

TITLE

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JOURNAL

Disability and Rehabilitation

DATE DEPOSITED

5 February 2019

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To cite this article: Chris Hammer, Leslie Podlog, Ross Wadey, Nick Galli, Anjali J. Forber-Pratt & Maria Newton (2019): Cognitive processing following acquired disability for para sport athletes: a serial mediation model, *Disability and Rehabilitation*, DOI: [10.1080/09638288.2018.1563639](https://doi.org/10.1080/09638288.2018.1563639)

To link to this article: <https://doi.org/10.1080/09638288.2018.1563639>



Published online: 31 Jan 2019.



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Cognitive processing following acquired disability for para sport athletes: a serial mediation model

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ABSTRACT

Purpose: To understand the cognitive processing that occurs in relation to a disabling life event among para sport athletes, as well as the role of para sport participation in shaping these cognitions, and subsequent perceptions of posttraumatic growth or distress.

Methods: Participants were 75 para sport athletes with acquired disability. Serial multiple mediation analysis was conducted to identify the various pathways through which posttraumatic growth or distress is experienced.

Results: Findings suggested that a disabling event initiated challenges to one's core beliefs which influenced subsequent perceptions of posttraumatic growth and distress through cognitive processing at two separate time frames. Moreover, the utility of deliberate rumination (at both time points) was evident in experiencing posttraumatic growth, while intrusive rumination only appeared beneficial if it prompted deliberate ruminations.

Conclusions: As several unique paths to posttraumatic growth were found, results suggest that a multitude of paths to growth may be possible. Para sport participation may have utility in facilitating deliberate ruminations and subsequent posttraumatic growth for those unable to deliberately ruminate in the immediate disability aftermath.

ARTICLE HISTORY

Received 2 May 2018
Revised 5 December 2018
Accepted 21 December 2018

KEYWORDS

Posttraumatic growth; intrusive rumination; deliberate rumination; adaptive sport; physical activity; distress

► IMPLICATIONS FOR REHABILITATION

- As challenges to core beliefs triggered ruminative thoughts that ultimately facilitated PTG, practitioners are encouraged to explicitly ask patients about *how* the adverse event might have influenced patients' self-perceptions and views about the meaning of life. Such questions may be revisited from injury onset throughout recovery and rehabilitation.
- Rehabilitation specialists should inform patients that intrusive ruminations may be salient in the post-trauma aftermath, but that such rumination may be facilitative if it gives way to more deliberate forms of rumination.
- Attempts to understand the meaning of a traumatic event may be instrumental in alleviating distress.
- Health practitioners should encourage individuals suffering physically disabling events to engage in activities such as para sport, given its potential to facilitate deliberate rumination and subsequent posttraumatic growth.

Introduction

Approximately 14% of the global population is estimated to possess a disability that limits bodily functions and activities [1]. While the term disability is broad in that it encompasses both physical and mental impairments, a subset of this population is those with acquired physical disabilities, such as the amputation of a limb or spinal cord injury. In the United States, it is estimated that the number of people living with the loss of a limb will exceed 3.6 million by 2050 [2]. Moreover, the United States has one of the highest annual reported incidence rates of spinal cord injury at 40 per million [3]. In addition to the obvious impairment in physical functioning, acquiring a physical disability can be accompanied by an array of adverse psychosocial consequences, such as depression, anxiety, body image concerns, social

discomfort, posttraumatic stress disorder (PTSD), and lower levels of life satisfaction [4,5].

Despite the prevalence of deleterious experiences often associated with acquired disability, the literature is also replete with examples of positive adjustment and constructive life changes following an acquired physical disability, such as greater empathy and acceptance of others, as well as greater appreciation for life [6]. One term used to describe the experience of positive psychological change following extremely stressful or traumatic life circumstances is posttraumatic growth [7]. Posttraumatic growth is commonly considered to be a positive change experienced as a result of the struggle with a major life crisis or a traumatic event. This growth can be experienced as a perceived change in the self, an altered sense of relationships with others, or as a transformed philosophy of life [8]. Posttraumatic growth, which has

traditionally been assessed retrospectively through participant self-reports, has been reported in individuals suffering a variety of stressful and traumatic events, including acquired physical disability [9,10].

Fundamental to the concept of posttraumatic growth is the notion that experiencing a traumatic event has a shattering effect on one's core beliefs about the world, and that these existential threats are necessary antecedents to growth [11]. This conceptualization of the relationship between disruption to one's core beliefs and subsequent posttraumatic growth has received empirical support among various populations, for example, in college students [12,13], leukemia patients [12], earthquake survivors [14], and those with acquired disability [15]. However, the experience of trauma and the resulting challenge to one's core beliefs is not in and of itself suggested to be sufficient to produce posttraumatic growth; rather growth is developed through effortful cognitive processing [16,17]. Specifically, the discomfort caused by the discrepancy between one's previous assumptive world and the newly acquired trauma information necessitates the need to engage in cognitive processing to alleviate distress and make sense of the experience [18].

This cognitive processing has frequently been conceptualized in terms of rumination, that is, repetitive thought about the traumatic event and its consequences [16,17]. Though rumination has traditionally been conceived of as synonymous with worry [19], various forms of rumination have been linked to effective cognitive processing and problem solving [20]. Consistent with this broader conceptualization of rumination, rumination following adversity has been theorized as being either intrusive or deliberate [21,22]. Whereas intrusive ruminations are unsolicited and unwanted thoughts about an event, deliberate ruminations are voluntary with the purpose of trying to understand and make sense of an event. As these two forms of rumination are conceptually distinct, it is important to examine the relative influences of each in predicting posttraumatic growth. Research has shown that intrusive ruminations are associated with unfavorable outcomes such as less posttraumatic growth [23], negative outlook [23], and distress [24]. Furthermore, lingering intrusive rumination has been associated with a host of similarly adverse outcomes [22,25], suggesting that persisting intrusive ruminations are indicative of difficulty finding meaning or an inability to constructively deal with trauma-related challenges [17,26].

Despite the deleterious consequences associated with intrusive rumination, particularly when it persists over an extended period of time, there is evidence to suggest that these intrusive thoughts have the potential to facilitate positive outcomes as well. For instance, investigators have also demonstrated a positive relationship between intrusive thoughts and posttraumatic growth [27]. While it may appear inconsistent for intrusive rumination to be negatively associated with posttraumatic growth in one study and positively associated with posttraumatic growth in another, it is important to consider the dynamic process through which posttraumatic growth occurs. For example, though intrusive ruminations may be accompanied by psychological distress in the moment, the experience of such thoughts may signify that the individual is working through and making sense of the stressor [28]. That is, intrusive thoughts may actually initiate the process of posttraumatic growth by prompting deliberate ruminations [24]. In contrast to the automatic, often distress inducing thoughts characterized by intrusive rumination, the purposeful, reflective, sense-making thoughts characterizing deliberate rumination, are constructive. These sorts of effortful thoughts about a trauma have been linked to posttraumatic growth in a number of studies

[22,23,25]. Moreover, the relationship between challenged core beliefs and posttraumatic growth, as well as intrusive rumination and posttraumatic growth, has been shown to occur through deliberate rumination [15,24]. These results indicate that the value of intrusive rumination in facilitating growth may be in precipitating deliberate rumination. However, if intrusive ruminations do not lead to deliberate ruminations, the value of such distressing cognitive processing may be lost, a contention requiring further empirical examination.

While a plethora of research has identified the mechanisms through which posttraumatic growth occurs, surprisingly few studies have examined the role of lifestyle activities in facilitating productive cognitive processing. One such activity, at least for individuals with acquired disability, is para sport participation (i.e., sport for people with disabilities). The efficacy of physical activity and sport in decreasing negative mental states and promoting healthy outcomes across a variety of domains is well documented [29]. As many individuals with acquired disability report negative experiences [4,5], the utility of para sport may be acutely apparent. Researchers have reported a range of benefits of para sport participation, including the satisfaction of psychological needs such as meaningful social relationships, and feelings of competence and autonomy [6,30,31]. Additionally, several qualitative studies have found that para sport may be an efficacious means to promote posttraumatic growth [6,9,10]. For example, in a qualitative study conducted on para triathletes with acquired disabilities, Hammer et al. [6] suggested that posttraumatic growth may be facilitated through social, competence, empowerment, and identity development processes afforded by para sport participation. Moreover, para sport may be particularly valuable in facilitating posttraumatic growth for individuals who identify as athletes, and for those with severe initial reactions to having acquired a disability (i.e., shattering of core beliefs). However, despite these initial qualitative accounts of para sport facilitating cognitive processing and subsequent posttraumatic growth, quantitative work is needed to further establish the direction of proposed relationships as well as the generalizability of these preliminary findings. Furthermore, additional work is needed to examine the implications of specific types of rumination in facilitating posttraumatic growth and/or alleviating distress among para sport participants. To our knowledge, researchers have just recently begun to quantitatively investigate the mechanisms through which para sport may facilitate this growth. Preliminary research in this area provides a measure of support for the utility of deliberate rumination in the experience of posttraumatic growth for para sport athletes, but the exact role of para sport in this process is less well understood [15]. For instance, in an investigation examining the role of rumination on the experience of posttraumatic growth for para sport athletes with acquired disabilities, deliberate rumination (at multiple time points) and posttraumatic growth were significantly related. However, the hypothesized mediating role of ruminative processes and posttraumatic growth only received partial support, leading Hammer et al. [15] to highlight the need for more research in this area.

A more refined understanding of whether particular cognitive processes lead to posttraumatic growth and/or distress can assist healthcare practitioners and para sport organizations in the development of therapeutic interventions. That is, should posttraumatic growth for individuals with acquired disability be found to be attained through ruminative processes, interventions can be designed to incite and foster constructive ruminations. Additionally, an understanding of how para sport participation may elicit constructive cognitive processing can have important

implications for the utility and efficacy of para sport interventions in promoting these cognitions, and ultimately posttraumatic growth.

Based on previous theorizing exploring the relationship between rumination and posttraumatic growth, as well as preliminary research highlighting the role of para sport in promoting posttraumatic growth, this investigation sought to examine the cognitive processing occurring in relation to a disabling life event among para sport athletes, as well as the role of para sport participation on disability-related ruminations. We hypothesized that the relationship between disruption to one's core beliefs and perceptions of both posttraumatic growth and distress could be explained by ruminative processes following a trauma, specifically intrusive and/or deliberate rumination occurring in the immediate disability aftermath and rumination brought about by recent para sport participation. In particular, four hypotheses were advanced. First, we predicted that deliberate rumination would mediate the relationship between challenged core beliefs and posttraumatic growth. This hypothesis was informed by aforementioned research and theory suggesting that disruption to core beliefs is a necessary antecedent in the experience of posttraumatic growth, and that growth is attained through effortful cognitive processing. Second, on the grounds that intrusive rumination has been shown to be constructive when it prompts deliberate rumination, deliberate rumination was hypothesized to mediate the relationship between intrusive rumination and posttraumatic growth. Third, given the utility of physical activity and para sport participation in the facilitation of posttraumatic growth for individuals with acquired disability, we hypothesized that one means by which para sport would exert its influence would be by prompting the deliberate ruminations hypothesized to mediate the relationship between core beliefs and posttraumatic growth, as well as

between intrusive rumination and posttraumatic growth. Finally, as research has demonstrated the maladaptive consequences of persisting intrusive ruminations that do not incite deliberate rumination, we anticipated that intrusive rumination would mediate the relationship between challenged core beliefs and current distress.

Methods

Participants

After attaining approval from the Institutional Review Board (IRB), the administrative body that assures the legal and ethical treatment of human research subjects, participants were recruited electronically through various adaptive sport organizations and personal contacts. Participants were required to be at least 18 years of age, have an acquired (rather than congenital) disability, and participate in para sport. Individuals who met these criteria and elected to participate in the study did so by completing several measures concerned with their experiences of core belief challenge, cognitive processing, posttraumatic growth, and distress. The questionnaire was completed entirely over the internet, and was accessed via a link provided at the point of contact (i.e., introductory email). There were no time restrictions in completing the questionnaires and participants could choose to save and return to their responses if they so wished. In total, 75 athletes across a variety of para sports participated in the study. The classification of disability varied greatly across participants (e.g., leg amputation, arm amputation, visual impairment, spinal cord injury, traumatic brain injury), as well as the settings in which injuries were sustained (e.g., automobile accident, military combat, disease). See Table 1 for additional sample characteristics.

Table 1. Characteristics of sample (N = 75).

Variables	Values, mean ± SD OR n (%)
Age; mean ± SD (years)	42.0 ± 11.36
Gender	
Male	40 (53.3%)
Female	35 (46.7%)
Race	
White	65 (86.7%)
Hispanic, Latino, or Spanish	7 (9.3%)
Black or African American	1 (1.3%)
Two or more races	1 (1.3%)
Prefer not to answer	1 (1.3%)
Education	
High school graduate, diploma, or the equivalent (e.g., GED)	1 (1.3%)
Some college credit, no degree	9 (12.0%)
Associates degree	5 (6.7%)
Bachelors degree	30 (40.0%)
Advanced degree	30 (40.0%)
Veteran	
No	49 (65.3%)
Yes	26 (34.7%)
Years disabled; mean ± SD	14.01 ± 9.87
How disability was acquired	
Traumatic accident, nonmilitary	46 (61.3%)
Acute injury	6 (8.0%)
Result of military combat	6 (8.0%)
Degenerative condition or illness	11 (14.7%)
other	6 (8.0%)
Years of para sport participation; mean ± SD	7.66 ± 6.28
Weekly hours participating in para sport; mean ± SD	11.09 ± 7.24
Para sport level of competition	
Paralympic Games	9 (12.0%)
International competitions	23 (30.7%)
National championships	17 (22.7%)
Regional competitions	4 (5.3%)
Local/recreational competitions	22 (29.3%)

Measures

Challenge to core beliefs

The notion of a “shattered assumptive world,” conceptualized as a significant challenge to core beliefs, was measured using the Core Beliefs Inventory [12]. The Core Beliefs Inventory is a nine-item instrument, scored on a six-point Likert scale ranging from 0 (*not at all*) to 5 (*to a very great degree*), which prompts individuals to rate the extent to which an event led them to examine their core beliefs. Specifically, the Core Beliefs Inventory focuses on assumptions pertaining to individual’s spiritual beliefs, human nature, relationships with other people, the meaning of life, and personal strengths and weaknesses. Sample items from the questionnaire include “Because of the event, I seriously examined my beliefs about the meaning of my life” and “Because of the event, I seriously examined my beliefs about my own value or worth as a person.” The Core Beliefs Inventory has demonstrated construct validity [25] and internal consistency [13]. In the present sample, Cronbach’s alpha was 0.85.

Cognitive processing

Cognitive processing, that is, intrusive and deliberate ruminations, was measured using the Event Related Rumination Inventory [22]. The Event Related Rumination Inventory is a two-factor instrument consisting of 20-items assessing intrusive and deliberate ruminations, rated on a four-point Likert scale ranging from 0 (*not at all*) to 3 (*often*). The Event Related Rumination Inventory is designed to assess rumination at two different time frames, “during the weeks immediately after the event” and “during the last couple of weeks.” The present investigation retained the first temporal condition for rumination. However, given our interest in how rumination may be brought about by para sport participation, the latter time frame was modified to stipulate that rumination occurred “during and/or due to recent para sport participation.” The construct validity, factor structure, as well as the internal consistency of the Event Related Rumination Inventory has received support [22]. In the present sample, Cronbach’s alpha was 0.97 and 0.91 for the intrusive and deliberate rumination subscales occurring in “the weeks immediately after the event,” respectively. For intrusive and deliberate rumination occurring “during and/or due to recent para sport participation,” Cronbach’s alpha was 0.96 and 0.94, respectively.

Posttraumatic growth

The Posttraumatic Growth Inventory [8] was used to measure current perceptions of posttraumatic growth. The Posttraumatic Growth Inventory consists of 21 items, rated on a six-point Likert scale from 0 (*I did not experience this change as a result of my crisis*) to 5 (*I experienced this change a very great degree as a result of my crisis*), that provide a total posttraumatic growth score, as well as scores for each of its five factors: relating to others, new possibilities, personal strength, spiritual change, and appreciation for life. The present study employed the composite score as an indicator of posttraumatic growth. The Posttraumatic Growth Inventory has exhibited content validity [32], as well as internal consistency [8]. In the current study, Cronbach’s alpha was 0.95.

Current distress

The Impact of Events Scale-Revised [33] was utilized to assess reflections of distress experienced during the past seven days. The Impact of Events Scale-Revised is a 22-item scale that assesses intrusion, avoidance, and hyperarousal. Results can be interpreted as a total score as well as for the individual subscales. Participants were prompted to rate the degree to which distressful symptoms

(with respect to their traumatic event) occurred during the past seven days on a five-point Likert scale ranging from 0 (*not at all*) to 4 (*extremely*). The present investigation used the total score as an indicator of current distress. The Impact of Events Scale-Revised has demonstrated concurrent and discriminative validity [34] while the internal consistency of the total instrument has also received support [24]. Cronbach’s alpha for the total instrument was .95.

Analysis

All statistical analyses were conducted using IBM SPSS 24. Approximately 8% of the data were missing. Little’s MCAR Test revealed that the data were missing completely at random ($\chi^2 = 118.56$, $df = 136$; $p = 0.857$), so the expectation maximization algorithm was employed to replace missing data. Furthermore, as results of the Shapiro Wilk test revealed that the assumption of normality was violated by all of the rumination, Posttraumatic Growth Inventory and Impact of Events Scale-Revised scales ($p < 0.05$), the expectation maximization was based on student’s t distribution. Bivariate correlations were then conducted on the study variables before a serial multiple mediator model was tested using model 6 of the SPSS macro PROCESS [35]. In contrast to a parallel multiple mediation model, the serial multiple mediation model assumes that mediator variables are causally linked, and allows for the assessment of a specific sequence among the variables. Informed by theory and research, the order of the proposed mediating variables was intrusive rumination (occurring soon after trauma), deliberate rumination (occurring soon after trauma), intrusive rumination (brought about by recent para sport participation), and deliberate rumination (brought about by recent para sport participation). The proposed serial multiple mediator model is illustrated in Figure 1. A serial multiple mediation approach allows one to examine multiple indirect effects, that is, the complex pathways between challenges to one’s core beliefs following disabling events, rumination, and posttraumatic growth/current distress. In order to determine the significance of specific direct and indirect paths, PROCESS utilizes ordinary least square regression to calculate coefficients while also providing bias-corrected bootstrap confidence intervals. An effect is significant if the confidence interval does not contain zero.

Results

Correlations as well as descriptive statistics for the measures included in the serial mediation model can be seen in Table 2. In describing results from our serial mediation analyses, we try to link specific results to each of the four hypotheses where possible. That said, there are instances where specific indirect effects highlighted below relate to multiple hypotheses simultaneously. Consistent with our central hypothesis, the serial multiple mediation analysis revealed that disruption to one’s core beliefs indirectly influenced both posttraumatic growth and current distress through its effect on cognitive processing. Specifically, five significant indirect effects from core beliefs to posttraumatic growth were detected, while three significant indirect effects from core beliefs to current distress were found. The direct effect of core beliefs on posttraumatic growth was not significant ($c_2 = 0.245$, $SE = 0.132$, 95% CI: $[-0.018, 0.509]$). Likewise, the direct effect of core beliefs on distress was not significant ($c_1 = 0.123$, $SE = 0.082$, 95% CI: $[-0.041, 0.288]$). As recommended by Hayes [35], all regression coefficients remain unstandardized due to the lack of substantive interpretive values of standardized coefficients. Table

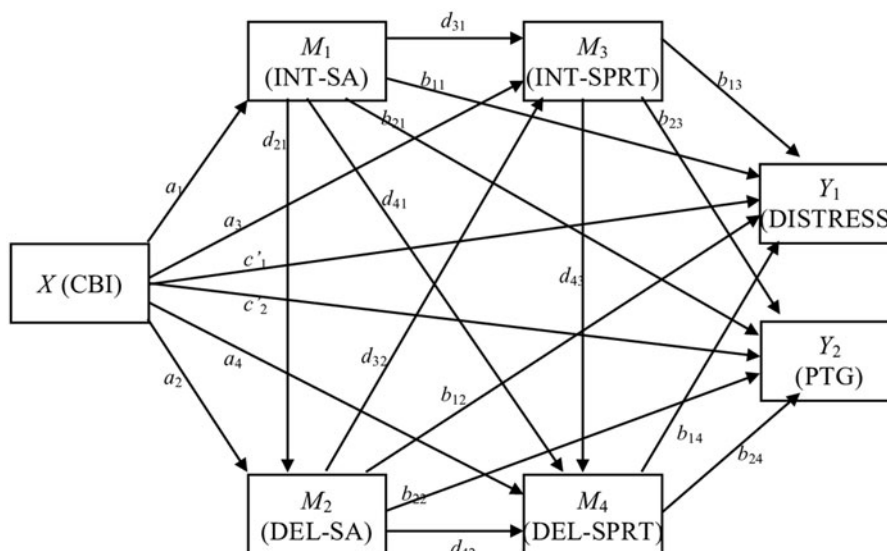


Figure 1. Serial multiple mediator model.

Table 2. Descriptive statistics and correlations among measured variables in the serial mediation model.

Correlations							
Variable	1	2	3	4	5	6	7
1. CBI	0.853						
2. Intrusive – Soon After	0.373**	0.971					
3. Deliberate – Soon After	0.475**	0.513**	0.907				
4. Intrusive – Para Sport	0.119	0.458**	0.340**	0.961			
5. Deliberate – Para Sport	0.396**	0.225	0.328**	0.486**	0.939		
6. PTGI	0.425**	0.164	0.347**	-0.044	0.287*	0.949	
7. IES-R	0.149	0.380**	0.094	0.624**	0.255*	-0.083	0.954
Mean	2.93	1.69	1.83	0.83	1.52	3.36	0.74
SD	1.09	0.97	0.73	0.77	0.82	1.12	0.80

N = 75. Cronbach's alphas are shown in italics on the diagonal. CBI: core belief inventory; PTGI: posttraumatic growth inventory; IESR-R: impact of events scale-revised.

*Denotes significance at $p < 0.05$; ** denotes significance at $p < 0.01$.

3 provides path coefficients and model summary statistics for all variables. Additionally, Figure 1 serves as a reference for the labels for the variables and individual paths.

For the first of the significant indirect effects from core beliefs to posttraumatic growth, challenges to core beliefs triggered intrusive rumination occurring soon after the trauma, which in turn led to deliberate rumination occurring soon after the trauma, which subsequently translated into greater posttraumatic growth (i.e., $X \rightarrow M1 \rightarrow M2 \rightarrow Y2$). The bias-corrected bootstrap confidence interval for the indirect effect ($a_1d_{21}b_{22} = 0.035$, $SE = 0.021$) was entirely above zero (0.006–0.098), indicating that this path leads to greater growth. This result supports the second hypothesis that deliberate rumination mediates the relationship between intrusive rumination and posttraumatic growth.

A second indirect effect occurred when challenges to one's core beliefs prompted intrusive rumination occurring soon after trauma, which led to intrusive rumination brought about by recent para sport participation. In turn, this intrusive rumination predicted deliberate rumination brought about by recent para sport participation, which then gave rise to greater posttraumatic growth (i.e., $X \rightarrow M1 \rightarrow M3 \rightarrow M4 \rightarrow Y2$). The bias-corrected bootstrap confidence interval for the indirect effect ($a_1d_{31}d_{43}b_{24} = 0.019$; $SE = 0.013$) was entirely above zero (0.004–0.069). This finding provides support for the third hypothesis, that deliberate rumination brought about by para sport would mediate the relationship between intrusive rumination and posttraumatic growth.

In support of the first hypothesis, a third indirect effect of core beliefs on posttraumatic growth appeared solely through deliberate rumination occurring soon after trauma (i.e., $X \rightarrow M2 \rightarrow Y2$), with the bias-corrected bootstrap confidence interval for the indirect effect ($a_2b_{22} = 0.079$; $SE = 0.057$) not containing zero (0.002–0.228). Similarly, the third hypothesis received additional support from a fourth indirect effect of core beliefs on posttraumatic growth which occurred only through deliberate rumination brought about by recent para sport participation (i.e., $X \rightarrow M4 \rightarrow Y2$), with the bias-corrected bootstrap confidence interval for the indirect effect ($a_4b_{24} = 0.094$; $SE = 0.054$) entirely above zero (0.007–0.225). A final indirect effect was evident as higher perceptions of challenged core beliefs were associated with intrusive rumination occurring soon after trauma, which led to intrusive rumination brought about by recent para sport participation, which translated into less posttraumatic growth (i.e., $X \rightarrow M1 \rightarrow M3 \rightarrow Y2$). This indirect effect ($a_1d_{31}b_{23} = -0.045$, $SE = 0.030$) was significantly negative, as the bias-corrected bootstrap confidence interval was below zero (-0.138 to -0.006).

The serial multiple mediation analysis similarly revealed that disruption to core beliefs indirectly influenced current distress through cognitive processing. Three indirect effects were significant. Two of these causal paths can be interpreted as predictive of less current distress, as their bootstrap confidence intervals were below zero. For the first of these two indirect effects, participants with challenged core beliefs had greater intrusive

Table 3. Regression coefficients and standard errors for the serial mediation model in Figure 1.

Antecedent	Consequent											
	M1 (INT-SA)		M2 (DEL-SA)		M3 (INT-SPRT)		M4 (DEL-SPRT)		Y ₁ (IES-R)		Y ₂ (PTGI)	
	Coeff (SE)	p	Coeff (SE)	p	Coeff (SE)	p	Coeff (SE)	p	Coeff (SE)	p	Coeff (SE)	p
X (CBI)	0.334 (0.097)	0.001	0.223 (0.069)	0.002	-0.087 (0.085)	0.310	0.276 (0.083)	0.001	0.123 (0.082)	0.140	0.245 (0.132)	0.068
M1	-	-	0.295 (0.077)	<0.001	0.323 (0.098)	0.002	-0.150 (0.101)	0.143	0.146 (0.095)	0.128	0.035 (0.152)	0.819
M2	-	-	-	-	0.201 (0.136)	0.145	0.084 (0.133)	0.531	-0.299 (0.124)	0.018	0.355 (0.198)	0.077
M3	-	-	-	-	-	-	0.526 (0.114)	<0.001	0.682 (0.121)	<0.001	-0.415 (0.194)	0.036
M4	-	-	-	-	-	-	-	-	-0.078 (0.111)	0.483	0.341 (0.177)	0.059
Constant	0.710 (0.304)	0.022	0.682 (0.207)	0.002	0.171 (0.257)	0.509	0.375 (0.248)	0.135	0.230 (0.233)	0.328	10.755 (0.374)	<0.001
	$R^2 = 0.139$		$R^2 = 0.357$		$R^2 = 0.236$		$R^2 = 0.372$		$R^2 = 0.455$		$R^2 = 0.272$	
	$F(1,73)=11.787$		$F(2,72)=19.976$		$F(3,71)=7.302$		$F(4,70)=10.382$		$F(5,69)=11.526$		$F(5,69)=5.153$	
	$p = 0.001$		$p < 0.001$		$p < 0.001$		$p < 0.001$		$p < 0.001$		$p < 0.001$	

SE: standard error; CBI: Core Belief Inventory; INT-SA: Intrusive rumination occurring soon after trauma; DEL-SA: Deliberate rumination occurring soon after trauma; INT-SPRT: Intrusive rumination occurring during recent para sport participation; DEL-SPRT: Deliberate rumination occurring during recent para sport participation; IES-R: Impact of Events Scale-Revised; PTGI: Posttraumatic Growth Inventory.

rumination occurring soon after trauma, which led to deliberate rumination occurring soon after trauma, the latter of which was predictive of less current distress (i.e., $X \rightarrow M1 \rightarrow M2 \rightarrow Y1$) ($a_1d_{21}b_{12} = -0.029$; SE = 0.016; 95% CI: [-0.082 to -0.009]). Similarly, the indirect effect of core beliefs on current distress through deliberate rumination occurring soon after trauma (i.e., $X \rightarrow M2 \rightarrow Y1$) was significant, as the bootstrap confidence interval of the effect ($a_2b_{12} = -0.067$; SE = 0.041) was also negative (-0.175 to -0.013). In support of the fourth hypothesis, a final indirect effect was evident in that challenged core beliefs were associated with intrusive rumination occurring soon after trauma, which in turn led to intrusive rumination brought about by recent para sport participation and subsequent greater distress (i.e., $X \rightarrow M1 \rightarrow M3 \rightarrow Y1$), with the bias-corrected bootstrap confidence interval for the indirect effect ($a_1d_{31}b_{13} = 0.073$; SE = 0.043) not containing zero (0.019–0.195).

Discussion

The purpose of this investigation was to assess the cognitive processing that occurs in the development of posttraumatic growth and/or distress in para sport athletes with an acquired disability. We also sought to examine the role that para sport participation may have on these ruminations. Specifically, grounded in posttraumatic growth theory [11,17], the present investigation examined a model in which challenges to one's core beliefs were cognitively processed through two types of rumination, which in turn were hypothesized to predict posttraumatic growth and/or distress. While relationships between these variables have been investigated in a variety of settings and populations [13,24,27], the current investigation, was to the authors' awareness, among the first to quantitatively assess the role of cognitive processing in the development of posttraumatic growth for a sport population with acquired disability. Additionally, a unique contribution of this investigation was an examination of the influence of ruminative thoughts brought about by recent para sport participation on posttraumatic growth and current distress levels. From a theoretical standpoint, the current study contributed to a deeper understanding of the specific influence of para sport in facilitating post-injury cognitive processing and subsequent post-traumatic growth for individuals with acquired disability. Furthermore, by employing a serial multiple mediation approach, we were able to examine multiple indirect effects, that is, the complex pathways between challenges to one's core beliefs following disabling events, rumination, and posttraumatic growth/current distress.

The central hypothesis of this investigation was that challenges to one's core beliefs initiated by a disabling event would indirectly influence subsequent perceptions of posttraumatic growth as well as distress through cognitive processing. That is, causally linked mediators relating to the characteristics of one's cognitive processing would explain the relationship between challenges to one's core beliefs brought about through acquiring a disability and subsequent perceptions of posttraumatic growth and distress. This hypothesis was supported by the results of the study, as several indirect effects from core beliefs to posttraumatic growth and distress were identified. Moreover, as the direct effects of core beliefs on both growth and distress were insignificant, there is no evidence for an association between core beliefs and posttraumatic growth/distress when the mechanism through rumination is accounted for. The existence of several indirect paths from core beliefs to posttraumatic growth suggests that the processes through which growth is attained is complex. For example,

challenged core beliefs has a significant impact on posttraumatic growth through deliberate rumination occurring soon after trauma, but also through deliberate rumination brought about by recent para sport participation. These results illustrate that there is no one “right” way to experience posttraumatic growth. Nonetheless, all paths predictive of growth have something in common, in that they all travel through deliberate rumination at one of the two time points (i.e., in the immediate aftermath or recently during para sport participation). This finding supports the first hypothesis that deliberate rumination would mediate the relationship between challenged core beliefs and posttraumatic growth, and is consistent with theory and research that posits the mediating role of deliberate rumination [15,17,24].

In support of our second hypothesis as well as literature that contends that intrusive rumination may be constructive if it initiates or leads to deliberate rumination [24], two indirect paths started with intrusive rumination before traveling through deliberate rumination at one of the two time points before posttraumatic growth was experienced. Interestingly, no paths from core beliefs to posttraumatic growth included deliberate rumination at both time points. That is, all paths from core beliefs to posttraumatic growth included *either* deliberate rumination soon after trauma or deliberate rumination brought about by recent para sport participation, but none of the significant indirect effects contained both. Perhaps engaging in deliberate rumination – either occurring soon after trauma or recently due to para sport participation – is sufficient for posttraumatic growth. Once growth is achieved, however, there may no longer be a need to ruminate. On the other hand, one path to posttraumatic growth consisted of intrusive rumination at both time points before one engaged in deliberate rumination. This path suggests that intrusive ruminations may persist, but as long as they eventually lead to deliberate rumination, posttraumatic growth may occur. Taken as a whole, there was no evidence that disruption to core beliefs influenced posttraumatic growth independent of its effect on cognitive processing. Instead, findings from the current study indicate that challenged core beliefs exert its effect indirectly on posttraumatic growth through various ruminative processes. In the case of the indirect effect, the utility of deliberate rumination is evident. Consistent with both our first and second hypotheses, all mediated paths ultimately traveled through one of the two deliberate rumination variables. These results support the literature that posit both the precipitating role of challenged core beliefs on posttraumatic growth, as well as the efficacy of deliberate rumination in facilitating said growth [16,21,22].

In terms of the influence of para sport on ruminative processes and subsequent posttraumatic growth, results from this study provide partial support for the third hypothesis that para sport participation would prompt deliberate ruminations, which would then mediate the relationship between core beliefs and posttraumatic growth. Beginning with the question pertaining to whether or not para sport participation would elicit deliberate ruminations, participants in the current study reported engaging in deliberate ruminations brought about by recent para sport participation at a mean rate between “rarely” and “sometimes.” Due to the cross-sectional nature of this design, one cannot conclude whether or not para sport *causes* deliberate ruminations. Nevertheless, this seemingly low rate of engagement in deliberate rumination due to para sport involvement may have a few explanations. For one, it is possible that those who engaged in deliberate rumination in the immediate aftermath of acquiring their disability may no longer have the need to deliberately ruminate. This explanation is supported by the fact that no significant path from core beliefs to

posttraumatic growth contained deliberate rumination at both time points. However, it is also possible that for some individuals para sport participation might not be an efficacious means to evoke deliberate ruminations. It is conceivable that para sport does not necessarily provide benefits beyond allowing for exercise and other social experiences. Future research should consider whether individual traits make it more or less likely that para sport will promote effective cognitive processing. For instance, in a qualitative study of para sport participants, it was posited that para sport may be particularly beneficial for individuals with prior sport backgrounds or who subscribe to an athletic identity [6].

Although occurring at a relatively low rate, deliberate ruminations brought about by para sport participation were found to mediate the relationship between core belief challenge and posttraumatic growth, as well as between intrusive ruminations and posttraumatic growth. Specifically, two paths emerged that contained deliberate rumination brought about by para sport participation. These results provide preliminary support that rumination during sport activities may contribute to posttraumatic growth. However, as other viable paths to posttraumatic growth occur entirely pre-para sport participation, it must be acknowledged that para sport participation may be only one of several means by which deliberate rumination may facilitate growth outcomes. The utility of para sport may be pronounced, however, if one is unable to deliberately ruminate in the immediate aftermath of the event or if intrusive ruminations persist. In this way, the present investigation substantiates previous qualitative findings that para sport may facilitate active rumination rather than passive reappraising [10].

In terms of current distress, only one path significantly predicted greater distress. As expected and consistent with the fourth hypothesis, this path traveled through intrusive rumination at both time points and did not include deliberate rumination. This same path also led to less posttraumatic growth. Two indirect effects, however, predicted significantly less distress. These indirect effects, both of which traveled through deliberate rumination occurring soon after trauma, also positively predicted posttraumatic growth. Though it is posited that posttraumatic growth is not synonymous with the absence of suffering [17,36], results from the present investigation demonstrate how the cognitive processing that leads to posttraumatic growth oftentimes leads to less distress, and vice versa. This is consistent with Joseph and Linley's [36] contention that posttraumatic growth would diminish distress symptoms over time. More research is needed to gain a better understanding of the complex relationship between posttraumatic growth, distress, and the cognitive processing that precipitates these experiences.

There are a number of applied implications that may be derived from the results of this study. For one, as challenges to core beliefs triggered ruminative thoughts that ultimately facilitated posttraumatic growth, practitioners are encouraged to explicitly ask patients about *how* having acquired a physical disability might have influenced patients' self-perceptions and views about the meaning of life. Moreover, health practitioners should consider encouraging individuals suffering physically disabling events to engage in activities such as para sport, given its potential to facilitate deliberate rumination and subsequent posttraumatic growth. However, despite para sport participation, some may continue to struggle to constructively process the trauma related information. For those unable to terminate intrusive ruminations, other interventions may be recommended, such as mindfulness [37] or rational emotive behavior therapy [38].

In considering the findings of this study, several limitations and cautions need to be acknowledged. First, given the relatively few people with acquired disabilities who participate in para sport, it was difficult to procure a large sample size. Although our sample size was relatively small, use of bootstrapping techniques afforded us the ability to nonetheless perform meaningful statistical analyses via ordinary least squares (OLS) regression. In fact, given the smaller sample size in the current investigation, Hayes [35] suggests that OLS regression might actually be preferable to other approaches (e.g., structural equation modeling) given that the inferential tests for path coefficients derived from structural equation modeling programs are more likely to be in error for small samples. Second, even though the model hypothesizes temporal and causal sequencing, the cross-sectional nature prohibits inferences regarding causal associations among variables. Future research employing a longitudinal, prospective design is necessary to assess causality and the sequential ordering of variables. Another limitation of the retrospective design is that recall bias may have influenced participant perceptions of past events. Along these lines, due to the challenges inherent to retrospective recall as well as the subjectivity of attributing the cause of rumination to a specific activity (i.e., para sport involvement), there is difficulty in disentangling the level of rumination as a result of para sport involvement and rumination that would occur otherwise. The present investigation also prompted participants to consider their ruminations having taken place in an open-ended time frame (i.e., “recent”). Here again, a prospective design would perhaps allow for a more accurate understanding of the ruminating processes, as well as the timing in which they occur. Furthermore, use of a qualitative or mixed-method approach could provide a richer understanding of the ways in which para sport participation influences cognitive processing. In the absence of a prospective methodology, cognitive interviewing techniques may allow for more accurate memory recall. Additionally, future studies may consider other ways to correct for human memory errors, such as immediate recall procedures or one-on-one sessions where techniques are used to enhance memory of past events. Regardless of the methodology, caution must be taken when asking participants to contemplate posttraumatic growth, as the perceived desirability of the experience can lead those who do not experience growth to feel like “coping failures” [39]. Similarly, the present investigation did not account for other potential responses to trauma such as emotional regulation and resilience, the latter of which has actually been shown to be inversely related to posttraumatic growth [40]. As such, posttraumatic growth might not be a viable outcome for some individuals. Another caution is the assumption that para sport would be an efficacious means to experience posttraumatic growth for all individuals with disabilities. It is possible that there is a self-selection bias for those who participate in para sport to be pre-disposed to deriving growth benefits from para sport participation. Conversely, those who are not athletically inclined may find less value in participation or choose not to participate altogether. Future research may consider investigating the utility of para sport participation for those individuals who may otherwise not be inclined to participate.

To conclude, these findings provide insight into the ruminative processes experienced by para sport athletes following a traumatic life event. Specifically, this research demonstrates how deliberate rumination may lead to posttraumatic growth, while its absence, along with persisting intrusive ruminations, may lead to distress. Moreover, this study provides preliminary evidence for the utility of para sport participation in facilitating the deliberate ruminative thinking known to lead to posttraumatic growth.

Based on these results, rehabilitation practitioners and psychologists are encouraged to identify how individuals are ruminating about a traumatic event, and when possible, to encourage effortful, “meaning making” contemplation and reflection. Furthermore, for individuals who struggle to deliberately ruminate in the immediate aftermath of having acquired a disability, para sport participation may be an efficacious means by which to facilitate constructive cognitive processing.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

- [1] Mitra S, Sambamoorthi U. Disability prevalence among adults: estimates for 54 countries and progress toward a global estimate. *Disabil Rehabil.* 2014;36:940–947.
- [2] Ziegler-Graham K, MacKenzie EJ, Ephraim PL, et al. Estimating the prevalence of limb loss in the United States: 2005 to 2050. *Arch Phys Med Rehabil.* 2008;89:422–429.
- [3] Singh A, Tetreault L, Kalsi-Ryan S, et al. Global prevalence and incidence of traumatic spinal cord injury. *Clin Epidemiol.* 2014;6:309–331.
- [4] Horgan O, MacLachlan M. Psychosocial adjustment to lower-limb amputation: a review. *Disabil Rehabil.* 2004;26: 837–850.
- [5] Post M, van Leeuwen C. Psychosocial issues in spinal cord injury: a review. *Spinal Cord.* 2012;50:382–389.
- [6] Hammer C, Podlog L, Galli N, et al. Understanding posttraumatic growth of para sport athletes with acquired disability. *Disabil Rehabil.* 2017;1. Advance online publication.
- [7] Calhoun LG, Tedeschi RG. Facilitating posttraumatic growth: a clinician’s guide. Mahwah, NJ: Erlbaum; 1999.
- [8] Tedeschi RG, Calhoun LG. The posttraumatic growth inventory: measuring the positive legacy of trauma. *J Traum Stress.* 1996;9:455–471.
- [9] Crawford JJ, Gayman AM, Tracey J. An examination of posttraumatic growth in Canadian and American ParaSport athletes with acquired spinal cord injury. *Psychol Sport Exerc.* 2014;15:399–406.
- [10] Day MC. The role of initial physical activity experiences in promoting posttraumatic growth in paralympic athletes with an acquired disability. *Disabil Rehabil.* 2013;35: 2064–2072.
- [11] Calhoun LG, Cann A, Tedeschi RG. The posttraumatic growth model: sociocultural considerations. In: Weiss T, Berger R, editors. *Posttraumatic growth and culturally competent practice: lessons learned from around the globe.* Hoboken, NJ: Wiley; 2010. p. 1–14.
- [12] Cann A, Calhoun LG, Tedeschi RG, et al. The Core Beliefs Inventory: a brief measure of disruption in the assumptive world. *Anxiety Stress Coping.* 2010;23:19–34.
- [13] Lindstrom CM, Cann A, Calhoun LG, et al. The relationship of core belief challenge, rumination, disclosure, and socio-cultural elements to posttraumatic growth. *Psychol Trauma Theory Res Pract Policy.* 2013;5:50–55.
- [14] Taku K, Cann A, Tedeschi RG, et al. Core beliefs shaken by an earthquake correlate with posttraumatic growth. *Psychol Trauma Theory Res Pract Policy.* 2015;7:563–569.
- [15] Hammer C, Podlog L, Wadey R, et al. From core belief challenge to posttraumatic growth in para sport athletes:

- moderated mediation by needs satisfaction and deliberate rumination. *Disabil Rehabil.* 2018;1.
- [16] Calhoun LG, Tedeschi RG. Posttraumatic growth: future directions. In: Tedeschi RG, Park CL, Calhoun LG, editors. *Posttraumatic growth: positive changes in the aftermath of crisis.* Mahwah, NJ: Erlbaum; 1998. p. 215–238.
- [17] Tedeschi RG, Calhoun LG. Posttraumatic growth: conceptual foundations and empirical evidence. *Psychol Inq.* 2004; 15:1–18.
- [18] Janoff-Bulman R. *Shattered assumptions: towards a new psychology of trauma.* New York, NY: Free Press; 1992.
- [19] Michael T, Halligan SL, Clark DM, et al. Rumination in post-traumatic stress disorder. *Depress Anxiety.* 2007;24: 307–317.
- [20] Watkins ER. Constructive and unconstructive repetitive thought. *Psychol Bull.* 2008;134:163–206.
- [21] Calhoun LG, Tedeschi RG. *Handbook of posttraumatic growth: research and practice.* Mahwah, NJ: Erlbaum; 2006.
- [22] Cann A, Calhoun LG, Tedeschi RG, et al. Assessing posttraumatic cognitive processes: the event related rumination inventory. *Anxiety Stress Coping.* 2011;24:137–156.
- [23] Stockton H, Hunt N, Joseph S. Cognitive processing, rumination, and posttraumatic growth. *J Traum Stress.* 2011;24: 85–92.
- [24] Triplett KN, Tedeschi RG, Cann A, et al. Posttraumatic growth, meaning in life, and life satisfaction in response to trauma. *Psychol Trauma Theory Res Pract Policy.* 2012;4: 400–410.
- [25] Cann A, Calhoun LG, Tedeschi RG, et al. Posttraumatic growth and depreciation as independent experiences and predictors of well-being. *J Loss Trauma.* 2010;15:151–166.
- [26] Calhoun LG, Cann A, Tedeschi RG, et al. A correlational test of the relationship between posttraumatic growth, religion, and cognitive processing. *J Traum Stress.* 2000;13:521–527.
- [27] Wilson B, Morris BA, Chambers S. A structural equation model of posttraumatic growth after prostate cancer. *Psychooncology.* 2014;23:1212–1219.
- [28] Helgeson VS, Reynolds KA, Tomich PL. A meta-analytic review of benefit finding and growth. *J Consult Clin Psychol.* 2006;74:797–816.
- [29] Rebar AL, Stanton R, Geard D, et al. A meta-meta-analysis of the effect of physical activity on depression and anxiety in non-clinical adult populations. *Health Psychol Rev.* 2015; 9:366–378.
- [30] Banack HR, Sabiston CM, Bloom GA. Coach autonomy support, basic need satisfaction, and intrinsic motivation of paralympic athletes. *Res Q Exerc Sport.* 2011;82:722–730.
- [31] Goodwin D, Johnston K, Gustafson P, et al. Its okay to be a quad: wheelchair rugby players sense of community. *Adapt Phys Activ Q.* 2009;26:102–117.
- [32] Shakespeare-Finch J, Martinek E, Tedeschi RG, et al. A qualitative approach to assessing the validity of the posttraumatic growth inventory. *J Loss Trauma.* 2013;18:572–591.
- [33] Weiss DS. The impact of event scale-revised. In: Wilson JP, Keane TM, editors. *Assessing psychological trauma and PTSD: a practitioner's handbook.* 2nd ed. New York: Guilford Press; 2007. p. 168–189.
- [34] Beck JG, Grant DM, Read JP, et al. The impact to event scale-revised: psychometric properties in a sample of motor vehicle accident survivors. *J Anxiety Disord.* 2008;22: 187–198.
- [35] Hayes AF. *Introduction to mediation, moderation, and conditional process analysis: a regression-based approach.* New York, NY: Guilford Press; 2013.
- [36] Joseph S, Linley PA. Positive adjustment to threatening events: an organismic valuing theory of growth through adversity. *Rev Gen Psychol.* 2005;9:262–280.
- [37] Garland EL, Farb NA, Goldin P, et al. Mindfulness broadens awareness and builds eudaimonic meaning: a process model of mindful positive emotion regulation. *Psychol Inq.* 2015;26:293–314.
- [38] Jarrett TA. Warrior resilience and thriving (WRT): rational emotive behavior therapy (REBT) as a resiliency and thriving foundation to prepare warriors and their families for combat deployment and posttraumatic growth in Operation Iraqi Freedom, 2005–2009. *J Rat-Emo Cognitive-Behav Ther.* 2013;31:93–107.
- [39] Wortman CB. Posttraumatic growth: progress and problems. *Psychol Inq.* 2004;15:81–90.
- [40] Levine SZ, Laufer A, Stein E, et al. Examining the relationship between resilience and posttraumatic growth. *J Traum Stress.* 2009;22:282–286.