Efficacy					
Configural invariance	43.336* (29)	.977	.049 [.017; .074]	-	-
Loading invariance	48.905* (33)	.975	.048 [.019; .073]	5.569 (4)	Loading vs. Configural invariance
Intercept invariance	53.491* (37)	.974	.047 [.017; .070]	4.586 (4)	Intercept vs. Loading invariance
Purpose in Life					
Configural invariance	27.603* (15)	.974	.064 [.023; .101]	-	-
Loading invariance	31.835* (18)	.971	.061 [.023; .095]	4.232 (3)	Loading vs. Configural invariance
Intercept invariance	38.137* (21)	.964	.063 [.029; .094]	6.302 (3)	Intercept vs. Loading invariance

Note. CFI = comparative fit index. RMSEA = root mean squared error of approximation. 90% CI = 90% confidence interval of RMSEA. $\Delta\chi^2$ = difference in chi-square between nested models. ΔModels = compared models.

* $p < 0.05$.

Table 4

Results of the Expanded Latent Change Score Models Examining the Associations Between Changes in Self-efficacy and Purpose in Life, Perceived PTG and PTD total scores and the Adjustment Indicators (n = 206)

	Depression	Anxiety	Life Satisfaction
Self-Efficacy models			
T1 Self-Efficacy	-.34***	-.37***	.39***
Δ Self-Efficacy	-.16*	-.15	.24*
PTG Total	-.26***	-.03	.15*
PTD Total	.48***	.37***	-.33***
R^2	.36	.31	.28
Purpose in Life models			
T1 Purpose in Life	-.52***	-.46***	.58***
Δ Purpose in Life	-.44***	-.30**	.43***
PTG Total	-.20**	-.01	.11
PTD Total	.40***	.34***	-.25***
R^2	.50	.36	.42

Note. Different models were estimated for each combination of Self-efficacy or Purpose in Life with one of the adjustment indicators. Results are presented as standardized beta coefficients. Δ = change from T1 to T2. PTG = posttraumatic growth. PTD = posttraumatic depreciation.

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.01$.

Table 5

Results of the Expanded Latent Change Score Models Examining the Associations Between Changes in Self-efficacy and Purpose in Life, Perceived PTG and PTD Strength Through - Suffering and Existential Reevaluation scores and the Adjustment Indicators (n = 206)

	Depression	Anxiety	Life Satisfaction
Self-Efficacy models			
T1 Self-Efficacy	-.39***	-.42***	.43***
Δ Self-Efficacy	-.20*	-.19*	.27**
PTG Strength Through Suffering	-.08	.10	.01
PTD Strength Through Suffering	.29***	.24**	-.20**
R^2	.29	.26	.25
Purpose in Life models			
T1 Purpose in Life	-.56***	-.49***	.60***
Δ Purpose in Life	-.46***	-.30***	.44***
PTG Existential Reevaluation	-.23***	-.05	.16*
PTD Existential Reevaluation	.42***	.36***	-.28***
R^2	.51	.37	.43

Note. Different models were estimated for each combination of Self-efficacy or Purpose in Life with one of the adjustment indicators. Results are presented as standardized beta coefficients. Δ = change from T1 to T2. PTG = posttraumatic growth. PTD = posttraumatic depreciation.

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.01$.

Supplemental Material

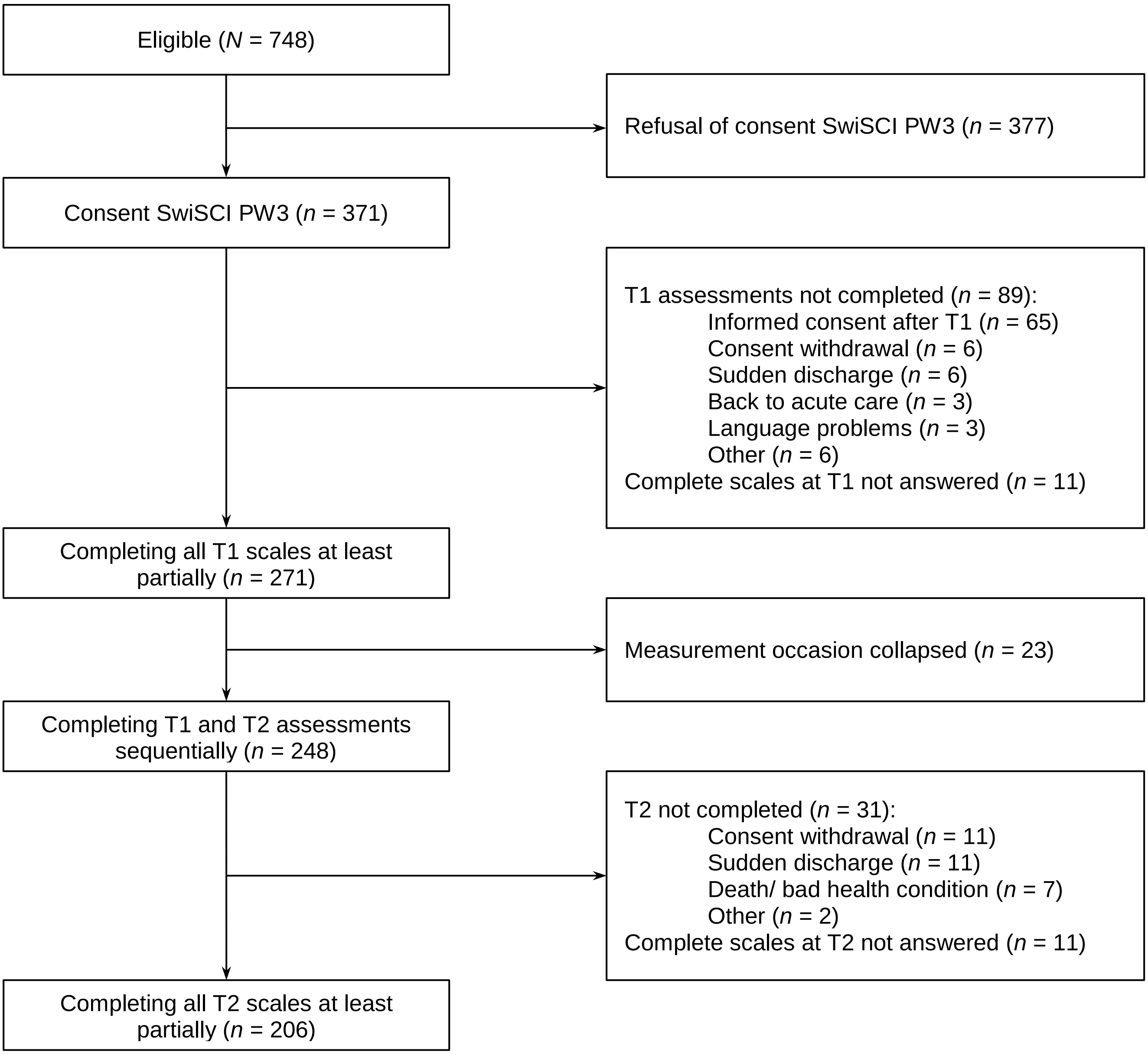

Figure S1. Flow diagram depicting participation in the present study.

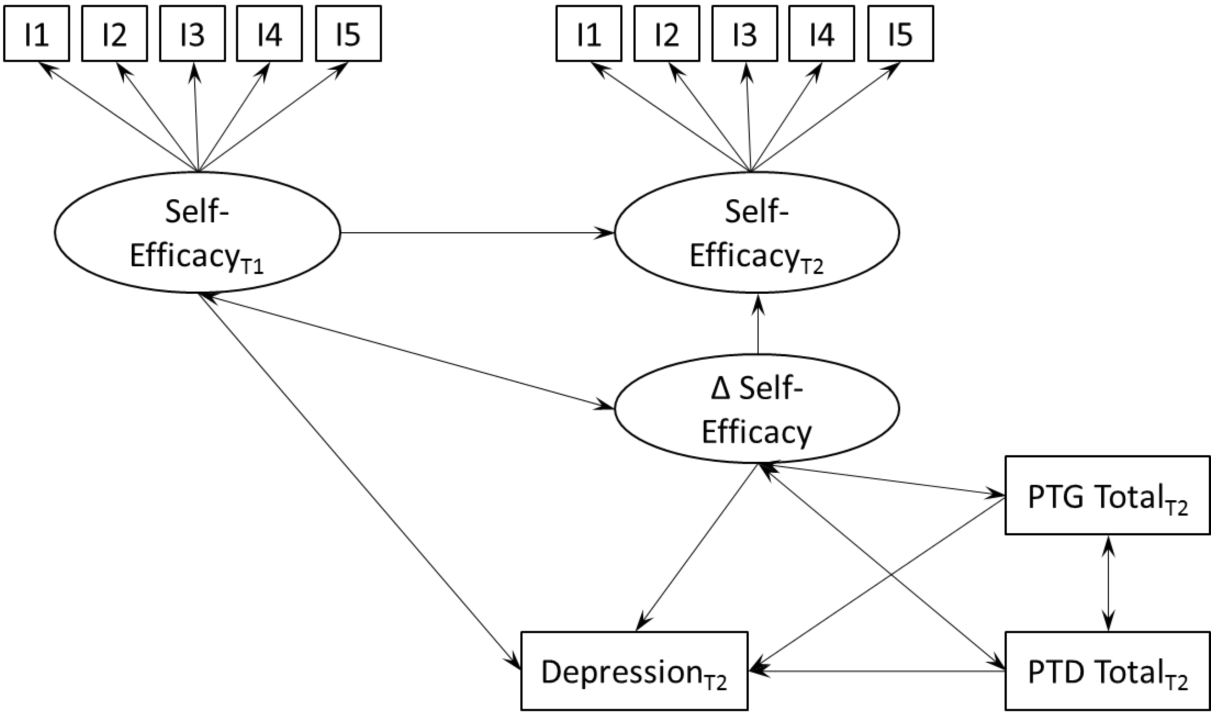

Figure S2. Latent change score model analyzing the associations between changes in Self-Efficacy, posttraumatic growth (PTG), posttraumatic depreciation (PTD), and symptoms of Depression. I1-I5 = Item1-Item5. Δ = change from T1 to T2. Single headed arrows represent regressions. Double headed arrows represent correlations. To simplify presentation, constraints on intercepts (including the one to set the scale of the latent factors), constraints on factor loadings, constraints on regression paths to create the latent change score factor, correlations of the same item across time, and correlations between PTG and PTD Total scores on one side and T1 Self-Efficacy scores on the other side are not depicted.