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Actual Change and Inaccurate Recall Contribute to Posttraumatic Growth Following Radiotherapy

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People with cancer often report that they experience personal growth as a result of the disease, but such reports have unclear validity. Some suggest such growth results from Rogers's (1951) hypothesized organismic valuing process (OVP), an innate tendency for people to gravitate toward well-being; others suggest this growth may be a positive illusion resulting from temporal self-comparisons. To test these conceptualizations, the authors examined 83 individuals with Stages 0–III breast or prostate cancer. Patients completed measures of positive attributes and personal life goals before radiotherapy (Time 1) and after radiotherapy (Time 2). At Time 2, participants also attempted to recreate their Time 1 responses and completed a posttraumatic growth (PTG) measure. PTG was significantly related with actual increases (but not perceived increases) in the relative importance of intrinsic goals versus extrinsic goals and with perceived increases (but not actual increases) in positive attributes. These measures were unrelated to one another and thus explained unique variance in PTG. Data suggest that both actual change processes related to the OVP and biases in autobiographic recall may independently contribute to PTG reports.

Keywords: cancer, posttraumatic growth, temporal comparisons, intrinsic valuing orientation

Most people diagnosed with cancer report that they experience positive changes in their lives as a result of their disease, and many say their experience with cancer was more positive than negative (Thornton, 2002). In the 1990s, Tedeschi and Calhoun (1996) coined the term posttraumatic growth (PTG) to describe reports of lasting positive change following an unusually stressful event. PTG has been a subject of considerable research interest since that time. The conceptualization of PTG has important similarities with constructs such as benefit finding (e.g., Tennen & Affleck, 2002), stress-related growth (Park, Cohen, & Murch, 1996), and positive reappraisal coping (e.g., Carver, Scheier, & Weintraub, 1989), and the terms are sometimes used interchangeably in the literature. PTG is used here to indicate the positive life gains individuals attribute to a stressful event.

A large number of studies related to PTG have focused on medical populations, with a particular interest in individuals with cancer (see Stanton, Bower, & Low, 2006; Thornton, 2002, for reviews). These studies agreed that people diagnosed with cancer report PTG with high frequency, so much so that some have speculated that the ability to perceive positive outcomes "may be a relatively 'easy,' natural process for most who confront cancer" (Sears, Stanton, & Danoff-Burg, 2003, p. 487). Although questions regarding the benefits of PTG remain, PTG has been shown in several studies to relate with less depression and more positive well-being (Helgeson, Reynolds, & Tomich, 2006), and this construct has received clinical interest in cancer settings.

There have been disagreements, however, as to whether PTG reflects actual, permanent positive change as described in Tedeschi and Calhoun's (1996) original conceptualization. The validation of patients' PTG reports has been difficult, largely due to the difficulty in obtaining pre-stressor data from individuals who subsequently survive a traumatic event. Thus, it is unknown whether individuals' reports of PTG reflect actual, measurable change from their pre-stressor state. With a few notable exceptions (e.g., Manne et al., 2004; Milam, 2004; Sears et al., 2003; Tennen & Affleck, 2002), the PTG literature has relied on cross-sectional data, and nearly all studies have used retrospective self-report to assess PTG. It has been well established, however, that retrospective self-reports may often be inaccurate and subject to cognitive biases, particularly when such reports refer to past personal attributes or behaviors (Greenwald, 1980; Neisser, 1994; Ross, 1989).

In cancer, investigators have attempted to compensate for the methodological difficulties in validating patients' PTG reports by using matched, non-patient comparison groups (e.g., Andrykowski et al., 1996; Cordova, Cunningham, Carlson, & Andrykowski, 2001; Frazier & Kaler, 2006). In these studies, the findings have been mixed. Although in at least one case cancer survivors have

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shown some differences from matched control participants in areas related to PTG, such as spirituality (Andrykowski et al., 1996), most indices show no difference. No study to date is known to have tracked patients' actual change over the course of cancer treatment to examine if these changes are related to PTG.

Models of PTG

A number of theoretical models of personal change following stressful life events would suggest that PTG is a valid construct (see Joseph & Linley, 2006, for a review). For example, Schaefer and Moos (1992) theorized that personal growth would arise from a stressful event based on personal factors (e.g., coping), event-related factors (e.g., severity), and environmental factors (e.g., social support). Likewise, Folkman (1997) suggested that the transactional model of stress and coping devised by Lazarus and Folkman (1984) be adapted to account for the increased sense of meaning, spirituality, purpose, and control found in caregiving partners of terminal HIV patients. In Folkman's formulation, negative psychological states drive individuals to change behaviors and beliefs, which result in the relief of distress, the emergence of greater well-being, and, perhaps, enduring behavioral and cognitive change.

An alternative model for PTG may be rooted in Rogers's (1951) concept of the *organismic valuing process* (OVP). According to Rogers, individuals naturally gravitate toward personal goals that contribute to personal satisfaction and well-being (Rogers, 1964). Researchers have recently shown that those who experience shifts toward self-actualizing goals also show increases in their personal well-being (Sheldon, 2005; Sheldon, Arndt, & Houser-Marko, 2003). This research, based in self-determination theory (Deci & Ryan, 2000), suggests that individuals experience greater feelings of competence, relatedness, and autonomy as their emphasis shifts from extrinsically oriented goals, such as wealth, popularity, and personal image, toward more intrinsically oriented goals, such as personal development, enduring relationships, and community building, a process called the *intrinsic valuing orientation* (Sheldon et al., 2003). This, in turn, creates greater feelings of well-being and personal growth.

Findings such as these have prompted Joseph and Linley (2005, 2006) to conceptualize the growth that follows a serious stressor as arising from this OVP. In this conceptualization, individuals' assumptions about the world are shattered as a result of their traumas (cf. Janoff-Bulman, 1992). As individuals make efforts to restore their worldview, they find meaning in the experience and accommodate the new perspectives that the experience generates (Taylor, 1983). Successful accommodation and meaning-making, in turn, contributes to improvements in one's relationships, sense of self, and spirituality, which result in a deeper sense of personal well-being. All of this is theorized to be generated by the OVP, which provides a normative push toward this meaning-making and accommodation process. Joseph and Linley's formulation, however, as yet has scant empirical evidence in regards to individuals who have experienced a stressful event such as life-threatening illness.

PTG and Temporal Comparisons

Alternative conceptualizations of PTG have been proposed by researchers who theorized that the perception of PTG may function as a coping process (e.g., Frazier & Kaler, 2006; McFarland & Alvaro, 2000; Tennen & Affleck, 2002; Thornton, 2002). Some of these ideas are based on research derived from *temporal self-appraisal theory* (Ross & Wilson, 2002; Wilson & Ross, 2000, 2001), which suggests that individuals have a tendency to perceive growth in their positive personal attributes even when objective evidence of growth is absent. Individuals do this by making a biased comparison of one's present self with a less enchanting version of one's remembered self (Ross & Buehler, 2001; Wilson & Ross, 2001).

Although temporal comparisons were first conceptualized as a means of making accurate self-evaluations (Albert, 1977), research now has suggested that temporal comparison processes are often inaccurate. In particular, individuals have been found to make biased use of temporal comparisons in order to increase their sense of personal well-being (Ross, 1989; Wilson & Ross, 2001). The possible connection of these temporal comparison processes to PTG was highlighted by McFarland and Alvaro (2000), who found that university students asked to remember a severely stressful event rated their past selves less positively than did those who had been asked to remember a mildly stressful event. The stronger derogation of the past self allowed these individuals to see a steeper growth trajectory in their personal attributes when more severe stressors were salient.

The self-serving errors introduced by biased reconstructions of the past self are thought to function in the same way as other *positive illusions* (Taylor & Brown, 1988), cognitive distortions used to maintain positive psychological adjustment. Taylor and Brown (1988) argued that these positive illusions lead to mental health because they contribute to feelings of well-being, increase optimism in one's choices and future path, elevate confidence in one's abilities, and otherwise promote positive self-regard, all of which have been associated with positive psychological outcomes (Mischel, 1979; Taylor & Brown, 1988). These positive illusions have been found to increase with threat, such as cancer (Taylor, 1983; Taylor & Armor, 1996), and are associated with positive psychological adjustment to the disease (Taylor & Armor, 1996; Taylor, Lichtman, & Wood, 1984; Wood, Taylor, & Lichtman, 1985).

Goals of the Present Study

The literature base, therefore, presents several hypotheses regarding the validity of PTG: (a) that PTG reports reflect actual change in one's personal attributes; (b) that PTG reports reflect actual change in one's goal orientation, from more extrinsically oriented to more intrinsically oriented; and (c) that PTG reports reflect perceived changes in these areas, due to temporal comparison processes. The goal of this study was to simultaneously test these hypotheses with a prospective methodology in which patients scheduled to receive radiotherapy for cancer would complete measures of relevant constructs prior to treatment initiation and again at treatment completion. We considered it possible that more than one of these hypotheses might be true, that is, that individuals could experience actual change but could inaccurately perceive such change due to errors in autobiographical memory processes (Ross, 1989).

To test these hypotheses, we designed a prospective study that allowed us to measure actual changes in patients' personal attributes

and goal orientation over the course of radiotherapy for cancer, and also to relate any actual change in these variables with PTG reported after radiotherapy was complete. In addition, this design allowed us to determine the accuracy of patients' recall of their earlier responses, similar to previous research in temporal comparisons (e.g., McFarland & Alvaro, 2000; Wilson & Ross, 2001). Specifically, we asked patients before radiotherapy to complete measures that asked about their current attributes and goal orientation, and we asked patients following radiotherapy to again rate themselves on these measures and then to recall the answers they had made earlier on these measures. Thus, patients' views were assessed three times.

Finally, in an effort to generalize the study to both men and women, we approached patients with either breast cancer or prostate cancer. These cancers are similar in disease prognosis and radiotherapy treatment regimen, as well as in the degree of distress and quality of life impairment caused by the disease (DeFlorio & Masie, 1995; Keller & Henrich, 1999; Riska & Ettorre, 1999).

Method

Participants

Participants were male and female patients scheduled for radiotherapy at the H. Lee Moffitt Cancer Center, which is a large stand-alone cancer hospital, or the James A. Haley VA Hospital, both located in Tampa, Florida. Female patients were diagnosed with Stage 0, I, II, or III breast cancer, and male patients were diagnosed with Stage I, II, or III prostate cancer. All patients also met the following eligibility criteria: (a) participants must have no previous history of cancer other than basal cell skin carcinoma; (b) participants must be scheduled to begin radiotherapy for treatment of their cancer; (c) participants must be greater than 18 years of age; (d) participants must be able to read and speak English; (e) participants must have at least a 6th grade education; (f) participants must provide informed consent.

Participant Recruitment and Compliance

A total of 148 individuals were approached for participation in the study. Four patients refused, 2 due to a lack of interest and 1 each due to privacy concerns and excessive distress. An additional 11 patients were found ineligible. Reasons for ineligibility included an earlier cancer diagnosis ($n = 6$) and an inability to understand the questionnaire due to language or cognitive problems ($n = 5$). An additional 8 participants became ineligible after consenting to the study. Seven of these had a change in their treatment regimen and did not complete radiotherapy, and 1 had a cancer recurrence.

Of the 125 participants who remained eligible, 2 did not follow instructions regarding their Time 1 questionnaire packet, and 15 failed to return their Time 1 packet prior to the start of radiotherapy. An additional 6 participants withdrew prior to completing their Time 1 packet. Two of those who withdrew did so because they felt the questionnaire content was too personal ($n = 1$) or too emotional ($n = 1$), and 1 withdrew because of general dislike for the hospital. Three others did not give reasons for withdrawal.

Of the 102 people who completed their Time 1 questionnaire packet, 3 did not complete their Time 2 packet after repeated follow-up attempts, and 1 person died. An additional 2 people withdrew from the study, 1 due to lack of time and another without providing a reason. Incomplete data were collected from 13 individuals who were unable to participate in the study analyses. The final sample numbered 83.

As a group, participants ranged from 38 to 83 years old. The sample included 27 male and 56 female patients. Fifteen male patients were recruited from the VA hospital, with the remainder of the patient sample recruited from the stand-alone cancer center. No male patient received chemotherapy prior to receiving radiotherapy. Additional descriptive information about the study sample appears in Table 1.

To determine whether the sample was biased by attrition from the Time 1 assessment to the Time 2 assessment, chi-square and *t*-test analyses were used to determine whether those who did not complete both assessments differed from those who completed all assessments. Analyses indicated that Hispanic individuals were less likely to fully complete the study than were patients of other races or ethnicities. No other demographic or clinical variable differed between completers and non-completers. Likewise, study variables (i.e., positive attributes, goal orientation) measured at Time 1 did not differ between those who completed all study measures and those who did not.

Procedure

Participants were screened for eligibility by using computerized medical databases and were identified through face-to-face contact at hospital clinics. During the first contact, those willing to participate signed an informed consent form and were asked to complete the first questionnaire packet. Participants could choose to complete the packet at the clinic or take it home and return it by mail before their radiotherapy was to begin. On completion of radiotherapy (approximately 6 weeks later), participants were given or mailed a second questionnaire packet and asked to complete it at the clinic or return it by mail. Additional data regarding the timing of the questionnaire packets and questionnaire completion are described in Table 1.

Measures

Demographics form. The first assessment used a self-report form to gather data on age, gender, ethnicity, race, education, marital status, and household income.

Personal Attribute Rating Scales (PARS). Also included in the first assessment, the PARS is a modified, 39-item measure based on a measure developed by McFarland and Alvaro (2000) in their study of self-perceptions of positive personal attributes. For this study, items from the original measure were condensed into one- or two-word descriptor adjectives (e.g., spiritual, appreciative, self-reliant, mature). The Likert scale ranged from 1 (*not at all*) to 9 (*extremely*) to ask respondents the degree to which each positive attribute describes them. In order to assess attributes most likely to be positively affected by a stressor, the original scale items were based on scales that measured perceived growth (e.g., Park, Cohen, & Murch, 1996; Tedeschi & Calhoun, 1996). The PARS had excellent internal consistency over four replications with university students ($\alpha = .93$–$.97$), and the modified version of the PARS used in this study had similarly good internal consistency ($\alpha = .93$–$.95$ over three replications).

Table 1
Demographic and Clinical Characteristics

Variable	Female			Male			Total		
	M	*SD*	%	*M*	*SD*	%	*M*	*SD*	%
Age[a]	56.2	10.2		65.2	8.8		60.2	11.8	
Sex									
Female									67.5
Male									32.5
Race/ethnicity									
White			91.0			81.5			88.0
Black			5.4			7.4			6.0
Asian			1.8						1.2
Hispanic			1.8			11.1			4.8
Marital status									
Married			71.4			77.8			73.5
Unmarried			28.6			22.3			26.5
Education (>some college[b])			83.9			66.7			78.3
Income (>$40,000/year[b])			67.9			44.4			65.0
Disease stage (women—Stage 0 or I; men—Stage I)			95.8			74.6			81.0
Mastectomy (among patients with breast cancer)			5.5						
Chemotherapy (among patients with breast cancer)			45.5						
Gleason score (among patients with prostate cancer)									
5						4.2			
6						41.7			
7						45.8			
>7						8.3			
Time between assessments (days)[b]	64.4	17.3		72.3	14.1		67.0	16.6	
Time between treatment completion and Time 2 assessment (days)[b]	12.4	11.0		6.8	9.1		10.5	10.7	

[a] Genders differ at $p < .001$. [b] Genders differ at $p < .05$.

Aspirations Index (AI). The final measure used in the first assessment was the AI (Kasser & Ryan, 1996, 2001), a 30-item measure that asks individuals to rate the importance of a variety of intrinsic and extrinsic personal goals with responses made on a 1 (*not at all*) to 7 (*a great deal*) Likert scale. Items dealing with desires for wealth, popularity, and beauty are added to form an Extrinsic Goals subscale, and those dealing with personal development, relationship building, and community enhancement are added to form an Intrinsic Goals subscale. A single value for goal orientation is generated by subtracting the Extrinsic Goals subscale from the Intrinsic Goals subscale; thus, positive scores indicate a relatively more intrinsic orientation, and negative scores indicate a more extrinsic orientation. The measure yielded excellent internal consistency over the three replications ($\alpha = .90–.91$).

The second assessment included all measures used in the first assessment except for the demographics questionnaire. In addition, the PARS and AI were re-administered with the following instructions: "We are interested in how well you can remember the answers you gave on this questionnaire from when you filled it out before you started radiation treatment. Please answer the following questions by circling the number you think you did at that time. We will compare your answers with the ones you made then, so please do your best." The Time 2 and Recalled Time 1 sections of the questionnaire packet were presented to participants in a counterbalanced order.

Posttraumatic Growth Inventory (PTGI). In addition to the above, the second assessment included the PTGI (Tedeschi & Calhoun, 1996). The PTGI is a 21-item measure that assesses the amount of growth perceived after one undergoes a highly stressful experience. In the present study, individuals were asked to report how much they changed "since you started radiotherapy for cancer." Each item is rated on a 0 (*I did not experience this change*) to 5 (*I experienced this change to a very great degree*) Likert scale. The scale shows good psychometric properties in community samples (Tedeschi & Calhoun, 1996) and has been successfully used in individuals with cancer (e.g., Cordova, Cunningham, Carlson, & Andrykowski, 2001; Sears et al., 2003; Widows, Jacobsen, Booth-Jones, & Fields, 2005). In this study, the total score was used and showed excellent internal consistency ($\alpha = .96$).

Results

Examination of Patient Characteristics by Recruitment Site

Because male patients were recruited from two separate sites, chi-square and *t*-test analyses were performed on all clinical, demographic, and outcome variables to determine whether differences existed between men recruited from the VA hospital and those recruited from the stand-alone cancer center. No significant differences were found on any variable.

Descriptive and Correlational Examination of Study Variables

Responses on the PARS were marked by high mean item scores and low variability at all assessments, with few people scoring on the low ends of this scale. Greater variability was found in responses on

the PTGI. On the AI, participants endorsed more intrinsic than extrinsic goals at all time points (see Table 2).

Relationship of Demographic and Clinical Variables to Change Measures and PTG

Preliminary analyses were first conducted to determine whether any demographic (e.g., age, gender, education) or clinical variable (e.g., disease stage, total radiation dose) was related to the study's primary outcomes. Since only patients with breast cancer could receive a Stage 0 diagnosis, all patients with Stage 0 and I disease were combined into a single group to avoid confounding disease stage with gender. Three significant ($p < .05$) relationships were found. Disease stage was related with both perceived changes ($r = .25$, $p = .02$) and actual changes ($r = .26$, $p = .02$) in goal orientation. Amount of time (in days) between the completion of radiotherapy and the completion of the Time 2 questionnaire packet was related with PTG ($r = .26$, $p = .02$) but not with perceived or actual changes in positive attributes or goal orientation. For patients with breast cancer, prior chemotherapy treatment and surgery type (mastectomy versus lumpectomy) were each unrelated with any study measure. Likewise, Gleason score (a measure of prostate cancer malignancy) was unrelated with any study measure among those with prostate cancer.

t-test and chi-square analyses indicated that men and women significantly differed on a number of demographic and clinical variables (see Table 1). Because of this, a series of partial correlational analyses were conducted to determine whether gender would relate to change measures and PTG while controlling for all variables that were found to differ between men and women (i.e., age, education, income, time between assessments, time between treatment completion and Time 2 assessment). All change-related variables remained unrelated to gender in these partial correlational analyses (all ps $> .50$).

Actual Change and Perceived Change in Positive Attributes

To test hypotheses related to actual change and perceived change in ratings of positive attributes (i.e., PARS scores) during the course of radiotherapy, we conducted an analysis of variance (ANOVA) with one between-groups factor (Group: breast cancer, prostate cancer) and one within-groups factor (Time of Assessment: Time 1, Time 2, Recalled Time 1). There was no main effect for group, $F(1, 81) = .42$, $p = .52$. As expected, the main effect for Time of Assessment was significant, $F(2, 160) = 7.43$, $p < .001$. The interaction between Group and Time of Assessment was not significant, $F(2, 160) = .26$, $p = .77$. Based on this pattern of results, we collapsed the sample into a single group and proceeded with planned comparisons to test study hypotheses about positive attributes (see Table 2).

Table 2
Comparison of Pre-Radiation, Post-Radiation, and Recall Assessments

	Time 1		Recalled Time 1		Time 2	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*
PARS	7.03_a	0.88	7.19_b	0.91	7.29_c	0.86
AI	2.34_a	1.19	2.61_b	1.34	2.63_b	1.30
PTGI					32.95	26.30

Note. Values for the Positive Attributes Rating Scale (PARS) range from 1 to 9. Values on the Aspiration Index (AI) are calculated by subtracting the AI's Extrinsic subscale from that of the AI's Intrinsic subscale. Values for each AI subscale range from 1 to 7. The Posttraumatic Growth Inventory (PTGI) was only administered at Time 2. Items with differing subscripts across rows differ at $p < .05$.

The first planned comparison examined the difference between patients' ratings of their positive attributes at Time 1 and Time 2 (see Table 2). We termed this comparison *actual change*. Patients' ratings of their positive attributes increased significantly between Time 1 and Time 2, $t(83) = 3.77$, $p < .001$, $d = .30$. In other words, participants showed actual improvement in their positive attribute ratings between Time 1 and Time 2.

The second planned comparison examined the difference between patients' ratings of their positive attributes at Time 2 and their Recalled Time 1 ratings (see Table 2). We termed this comparison *perceived change*. Individuals perceived their positive attributes as increasing over the course of radiation therapy, $t(83) = 2.48$, $p = .02$, $d = .11$, although the effect size was small.

Finally, a third planned comparison examined the difference between patients' actual Time 1 ratings and their recalled Time 1 ratings on positive attributes. A significant difference on these variables was found, $t(83) = -2.19$, $p = .04$, $d = -.17$. Results suggested that individuals recalled their earlier attributes as having been more favorable than they had originally reported.

Actual Change and Perceived Change in Goal Orientation

To test hypotheses related to actual and perceived change in goal orientation, we conducted an ANOVA with one between-groups factor and one within-groups factor (Time of Assessment: Time 1, Time 2, Recalled Time 1). As with previous analyses, cancer group was a between-groups factor (Group: breast cancer, prostate cancer). Again, the main effect for Time of Assessment was significant, $F(2, 162) = 6.96$, $p = .001$; and there was no main effect for Group, $F(1, 81) = .03$, $p = .87$. The interaction between Group and Time of Assessment, $F(2, 162) = .38$, $p = .69$, was also insignificant. Based on this pattern of results, we proceeded with planned comparisons designed to test study hypotheses regarding goal orientation (see Table 2).

The first planned comparison (actual change) examined the difference between patients' goal orientation at Time 1 and Time 2 (see Table 2). Patients' actual ratings of their relative intrinsic goal orientation increased significantly between Time 1 and Time 2, $F(1, 82) = 10.42$, $p = .002$, $d = .23$. In other words, participants showed an actual shift toward a more intrinsic goal orientation between Time 1 and Time 2.

The second planned comparison (perceived change) examined the difference between patients' actual ratings of their goal orientation at Time 2 and their Recalled Time 1 ratings (see Table 2). Individuals did not perceive their goal orientation as becoming more intrinsic over the course of radiation therapy, $F(1, 82) = .11$, $p = .74$.

The third planned comparison examined the difference between patients' actual Time 1 ratings and their recalled Time 1 ratings on goal orientation. A significant difference on these variables was found, $t(83) = -17.74$, $p < .001$, $d = -.22$. Results suggested that individuals recalled their goal orientation as having been relatively more intrinsic than they had originally reported.

Relation of Changes in Positive Attributes and Goal Orientation to PTG

To determine whether actual or perceived changes in positive attributes and goal orientation would be related to PTG, individual regression analyses were used to determine whether residualized change scores on the PARS and AI would separately predict PTGI scores (see Table 3). Separate regression analyses were calculated to determine whether Time 2 scores on the PARS or the AI would predict PTGI scores while controlling for Time 1 scores on those measures, an indicator of actual change. Likewise, regression analyses were conducted to determine whether Time 2 scores on either measure would predict PTGI scores while controlling for recalled scores at Time 1, a measure of perceived change. Actual (but not perceived) changes in goal orientation ($\beta = .34$, $p = .05$, $R^2 = .04$) and perceived (but not actual) changes in positive attributes ($\beta = .60$, $p = .03$, $R^2 = .06$) were the only significant predictors of PTGI scores.

We also examined whether variables related to PTG were related with one another (see Table 4). To do so, difference scores were calculated for actual changes (Time 2 scores – Time 1 scores) and perceived changes (Time 2 scores – Recalled Time 1 scores) on these measures. Change variables related with PTG were found to be unrelated with one another. In addition, there was no significant correlation between the PTGI and any of the three individual assessments of either the PARS or the AI (see Table 5).

Post Hoc Power Analysis

Finally, the G*Power 3 software package (Faul, Erdfelder, Lang, & Buchner, 2007) was used to conduct post hoc power analyses to determine whether the final sample size of 83 had adequate power to detect medium effect sizes. In the repeated measures ANOVA analyses, the current study had a 99% chance to detect a medium effect size in the interactions, a 97% chance to detect a medium effect size in the within-groups main effects, and a 100% chance to detect a medium effect size in the between-groups main effects. The study had a 99% chance to detect a medium effect size in the planned comparison *t*-tests, an 88% chance to detect a medium effect size in the multiple regression analyses, and a 94% chance to detect a medium effect size in the correlation analyses. The ability to detect medium sized effects in correlation analyses that used only patients of a single gender was 81% and 49% for women and men respectively.

Table 4
Zero-Order Intercorrelations of Change Scores and Posttraumatic Growth

Score	1	2	3	4	5
1. PARS Actual Change	—				
2. PARS Perceived Change	.23*	—			
3. AI Actual Change	.21	.14	—		
4. AI Perceived Change	.04	.30**	.41***	—	
5. PTGI	.04	.22*	.23*	.05	—

Note. Actual change scores on the Positive Attributes Rating Scale (PARS) and the Aspiration Index (AI) were calculated by subtracting Time 1 scores from Time 2 scores on each respective measure. Perceived change scores on the PARS and AI were calculated by subtracting Recalled Time 1 scores from Time 2 scores. PTGI = Posttraumatic Growth Inventory.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

The findings of this study suggest that both actual change in goal orientation and perceived change in growth-related personal attributes may influence patients' reports of PTG following radiotherapy for cancer. Although this study is somewhat limited by the nature of radiotherapy for cancer, which for some patients may be a less stressful experience than other aspects of cancer diagnosis and treatment, it is noteworthy that both actual and perceived change were evidenced in this sample and that patients' PTG reports were independently related with both of these change-related variables.

In terms of actual change, we found that a shift toward a more intrinsic goal orientation predicted PTG. This finding gives empirical support for the theorized relationship between Rogers's (1951) conceptualization of the OVP and reports of PTG in people

Table 3
Regression Analyses of Residualized AI and PARS Change Scores Onto Posttraumatic Growth

Predictive group	Predictor	Standardized β	R^2	*p*
PARS Actual Change	PARS Time 1	0.14		
	PARS Actual Change	0.10	.01	.43
PARS Perceived Change	PARS Recalled Time 1	0.13		
	PARS Perceived Change	0.26	.06	.03
AI Actual Change	AI Time 1	–0.06		
	AI Actual Change	0.21	.06	.05
AI Perceived Change	AI Recalled Time 1	0.04		
	AI Perceived Change	0.06	.00	.56

Note. Actual change scores on the Positive Attributes Rating Scale (PARS) and the Aspiration Index (AI) were calculated by subtracting Time 1 scores from Time 2 scores on each respective measure. Perceived change scores on the PARS and AI were calculated by subtracting Recalled Time 1 scores from Time 2 scores.

Table 5
Zero-Order Correlations of Time 1, Time 2, and Recalled Time 1 Measures With Posttraumatic Growth

	PTGI		
Measure	Time 1	Time 2	Recalled Time 1
PARS	.11	.24	.04
AI	−.11	.05	.02

Note. PARS = Positive Attributes Rating Scale; AI = Aspirations Index; PTGI = Posttraumatic Growth Inventory.

with cancer (Joseph & Linley, 2005, 2006). Although subjective well-being was not assessed in the present study, OVP variables (e.g., Sheldon et al., 2003), cognitive distortions (e.g., Taylor & Armor, 1996), and PTG (e.g., Helgeson et al., 2006) may relate with well-being in a variety of samples. Further research may clarify what interrelationships may exist between each of these constructs in cancer patients.

The amount of variance in PTG accounted for by OVP processes in this study was similar in magnitude to the variance accounted for by temporal comparison processes. Thus, a second theoretical explanation for PTG was supported in the present data. Similar to findings by McFarland and Alvaro (2000), individuals' PTG reports were related with perceptions of change in one's positive attributes, but not with actual change in these attributes. Thus, in addition to actual changes in goal orientation, perceived changes in one's personal attributes was also related to PTG. These two factors were unrelated to each other.

Unlike previous research in temporal comparisons, however, patients here did not derogate their previous standing. In fact, they inflated it. This finding runs counter to McFarland and Alvaro (2000) and to other studies (e.g., Wilson & Ross, 2001), all of which primarily used university students who were not generally undergoing major life stressors such as a serious illness. The differences between the present study and earlier temporal comparison studies might be related to the differences in the samples used. Literature has suggested that younger people, such as those in previous temporal comparison studies, may be psychologically biased to see themselves as undergoing positive change, whereas mature adults, such as those in the present sample, may look back on the prior self with the assumption of stability (Ross, 1989). If so, older individuals may erroneously report that their present selves accurately reflect their past selves in circumstances where change had actually occurred. By assuming that one's attributes are constant, individuals construct a remembered version of the self that reflects the presence of little change (McFarland, Ross, & Giltrow, 1992; Ross, 1989; Ross & Buehler, 2001) and thus results in the misperception that the past self was actually better than it had been. In the present study, patients indeed perceived growth in their personal attributes. Thus, participants did not see their attributes as entirely stable, perhaps to account for a perception that cancer is a life-changing event, but they continued to significantly underestimate the actual change that had occurred. This pattern suggests that a bias against change still existed even as patients acknowledged perceiving some growth.

On the other hand, although patients erroneously saw themselves as being relatively stable as they looked back to their previous selves, they also erroneously saw their past selves as having been significantly better than they originally reported. This raises a further possible explanation—that these patients may have been motivated to inflate the remembered version of the self. Although the present data are unable to examine which possibility may be the case, one may speculate that patients who wish to see themselves as successful copers during cancer treatment may invoke a stronger remembered version of the self in order to enhance their self-evaluations overall. Indeed, patients had a tendency to highly rate their positive attributes at all time points, a finding consistent with the well-established "better than average effect" (e.g., Suls, Lemos, & Stewart, 2002; Taylor & Brown, 1988).

Another remaining question is why patients' perceived and actual changes did not relate to PTG in similar ways across the two measures. Interestingly, the findings of this study support both McFarland and Alvaro's (2000) finding that PTG was related with perceived but not actual change in positive attributes, as well as Sheldon et al.'s (2003) finding that individuals experience changes in goal orientation outside of awareness and that these unperceived changes are associated with better self-reported psychological well-being. It is possible, therefore, that individuals may not have the intrapersonal sensitivity to accurately assess the areas in which their positive changes occur. Although individuals may have a general perception that they experienced personal positive change, their explanations of these changes may be incorrect. Having sensed change, individuals may point to their personal attributes as changing, when in fact they experienced change in other areas, those related to their most deeply held goals.

It should be noted that PTGI scores in the present study were low compared with those of other studies that used this measure with individuals with cancer. Among 70 survivors of breast cancer, Cordova et al. (2001) reported an average PTGI score of 64.1. Manne et al. (2004) reported average PTGI scores that ranged from 49.0 to 55.7 over three assessments. Widows et al. (2005) reported an average score of 65.7 in patients who received hematopoietic stem cell transplantation, a particularly aggressive form of cancer therapy, and Gotay, Ransom, and Pagano (2007) reported an average PTGI score of 66.9 in survivors of more than one lifetime primary cancer diagnosis. The average PTGI score in this study, 33.0, may reflect a number of different methodological differences between this study and earlier studies. These differences include a shorter delay between treatment completion and the assessment of PTG, as well as the study's focus on changes occurring during radiotherapy alone.

In the present study, patients' PTGI scores were higher as the number of days between treatment completion and their assessment of PTG increased. This corresponds with other studies that suggest that PTG may increase as individuals have more time to process a stressor (e.g., Manne et al., 2004). PTG was assessed in this study an average of 10.5 days following treatment completion, whereas most studies of cancer patients have assessed this variable months or years after treatment completion, and it is possible that greater PTG may have been found if PTG had been assessed later. It is interesting to note that in this study PTG showed a relationship with time since treatment completion but that other indices of perceived or actual growth did not. This may suggest that the cognitive processing of a stressor over time, which is thought to contribute to feelings of PTG (Manne et al., 2004), may not be as important for the other growth-related indices measured in this study.

In addition, patients in this study were asked to report the growth they experienced since the start of radiotherapy. Radiotherapy has long been conceptualized as a threatening aspect of cancer treatment (e.g., Andersen & Tewfik, 1985; Fritzsche, Liptai, & Henke, 2004; Karasawa et al., 2005; Stiegelis, Ranchor, & Sanderman, 2004), but patients in this sample had already coped with a cancer diagnosis and previous treatments prior to study entry. Unfortunately perceived stress was not assessed in the present study, an important study limitation. In previous PTG research, disease severity and time since the stressor both have been considered proxy variables in assessing the impact of a stressor (Helgeson et al., 2006), although not without dispute (see, e.g., Stanton et al., 2006). In this study, both disease stage and time since treatment completion showed relationships with at least one of this study's growth or change measures. Future studies that assess patients prior to diagnosis (e.g., at initial biopsy) and that follow patients through all aspects of cancer treatment may provide a stronger test of the change processes proposed here, as might research that assesses a larger number of patients with more advanced disease.

Two other limitations in this study include a relatively modest sample size and the lack of a non-cancer control group. The addition of a control group would help determine whether actual and perceived changes in personal attributes and goal orientation reflect actual responses to the stressor, or whether these processes represent normative changes experienced by the population at large. Likewise, it is essential that future studies reflect in their samples greater diversity than does the present sample to be able to examine ethnic and cultural differences in PTG. The cultural values often intertwined with ethnicity may play an important role in the way individuals interpret and report such growth. Religiocultural values could have particularly meaningful relationships with PTG (Shaw, Joseph, & Linley, 2005), and non-Whites have been found to report greater spirituality and greater PTG than do Whites (e.g., Milam, 2004, 2006; Milam, Ritt-Olsen, & Unger, 2004). In short, diverse patient samples will enable researchers to more fully understand the psychology of PTG and associated changes in other variables.

Despite the limitations it should be noted that the methodology used here appears to have been adequate to test the study's hypotheses since patients in this study showed actual and perceived change over the course of their radiotherapy. Findings, however, do raise additional questions about the nature of these changes and about how PTG arises and develops over time.

This article is thought to be the first to have measured personal characteristics before and after a cancer-related stressor and to subsequently relate actual change on these measures to self-reported PTG. Although temporal derogation was not found, this study identified a relationship between PTG and perceived change in people with cancer. While supporting the idea that autobiographical memory processes are related to PTG, the findings here also suggest that temporal comparisons may function differently in people with cancer than in the relatively more youthful university student population. In addition, this study is the first to find OVP processes at work in a sample of individuals with cancer, a finding of interest to researchers in humanistic psychology. This study provides the first evidence of the link between the OVP and PTG in people with cancer, as theorized by Joseph and Linley (2005, 2006).

From a clinical perspective, some clinicians have started to examine whether PTG and related concepts such as benefit finding would be useful in their client conceptualizations and therapeutic approach, particularly in light of research that suggests these constructs are associated with a number of positive outcomes such as higher quality of life (Andrykowski et al., 1996), greater well-being (Helgeson et al., 2006), increases in optimism (Antoni et al., 2001), and decreases in depression (Antoni et al., 2001; Helgeson et al., 2006). Other studies, however, have suggested that PTG is related with less positive outcomes among some patients, such as higher negative affect and lower quality of life (Tomich & Helgeson, 2004), and researchers have cautioned that current efforts to facilitate on PTG may be premature, or even ethically questionable, due to ongoing questions regarding the nature of the construct (Park & Helgeson, 2006). A greater understanding of PTG processes such as those explored in this study may be useful in determining whether a clinical focus on PTG is warranted and, if so, how to better facilitate PTG in the appropriate patient.

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