Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Post-traumatic growth in PhD students during the COVID-19 pandemic

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ABSTRACT

Throughout the COVID-19 pandemic, graduate students have faced increased risk of mental health challenges. Research suggests that experiencing adversity may induce positive psychological changes, called post-traumatic growth (PTG). These changes can include improved relationships with others, perceptions of oneself, and enjoyment of life. Few existing studies have explored this phenomenon among graduate students. This secondary data analysis of a survey conducted in November 2020 among graduate students at a private R1 University in the northeast United States examined graduate students' levels and correlates of PTG during the COVID-19 pandemic. Students had a low level of PTG, with a mean score of 10.31 out of 50. Linear regression models showed significant positive relationships between anxiety and PTG and between a measure of self-reported impact of the pandemic and PTG. Non-White minorities also had significantly greater PTG than White participants. Experiencing more negative impact due to the pandemic and ruminating about the pandemic were correlated with greater PTG. These findings advance research on the patterns of PTG during the COVID-19 pandemic and can inform future studies of graduate students' coping mechanisms and support efforts to promote pandemic recovery and resilience.

1. Introduction

The COVID-19 pandemic has significantly disrupted life across the globe. Students have been particularly impacted by changes to daily life that were introduced due to lockdowns, restrictions in local and international travel, relocating from residential campuses, transitioning to remote school and work, facing unanticipated financial difficulties, and decreased social interaction (Son et al., 2020). These multiple challenges have led to increases in mental health concerns among young adults. For instance, the online, cross-sectional study titled CARES 2020 (COVID-19 Adult Resilience Experiences Study) identified that over a third of US young adults (18–30 years old) were reporting clinically elevated depression, anxiety, and PTSD symptoms in April 2020, at levels that were higher than studies prior to the COVID-19 pandemic (Liu et al., 2020). According to the United States Centers for Disease Control and Prevention (CDC), the percentage of US young adults aged 18–29 experiencing symptoms of anxiety was 49.0% at the end of November 2020 and the percentage experiencing symptoms of depression was 42.1% (CDC, 2021). This is much higher than before the pandemic in 2019, when 18.9% of 18–29-year-olds were experiencing symptoms of anxiety (Terlizzi and Villarroel, 2020) and 21.0% were experiencing symptoms of depression (Villarroel and Terlizzi, 2020). Mental illness among young

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adults was already on the rise prior to the pandemic, a trend that appears to have been exacerbated in this vulnerable group during the pandemic (Reinert et al., 2021; Varma et al., 2021).

Indicators of student wellbeing have decreased during the pandemic (Copeland et al., 2021) and young adults have faced increased stress and anxiety (Czeisler et al., 2020; Son et al., 2020). Within the broad student population, graduate students are particularly vulnerable, facing a much higher prevalence of mental health symptoms than the general population and young adults in general (Levecque et al., 2017; Satinsky et al., 2021). Prior research has found that experiencing anxiety and depression positively correlates with time spent in a graduate program, suggesting that the stressors involved in completing graduate programs are related to these common mental health challenges (Gallea et al., 2021). Among graduate students, PhD students in particular face a myriad of stressors, including balancing coursework with teaching and research, advisor-student power relations, and underrepresentation of minority populations (Satinsky et al., 2021). Additionally, students in PhD programs depend heavily on their academic programs for financial and professional support, which may have been jeopardized by the restriction measures undertaken during the pandemic (Boyle and McKinzie, 2021). The poor mental health of PhD students makes this an important population to study, particularly with the added stress of the COVID-19 pandemic.

Negative consequences of the COVID-19 pandemic on graduate students' mental health are expected. However, prior research suggests that when faced with adversity, a major life crisis, or a traumatic event, some individuals may show positive psychological changes spanning self-perceptions, relationships with others, and life philosophy (Tedeschi and Calhoun, 1996; Tamiolaki and Kalaitzaki, 2020). Because of this, the pandemic may also be impacting other social and emotional experiences of graduate students in unexpected ways. For instance, there have already been reported beneficial changes in eating and substance use habits, some of which include substance use reduction (Dumas et al., 2020) and increased consumption of fruits, vegetables, and homemade food (Coulthard et al., 2021). Contending with the challenges posed by the pandemic may also lead to a general form of personal psychological growth called post-traumatic growth. It is important to investigate whether graduate students have experienced positive psychological changes in struggling with the unique challenges they have faced during the pandemic. By gaining a greater understanding of these potential benefits, it may be possible to inform efforts to promote pandemic recovery and resilience among at-risk graduate students.

1.1. Post-traumatic growth

Post-traumatic growth (PTG) encompasses positive psychological impacts that come about as a result of trauma or other challenging experiences (Tedeschi and Calhoun, 1996). While the pandemic does not necessarily meet the clinical threshold for trauma (Norrholm et al., 2021), the originators of the scale support its use across a range of adverse events, not limited to those that qualify as trauma (Tedeschi and Calhoun, 1996). Robert Tedeschi and Lawrence Calhoun (1996), pioneers of the concept of PTG, contend that the process begins with a major event that shakes one's conception of the world and their role within it. Following the event, the individual engages in coping and cognitive processing of what happened. The social community surrounding the person can contribute to this processing by suggesting new growth-oriented schemas and allowing the individual to share their perspectives. Over time, this processing, combined with the individual's other coping processes, may lead to a reduction in distress, as well as positive changes in the form of post-traumatic growth (Tedeschi and Calhoun, 2004). PTG can include growth across a variety of different domains, including relationships with others, perceptions of oneself, and enjoyment of life (Tedeschi and Calhoun, 1996).

The degree of PTG that occurs is influenced by a wide variety of factors before and after trauma. These include characteristics of the individual (such as temperament and prior trauma) and characteristics of the environment (such as social support, family stability, and community resources) (Schaefer and Moos, 1992). Developing PTG necessitates experiencing some stress as a result of the difficult event, and several researchers have identified a positive relationship between post-traumatic stress symptoms and PTG (Aftyka et al., 2017; Hyun et al., 2021; Magid et al., 2019; Seo and Lee, 2020). Others have found an inverted U-shaped relationship between PTG and stress, with the most PTG occurring at moderate levels of stress among combat veterans (Greenberg et al., 2021) and adolescents (Levine et al., 2008). These results suggest that experiencing some detrimental consequences from the event are a prerequisite of experiencing PTG, and that distress can coexist with psychological growth. Symptoms that are extremely severe, however, may overwhelm an individual's ability to process the trauma and inhibit PTG (Greenberg et al., 2021).

A limited number of recent studies have evaluated PTG in the context of the COVID-19 pandemic. Most participants in each of these studies—which spanned populations including nurses in China (Cui et al., 2021), caretakers in Portugal (Stallard et al., 2021), adults in Spain (Vazquez et al., 2021), young adults in Italy (Ellena et al., 2021), college students in China (Chi et al., 2020), and young adults in the US (Hyun et al., 2021) reported experiencing some PTG. While these studies provide some insight into the degree to which PTG is an outcome of the pandemic, there has been minimal investigation of PTG among graduate students and, to our knowledge, no studies that investigate PTG among graduate students during COVID-19.

Given the unique challenges that graduate students face, it is important to study their coping and recovery from the impacts of the pandemic. PTG may be an indicator of how well graduate students have coped with the pandemic, which could inform future studies of graduate students' coping patterns and student support programs at universities. It is also important to investigate the sociodemographic, environmental, and individual factors that may correlate with PTG. Particularly relevant during the COVID-19 pandemic is the relationship between mental health and PTG.

As a measure of positive growth, it may appear that PTG should be associated with better mental health. However, the literature reports mixed findings regarding how PTG relates to mental health outcomes. Some studies have found PTG to be negatively correlated with mental health symptoms, including negative associations between PTG and acute painful emotions, suicidal ideation, and depression symptoms (Cheng et al., 2006; Levi-Belz et al., 2020; Shand et al., 2015). PTG, specifically in relation to COVID-19, has also been found to be correlated with decreased anxiety and improved wellbeing (Stallard et al., 2021). However, other studies show no relationship between measures of mental health and PTG (Maitlis, 2020). Additionally, PTG during the pandemic has been found to correlate with post-traumatic stress (Vazquez et al., 2021) and deliberate rumination about COVID-19 (Cui et al., 2021).

The present study seeks to answer the following two questions: (1) *To what degree have graduate students experienced PTG during the COVID-19 pandemic?* and (2) *What characteristics are associated with PTG among graduate students during the pandemic?* Drawing from a secondary analysis of data collected from a routine survey of graduate students, we examined the relationship of PTG with several variables, including demographics, mental health, social support, and impact of COVID-19.

2. Methods

2.1. Procedure

This study involved a secondary analysis of data collected as part of a cross-sectional mental health survey administered in November 2020. The survey is anonymous, collected semi-annually, and conducted online to capture insights about the mental health of PhD-seeking graduate students at a private R1 University in the northeast. The semi-annual

survey is conducted through the school's health services and graduate student health initiative focused on PhD students' social, emotional, and educational experiences while in their training program. Similar to past years, the November 2020 survey was administered online via Qualtrics by the graduate school administration. Each semester's survey recruits from different departments across the University. The participant sample for this analysis was recruited from the social sciences and humanities departments through communication from the school's administration. At the beginning of the survey, students read a consent form and provided online consent to participate. Participants were not offered an incentive for responding to the survey, as it would not be possible to pay participants without collecting identifiable information. Following the conclusion of the survey, our research team received the anonymized data for conducting the secondary analyses described here. All procedures described in this study were approved by the ethical review board at Harvard Medical School, USA (IRB20-2005).

2.2. Measures

The survey included a range of questions about graduate students' experiences within their academic departments, including departmental support, use of the school's health services, and health habits. Participants were also asked to report demographic characteristics. These questions were developed with the feedback of graduate students and had been used in prior years of the survey's administration. In addition to the standard survey questions, a block related to the COVID-19 pandemic was added, which included the COVID-19 Impact Measure and the Post-Traumatic Growth Inventory Short Form (PTGI-SF), both described in the sections below.

2.2.1. COVID-19 impact measure

A measure of the impact of the COVID-19 pandemic on participants' lives, created by the © 2020 Higher Education Data Sharing Consortium ("HEDS COVID-19 Surveys and Reports," 2020), was adapted for this survey. The original measure asked about various impacts of COVID-19 on work productivity and personal stress. The research team and graduate school administrators involved with survey development sought feedback from graduate students about issues that were important to them. Our research team then eliminated redundant items and added additional items based on students' feedback. Items added included those specific to graduate student life, such as impact of the pandemic on teaching, research productivity, and connection with academic departments.

On the adapted COVID-19 Impact Measure, participants were asked to respond to the prompt "How has the COVID-19 pandemic impacted the following?" regarding sixteen different aspects of life (physical health, mental health, family members' and friends' health and safety, financial health, uncertainty about future employment, viability of research projects, remote work, research productivity, teaching, professional network, finishing graduate program, personal relationships, connection to academic department, academic advising, access to libraries and research materials, and living arrangements) on a scale from 1 (not at all) to 5 (to a great extent). Total scores ranged from 0 to 80, with higher scores indicating a greater degree of impact.

2.2.2. Depressive symptoms

The Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001) was used to measure current depressive symptoms. On a scale of 0 (not at all) to 3 (nearly every day), participants indicated a frequency of nine depression symptoms over the past two weeks, with total scores ranging from 0 to 27. Following established cutoffs (Kroenke et al., 2001), a score of 0–4 indicated no depression, 5–9 indicated mild depression, 10–14 indicated moderate depression, 15–19 indicated moderately severe depression, and 20+ indicated severe depression.

2.2.3. Anxiety symptoms

The Generalized Anxiety Disorder Scale (GAD-7) (Spitzer et al., 2006) was used to assess current anxiety symptoms. On a scale of 0 (not at all) to 3 (nearly every day), participants indicated a frequency of seven anxiety symptoms over the past two weeks, with total scores ranging from 0 to 21. Following established cutoffs (Spitzer et al., 2006), a score of 0–4 indicated no anxiety, 5–9 indicated mild anxiety, 10–14 indicated moderate anxiety, and 15+ indicated severe anxiety.

2.2.4. Post-Traumatic Growth Inventory Short Form (PTGI-SF)

The PTGI-SF is a validated ten-item scale to evaluate posttraumatic growth (Cann et al., 2010). The scale includes two items from each of the following subscales: New Possibilities, Relating to Others, Personal Strength, Spiritual Change, and Appreciation of Life (Tedeschi and Calhoun, 1996). The Likert scale options on the original PTGI-SF ask participants to indicate the degree of change they experienced as a result of "my crisis" (e.g. "I experienced this change to a very great degree as a result of my crisis."). Our research team revised this language to reflect the COVID-19 pandemic instead of a personal crisis. For instance, the scale choice "I experienced this change to a very great degree as a result of my crisis" was shortened to "Very great degree of change." The participants were instructed: *"Listed below are 10 areas that may have changed due to the COVID-19 pandemic. Please mark the degree to which you feel you have experienced change in the area described."* The participants responded on a scale of 0 (did not experience change) to 5 (very great degree of change) across ten items of posttraumatic growth. Example items included "I have a greater appreciation for the value of my own life." Possible total scores range from 0 to 50, with greater scores indicating more growth. Subscale scores could range from 0 to 10, as there are two items for each of the five subscales.

2.2.5. Social support

The survey included two measures of social support, one to measure faculty support and one to measure peer support. These sections were developed by the University department that administered the survey. The peer support section included six questions, such as "I have friendly relationships with other graduate students in my department" and "There is at least one peer in my department that I feel like I can turn to if I need help." The faculty support section also included six questions, such as "I believe that the faculty in my department care about my mental health and well-being" and "I have at least one faculty member in my department aside from my adviser from whom I can seek advice and guidance." On both scales, participants responded on a scale of 1 (strongly disagree) to 5 (strongly agree). Possible total scores for each scale range from 6 to 30, with greater scores indicating greater peer or faculty support.

2.3. Statistical analysis

All participants who did not complete the PTGI-SF were excluded from this analysis. Remaining participants' missing data were handled via median imputation. Summary statistics, including measures of central tendency and frequencies, for demographic information and PTGI-SF scores were calculated. Cronbach's alpha was calculated for the COVID-19 impact measure and PTGI-SF; both measures had high internal consistency, with alpha equal to 0.88 and 0.89, respectively. PTGI-SF scores were then plotted against continuous variables to visually check for non-monotonic relationships. Simple univariable linear regression models were calculated to test the relationship between PTGI-SF and the independent variables: gender, race, age, measures of mental health (PHQ-9 and GAD-7), social support, and the impact of the COVID-19 pandemic. Each of these variables were then added to a multivariable linear regression model. All variables were retained in the multivariable model to concurrently account for multiple relationships between the independent variables and PTGI-SF score. Variance inflation factor was calculated for each variable to check for multicollinearity. Unstandardized beta and model fit statistics for the regression models are reported in

this analysis.

In addition to assessing the relationship between PTGI-SF score and these factors, we conducted exploratory factor analysis to characterize our version of the PTGI-SF, which was modified to fit the circumstances of the COVID-19 pandemic. All data analysis was conducted with Stata 16 ("StataCorp - Stata Statistical Software Release 16," 2019).

2.3.1. Factor analysis

Exploratory factor analysis, using a principal factor analysis approach and orthogonal varimax rotation, showed that four factors explained most of the variance of PTGI-SF scores (each factor ranged from 15 to 36% in terms of proportion of the variance explained), with one factor explaining a small (3%) proportion of the variance. This factor structure is similar to the original PTGI-SF, which has five factors, each explaining a similar proportion of the variance (Cann et al., 2010; Kaler et al., 2011). Additionally, the loadings of the five factors found in our analysis were quite similar to the original scale. Approximately two items loaded onto each factor, indicating that, overall, the factor structure was similar to the original PTGI-SF.

3. Results

Participant demographic information is included in Table 1. Out of 510 PhD-seeking graduate students ranging from their first to ninth year of graduate school invited to take the survey, a total of 418 responded to the survey, for a response rate of 82%. Of these 418 students, 290 responded to all of the questions on the PTGI-SF, the main dependent variable in our study. This set of 290 students comprises the analytic sample presented in this paper. The relatively high rate of participant dropout could be due to survey burden as the items for the PTGI-SF were located at the end of the long survey.

The sample consisted of 53.8% women and 42.4% men. Additionally, the sample was 20.7% Asian, 6.2% Black, 15.6% Hispanic/Latino, 64.1% White, and 7.6% other/prefer not to say (participants could choose more than one race; Table 1). The majority (59.6%) were US citizens or permanent residents, 38.3% were international students, and 2.1% did not respond (Table 1). There were no significant differences across our independent or dependent variables between the analytic sample and those excluded from analysis because they did not complete the PTGI-SF.

Table 1
Sample demographics (n = 290).

Variable	n (%)
Age	
≤24	38 (13.1%)
25-29	188 (64.8%)
30-34	54 (18.6%)
35-39	9 (3.1%)
≥40	1 (0.3%)
Gender	
Female	156 (53.8%)
Male	123 (42.4%)
Prefer not to say	11 (3.8%)
Race	
White	177 (64.1%)
Asian	57 (20.7%)
Hispanic/Latinx	43 (15.6%)
Black	17 (6.2%)
Other/prefer not to say	22 (7.6%)
LGBTQ+	
No	203 (70.0%)
Yes	53 (18.3%)
Unsure/prefer not to say	34 (11.7%)
Citizenship	
US Citizen	166 (57.2%)
US Permanent Resident	7 (2.4%)
International student	111 (38.3%)
Did not respond	6 (2.1%)

3.1. Post-traumatic growth scores

The mean and median PTGI-SF scores for this sample were low. The mean total PTGI-SF score was 9.91 (SD = 8.96) and the median was 8 (IQR = 3–14) of a possible 50 points (Table 2). Of the five subscales on the PTGI-SF, the subscale with the highest median score was Appreciation of Life, at 3 (IQR = 1–6) of 10 possible points. All other subscales, including Spiritual Change, Relating to Others, New Possibilities, and Personal Strength had a median of one or fewer points.

The multivariable model we tested included the independent variables of age, race, gender, GAD-7 score, PHQ-9 score, social support, and total impact of the COVID-19 pandemic, and had an R^2 of 0.2016 and adjusted R^2 of 0.1543. In both the univariable and multivariable regressions, there were no significant differences in PTGI-SF score between females and males, or across age groups. However, Black/African American ($\beta = 8.90$, $p < 0.001$), and Hispanic/Latino ($\beta = 6.58$, $p < 0.001$) participants each had a positive and significantly higher PTGI-SF score than White participants in the multivariable model.

3.2. Post-traumatic growth scores and mental health and social support

Within our sample, 28.3% met criteria for anxiety and 26.2% did for depression. In the multivariable model, moderate anxiety levels were correlated with a greater PTGI-SF score and mild depression levels were correlated with a lower PTGI-SF score. (Table 3). Specifically, those who scored within the moderate ($\beta = 3.68$, $p = 0.045$) anxiety category had significantly higher PTGI-SF scores compared to those with no anxiety or those with mild anxiety. Those who scored within the mild depression category had significantly lower ($\beta = -3.63$, $p = 0.012$) PTGI-SF scores compared to those with no depression or more severe depression. Of the measures of social support we tested, which included questions about peer support and about faculty support, neither was significantly related to PTGI-SF score.

3.3. Post-traumatic growth and COVID-19 impact

On the COVID-19 impact scale, the mean total score on the COVID impact measure was 46.81 (SD = 11.93) of a possible 80 points. A moderate positive relationship between the COVID-19 impact score and PTGI-SF ($\beta = 0.16$, $p = 0.001$) was identified (Table 3).

4. Discussion

PTG, the development of positive psychological growth due to a traumatic or stressful event, can result after an exposure to challenging experiences (Tedeschi and Calhoun, 2004). However, the prevalence of correlates of PTG in students during the COVID-19 pandemic requires further investigation. Overall, the sample of graduate students in our study demonstrated a lower level of PTG than is usually reflected by young adults who have experienced a traumatic event as reported in prior studies. For instance, college students who had experienced a moderate amount of parentification, a form of child neglect, reported a much higher level of PTG compared to the level reported in our study. As measured on the long form of the PTGI (which has 11 more items than the 10-item PTGI-SF which was used in the present study), students had a mean score of 67.03 (out of 105 possible points) (Hooper et al., 2009). In another study, female college students who had experienced a range of difficult experiences like criminal victimization, divorce of parents, or academic problems had a mean score of 75.18 on the PTGI; male students had a mean score of 67.77 (Tedeschi and Calhoun, 1996). In our study, which used the PTGI-SF, graduate students had a mean score of 9.91 (out of 50 possible points). This is also lower than the level of PTG due to the pandemic in a study of adults in Spain: the sample had a mean score of 36.51 on the PTGI-SF (Vazquez et al., 2021).

One potential explanation for the low rate of PTG in our sample could be the timing of administration of the questionnaire. The survey was

Table 2
Post-Traumatic Growth Inventory Short Form (PTGI-SF) frequencies (n = 290).

Subscale	Mean score (SD)	Median score (IQR)	Item	Did not experience change	Very small degree of change	Small degree of change	Moderate degree of change	Great degree of change	Very great degree of change
Appreciation of Life	3.57 (2.66)	3 (1–6)	I changed my priorities about what is important in life.	22.8%	14.1%	22.8%	25.9%	9.3%	5.2%
			I have a greater appreciation for the value of my own life.	37.6%	14.1%	18.6%	16.6%	10.3%	2.8%
New Possibilities	1.72 (1.99)	1 (0–3)	I am able to do better things with my life.	54.8%	16.2%	15.5%	8.6%	4.8%	54.8%
			I established a new path for my life.	62.1%	12.8%	13.5%	8.3%	2.1%	1.4%
Spiritual Change	1.13 (2.16)	0 (0–1)	I have a better understanding of spiritual matters.	71.4%	8.3%	8.3%	5.9%	4.8%	1.4%
			I have stronger spirituality and/or religious faith.	79.0%	9.0%	5.2%	3.5%	2.4%	1.0%
Relating to Others	1.87 (2.21)	1 (0–3)	I have a greater sense of closeness with others.	49.0%	17.6%	14.8%	11.7%	4.8%	2.1%
			I learned a great deal about how wonderful people are.	63.1%	15.2%	11.4%	6.2%	2.8%	1.4%
Personal Strength	1.63 (2.20)	1 (0–3)	I know better that I can handle difficulties.	54.5%	17.2%	14.1%	10.0%	3.8%	0.3%
			I discovered that I'm stronger than I thought I was.	64.8%	15.2%	10.7%	4.8%	2.8%	1.7%
Total	9.91 (8.96)	8 (3–14)	–	–	–	–	–	–	–

Table 3
Linear regression models testing the relationship between PTGI-SF and participants' demographic characteristics, mental health, social support, and perceived impact of the COVID-19 pandemic (n = 290).

Variable	Description	Univariable beta coefficient (95% CI)	p-value	Multivariable beta coefficient (95% CI)	p-value
GAD-7 (ref: no anxiety)	Categorical: Score of 0–4 = none (ref, n = 208)				
	5-9 = mild (n = 48)	2.79 (0.01, 5.58)	0.049	2.21 (−0.61, 5.04)	0.124
	10-14 = moderate (n = 34)	4.59 (1.37, 7.80)	0.005	3.85 (0.29, 7.41)	0.034
Total COVID impact	Continuous. COVID impact measure was 16 items, Likert scale was 1–5, 1 being "no impact at all" to 5 being "to a great extent." Scores can range from 16 to 80	0.14 (0.05, 0.23)	0.001	0.16 (0.06, 0.25)	0.001
Race (ref: White)	Categorical: White (ref, n = 177)				
	Asian (n = 57)	1.39 (−1.19, 3.97)	0.209	1.88 (−0.71, 4.47)	0.154
	Black/African American (n = 17)	8.66 (4.42, 12.89)	<0.001	8.90 (4.72, 13.07)	<0.001
	Hispanic/Latino (n = 43)	6.85 (3.98, 9.71)	<0.001	6.58 (3.73, 9.42)	<0.001
	Other (n = 22)	0.02 (−3.76, 3.80)	0.993	−0.27 (−3.95, 3.41)	0.885
	Note: participants could choose more than one race				
Male (ref: female)	Categorical	−0.61 (−2.11, 0.90)	0.428	−0.03 (−1.56, 1.50)	0.968
Age	Categorical:≤24 (ref, n = 38)				
	24-29 (n = 188)	−1.44 (−4.58, 1.70)	0.368	−0.77 (−3.81, 2.27)	0.618
	30+ (n = 64)	−1.17 (−4.79, 2.44)	0.526	−1.16 (−4.67, 2.35)	0.515
PHQ-9 (ref: no depression)	Categorical: Score of 0–4 = none (ref, n = 214)				
	5-9 = mild (n = 51)	−1.86 (−4.60, 0.89)	0.184	−3.79 (−6.55, −1.03)	0.007
	10-14 = moderate (n = 20)	0.00 (−4.12, 4.12)	1.000	−3.30 (−7.64, 1.04)	0.135
	15-19 = moderately severe (n = 5)	5.25 (−2.71, 13.22)	0.196	0.88 (−7.10, 8.85)	0.829
Faculty support	Continuous. Measure had 6 items, Likert scale was 1–5, 1 being "strongly agree" and 5 being "strongly disagree." Scores can range from 6 to 30	0.10 (−0.10, 0.31)	0.328	0.13 (−0.10, 0.36)	0.260
Peer support	Continuous. Measure had 6 items, Likert scale was 1–5, 1 being "strongly agree" and 5 being "strongly disagree." Scores can range from 6 to 30	0.16 (−0.08, 0.40)	0.193	0.10 (−0.16, 0.37)	0.445

administered in November 2020, which was several months into the pandemic and during this time, many state governments were issuing new policies to curb a rise in COVID-19 cases (Turner et al., 2020). Graduate students were also located in many different places across the world due to remote coursework and may have been living through varying situations with differing challenges and circumstances. A high proportion of survey respondents, 16.55%, reported being outside of the US. Because the graduate students in our study were still living through these and other difficulties posed by COVID-19, they could have still been experiencing the challenging exposure and not have had time to develop PTG. Developing PTG, which involves coping, cognitive processing, and ruminating about the event, requires time after the event has passed (Tedeschi and Calhoun, 2004; Zoellner and Maercker, 2006). It is also possible that the low rate of PTG is a result of other stressful events occurring during November 2020, such as the turbulent United States presidential election. Graduate students also experience stress due to academic and teaching responsibilities, which may have compounded difficulties introduced by the pandemic (Satinsky et al., 2021).

4.1. PTG and COVID-19 impact

While graduate students demonstrated low rates of PTG overall, their

reported impact of the COVID-19 pandemic and PTG scores were positively correlated, aligning with our expectations. Prior research shows that at least some post-traumatic stress is necessary to develop PTG (Liu et al., 2016; Seo and Lee, 2020), which is intuitive, as grappling with challenge is necessary in order to grow after a difficult event. This implies that those who may have been more impacted by the pandemic at the time this study was conducted may develop greater PTG after the pandemic ends and restrictions are lifted.

In addition to the overall relationship between COVID-19 impact and PTG, there are also specific aspects of the pandemic that may have led students to experience more or less PTG. For instance, our measures of social support were not significantly associated with PTG, even though social support is generally considered to facilitate PTG (Barskova and Oesterreich, 2009; Levi-Belz et al., 2020). It is possible that social support contributed less to PTG during the pandemic because of pandemic safety measures, which decreased venues for social interaction and forced many activities to shift to a socially distanced or virtual format. Additionally, the measures of social support we used included questions about peer and faculty support, and did not ask about family support, which may have been the most relevant during the pandemic due to increased time at home. Prior research has found a positive association between family connectedness and PTG due to COVID-19 (Hyun et al., 2021) which would not have been captured in our study and may contribute to the lack of a relationship between social support and PTG that we identified.

4.2. Demographic correlates of PTG

We identified a higher level of PTG among Black and Hispanic participants than White participants. This may be because the pandemic has impacted different minority populations in different ways. For instance, Black and Hispanic Americans have faced a much higher mortality rate from COVID-19 than White Americans, with death rates being twice as high for Black people and 2.3 times as high for Hispanic people than White people (CDC, 2021). Additionally, non-White minority populations have also experienced increased turmoil and victimization since the start of the pandemic. For instance, in 2020, the killing of George Floyd sparked racial reckonings (Njoku et al., 2021). Contending with greater severity of potential trauma may be associated with the observed differences in post-traumatic growth. Though the mechanism behind this pattern is unknown, some have hypothesized that members of minority populations may have developed a greater capacity for positive coping due to marginalization (Yi et al., 2015). While our finding that non-White participants have a higher degree of PTG generally aligns with findings of prior studies (Kirkner and Ullman, 2020; Rzeszutek and Gruszczyńska, 2018; Yi et al., 2015), it is not possible to draw conclusions about the association between race and PTG in the current study given the modest sample size for each racial group, thereby highlighting the need for further research on this topic. Therefore, these results should be interpreted with caution as the sample sizes for each racial group were small.

In contrast with our expectations, we also identified no difference in PTG between participants who identified as female or male. Other studies have found women to show more PTG than men across several populations, including cancer patients (Shand et al., 2015), people experiencing other severe medical conditions (Barskova and Oesterreich, 2009), and people with HIV (Rzeszutek and Gruszczyńska, 2018). This difference appears to be small to moderate, with one meta-analysis calculating a Hedge's g of 0.27 (Vishnevsky et al., 2010). The levels of PTG in our sample may have been too low to discern a significant difference between women and men.

4.3. PTG and mental health

The prevalence of anxiety and depression within our sample was comparable to the prevalence among a general sample of young adults within a similar age group. In the CDC's national survey of adults aged 25–44, 35.3% met criteria for an anxiety disorder and 32.5% met criteria for a depressive disorder (Czeisler et al., 2020), compared to the 28.3% and 26.2% in our sample that met criteria for anxiety and depression, respectively. Most prior studies have found no relationship between PTG and anxiety (Barskova and Oesterreich, 2009; Cui et al., 2021; Shand et al., 2015), somewhat contrasting with the positive relationship between PTGI-SF score and anxiety as measured on the GAD-7 identified in our study. Our results should be interpreted with caution, given the consistency of prior literature and the finding that only moderate anxiety, not mild anxiety, had a relationship between PTG. The discrepancy between the literature and our findings may be because our study investigates PTG during the pandemic, which has led to a wide range of psychological impacts, not all of which fall under the clinical category of trauma (Norrholm et al., 2021). Additionally, due to the timing of our survey, present results may reflect the process of developing PTG, rather than the outcome. Rumination is part of the PTG development pathway proposed by Richard Tedeschi and Lawrence Calhoun (Tedeschi and Calhoun, 2004), so it is possible that individuals with high anxiety may be thinking about the pandemic more, therefore expressing greater PTG. Within our sample, there were no students who scored within the clinically severe range of anxiety; thus, it is possible that our data does not capture the full span of possible relationships between PTG and anxiety. For instance, there may be a nonlinear relationship between anxiety and PTG, with PTG increasing with moderate anxiety but decreasing as anxiety becomes clinically significant.

The literature regarding symptoms of depression and PTG is mixed, with some identifying a negative correlation (Cheng et al., 2006; Maitlis, 2020; Shand et al., 2015) and others finding no relationship between depression and PTG (Cordova et al., 2001). Our results align with the former studies, reflecting a negative relationship between PTGI-SF score and mild depression as measured on the PHQ-9. Depression could interfere with one's ability to cope with a stressor, leading to less PTG (Cheng et al., 2006). Our findings did not reflect the same negative relationship between moderate or moderately severe depression and PTG, which may be due to the small sample sizes for these categories of depression symptoms.

4.4. Implications

PTG is an important, positive outcome that may have emerged from the challenges posed by the COVID-19 pandemic. PTG is thought to arise from changes to one's worldview, which leads to transformed relationships, values, and other personally significant changes (Sanki and O'Connor, 2021). Therefore, PTG indicates a form of processing and coping with difficult circumstances. Our results indicate that the PhD students in our sample have experienced a relatively low level of this form of growth. It is not entirely clear whether this result has positive or negative implications for student well-being, though given the high rates of mental health concerns in this population group owing to the disruption caused by the pandemic, our findings suggest that PhD students could benefit from interventions that encourage reflection and processing of the pandemic. Importantly, understanding the characteristics of individuals who experience PTG can shed more light on the varied impact of stress and help inform the development of tailored interventions aimed at supporting coping and promoting mental health and wellbeing, which could be especially well-suited for those who experienced less PTG.

Additionally, due to the timing of our study several months into the pandemic, these results could be indicative of the process of developing PTG, and may serve as the basis for future research on the mediating factors behind PTG. However, it is important to note that no causal conclusions between the pandemic and PTG can be drawn from our cross-sectional data.

4.5. Limitations

While the timing of PTG measurement may speak to the pathway to

PTG development, it is not necessarily indicative of the final, post-pandemic levels of PTG that these graduate students may eventually attain. The level of PTG was low at the time of measurement, but it is possible that graduate students' degree of PTG will fluctuate over the course of the pandemic and could even be higher in later stages of the pandemic. Additionally, the experience of the pandemic is different for each individual due to varied circumstances. Each respondent may have endured different levels of stress at different times, leading to inconsistencies in PTG. Due to the cross-sectional nature of the survey, we were not able to capture potential trends in PTG over time.

Due to the schedule of the survey's administration, the scope of our study was limited to graduate student departments within the humanities and social sciences. Students in other departments, schools, or geographic regions may have different experiences of the pandemic and therefore different experiences of developing PTG. There may have also been differences in PTG based on whether a student fell ill with COVID or not, or the extent to which COVID may have impacted their family or friends, which were not captured in the survey. It is also possible that, because the survey was being administered by a University department, students may have been reluctant to share their symptoms of anxiety or depression. This may have influenced their responses to the PHQ-9 and GAD-7.

Finally, it is possible that due to the placement of the PTGI-SF at the end of the survey, many students who began the survey could not be included in this analysis because they did not complete the measure. While we included as much of the sample as possible, and we did not observe any demographic differences between survey respondents who completed the PTGI-SF versus those who did not, we recognize this may have introduced potential bias to our results.

4.6. Future directions

Subsequent surveys will be conducted, which will further help us determine how PTG changes over the course of a long-term challenging and dynamic event. Future studies of PTG during situations like the pandemic could help elucidate the mediating factors that lead to the development of PTG.

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Declaration of competing interest

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References

Aftyka, A., Rozalska-Walaszek, I., Rosa, W., Rybojad, B., Karakuła-Juchnowicz, H., 2017. Post-traumatic growth in parents after infants' neonatal intensive care unit hospitalisation. J. Clin. Nurs. 26, 727–734. https://doi.org/10.1111/jocn.13518.

Barskova, T., Oesterreich, R., 2009. Post-traumatic growth in people living with a serious medical condition and its relations to physical and mental health: a systematic review. Disabil. Rehabil. https://doi.org/10.1080/09638280902738441.

Boyle, K.M., McKinzie, A.E., 2021. The prevalence and psychological cost of interpersonal violence in graduate and law school. J. Interpers Violence 36, 6319–6350. https://doi.org/10.1177/0886260518816329.

Cann, A., Calhoun, L.G., Tedeschi, R.G., Taku, K., Vishnevsky, T., Triplett, K.N., Danhauer, S.C., 2010. A short form of the posttraumatic growth inventory. Hist. Philos. Logic 23, 127–137. https://doi.org/10.1080/10615800903094273.

CDC, 2021. Mental health - household pulse survey - COVID-19 [WWW document]. URL. https://www.cdc.gov/nchs/covid19/pulse/mental-health.htm, 10.15.21.

Cheng, S.K.W., Chong, G.H.C., Chang, S.S.Y., Wong, C.W., Wong, C.S.Y., Wong, M.T.P., Wong, K.C., 2006. Adjustment to severe acute respiratory syndrome (SARS): roles of appraisal and post-traumatic growth. Psychol. Health 21, 301–317. https://doi.org/10.1080/14768320500286450.

Chi, X., Becker, B., Yu, Q., Willeit, P., Jiao, C., Huang, L., Hossain, M.M., Grabovac, I., Yeung, A., Lin, J., Veronese, N., Wang, J., Zhou, X., Doig, S.R., Liu, X., Carvalho, A.F., Yang, L., Xiao, T., Zou, L., Fusar-Poli, P., Solmi, M., 2020. Prevalence and psychosocial correlates of mental health outcomes among Chinese college students during the coronavirus Disease (COVID-19) pandemic. Front. Psychiatr. 11, 1–9. https://doi.org/10.3389/fpsyt.2020.00803.

Copeland, W.E., McGinnis, E., Bai, Y., Adams, Z., Nardone, H., Devadanam, V., Rettew, J., Hudziak, J.J., 2021. Impact of COVID-19 pandemic on college student mental health and wellness. J. Am. Acad. Child Adolesc. Psychiatry 60, 134–141.e2. https://doi.org/10.1016/j.jaac.2020.08.466.

Cordova, M.J., Cunningham, L.L.C., Carlson, C.R., Andrykowski, M.A., 2001. Posttraumatic growth following breast cancer: a controlled comparison study. Health Psychol. 20, 176–185. https://doi.org/10.1037/0278-6133.20.3.176.

Coulthard, H., Sharps, M., Cunliffe, L., van den Tol, A., 2021. Eating in the lockdown during the Covid 19 pandemic; self-reported changes in eating behaviour, and associations with BMI, eating style, coping and health anxiety. Appetite 161, 105082. https://doi.org/10.1016/j.appet.2020.105082.

Cui, P.P., Wang, P.P., Wang, K., Ping, Z., Wang, P., Chen, C., 2021. Post-traumatic growth and influencing factors among frontline nurses fighting against COVID-19. Occup. Environ. Med. 78, 129–135. https://doi.org/10.1136/oemed-2020-106540.

Czeisler, M.É., Lane, R.I., Petrosky, E., Wiley, J.F., Christensen, A., Njai, R., Weaver, M.D., Robbins, R., Facer-Childs, E.R., Barger, L.K., Czeisler, C.A., Howard, M.E., Rajaratnam, S.M.W., 2020. Mental health, substance use, and suicidal ideation during the COVID-19 pandemic — United States, june 24–30, 2020. MMWR. Morbidity and Mortality Weekly Report 69, 1049–1057. https://doi.org/10.15585/mmwr.mm6932a1.

Dumas, T.M., Ellis, W., Litt, D.M., 2020. What does adolescent substance use look like during the COVID-19 pandemic? Examining changes in frequency, social contexts, and pandemic-related predictors. J. Adolesc. Health 67, 354–361. https://doi.org/10.1016/J.JADOHEALTH.2020.06.018.

Ellena, A.M., Aresi, G., Marta, E., Pozzi, M., 2021. Post-traumatic growth dimensions differently mediate the relationship between national identity and interpersonal trust among young adults: a study on COVID-19 crisis in Italy. Front. Psychol. 11, 1–10. https://doi.org/10.3389/fpsyg.2020.576610.

Gallea, J.I., Medrano, L.A., Morera, L.P., 2021. Work-related mental health issues in graduate student population. Front. Neurosci. 15. https://doi.org/10.3389/fnins.2021.593562.

Greenberg, J., Tsai, J., Southwick, S.M., Pietrzak, R.H., 2021. Can military trauma promote psychological growth in combat veterans? Results from the national health and resilience in veterans study. J. Affect. Disord. 282, 732–739. https://doi.org/10.1016/j.jad.2020.12.077.

HEDS COVID-19 surveys and reports [WWW document]. , n.d. URL. https://www.hedsconsortium.org/heds-covid-19-response-information/, 10.15.21.

Hooper, L.M., Marotta, S.A., Depuy, V., 2009. A confirmatory factor analytic study of the Posttraumatic Growth Inventory among a sample of racially diverse college students. J. Ment. Health 18 (4), 335–343. https://doi.org/10.1080/09638230802522502.

Hyun, S., Wong, G.T.F., Levy-Carrick, N.C., Charmaraman, L., Cozier, Y., Yip, T., "Chris" Hahm, H., Liu, C.H., 2021a. Psychosocial correlates of posttraumatic growth among U.S. young adults during the COVID-19 pandemic. Psychiatr. Res. 302. https://doi.org/10.1016/j.psychres.2021.114035.

Hyun, S., Wong, G.T.F., Levy-Carrick, N.C., Charmaraman, L., Cozier, Y., Yip, T., "Chris" Hahm, H., Liu, C.H., 2021b. Psychosocial correlates of posttraumatic growth among U.S. young adults during the COVID-19 pandemic. Psychiatr. Res. 302, 114035. https://doi.org/10.1016/j.psychres.2021.114035.

Kaler, M.E., Erbes, C.R., Tedeschi, R.G., Arbisi, P.A., Polusny, M.A., 2011. Factor structure and concurrent validity of the posttraumatic growth inventory-short form among veterans from the Iraq war. J. Trauma Stress 24, 200–207. https://doi.org/10.1002/jts.20623.

Kirkner, A., Ullman, S.E., 2020. Sexual assault survivors' post-traumatic growth: individual and community-level differences. Violence Against Women 26, 1987–2003. https://doi.org/10.1177/1077801219888019.

Kroenke, K., Spitzer, R.L., Williams, J.B.W., 2001. The PHQ-9. J. Gen. Intern. Med. 16, 606–613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x.
Levecque, K., Anseel, F., De Beuckelaer, A., Van der Heyden, J., Gisle, L., 2017. Work organization and mental health problems in PhD students. Res. Pol. 46, 868–879. https://doi.org/10.1016/j.respol.2017.02.008.
Levi-Belz, Y., Krysinska, K., Andriessen, K., 2020. Turning personal tragedy into triumph": a systematic review and meta-analysis of studies on posttraumatic growth among suicide-loss survivors. Psychological Trauma: Theory, Research, Practice, and Policy 13, 322–332. https://doi.org/10.1037/tra0000977.
Levine, S.Z., Laufer, A., Hamama-Raz, Y., Stein, E., Solomon, Z., 2008. Posttraumatic growth in adolescence: examining its components and relationship with PTSD. J. Trauma Stress 21, 492–496. https://doi.org/10.1002/JTS.20361.
Liu, A.N., Wang, L.L., Li, H.P., Gong, J., Liu, X.H., 2016. Correlation between posttraumatic growth and posttraumatic stress disorder symptoms based on Pearson correlation coefficient: a meta-analysis. J. Nerv. Ment. Dis. https://doi.org/10.1097/NMD.0000000000000605.
Liu, C.H., Zhang, E., Wong, G.T.F., Hyun, S., Hahm, H. "Chris, 2020. Factors associated with depression, anxiety, and PTSD symptomatology during the COVID-19 pandemic: clinical implications for U.S. young adult mental health. Psychiatr. Res. 290, 113172. https://doi.org/10.1016/j.psychres.2020.113172.
Magid, K., El-Gabalawy, R., Maran, A., Serber, E.R., 2019. An examination of the association between post-traumatic growth and stress symptomatology in cardiac outpatients. J. Clin. Psychol. Med. Settings 26, 271–281. https://doi.org/10.1007/s10880-018-9585-4.
Maitlis, S., 2020. Posttraumatic growth at work. Annual Review of Organizational Psychology and Organizational Behavior 7, 395–419. https://doi.org/10.1146/annurev-orgpsych-012119-044932.
Njoku, A., Ahmed, Y., Bolaji, B., 2021. Police brutality against Blacks in the United States and ensuing protests: implications for social distancing and Black health during COVID-19. J. Hum. Behav. Soc. Environ. 31, 262–270. https://doi.org/10.1080/10911359.2020.1822251.
Norrholm, S.D., Zalta, A., Zoellner, L., Powers, A., Tull, M.T., Reist, C., Schnurr, P.P., Weathers, F., Friedman, M.J., 2021. Does COVID-19 count?: defining Criterion A trauma for diagnosing PTSD during a global crisis. Depress. Anxiety 38, 882–885. https://doi.org/10.1002/da.23209.
Reinert, M., Fritze, D., Nguyen, T., 2021. The State of Mental Health in America 2022. Mental Health America, Alexandria VA.
Rzeszutek, M., Gruszczyńska, E., 2018. Posttraumatic growth among people living with HIV: a systematic review. J. Psychosom. Res. 114, 81–91. https://doi.org/10.1016/j.jpsychores.2018.09.006.
Sanki, M., O'Connor, S.A., 2021. Developing an understanding of post traumatic growth: implications and application for research and intervention. Int. J. Wellbeing 11 (2), 1–19. https://doi.org/10.5502/ijw.v11i2.1415.
Satinsky, E.N., Kimura, T., Kiang, M.V., Abebe, R., Cunningham, S., Lee, H., Lin, X., Liu, C.H., Rudan, I., Sen, S., Tomlinson, M., Yaver, M., Tsai, A.C., 2021. Systematic review and meta-analysis of depression, anxiety, and suicidal ideation among Ph.D. students. Sci. Rep. 11, 1–12. https://doi.org/10.1038/s41598-021-93687-7.
Schaefer, J.A., Moos, R.H., 1992. Life crises and personal growth. In: Carpenter, B.N. (Ed.), Personal Coping: Theory, Research, and Application. Praeger Publishers/Greenwood Publishing Group, pp. 149–170.
Seo, H., Lee, O., 2020. Mediating role of post-traumatic stress disorder in post-traumatic growth in adults who experienced the 2017 Pohang earthquake. J. Affect. Disord. 263, 246–251. https://doi.org/10.1016/j.jad.2019.11.162.
Shand, L.K., Cowlishaw, S., Brooker, J.E., Burney, S., Ricciardelli, L.A., 2015. Correlates of post-traumatic stress symptoms and growth in cancer patients: a systematic review and meta-analysis. Psycho Oncol. 24, 624–634. https://doi.org/10.1002/pon.3719.
Son, C., Hegde, S., Smith, A., Wang, X., Sasangohar, F., 2020. Effects of COVID-19 on college students' mental health in the United States: interview survey study. J. Med. Internet Res. 22, 1–14. https://doi.org/10.2196/21279.
Spitzer, R.L., Kroenke, K., Williams, J.B.W., Löwe, B., 2006. A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch. Intern. Med. 166, 1092–1097. https://doi.org/10.1001/archinte.166.10.1092.
Stallard, P., Pereira, A.I., Barros, L., 2021. Post-traumatic growth during the COVID-19 pandemic in carers of children in Portugal and the UK: cross-sectional online survey. BJPsych Open 7, 1–5. https://doi.org/10.1192/bjo.2021.1.
StataCorp, 2019. Stata Statistical Software Release 16.
Tamiolaki, A., Kalaitzaki, A.E., 2020. That which does not kill us, makes us stronger": COVID-19 and Posttraumatic Growth. Psychiatr. Res. 289, 113044. https://doi.org/10.1016/j.psychres.2020.113044.
Tedeschi, R.G., Calhoun, L.G., 2004. Posttraumatic growth: conceptual foundations and empirical evidence. Psychol. Inq. 15, 1–18. https://doi.org/10.1207/s15327965pli1501_01.
Tedeschi, R.G., Calhoun, L.G., 1996. The posttraumatic growth inventory: measuring the positive legacy of trauma. J. Trauma Stress 9, 455–471. https://doi.org/10.1002/jts.2490090305.
Terlizzi, E.P., Villarroel, M.A., 2020. Symptoms of Generalized Anxiety Disorder Among Adults: United States, 2019. NCHS Data Brief 1–8.
Turner, J.L., Martinez, T.L., Kirila, J.S., Patton, S., Us, B., 2020. COVID-19 : US State Policy Report –.
Varma, P., Junge, M., Meaklim, H., Jackson, M.L., 2021. Younger people are more vulnerable to stress, anxiety and depression during COVID-19 pandemic: a global cross-sectional survey. Prog. Neuro Psychopharmacol. Biol. Psychiatr. 109, 110236.
Vazquez, C., Valiente, C., García, F.E., Contreras, A., Peinado, V., Trucharte, A., Bentall, R.P., 2021. Post-traumatic growth and stress-related responses during the COVID-19 pandemic in a national representative sample: the role of positive core beliefs about the world and others. J. Happiness Stud. 22, 2915–2935. https://doi.org/10.1007/s10902-020-00352-3.
Villarroel, M.A., Terlizzi, E.P., 2020. Symptoms of Depression Among Adults: United States, 2019. NCHS Data Brief 1–8.
Vishnevsky, T., Cann, A., Calhoun, L.G., Tedeschi, R.G., Demakis, G.J., 2010. Gender differences in self-reported posttraumatic growth: a meta-analysis. Psychol. Women Q. 34, 110–120. https://doi.org/10.1111/j.1471-6402.2009.01546.x.
Yi, J., Zebrack, B., Kim, M.A., Cousino, M., 2015. Posttraumatic growth outcomes and their correlates among young adult survivors of childhood cancer. J. Pediatr. Psychol. 40, 981–991. https://doi.org/10.1093/JPEPSY/JSV075.
Zoellner, T., Maercker, A., 2006. Posttraumatic growth in clinical psychology - a critical review and introduction of a two component model. Clin. Psychol. Rev. 26, 626–653. https://doi.org/10.1016/j.cpr.2006.01.008.