

Research

The role of rumination and metamemory beliefs in posttraumatic growth and posttraumatic stress

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Received: 15 December 2023 / Accepted: 26 July 2024

Published online: 04 September 2024

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Abstract

The risk of developing posttraumatic stress symptoms following exposure to traumatic events is well documented, however, emerging research also lends support to the potential development of growth in some people. Rumination and memory have been identified as important factors in post-trauma outcomes, yet, current research in this area is limited, particularly in the context of a multidimensional view of rumination (i.e., intrusive and deliberate rumination) and metamemory beliefs. This study explored the association between rumination styles, beliefs about memory, and posttraumatic stress symptoms and posttraumatic growth. Participants ($N = 151$) who experienced a traumatic event completed relevant measures online. Path analysis showed that intrusive rumination was significantly related to higher levels of posttraumatic stress symptoms ($\beta = 0.19, p < 0.01$), while deliberate rumination was related to higher levels of both posttraumatic growth ($\beta = .52, p < 0.001$) and posttraumatic stress symptoms ($\beta = 0.15, p < 0.05$). Additionally, negative beliefs about memory were significantly related to higher posttraumatic stress symptoms ($\beta = 0.48, p < 0.001$). No significant associations were found for positive beliefs about memory. The findings suggest that rumination may be understood as multidimensional, incorporating both adaptive and maladaptive processes. Further, the present study contributes to the limited literature concerning metamemory beliefs and may provide an increased understanding of factors contributing to stress or growth.

Keywords Rumination · Posttraumatic growth · Posttraumatic stress · Metacognitive

1 Introduction

Lifetime prevalence rates for exposure to traumatic events range from 50 to 89% [21, 33], and the psychological consequences of exposure vary in intensity and duration. Posttraumatic Stress Disorder (PTSD) is the most extreme and enduring form of disturbance, and is characterised by recurrent, involuntary, and intrusive memories of the trauma, which are experienced as distressing, avoidance of internal (memories, thoughts, and feelings) and external (places, situations) reminders, and negative alterations in cognitions and mood associated with the traumatic event [1, 2]. The prevalence rates for PTSD are low when compared to the prevalence of lifetime exposure, indicating that most individuals recover from traumatic exposure. In addition, some individuals may also experience posttraumatic growth (e.g., [27, 28, 33, 43]).

Posttraumatic growth (PTG) is defined as the subjective experience of positive psychological change after an experience of trauma, such as a change or enhancement in relating to others, developing new possibilities, personal strength,

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spirituality, and a greater appreciation of life [44]. Models of PTG propose that to achieve growth, an event must have had a significant impact on a person's schemas (i.e., beliefs and worldview) and have altered these substantially. PTG then occurs through a process of revising and reconstructing these altered schemas [45]. Theoretically, the individual goes through a process of disengaging from the previously held schemas (that have been invalidated by the trauma experience) and generates new schemas and goals that facilitate a sense of moving forward, resulting in increased life satisfaction. Therefore, active cognitive processing is crucial for reformulating new schemas to achieve PTG.

Rumination has been identified as a key active mechanism or maladaptive cognitive process in both the maintenance of PTSD [12, 33]) and potential development of PTG [9, 34]. Shigemoto and colleagues [36] examined post-trauma outcomes for undergraduate students who had experienced a traumatic event within the previous three years. They demonstrated that intrusive rumination, defined as uncontrollable, negative, and unwanted thoughts of the traumatic event, was associated with post-traumatic stress, while deliberate rumination, which refers to purposeful thoughts generated specifically to make sense of and reflect meaningfully on the traumatic event, were associated with posttraumatic growth. Other studies have reported similar findings (e.g., [14, 55, 57]).

It has also been suggested that there is a temporal sequence to these different types of rumination in that intrusive rumination may predominate in the early posttraumatic period [9], whereas deliberate rumination is most likely to occur later. Theoretically, the failure to move from intrusive rumination to deliberate rumination is the mechanism by which PTSD develops [55]. However, many of these studies used an alternative measure of rumination (brooding and reflective) designed for depressive populations. While brooding may be more maladaptive, and reflection more adaptive, research on the measure has identified them as one factor, rather than separate constructs as found in intrusive and deliberate rumination [36].

As an additional cognitive process influencing post-trauma outcomes, key theoretical models of PTSD have emphasised the importance of memory in the development and maintenance of symptoms. Ehlers and Clark's [12] cognitive model highlights the appraisal of the memory content as underpinning the onset and maintenance of PTSD, whereas the metacognitive model proposed by Wells and Sembi [52] suggests that metacognitions, defined as the process of thinking or reflecting upon one's thoughts, feelings, and memories, are more important in precipitating and maintaining symptoms of PTSD than the actual memories [5]. These may be either positive or negative metacognitive beliefs. For example, a negative meaning and consequence may be applied to fragmented memory in that the memory gaps may prevent the individual from moving past the event, or a positive metacognitive belief may be conceptualised through the need for memory completeness. These beliefs then lead to an individual remaining focused on the traumatic event, which inhibits normal adaptation processes [51]. The metacognitive model of PTSD proposes that the emotional processing of the trauma that facilitates the development of plans to guide thoughts and behaviour in response to future threats is known as the Reflexive Adaptation Process (RAP; [52]). The RAP is initiated automatically in response to intrusive thoughts and is considered a normal response to a traumatic experience. However, if an individual is unable to exit the RAP cycle, maladaptive processing and metacognitions can arise in the form of worry, rumination, threat monitoring, and negative appraisals of coping, which maintain a sense of current threat [52].

An investigation using the metacognitive model showed that participants who held more maladaptive metacognitions and negative beliefs about their trauma memories were at significantly greater risk for elevated and ongoing PTSD [39]. However, unlike Bennett and Wells' study [5], no significant findings were reported for positive beliefs about memory and posttraumatic stress symptoms. In contrast, Kannis-Dymand et al. [18] studied metamemory beliefs in response to a natural disaster and found that there was a comparable effect size for both negative and positive beliefs associated with higher levels of PTSD symptoms.

The metacognitive model of PTSD supports the view that maladaptive metacognitions inhibit an individual's adaptation process of trauma, increasing their focus on the threat and thus maintaining symptoms. This in turn may lend support to the assumption of the PTG model that more adaptive cognitions promote growth. That is, metacognitions may have an adaptive role and facilitate growth after trauma. Metacognition allows individuals to compare pre and post versions of themselves which, in some circumstances may promote the recognition of growth [41]. Processes on a metacognitive level may also allow for an alteration of one's life narrative, leading a person to find meaning and a sense of resolution after a traumatic experience [42]. More adaptive metacognitions, such as confidence in extinguishing perseverative thoughts, interpreting emotional cues, and setting and achieving post-trauma goals have been associated with self-regulation and goal orientation, promoting adaptive coping and inhibiting maladaptive coping [3, 4], lowering PTSD symptoms, and greater posttraumatic growth [30]. However, minimal research has examined metamemory beliefs, rumination, and possible relationships with PTG. Given that metamemory beliefs are conceptualised as maladaptive and

that negative and positive beliefs potentially maintain perseverative worry and rumination, it is possible that metamemory beliefs may have a negative impact on PTG.

Our study focused on extending knowledge of maladaptive and adaptive cognitions in the development of psychological growth and stress after a traumatic event. We addressed two main questions: (1) Do particular types of rumination (intrusive and deliberate) about a traumatic event lead to posttraumatic growth or posttraumatic stress symptoms (PTSS); and (2) Are beliefs about memory (positive and negative) following a traumatic event related to the development of posttraumatic growth or posttraumatic stress symptoms. Our hypotheses were that (1) that intrusive rumination would be positively associated with PTSS and negatively associated with PTG; (2) deliberate rumination would be positively associated with PTG and negatively associated with PTSS; (3) that negative beliefs about memory would be positively associated with PTSS and negatively associated with PTG; and (4) that positive beliefs about memory would be positively associated with PTSS and negatively associated with PTG.

2 Method

2.1 Participants

Participants ≥ 18 years with an English-speaking background who have experienced at least one traumatic event were eligible to participate in the study. The original sample consisted of a total of 231 participants. Data for participants who exited the survey before completion were deleted, excluding eighty cases. The final sample consisted of 151 participants (84.4% females), aged 18–71 years ($M = 35.78$; $SD = 11.92$). The number of years since participants' traumatic event ranged from 0–48 years ($M = 13.32$, $SD = 12.08$). Additional demographic data are reported in Table 1.

2.2 Materials

Demographics Items included age, gender, education level, relationship status, and ethnicity.

Trauma history screen The Trauma History Screen (THS; [10]) includes 14 possible traumatic events (e.g., 'attack with gun, knife, or weapon', 'a hurricane, flood, earthquake, tornado, or fire') and asks participants to select either 'Yes if that kind of thing has happened to you' or 'No if that kind of thing has not happened to you'. Additional items included if the event occurred a single time or multiple times, age at the event, and the degree of emotional distress (Not at all, A little, Somewhat, Much, Very much).

Posttraumatic stress Posttraumatic stress was measured using the PTSD Checklist for DSM-5 (PCL-5; [50]). The scale included 20 items corresponding with the DSM-5 criteria of PTSD and ratings were recorded on a Likert scale ranging from 0 = 'Not at all' to 4 = 'Extremely'. Items were summed to provide a total severity score with higher scores indicating higher levels of PTSD symptoms (range = 0–80). The Cronbach's alpha for the current study was 0.96.

Beliefs about memory Beliefs about memory were measured using the Beliefs About Memory Questionnaire (BAMQ; [5]). The measure had a total of 15 items and included the Negative beliefs about memory subscale ("Gaps in my memory for the event are preventing me from getting over it") and Positive beliefs about memory subscale ("I need to have a complete memory for what happened so that I can learn from the incident"). A Likert scale was used ranging from 1 = 'Do not agree' to 4 = 'Agree very much'. Possible scores ranged from 7–28 for negative beliefs and 8–32 for positive beliefs. Higher scores indicated stronger memory beliefs. The Cronbach's alpha for the current study was 0.90 (positive beliefs about memory = $\alpha = 0.87$; negative beliefs about memory = $\alpha = 0.83$).

Posttraumatic growth Posttraumatic growth was measured using the Posttraumatic Growth Inventory (PTGI; [43]). The PTGI included 21 items, and responses were rated on a Likert scale ranging from 0 = 'I did not experience change as a result of my crisis' to 5 = 'I experienced this change to a very great degree as a result of my crisis'. The PTGI included 5 factors that measured Relating to Others, New Possibilities, Personal Strength, Spiritual Change, and Appreciation of Life. Example items included "I changed my priorities about what is important in life" and "I know that I can better handle difficulties". Possible scores ranged from 0–105 with higher scores indicating higher growth. Cronbach's alpha for the current study was 0.95.

Rumination Rumination style was measured using the Event Related Rumination Inventory (ERRI; [9]). This measure included two subscales, Intrusive rumination (10 items; "I tried not to think about the event but could not keep the thoughts from my mind") and Deliberate rumination (10 items; "I deliberately thought about how the event had affected me") and a Likert scale was used ranging from 0 = 'Not at all' to 3 = 'Often'. Higher scores on each subscale indicated higher

Table 1 Demographic characteristics of participants

	<i>n</i>	%
Gender		
Male	22	14.6
Female	129	85.4
Ethnicity		
Australian	110	72.8
Australian Aboriginal	2	1.3
New Zealander	11	7.3
British	4	2.6
European	3	2.0
Asian	9	6.0
North American	7	4.6
South American	1	0.7
Southern and East African	1	.7
Other	3	2.0
Education		
Less than Year 12 or equivalent	8	5.3
Year 12 or equivalent	21	13.9
TAFE, diploma, or certificate	45	29.8
University degree	77	51.0
Marital Status		
Single, never married	53	35.1
Married	63	41.7
Divorced or separated	22	14.6
Widowed	2	1.3
De Facto relationship	10	6.6
Trauma Event		
Forced sexual contact as child	27	17.9
Sudden death of close family or friend	26	17.2
Forced sexual contact as adult	14	9.3
Abandoned by spouse, parent, or family	13	8.6
Car, boat, train, or airplane accident	9	6.0
Witness of death or injury	8	5.3
Attacked with gun, knife, or weapon	7	4.6
Accident at work or home	6	4.0
Hurricane, flood, earthquake, tornado, or fire	4	2.6
Physical assault as child	4	2.6
Sudden loss of home/possessions	3	2.0
Military related	2	1.3
Physical assault as adult	1	0.7
Other	26	17.2

levels of intrusive and deliberate rumination style (range=0–30 for each subscale). The Cronbach's alpha for the current study was 0.95 (intrusive rumination $\alpha=0.97$; deliberate rumination $\alpha=0.93$).

Rumination frequency An additional rumination item was included using a rating devised by Bennett and Wells [5]. Participants were asked "Since the event occurred, how much of the time have you been preoccupied with and gone over the event in your mind". Responses were rated on a four-point Likert scale from 1 = 'Never' to 4 = 'All of the time'.

Depression and anxiety Measures of depression and anxiety were also included. The Patient Health Questionnaire (PHQ-9; [25]) is a measure of symptoms of depression and includes 9 items (Likert scale ranging from 0 = 'Not at all' to 3 = 'Nearly every day'; range = 0–27). The Cronbach's alpha was 0.93. The Generalized Anxiety Disorder screener (GAD-7; [38]) is a measure of anxiety and includes 7 items (Likert scale ranging from 0 = 'Not at all' to 3 = 'Nearly every day'; range

0–21). Items were summed to provide a total severity score depression and anxiety. The Cronbach's alpha was 0.93 for both measures.

2.3 Design

The study was a descriptive research design using path analysis to test the proposed model of PTG, PTSS, subscales of rumination, and subscales of beliefs about memory. This method of analysis allowed for the estimation of multiple and interrelated dependence in a single analysis. All variables were defined as observed variables. Intrusive rumination, deliberate rumination, positive beliefs, and negative beliefs about memory were entered as exogenous variables, while PTSS and PTG were entered as endogenous variables.

2.4 Procedure

Ethical approval was obtained from a University Human Research Ethics Committee. Participants were recruited through a university research participation system which invited students to participate in research projects for course credit, social media, and email advertisements to mental health and trauma organisations and support groups. Participants were given the web link to an online, anonymous survey hosted by SurveyMonkey.com. Accessing the link led participants to the research participant information sheet and consent form. After indicating consent, participants began the questionnaire, starting with questions about whether or not they had experienced particular traumatic events, which were answered by selecting 'Yes' or 'No'. Then, questions around posttraumatic stress, posttraumatic growth, rumination style, beliefs about memory of the traumatic event, depression, and anxiety were provided. Details of support services were available for participants to assist with possible distress pre- and post-survey. The average time to complete the survey was 14 min. Participation was voluntary and a small incentive (entering a draw for a \$40 gift voucher) was offered.

3 Results

3.1 Initial analyses

Data were handled in SPSS and AMOS (v29). A series of Pearson's bivariate correlations and one-way analyses of variance (ANOVAs) were calculated to examine potential differences across demographic characteristics with PTSS and PTG. Assumption testing of z-scores and boxplots indicated that there were no significant outliers, and approximate univariate normality was observed. The homogeneity of variance assumption was examined using a series of Levene's *F* tests and Turkey's HSD post hoc comparisons were used when appropriate. Across most variables, the homogeneity of variance assumption was acceptable, however, where the assumption was violated ($p < 0.05$), the Welch's adjusted *F* ratio and Games-Howell post hoc procedures were implemented [13].

Pearson's correlation analyses showed that older participants (measured as a continuous variable) tended to have higher levels of PTG, $r = 0.204$, $p = 0.012$. However, there was no significant relationship between age and PTSS. Significant univariate main effects were found between level of education and PTSS, however, Levene's *F* test revealed that the homogeneity of variance assumption was not met, therefore, the Welch's *F* test was used. The analysis indicated that participants with a university education reported significantly less PTSS than those with an education level at less than Year 12 or equivalent, Welch's $F(3, 34.12) = 5.81$, $p = 0.003$. There was a significant effect of relationship status on PTSS, $F(4, 145) = 2.68$, $p = 0.034$, with those who were married reporting lower levels of PTSS than those separated or divorced. There were also significant differences found across relationship status with levels of PTG, $F(4, 145) = 6.02$, $p < 0.001$, with those in de facto relationships reporting significantly less PTG than those married, divorced or separated, and widowed. However, there were no significant effects for PTG and education, $F(3, 147) = 1.51$, $p = 0.215$.

3.2 Bivariate correlations

The Pearson bivariate correlations between the main variables are presented in Table 2. Correlations were examined between PTSS, PTG, rumination, and beliefs about memory, as well as measures of depression (PHQ-9), anxiety (GAD-7),

Table 2 Bivariate correlations between the measured variables

Variables	1	2	3	4	5	6	7	8	9	10
1. PTSS	–	0.06	0.40***	0.26***	0.51***	0.58***	0.67***	0.59***	0.09	0.44***
2. PTG		–	0.13	0.47***	–0.04	–0.14	–0.24**	–0.19*	–0.18*	0.15
3. Intrusive			–	0.42***	0.39***	0.22**	0.27**	0.29***	0.08	0.59***
4. Deliberate				–	0.27**	–0.01	0.03	0.08	–0.02	0.38***
5. Pos. meta-memory beliefs					–	0.60***	0.49***	0.54***	0.11	0.29***
6. Neg. meta-memory beliefs						–	0.65***	0.58***	0.20*	0.20*
7. PHQ-9							–	0.82***	0.11	0.30***
8. GAD-7								–	0.06	0.27**
9. Years									–	0.08
10. Rumination										–

Note. *N* = 151. PTSS = Posttraumatic Stress Symptoms, as measured by the total score of the PCL-5. PTG = Posttraumatic Growth, as measured by the total score of PTGI. Intrusive = intrusive rumination subscale of the ERRI. Deliberate = deliberate rumination subscale of the ERRI. Pos. meta-memory beliefs = Positive meta-memory beliefs subscale of the BAMQ. Neg. meta-memory beliefs = Negative meta-memory beliefs subscale of the BAMQ. PHQ-9 = Patient Health Questionnaire. GAD-7 = Generalized Anxiety Disorder scale. Years = Number of years since the traumatic event. Rumination = single item scale measuring frequency of rumination since traumatic event (never – all of the time)

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

and single-item scales measuring the number of years since the traumatic event, and the frequency of rumination about the event.

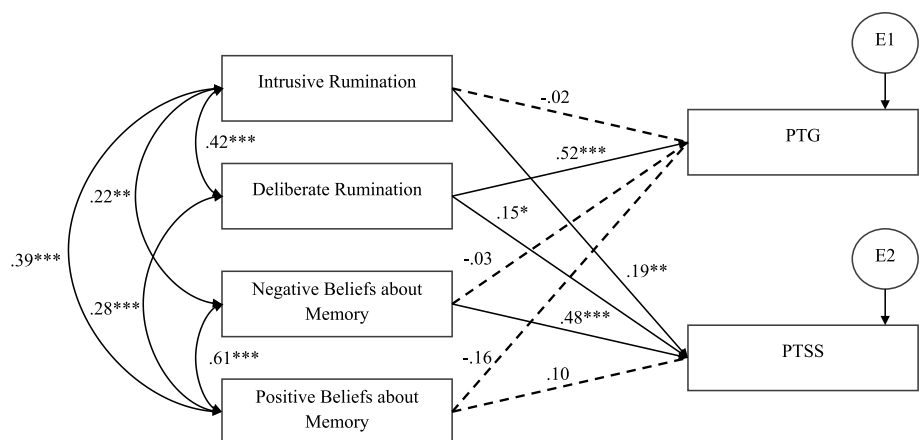
The results indicated that PTSS was significantly and positively correlated with intrusive rumination ($r = 0.401, p < 0.001$), deliberate rumination ($r = 0.258, p = 0.001$), positive beliefs ($r = 0.505, p < 0.001$) and negative beliefs ($r = 0.578, p < 0.001$) about memory, depression ($r = 0.674, p < 0.001$), anxiety ($r = 0.588, p < 0.001$) and frequency of rumination ($r = 0.436, p < 0.001$). PTG was significantly and positively related to deliberate rumination ($r = 0.469, p < 0.001$) and negatively related to depression ($r = -0.240, p = 0.003$), anxiety ($r = -0.185, p = 0.024$), and number of years since the traumatic event ($r = -0.180, p = 0.027$). Correlations between PTG and positive and negative beliefs about memory were not significant.

3.3 Path analysis model

Path analysis with maximum-likelihood estimation was conducted to test the hypotheses. To statistically evaluate model fit, chi-square test was examined (χ^2) with $p > 0.05$ suggesting an acceptable fit. Additional criteria for acceptable model fit range from CFI ≥ 0.90 and SRMR and RMSEA ≤ 0.10 to conservative criteria of CFI ≥ 0.95 , SRMR ≤ 0.08 , and RMSEA ≤ 0.06 [17]. The results showed that the model fit was acceptable: $\chi^2 = 0.459, df = 2, p = 0.795, CFI = 1.00, SRMR = 0.008, RMSEA = 0.000$. The results of the path analysis are outlined in Fig. 1.

Intrusive rumination was related to higher levels of PTSS ($\beta = 0.19, p = 0.007$), and deliberate rumination was related to higher levels of PTG ($\beta = 0.52, p < 0.001$) and higher levels of PTSS ($\beta = 0.15, p = 0.027$). Moreover, negative beliefs

Fig. 1 Path analysis model of Posttraumatic Growth (PTG), Posttraumatic Stress Symptoms (PTSS), rumination, and beliefs about memory. E = error. Dashed lines represent removed pathways. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.



about memory were related to higher levels of PTSS ($\beta = 0.48, p < 0.001$). However, there were no significant associations between intrusive rumination, positive or negative beliefs about memory and PTG. The path between positive beliefs about memory and PTSS was also not significant. When non-significant pathways were removed, model fit remained acceptable: $\chi^2 = 8.217, df = 6, p = 0.223, CFI = 0.99, SRMR = 0.053$, and $RMSEA = 0.050$ with marginal changes in standardized coefficients: intrusive rumination \rightarrow PTSS ($\beta = 0.21, p = 0.003$), deliberate rumination \rightarrow PTG ($\beta = 0.47, p < 0.001$), deliberate rumination \rightarrow PTSS ($\beta = 0.17, p = 0.010$), and negative beliefs about memory \rightarrow PTSS ($\beta = 0.58, p < 0.001$).

4 Discussion

This study examined how different rumination styles and beliefs about memory relate to the post-trauma outcomes of posttraumatic growth and posttraumatic stress symptoms. As demonstrated in previous research [14, 36]. Our findings suggest that different forms of rumination can influence the outcomes observed after a traumatic event. It was hypothesised that intrusive rumination would be positively associated with PTSS and negatively associated with PTG, and the results indicated partial support for this hypothesis. As expected, intrusive rumination was significantly associated with higher levels of PTSS. This is consistent with previous research which demonstrated that intrusive rumination predicted PTSD symptoms [9, 36, 47]. Intrusive rumination has been conceptualised as negative and unwanted thoughts about the traumatic event and is consistent with the theoretical underpinnings of PTSD symptomology, therefore the positive association is not surprising. It was also hypothesised that intrusive rumination would be negatively associated with PTG, however, this was not supported by the data; the bivariate correlations and the model path indicated no significant relationship. These results are aligned with Taku et al.'s [40] study that found intrusive rumination did not significantly predict PTG. Failure to observe a relationship between these variables may suggest that the presence of intrusive rumination, or lack thereof, may not have a substantial bearing on the potential development of PTG.

The second hypothesis, that deliberate rumination would be positively associated with PTG and negatively associated with PTSS was partially supported; deliberate rumination was significantly associated with higher levels of PTG. These findings extend the limited research of the direct effects of event related rumination [9, 40], and support Tedeschi and Calhoun's [44] model suggesting that the process of rebuilding meaningful assumptions of the world and incorporating adaptive changes after a traumatic event is facilitated through deliberate rumination processes. Deliberate rumination is a cognitive process of framing the traumatic experience into a new meaning, thereby likely contributing to growth in the areas of personal strength, discovering new possibilities, appreciation of life, improving relationships with others, and spiritual change. However, of note was the small, but significant, effect for deliberate rumination and PTSS, which was not in line with our hypothesis. These results contrasted Garcia et al.'s [15] study which found no effect, however, aligned with the direct effect observed between the two variables by Leal-Soto et al. [26]. There are several explanations for how deliberate rumination may lead to distress. The model from Tedeschi and Calhoun [44] proposed that to achieve growth and engage in cognitive restructuring processes, deliberate rumination must first be facilitated by the experience of distress. Further, it is thought that growth and distress are not mutually exclusive experiences, and they may in fact co-exist. Alternatively, according to Wells and Sembi's [52] theoretical metacognitive model of PTSD, engaging in any form of rumination may lead to perseverating on the trauma event, thus maintaining a level of distress. Similarly, Ehlers and colleagues suggested that rumination in response to intrusive memories was associated with PTSD [29]. Therefore, even deliberate rumination, which fosters active processing of the event, can lead to some form of distress given the trauma-focused nature of the rumination. Findings for hypotheses one and two may be reflective of Kleim and Ehlers' [22] findings that PTSD and PTG share a curvilinear relationship, wherein moderate levels of PTG did not ameliorate post-traumatic symptomatology in their research. However, low and high PTG were associated with lower levels of PTSD and depressive symptoms. Further, those who engaged in higher ruminative thinking at two weeks post an assault, amongst other variables (e.g., ethnicity, religiousness, peritraumatic fear, shame), experienced greater PTG at 6 months; yet, the nature of this ruminative style was not expanded upon [22].

The third and fourth hypotheses proposed that negative and positive beliefs about memory would be positively associated with PTSS and negatively associated with PTG. There was only partial support for these hypotheses with the only significant pathway in the model demonstrating that negative beliefs about memory were positively associated with PTSS. In contrast to Kannis-Dymand et al. [18] and Bennett and Wells [5], there was no association found between positive beliefs about memory and PTSD symptoms. However, these findings aligned with Takarangi et al. [39] who also studied metamemory beliefs in a non-clinical population. Further, Michael et al. [29] found that found that negative metacognitive beliefs and PTSD symptoms were significantly positively correlated to PTSD symptoms

in a retrospective sample, but metacognitive assumptions did not predict PTSD severity in a separate, 6-month prospective evaluation. However, they did note that their assessment of metacognitive beliefs may have lacked sensitivity and that they did not have a precise definition of rumination, suggesting further research was warranted.

Bennett and Wells [5] proposed that negative beliefs about memory (i.e., “if I can’t remember everything about the event it is because something really bad happened”), may maintain a sense of threat due to continued processing of the negative aspects of the trauma. It is this continued sense of threat that is likely to give rise to the maintenance of PTSD symptoms, as observed in the current study. On the other hand, positive beliefs about memory (i.e., “I need to have a perfect memory of the event because I need to find answers”) may sustain perseveration on the event through attempts to fill in memory gaps. However, Bennett and Wells suggested that positive beliefs about memory may have weaker relationship with anxiety, as they do not stimulate the same level of imminent threat. This may explain why no significant relationship was found in the current study. Notably, Kannis-Dymand et al. [18] found that negative and positive beliefs had a comparable effect on outcomes and suggested this may be due to the nature of the trauma event in their sample. Someone who has experienced a natural disaster may be more likely to believe that remembering the event in detail will help them prepare for the possible recurrence of another disaster, thus leading to more prominent positive beliefs [18]. The present study expanded the current literature on metamemory beliefs and explored a potential relationship with PTG. There was no significant relationship found between beliefs about memory and PTG, suggesting that metamemory cognitions may not necessarily enhance or inhibit the potential for growth. Rather, achieving growth may be better understood through employing adaptive cognitive processes, such as positive metacognitions (e.g., [30]).

We also examined the differences between age, level of education, and relationship status and post-trauma outcomes, and showed that older age was related to higher levels of PTG. These results are consistent with previous findings of older age predicting PTG in cancer survivors [24], however other studies have failed to find a relationship between age and PTG (e.g., [46]), or a negative relationship was indicated [16]. Boyle, Stanton, Ganz, and Bower [7] suggested that the relationship between age and PTG may be better understood through the consideration of lifespan development and that different facets of PTG may be more prominent at different stages of life. On the other hand, unlike Wu et al.’s [55] study, our results failed to find a significant relationship between age and PTSS. Norris et al. [32] considered the effects of age on PTSD amongst different populations and concluded that there was likely no consistent effect. Rather, the authors suggested that other factors such as social, cultural, and economic contexts were more relevant determinants of PTSD.

Our results indicated that lower levels of education were related to higher PTSS, with those who did not finish high school reporting the most distress. The finding that education may be a protective factor in the development of PTSD is consistent with previous research (e.g., [6, 55]). Prior research has suggested that education may also be linked to increased PTG (e.g., [35, 55]), however no such relationship was found in the current study. Finally, our findings indicated that those who were married reported lower levels of PTSS than those who are separated or divorced. Social support has been proposed as a key mechanism in the prevention and treatment of PTSD [53].

This study contributed to the research in several areas. Our findings support the current literature suggesting that rumination can be multidimensional and may incorporate both adaptive and maladaptive processes. Assisting individuals to engage in deliberate rumination after a traumatic event may have important implications for treatment. Also of benefit is the understanding of how intrusive rumination may maintain PTSD symptoms and a current sense of threat. Further, this study contributes to the growing literature on metamemory beliefs and highlights the point that targeting negative beliefs about memory may have important clinical applications as proposed in the metacognitive model of PTSD [8, 19, 52].

There were several limitations to our study. The sample size was relatively small for structural equation modelling. While some researchers have recommended a minimum sample size of 200 for an SEM analysis (e.g., [23]), others have demonstrated that smaller sample sizes are acceptable in simple model designs consistent with our study [37, 54]. Therefore, although there is a risk of reduced power in a small sample, our relatively simple path analysis would suggest the results may be interpreted with confidence. Future research may benefit from replicating the study’s findings with larger samples while exploring more complex mode interactions (e.g., mediation, moderation).

The sample had an imbalance in gender; most participants were female. Wu et al. [55] found that males reported greater levels of PTG compared to females, while other research suggests that female gender to be more strongly connected to PTG [24], and therefore it is unclear if gender and the limited number of male participants in the current study influenced the findings. Additionally, the current sample was well educated with almost 80% having attained an education level greater than Year 12 or equivalent. Research has postulated that education level is a protective factor in the development of PTSD [11] and therefore, this imbalance may have led to potential bias in the reported

outcomes. Although the sample had some ethnic diversity, future research would benefit from greater diversity regarding ethnicity, gender, age, and education level.

In addition, the current study was cross-sectional in design, therefore limiting our understanding of the trajectory of rumination styles and metacognitions and the subsequent development of PTG and PTSS. All measures were self-report which may introduce bias and limit the strength of the study's conclusions. Further, there was a considerable spread in the number of years since the participants' traumatic event (average of 13.32 years), which may have led to potential inaccuracies in self-reporting and further bias. Participants were asked to focus on their most distressing traumatic event when providing responses, and therefore it is unclear whether there is a cumulative effect of multiple traumatic experiences on post-trauma outcomes in PTG and PTSS. Additionally, approximately 90% of our participants indicated that they had experienced more than one traumatic event, limiting our ability to compare the outcomes between single and multiple traumatic experiences. Future research may benefit from investigating whether a cumulative effect of trauma influences the development of PTG or PTSS. Further, the sample used in the current study was not a clinical sample, which is often a consistent limitation in this field of research. Future research should consider if similar outcomes can be observed in participants with clinically significant levels of PTSD, particularly given that PTSD and PTG are not mutually exclusive.

Finally, this study did not account for additional factors that may influence post-trauma outcomes beyond rumination and metamemory beliefs. Previous research has demonstrated that factors such as social support [31], resilience [55], personality [20, 48, 49], core beliefs [56], and attachment style [33] may have a role in an individual's ability to adapt and cope after a traumatic event. Therefore, further research incorporating a multi-dimensional and longitudinal approach may assist in clarifying the development of outcomes after a traumatic effect.

In conclusion, this research project sought to explore the associations between PTG and PTSS with adaptive and maladaptive rumination styles and metamemory beliefs. The results indicated that different styles of rumination do indeed have an impact on post-trauma outcomes and this work contributes to our understanding of how rumination may influence the development of growth of distress. Further, the study supported previous research suggesting that negative metamemory beliefs may contribute to the development and maintenance of PTSD symptoms. The current study did not find any significant associations between metamemory beliefs and PTG.

Authors contributions All authors contributed to the conception of the study, analyses, interpretation, and writing of the manuscript. EC, AA, and DS contributed notably to the statistical analyses. BH, AA, and LKD provided expertise on PTSD and metacognitive processes. LKD and DS provided supervision for the research project. AA and LKD managed and completed most of the revisions.

Funding Not applicable.

Data availability The data that support the findings of this study are available from the corresponding author, Lee Kannis-Dymand, upon reasonable request.

Code availability Not available.

Declarations

Ethics approval and consent to participate This study involved an online, anonymous questionnaire-based survey of people 18 years and older who had experienced a traumatic event. The study protocol, including the consent process, was assessed and approved by the University of the Sunshine Coast University's Human Research Ethics Committee (ethics approval number: S/17/1126). Participants provided their consent by selecting a tick-box confirming that they had read the Research Project Information Sheet, whether they agreed to participate (or not), and that they were 18 years or older. Contact details for psychological support services was provided within the online survey.

Competing interests The authors declare no competing interests.

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