

Keep going, keep growing: A longitudinal analysis of grit, posttraumatic growth, and life satisfaction in school students under COVID-19

Nicole Casali^a, Tommaso Feraco^{b,*}, Chiara Meneghetti^b

^a Max Planck Institute for the Study of Crime, Security and Law, Freiburg, Germany

^b Department of General Psychology, University of Padova, Padua, Italy

ARTICLE INFO

Keywords:

Grit
Posttraumatic growth
Life satisfaction
COVID-19
Adolescents

ABSTRACT

The COVID-19 pandemic disrupted students' daily life, but grit could have sustained students' wellbeing by helping them work hard and stay goal-oriented over time despite adversity. Gritty students may also have interpreted COVID-19-related adversity as an opportunity to grow, thus displaying higher levels of post-traumatic growth. In this study, 445 students in grades 6–12 (160 males, Mage = 14.25, SDage = 2.11) completed measures of grit and life satisfaction at the beginning (Time 1) and at the end (Time 2) of the school year, together with a measure of posttraumatic growth. A longitudinal SEM model shows that perseverance positively relates to posttraumatic growth, indirectly favoring life satisfaction at Time 2. In conclusion, perseverance, rather than consistency, appeared to have sustained students' positive adjustment to the COVID-19 pandemic. Teaching students how to nurture this quality can have important beneficial effects for their well-being under adverse conditions.

1. Educational relevance and implications of this research

The present study investigated the impact of grit (perseverance of effort and consistency of interests) on well-being and posttraumatic growth following the COVID-19 pandemic. Our findings revealed a direct relationship between perseverance at the beginning of the school year and posttraumatic growth at the end of the school year. Moreover, we observed an indirect effect where perseverance also positively influenced life satisfaction. This suggests that fostering perseverance can help students face adversities, supporting their well-being and facilitating growth in challenging circumstances.

Grit is a widely studied construct in educational psychology, as it seems to support several positive academic and nonacademic outcomes, remarkably academic achievement, self-regulated learning, and life satisfaction (Duckworth et al., 2007; Muenks et al., 2017), also in longitudinal studies which even better highlight the effect of this construct over time (Jiang et al., 2019; Postigo et al., 2021b; Tang et al., 2020). In the context of the COVID-19 pandemic, it may have supported students' life satisfaction and provided room for students to positively reappraise such a stressful situation (the so-called posttraumatic growth), as it is suggested to make individuals interpret life challenges in a more positive way, as an inevitable component of their goal-striving, in line with top-

down theories of subjective well-being (Diener, 1984; Diener & Ryan, 2009), coping theories (Carver & Connor-Smith, 2010) and more recent conceptualizations of the role of positive personal qualities under adversity (Casali et al., 2022; Waters, Allen, & Arslan, 2021). This might have been particularly crucial in Italy, which was the first Western country hit by the pandemic, and Italian students who had to face prolonged periods of school closure, social distancing and interruption of any extracurricular activity (UNESCO, 2021). Therefore, elucidating the grit-posttraumatic growth-life satisfaction links may help researchers and practitioners alike to better understand how students successfully coped with learning in a highly stressful situation as a pandemic can be. In this study, we aim to examine the longitudinal relations between the two separate facets of grit (perseverance of effort and consistency of interest), life satisfaction at both the beginning and end of the school year, and posttraumatic growth possibly reported at the end the of the school year in a sample of students in grades 6–12.

2. Literature review

2.1. Grit

Grit was first defined by Duckworth et al. (2007) as perseverance and

* Corresponding author at: via Venezia 8, Padova, Italy.

E-mail address: tommaso.feraco@unipd.it (T. Feraco).

passion for long-term goals, which means working hard and maintaining one's interest and effort over time even under adverse situations. Operationally, grit was conceived as having two facets converging in an overarching grit factor: Consistency of interests (keeping the same objective for a reasonable amount of time without losing interest), and perseverance of effort (strive despite failures). Recent studies (Credé, 2018; Credé et al., 2017; Ponnock et al., 2020; Rimfeld et al., 2016) have questioned this structure and in particular the role of consistency of interests, which seems to have a much lower predictive role compared to perseverance of effort. Indeed, Credé et al. (2017) meta-analysis did not support grit's structural validity (i.e., perseverance of effort and consistency of interests did not satisfactorily converge into a second-order factor). Consequently, authors (Credé, 2018; Datu, 2021; Guo et al., 2019) have proposed to study the two dimensions separately and to focus more on the perseverance facet (Credé et al., 2017). Other studies have championed the need to revise the original grit scales, and modified versions have been developed using newer techniques, including the Academic Grit Scale (Clark & Malecki, 2019), that specifically focuses on academic achievement in youth and was developed under the item response theory (IRT), the Oviedo Grit Scale (Postigo et al., 2021a), which followed expert guidelines on instrument development, or the (Morell et al., 2021), which specifically addresses grit's temporal dimension. All these scales resulted unidimensional. Similarly, more recent investigations of the Short Grit Scale also suggest grit to be unidimensional (Gonzalez et al., 2020). Lastly, it has been suggested to include adaptability as either a third dimension of grit (see the triarchic model by Datu et al., 2017) or a key component of grit together with perseverance of effort, to be preferred to consistency of interests, at least when considering gifted students (Datu et al., 2022). These modified versions have proved particularly reliable in collectivistic contexts such as the Philippines and China. Following this debate on grit facets, in the present study we decided to consider perseverance of effort and consistency of interests as separate dimensions (supported by meta-analytic evidence, Credé et al., 2017), and our expectations centered around perseverance as it appears to be the subdimension contributing the most to life satisfaction (Credé et al., 2017). More specifically, we anticipated that perseverance (rather than consistency) would be positively related to both our variables of interest, that is, posttraumatic growth and life satisfaction.

2.2. Posttraumatic growth

Posttraumatic growth consists of the positive enduring changes reported by individuals after encountering major stressors (e.g., the COVID-19 pandemic) that invalidate the way they see the world (Calhoun & Tedeschi, 2014; Tedeschi & Calhoun, 1995). Posttraumatic growth changes generally occur in five domains (i.e., openness to new possibilities, interpersonal relationships, personal strengths, appreciation of life, and the spiritual domain) and have been found in both adults and adolescents (Meyerson et al., 2011). Meta-analytic evidence (Vishnevsky et al., 2010) shows that women tend to report higher posttraumatic growth and that age moderates this effect, with older women reporting higher PTG. However, this construct is not exempt from criticism. As reviewed by Infurna and Jayawickreme (2019), posttraumatic growth, especially when measured through retrospective recalling, may be better seen as a coping strategy rather than actual personality change. Only a few prospective longitudinal studies have been conducted to examine actual growth in the aftermath of adverse events, and none of them with adolescents (Harmon & Venta, 2021). Given the lack of evidence, we preferred to err on the side of caution and conceptualize posttraumatic growth in terms of coping rather than personality change, even though the role of posttraumatic growth may be relevant to student learning in pandemic conditions. In particular, posttraumatic growth could be regarded as a form of meaning-focused coping, in which individuals draw on their values to positively reappraise a stressful experience (Carver & Connor-Smith, 2010); this kind of coping is

especially likely when the stressful situation is uncontrollable. In this sense, the positive changes reported under the COVID-19 pandemic, few months after the first wave in adults and high-school graduates (Chen et al., 2021; Yu et al., 2021), as well as in adolescents (Waters, Allen, & Arslan, 2021), may rather signal a positive adaptation to the pandemic situation. Importantly, scarce attention has been paid in these studies to the individual characteristics possibly explaining why some individuals experience such growth (or positively respond to a traumatic event, a form of meaning-focused coping (Carver & Connor-Smith, 2010), while others do not. Because of the attention dedicated to grit as an important factor of success in adolescence (and adulthood), it might be of interest to understand whether gritty students are also capable of a better reframing of a difficult situation, possibly resulting in posttraumatic growth. Encouraging evidence exists, for example, that grit dimensions serve as resilience factors in at-risk adolescents (Tang et al., 2021), moderating the effect of burnout on depressive symptoms. Similarly, recent studies underline the conceptual similarity of these two constructs (Cheng et al., 2023), and newer conceptualizations of (academic) grit explicitly integrated resilience to precisely emphasize how grit is an effortful goal pursuit despite delays in progress and adversity (Clark & Malecki, 2019). Overall, this evidence strengthens the idea that grit is a resilience factor for students, facilitating both positive reappraisal and life satisfaction.

2.3. Life satisfaction

Born in the positive psychology research field, life satisfaction represents the cognitive component of subjective wellbeing (Diener, 1984), and can be defined as a global assessment of one's contentment with their life conditions. Even though it is considered as quite stable compared to the affective component of subjective wellbeing, life satisfaction can be affected by gender (with females usually reporting lower life satisfaction than males, see Chen et al., 2019), age (with a decrease over the course of adolescence, an in very old age, e.g., Baird et al., 2010; Fergusson et al., 2015), and external events (Anusic & Schimmack, 2016). In particular, longitudinal studies suggest that life satisfaction significantly decreased from pre- to during the pandemic in adolescents (Magson et al., 2021; von Soest et al., 2020). However, these studies considered only the immediate effects of the pandemic (around two months after lockdown was declared), while there is a lack of research on longer term effects on life satisfaction. Since life satisfaction has multiple cascading effects (e.g., on mental health; Fergusson et al., 2015), a deeper understanding of the individual features potentially protecting students from experiencing such decrease in life satisfaction is warranted.

2.4. Grit, posttraumatic growth, and life satisfaction

Grit, and especially perseverance, is regarded as a crucial intrapersonal competency across several important taxonomies, ranging from the National Research Council classification of the 21st century competencies, to the VIA classification of character strengths (Peterson & Seligman, 2004), to the World Economic Forum (2016) character qualities for 21st century students, as it is suggested to be associated with a higher level of life satisfaction in students (Bruna et al., 2019; Credé et al., 2017; Feraco et al., 2023; Singh & Jha, 2008). Furthermore, there is growing interest in understanding the psychological mechanisms that link grit to life satisfaction. In this vein, there is evidence that basic psychological needs satisfaction plays a relevant mediating role in the relationship between grit and life satisfaction (Jiang et al., 2019; Jin & Kim, 2017). In these studies, grit is conceptualized as a dispositional quality that favors needs satisfaction, which in turn leads to greater subjective wellbeing. But what about adverse situations? Which mechanisms can explain the grit-wellbeing relationship in such contexts?

Grit seems to be of special relevance under stressful conditions (Bono et al., 2020). In line with classic coping theorizations (Carver & Connor-

Smith, 2010), personal qualities like grit and coping strategies such as posttraumatic growth have mediating effects on well-being, namely grit facilitates posttraumatic growth, which in turn influences well-being, therefore favoring adjustment to the stressful situation. Even more precisely, according to recent theorizations in positive psychology, intrapersonal features as grit favor growth following major stressors through a “building effect”, that is, the possibility to turn a crisis into an opportunity to develop new practices, processes and visions, which in turn leads to better mental health (Waters, Algoe, et al., 2021). In this sense, grittier students should be better equipped to keep a positive attitude even under adverse situations, being better able to interpret them as opportunities for growth, as shown by studies conducted during the COVID-19 pandemic in student populations (Bono et al., 2020; Wang et al., 2023). Accordingly, perseverance has been associated with growth following traumatic life events (Peterson et al., 2008) and earthquakes (Duan & Guo, 2015). Similarly, in a pandemic situation grit can directly positively impact life satisfaction by helping students stay focused and keep pursuing their objectives, thus maintaining a steady level of subjective satisfaction (Bono et al., 2020).

In turn, posttraumatic growth has been suggested to relate to life satisfaction: Reporting positive changes after a major traumatic event brings about greater life satisfaction by helping individuals find meaning in the traumatic event, and integrate it within one's vision of life, therefore acting as a positive coping strategy (Chen et al., 2021; Triplett et al., 2012). At the same time, being satisfied with one's life conditions paves the way to experiencing higher posttraumatic growth (Tomaszek & Muchacka-Cymerman, 2020). Therefore, it could be that students who were generally satisfied with their life at the beginning of the school year (Time 1) may have experienced greater growth following COVID-19 pandemic (Time 2), and this in turn may have positively affected their subsequent life satisfaction.

These considerations are in line with top-down theories of subjective well-being (Diener, 1984; Diener & Ryan, 2009) positing that relatively stable personal qualities (like grit) contribute to subjective well-being (life satisfaction) by impacting the way individuals react to events and interpret reality (e.g., a global pandemic). In this view, individuals holding more positive attitudes should appraise certain situations more positively than those with negative attitudes. This is the case for gritty individuals, who tend to retain optimistic views even in the face of adversity and setbacks (Duckworth et al., 2007; Jin & Kim, 2017), which in turn should lead them to appraise stressful situations as opportunities for growth, which may prompt the development of higher levels of life satisfaction. Indeed, recent evidence suggests that grit predicts posttraumatic growth following COVID-19 pandemic in university students (Wang et al., 2023). More in general, a systematic review (Henson et al., 2021) showed how personality traits (such as conscientiousness, which is closely linked to grit) are among the main determinants of posttraumatic growth.

2.5. Rationale and hypotheses

To our knowledge, no studies have investigated the relation between Duckworth's grit and posttraumatic growth, except for a study examining the validity of the PTGI measure (Silverstein et al., 2018), nor its longitudinal effect on life satisfaction. Moreover, there is a lack of knowledge on the longer-term effects of COVID-19 pandemic on life satisfaction and which personal qualities can support it.

The present study aims at assessing the direct and indirect relations longitudinally linking grit components (perseverance of effort and consistency of interests), life satisfaction at two time-points (to account for its possible variation over time, (Magson et al., 2021), and posttraumatic growth in school-aged students. More specifically, based on previous studies and top-down theoretical considerations on the relationship between personal qualities, meaning-focused coping strategies, and well-being (Carver & Connor-Smith, 2010) as well as grit's building effects (Waters, Algoe, et al., 2021), we hypothesize the following:

Hypothesis 1. Perseverance of effort at Time 1 (beginning of school year) will be positively associated with both posttraumatic growth and life satisfaction at Time 2 (end of school year);

Hypothesis 2. Posttraumatic growth at Time 2 will mediate the relationship between perseverance at Time 1 and life satisfaction at Time 2;

Hypothesis 3. (explorative): Posttraumatic growth at Time 2 will mediate the relationship between life satisfaction at Time 1 and life satisfaction at Time 2; those students who were already satisfied with their life may have more available resources and therefore be more prone to report growth following the COVID-19 pandemic.

3. Materials and methods

3.1. Participants

A total of 558 students in grades 6–12 (i.e., 11–18 years old) completed the first part of the study (i.e., the measurement of grit and life satisfaction) and 494 (88.5 %) completed the second part because some of them were absent from school. Finally, complete¹ records for 445 (160 males, $M_{age} = 14.25$, $SD_{age} = 2.11$) students matched between Time 1 and Time 2 and were included in the analysis.² Students participated on a voluntary basis after their parents or the students themselves (if 18 years old) provided their informed consent. The study was approved by the Ethical Committee of the University of [BLINDED]. All participants were informed about the purposes of the study and gave their written informed consent in accordance with the Declaration of Helsinki (World Medical Association, 2013).

Power analysis was performed via simulation prior to data collection. We simulated 10,000 data sets for different sample sizes starting from a theory-based covariance matrix with small-to-medium hypothetical correlations (i.e., $r = 0.30$) between grit, posttraumatic growth, and life satisfaction. For each simulated data set, the hypothesized model (see Results section) was fitted, and the results were saved for power calculation. Assuming a significance level of $\alpha = 0.05$, it emerged that with 400 participants power was equal to 0.74 and with 500 to 0.87.

3.2. Materials

The Short Grit Scale (Duckworth & Quinn, 2009; validated in Italian by Sulla et al., 2018) was administered at Time 1 only. This involves eight items on a 5-point Likert scale measuring two facets of grit (i.e., passion for long-term goals): consistency of interest, i.e., to keep focused on the same interests for a long time (four items, e.g., “New ideas and projects sometimes distract me from previous ones”), and perseverance of effort, i.e., to maintain one's effort despite failures (four items, e.g., “Setbacks don't discourage me”). Four items were reversed to calculate the scores. The scale displayed acceptable-to-satisfactory internal consistency in the Italian version ($\alpha = 0.76$ for the overall mean score and the consistency subscale, $\alpha = 0.61$ for perseverance) and acceptable in the present study as well ($\alpha = 0.75$, 0.67, and 0.71 respectively). Given the heated debate on grit's internal structure, we evaluated it in our sample, by comparing the unidimensional model (considering grit as a unique factor composed by the eight items), the two-correlated factors model (considering consistency of interests and perseverance of effort separately), and the hierarchical model (considering the convergence of consistency and perseverance into a second-order grit factor). The results indicated better fit for the two-factor model ($\chi^2(19, N = 445) = 23.75$, $p < .01$, CFI = 0.99, NNFI = 0.99, RMSEA = 0.02, 90 %

¹ Some students were only present for the second part of the study (they were absent during the first day of data collection), while others failed to report their subject's code correctly, making it impossible to match their records.

² Please note that the posttraumatic growth data were already published in a different manuscript (Feraco et al., 2022)

confidence interval for RMSEA [0.00, 0.05]) than the unidimensional one ($\chi^2(20, N = 558) = 95.02, p < .01, CFI = 0.92, NNFI = 0.89, RMSEA = 0.08, 90\%$ confidence interval for RMSEA [0.07, 0.10]), while the hierarchical model did not even converge.

The Revised Posttraumatic Growth Inventory for Children (Kilmer et al., 2009) was administered at Time 2 only. This involves 10 items on a 4-point Likert scale (from 0 = “I did not experience any change” to 3 = “I experienced change to a very great degree”) measuring posttraumatic growth. The scale was translated in Italian following a back-translation procedure and instructions were adapted to suit to the COVID-19 pandemic. The questionnaire includes two items for each of five domains of posttraumatic growth: Others (e.g., “I learned how nice/helpful people can be”), new possibilities (e.g., “I have a chance to do things I couldn’t”), personal strength (e.g., “I can handle big problems better”), spirituality (e.g., “My faith/belief in God is stronger”), and appreciation of life (e.g., “I know what is important to me”). A total score is calculated as indicated in the validation study. A confirmatory factor analysis run on our data supported the factorial structure of the original scale: $\chi^2(35, N = 454) = 89.81, p < .01, CFI = 0.96, NNFI = 0.94, RMSEA = 0.06, 90\%$ confidence interval for RMSEA [0.04, 0.07]. The scale showed good internal consistency (Cronbach’s $\alpha = 0.85, Kilmer et al., 2009$; Cronbach’s $\alpha = 0.76$ for the current sample).

The Satisfaction With Life Scale (Diener et al., 1985; Italian validation by Di Fabio & Gori, 2016) was administered at both Times 1 and 2. This contains five items scored on a 7-point Likert scale (from 1 = “completely disagree” to 7 = “completely agree”) and measures overall life satisfaction (e.g., “The conditions of my life are excellent”). The average score was calculated. The scale showed good internal consistency (Cronbach’s $\alpha = 0.85, Di Fabio & Gori, 2016$; Cronbach’s $\alpha = 0.85$ at Time one and 0.84 at Time two for the current sample). Moreover, multigroup CFA supported strict measurement invariance across time-points, as shown in Table 1.

3.3. Procedure

Italy was the first European country to face the COVID-19 outbreak in February 2020. To respond to the pandemic situation, schools were closed (March 5th) and lessons moved online for the rest of the academic year. The following academic year (2020/2021) was again characterized by school closures and restrictions that varied depending on the regional COVID-19 situation, causing schools to close and reopen on multiple occasions. Moreover, also when opened, students had to follow strict rules regarding social contacts, use of masks, and use of school spaces.

At the beginning of the school year (September 2020), schools were contacted by email or phone to explain the project. A total of 27 classes from five different schools located in four different Italian regions agreed to participate to the study. Consent forms were provided to schools that showed interest, and the teachers of the participating classes distributed them to students (if 18 years old) or their parents. After the signed consent forms were returned, a Qualtrics link was provided to the teachers, and the students completed the questionnaires at two time points during school time under the supervision of a trained psychologist. During the first data collection (between October 2020 and the beginning of January 2021), personal information (e.g., gender,

Table 1
Measurement invariance for SWLS across time-points (Time 1 vs. Time 2).

	Df	χ^2	$\Delta\chi^2$	ΔDf	p
Configural	10	0.53			
Metric	14	3.79	3.26	4	.52
Scalar	18	5.03	1.24	4	.87
Strict	23	9.78	4.75	5	.45

Note. Df = degrees of freedom, χ^2 = chi squared, $\Delta\chi^2$ = difference in chi squared, ΔDf = difference in degrees of freedom.

age, class) were collected, together with the responses to the Short Grit Scale and the Satisfaction With Life Scale. During the second data collection (between the last two weeks of May and the first two weeks of June 2021), students answered to the two questionnaires about post-traumatic growth and life satisfaction. Completion of all the questionnaires required no more than 20 min per class. The interval between the two data collection was chosen to cover the entire academic year.

3.4. Data analysis

All analyses were run using R (R Core Team, 2020). Preliminarily, we inspected the internal structure of the self-report measures used in the study by means of confirmatory factor analysis (CFA), using the package lavaan (Rosseel, 2012). We considered items as ordinal and adopted diagonally weighted least squares (DWLS) as estimator. The goodness of fit to the data for each model was examined using multiple indices: The comparative fit index (CFI); the non-normed fit index (NNFI); and the root mean squared error of approximation (RMSEA). Models with CFI and TLI values of 0.95 or more (Bentler & Bonett, 1980), and RMSEA values of 0.08 or less (Schermelleh-engel et al., 2003) should be considered adequate. To assess measurement invariance between SWLS at Time 1 and SWLS at Time 2, we adopted multigroup CFA and compared configural (Time 1 vs. Time 2), metric (equal loadings), scalar (equal loadings and intercepts), and strict (equal loadings, intercepts, and residuals) models by means of ANOVA, where $p > .05$ indicate the models do not significantly differ. Then, we used paired t-tests to compare life satisfaction scores at Time 1 and 2. Lastly, we fitted a longitudinal SEM model (see Fig. 1) to examine the multivariate associations between grit dimensions (i.e., consistency of interests and perseverance of effort, considered as correlated latent factors), post-traumatic growth, and life satisfaction. In particular, we estimated i) the direct associations of the two grit’s dimensions at Time 1 and of life satisfaction at Time 1 with posttraumatic growth at Time 2 and life satisfaction at Time 2 ii) and the direct associations of posttraumatic growth at Time 2 with life satisfaction at Time 2. The indirect effects of posttraumatic growth at Time 2 on the relation between grit’s facets at Time 1 and life satisfaction at Time 2, as well as between life satisfaction at Times 1 and 2 were also calculated.

Given that age and gender are related with the variables considered (Chen et al., 2019; Fergusson et al., 2015; Vishnevsky et al., 2010), they were both entered as covariates in all the specified regressions.

4. Results

Table 2 shows the means, standard deviations, and correlations between all the variables.

4.1. Life satisfaction at Times 1 and 2

Life satisfaction at Times 1 and 2 was compared through t-test to assess any changes. The results indicated that life satisfaction at Time 1 was significantly higher than at Time 2 ($t(888) = 3.70, p < .001, d = 0.25$).

4.2. Association between grit, post-traumatic growth, and life satisfaction

The longitudinal SEM model (Fig. 2) displayed satisfactory fit indices ($\chi^2(386, N = 445) = 988.07, p < .01, CFI = 0.97, NNFI = 0.97, RMSEA = 0.06, 90\%$ confidence interval for RMSEA [0.055, 0.064]). The results (see Table 3) showed that perseverance of effort at Time 1 ($\beta = 0.20, p < .001$) and life satisfaction at Time 1 ($\beta = 0.23, p < .001$) significantly related to posttraumatic growth at Time 2. Second, posttraumatic growth at Time 2 ($\beta = 0.26, p < .001$) and life satisfaction at Time 1 ($\beta = 0.64, p < .001$), but not perseverance of effort at Time 1 ($\beta = -0.08, p > .05$), significantly related to life satisfaction at Time 2. Consistency of interests was not significantly related to any of the outcome measures.

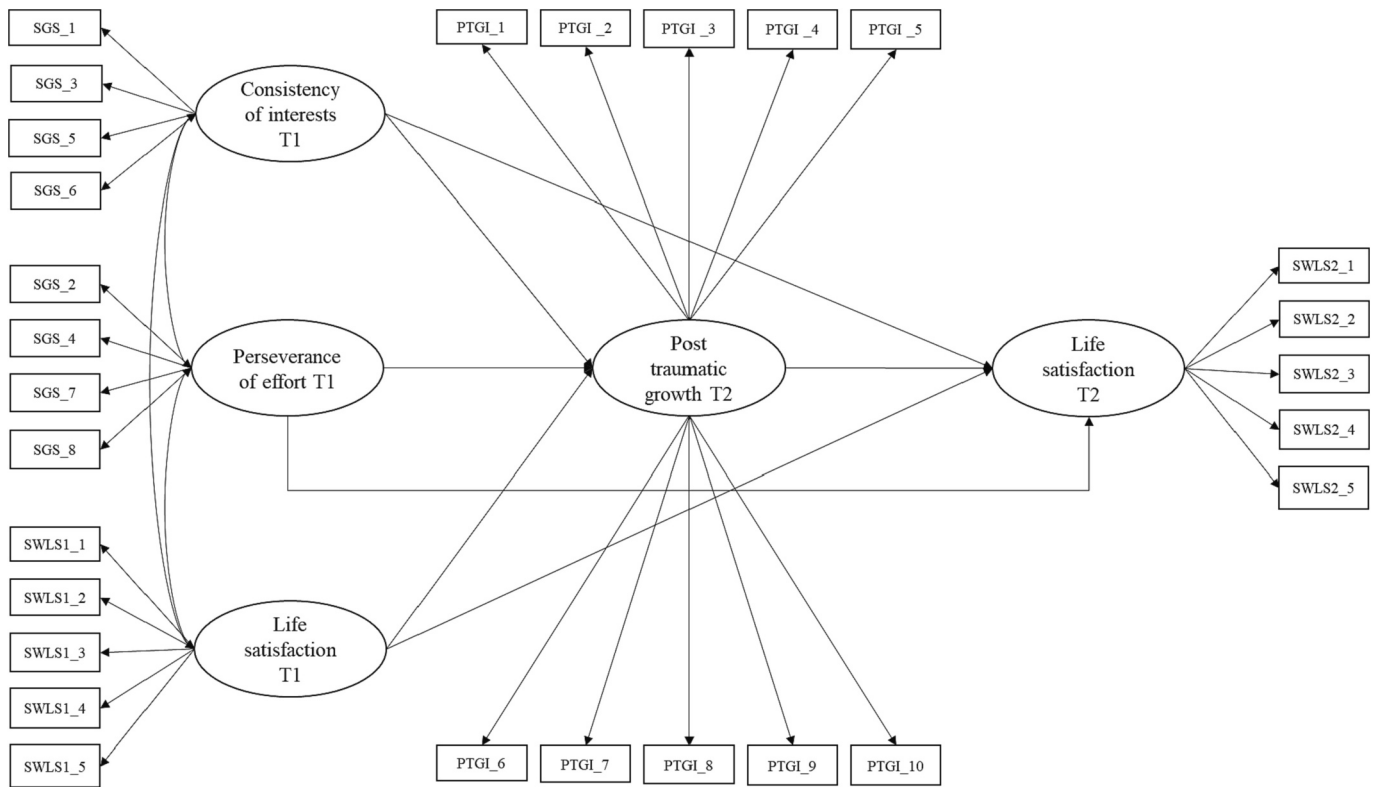


Fig. 1. Graphical representation of the hypothesized model.

Table 2
Means, standard deviations, and correlations between all study variables.

	M	SD	1.	2.	3.	4.	5.	6.
1.Age	14.26	2.11						
2.Consistency of interests T1	13.21	2.82	-0.01					
3.Perseverance of effort T1	13.35	2.92	-0.04	0.41***				
4.Life satisfaction T1	24.02	6.59	-0.19**	0.20***	0.42***			
5.Life satisfaction T2	22.37	6.7	-0.15**	0.17***	0.31***	0.60***		
6.Posttraumatic growth T2	23.16	5.38	-0.11*	0.08	0.22***	0.29***	0.39***	
7.Gender ^a	-	-	0.17***	0.11*	0.02	-0.15**	-0.19***	-0.12*

^a Polychoric correlations were calculated.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Descriptively, age and gender resulted significantly negatively related with life satisfaction at Time 1, with males and younger students reporting higher satisfaction ($\beta = -0.10$ and $\beta = -0.18$, respectively). Moreover, male students also reported slightly higher posttraumatic growth at Time 2 ($\beta = -0.07$, $p = .01$) and lower consistency of interests at Time 1 ($\beta = 0.11$, $p = .01$).

Posttraumatic growth fully mediated the relation between perseverance of effort and life satisfaction at Time 2 ($\beta = 0.05$, $p = .001$); it also partially mediated the relation between life satisfaction at Times 1 and 2 ($\beta = 0.06$, $p < .001$).

5. Discussion and conclusions

Since the beginning of COVID-19 pandemic, life has deeply changed for nearly everybody, and especially school-aged students, whose scholastic and personal conditions had to completely be re-arranged. This abrupt and massive shift has been suggested to affect not only students' academic life, but also their subjective wellbeing, i.e., their satisfaction with life (Magson et al., 2021; von Soest et al., 2020). In this

scenario, the present study drew on a top-down approach to well-being (Diener, 1984), classical coping theories (Carver & Connor-Smith, 2010) and recent theorizations on the role of positive psychology in a pandemic (Waters, Algoe, et al., 2021) to investigate whether grit, an intraindividual quality identified as one of the most prominent noncognitive factors sustaining students (Lavy, 2020), longitudinally supported students' life satisfaction as well as promoting a positive reappraisal of the pandemic, as expressed by posttraumatic growth reported at the end of the school year.

Preliminarily, our findings evidenced the two correlated factors model as the one best fitting our data, as it performed better than both the unidimensional model and the hierarchical one. This result contradicts recent evidence in support of grit's unidimensionality (Clark & Malecki, 2019; Gonzalez et al., 2020; Postigo et al., 2021a), while being in line with previous findings on a high-school sample (Muenks et al., 2017). Generally, it may be argued that the original grit scale has a varying internal structure (Morell et al., 2021) and that more rigorously developed measures exhibit more stable structures and possibly better represent the grit construct.

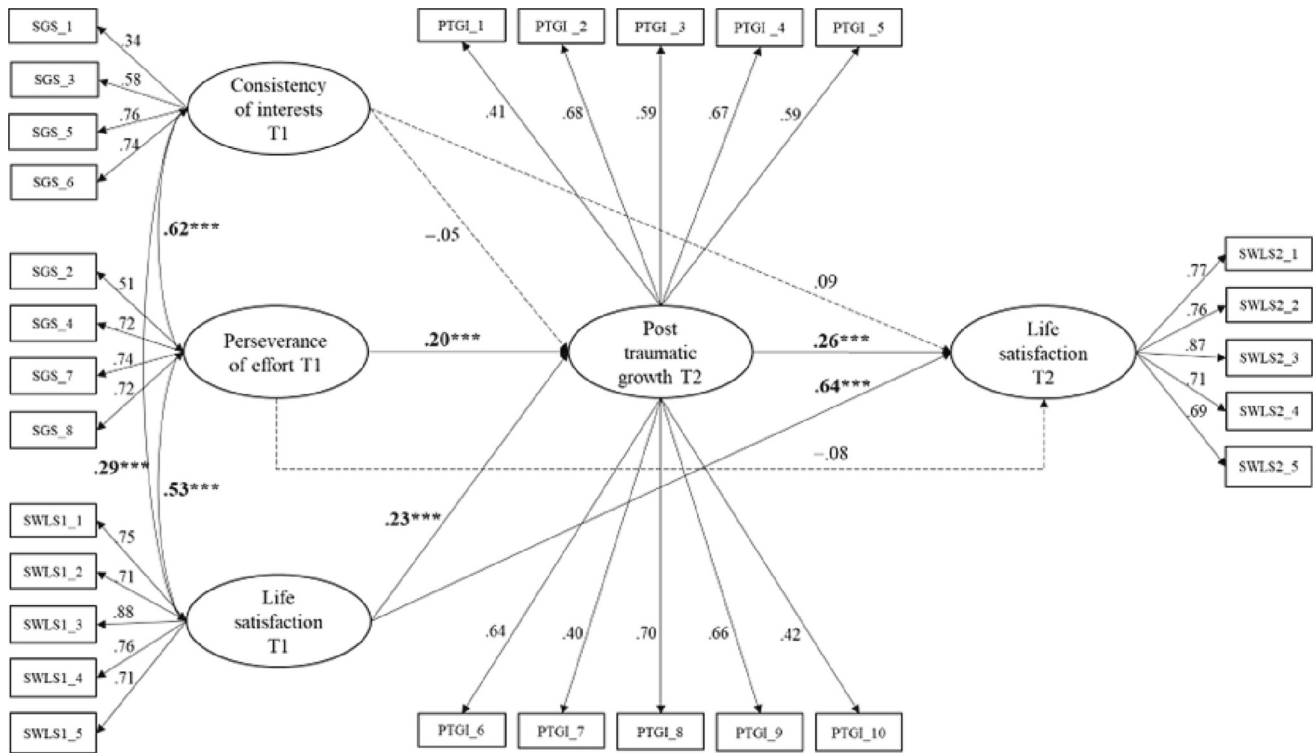


Fig. 2. The model results.

Note. Numbers represent standardized beta coefficients, and dotted lines represent non-significant relations. Age and gender were added as covariates in every relation. All loadings are significant for $p < .001$.
 *** $p < .001$.

Then, the longitudinal SEM model provided us with a deeper understanding of the role of grit components with respect to life satisfaction and posttraumatic growth. It emerged that only perseverance of effort at Time 1 was significantly related to posttraumatic growth following the COVID-19 pandemic, while the direct relation of perseverance at Time 1 with life satisfaction at Time 2 was not confirmed. These results partially support our hypothesis (H1) and advocate for a more prominent role of the perseverance component compared to the consistency one, as recently suggested by other studies (Credé, 2018; Credé et al., 2017; Rimfeld et al., 2016). Moreover, these findings indicate that perseverance of effort can enable a more positive appraisal of a traumatic experience such as a global pandemic, possibly making students more able to keep working hard in spite of this stressful situation, extending previous findings on adults to adolescents (Duan & Guo, 2015; Peterson et al., 2008; Silverstein et al., 2018). In other words, our results favor perseverance’s “building effect” and ability to positively influence positive reappraisal, i.e., being able to transformatively get through a crisis by developing a new outlook, which can then lead to improved wellbeing.

Even more interestingly, and in accordance with our hypotheses (H2–H3), posttraumatic growth at Time 2 fully mediated the relationship between perseverance of effort at Time 1 and life satisfaction at Time 2, and partially mediated the relationship between life satisfaction at Times 1 and 2. As for the first mediation effect, perseverance appeared to act as a dispositional individual resource that enables growth at the end of the school year (the abovementioned building effect), which in turn seems to make students more satisfied with their life (a positive cascading effect of the building effect). Furthermore, our results point to a bidirectional virtuous circle, that is, life satisfaction at Time 1 positively affected posttraumatic growth at Time 2, which in turn was related to greater life satisfaction at Time 2, even after accounting for life satisfaction at Time 1 (Tomaszek & Muchacka-Cymerman, 2020). Better understanding such intervening mechanisms could shed light on

the actual processes that bring grittier people to achieve higher life satisfaction in their lives. These results support a top-down view of wellbeing as being affected by personality traits (in our case, perseverance of effort) that enable a more positive appraisal of life situations (as expressed by posttraumatic growth). Moreover, our findings align with the idea that posttraumatic growth can be viewed as a coping strategy (Infurna & Jayawickreme, 2019) focused on finding meaning even in the face of an uncontrollable, highly stressful situation (the COVID-19 pandemic). In this sense, perseverance of effort may be understood as a resilience factor (Tang et al., 2021) that facilitates such meaning-making coping, enabling a more positive view of one’s life. Prospective studies should be conducted to better understand whether this line of thought is preferable to conceiving posttraumatic growth in terms of personality change.

Lastly, age and gender showed some small, yet significant effects. More specifically, male and younger students displayed higher life satisfaction at the beginning of the school year, in line with meta-analytical evidence indicating a slightly higher subjective wellbeing in males in European countries (Chen et al., 2019). Nevertheless, it should be kept in mind that male students were slightly underrepresented in our sample, making it harder to generalize this finding. As for age, our result is in line with some previous evidence showing a small decline in life satisfaction with the onset of adolescence (Baird et al., 2010; Cavallo et al., 2015; Goldbeck et al., 2007; Moksnes et al., 2013). This decrease may be seen as a physiological phenomenon due to increasing challenges associated with the transition from childhood to adulthood. Male students also reported greater posttraumatic growth at Time 2 and lower consistency of interests at Time 1. These results are not in line with meta-analytical evidence showing higher posttraumatic growth in women than men (Vishnevsky et al., 2010). However, it should be noted that this meta-analysis only considered adult samples and that moderator analysis showed gender differences to be more pronounced with age. As for consistency of interests, previous studies did not evidence gender

Table 3
Complete results for direct and indirect effects analyzed.

Dependent variable	Predictor	SE	z	β
Direct effects				
Life satisfaction T2	Consistency of interests T1	0.08	1.74	0.09
Life satisfaction T2	Perseverance of effort T1	0.10	-1.34	-0.08
Life satisfaction T2	Posttraumatic growth T2	0.04	9.63	0.26***
Life satisfaction T2	Life satisfaction T1	0.07	14.49	0.64***
Life satisfaction T2	Gender	0.11	-0.68	-0.06
Life satisfaction T2	Age T1	0.03	0.24	0.01
Posttraumatic growth T2	Consistency of interests T1	0.05	-1.09	-0.05
Posttraumatic growth T2	Perseverance of effort T1	0.06	3.71	0.20***
Posttraumatic growth T2	Life satisfaction T1	0.03	7.65	0.23***
Posttraumatic growth T2	Gender	0.07	-2.46	-0.08*
Posttraumatic growth T2	Age T1	0.02	-1.55	-0.05
Life satisfaction T1	Gender	0.06	-3.61	-0.11***
Life satisfaction T1	Age T1	0.02	-6.99	-0.22***
Consistency of interest	Gender	0.09	2.63	0.11**
Consistency of interest	Age T1	0.02	-0.21	-0.01
Perseverance of effort	Gender	0.08	-1.49	0.05
Perseverance of effort	Age T1	0.02	-1.00	-0.06
Indirect effects				
Life satisfaction T2	Consistency T1 x Posttraumatic growth T2	0.02	-1.07	-0.01
Life satisfaction T2	Perseverance T1 x Posttraumatic growth T2	0.08	3.22	0.05**
Life satisfaction T2	Life satisfaction T1 x Posttraumatic growth T2	0.01	8.15	0.06***
Correlations				
Consistency of interest	Perseverance of effort T1	0.03	21.29	0.62***
Consistency of interest	Life satisfaction T1	0.02	12.43	0.29***
Perseverance of effort	Life satisfaction T1	0.02	24.61	0.53***

Note. SE = standard error; z = test statistic; β = standardized beta coefficient.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

differences in this subdimension (Duckworth & Quinn, 2009); future studies with more balanced samples would be needed to better ascertain this point. Another limitation of the present study is the lack of pre-pandemic measures and of a measure of grit at Time 2. This means we cannot assess whether grit and satisfaction with life changed already as a result of the pandemic. Adding a third wave of data collection would have allowed to strengthen our results by providing evidence of enduring positive effects of grit and posttraumatic growth on life satisfaction, as well allowing us to test for reciprocal effects of our variables. Future studies could incorporate multiple waves and also focus on the moderating effects of grit components on well-being. Furthermore, we did not examine students' perceptions about COVID-19, which may have strengthened our understanding of posttraumatic growth as meaning-focused coping strategy. Last, our choice of fitting a single model for both waves might be regarded as a limitation. We did so to specifically examine the contemporary associations of grit with life satisfaction at both time-points, as well as exploring the effect of baseline life satisfaction on posttraumatic growth.

Despite these shortcomings, this study supports the building effect of perseverance of effort with respect to posttraumatic growth, and a reciprocal positive influence of posttraumatic growth and life satisfaction. Fostering perseverance through dedicated training programs could therefore prove particularly relevant in stressful contexts as a means of

building students' resources and help them keep and further develop a positive outlook on the situation itself and their life conditions. This could be done as a preventative universal measure to teach students how to bring forth their perseverance in everyday life, as well as a means to manage stressful situations. Such preventative interventions may also have cascading positive implications effects on students' academic outcomes, including self-regulated learning and academic achievement. Our findings also suggest that this kind of work may benefit older and female students even more, provided they seem to be at increased risk of experiencing lower life satisfaction and posttraumatic growth. Other than specific training programs, teachers could support their students' goal-striving especially when they encounter setbacks, encouraging them to find strategies to continue working towards their objectives.

Informed consent for human participants

The study was approved by the University of Padova's Ethics Committee for Research in Psychology. All the participants (or their parents) signed a consent form before they participated in the study.

CRediT authorship contribution statement

Nicole Casali: Conceptualization, Methodology, Formal analysis, Writing – original draft, Writing – review & editing. **Tommaso Feraco:** Conceptualization, Data curation, Writing – original draft, Writing – review & editing. **Chiara Meneghetti:** Writing – review & editing, Supervision.

Declaration of competing interest

This research did not receive any specific grants from funding agencies in the public, commercial, or not-for-profit sectors.

The authors have no potential conflicts of interest to report.

Data availability

Data are available on Figshare, <https://doi.org/10.6084/m9.figshare.19403054>.

Acknowledgments

The present work was conducted as part of the Dipartimenti di Eccellenza research program (DM 11/05/2017 n. 262), supported by a grant from MIUR to the Department of General Psychology, University of Padua.

References

- Anusic, I., & Schimmack, U. (2016). Stability and change of personality traits, self-esteem, and well-being: Introducing the meta-analytic stability and change model of retest correlations. *Journal of Personality and Social Psychology*, 110, 766–781. <https://doi.org/10.1037/pspp000066>
- Baird, B. M., Lucas, R. E., & Donnellan, M. B. (2010). Life satisfaction across the lifespan: Findings from two nationally representative panel studies. *Social Indicators Research*, 99, 183–203. <https://doi.org/10.1007/s11205-010-9584-9>
- Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, 88(3), 588–606. <https://doi.org/10.1037/0033-2909.88.3.588>
- Bono, G., Reil, K., & Hescocox, J. (2020). Stress and wellbeing in urban college students in the U.S. during the COVID-19 pandemic: Can grit and gratitude help? *International Journal of Wellbeing*, 10(3). <https://internationaljournalofwellbeing.org/index.php/ijow/article/view/1331>
- Bruna, M. O., Brabete, A. C., & Izquierdo, J. M. A. (2019). Reliability generalization as a seal of quality of substantive meta-analyses: The case of the VIA inventory of strengths (VIA-IS) and their relationships to life satisfaction. *Psychological Reports*, 122(3), 1167–1188. <https://doi.org/10.1177/0033294118779198>
- Calhoun, L. G., & Tedeschi, R. G. (2014). *Handbook of posttraumatic growth: Research and practice*. Routledge.
- Carver, C. S., & Connor-Smith, J. (2010). Personality and coping. *Annual Review of Psychology*, 61(1), 679–704. <https://doi.org/10.1146/annurev.psych.093008.100352>

- Casali, N., Feraco, T., & Meneghetti, C. (2022). Character strengths sustain mental health and post-traumatic growth during the COVID-19 pandemic. A longitudinal analysis. *Psychology & Health, 37*(12), 1663–1679. <https://doi.org/10.1080/08870446.2021.1952587>
- Cavallo, F., Dalmaso, P., Ottová-Jordan, V., Brooks, F., Mazur, J., Välimaa, R., ... Positive Health Focus Group. (2015). Trends in life satisfaction in European and North-American adolescents from 2002 to 2010 in over 30 countries. *European Journal of Public Health, 25*(Suppl. 2), 80–82. <https://doi.org/10.1093/eurpub/ckv014>
- Chen, R., Sun, C., Chen, J.-J., Jen, H.-J., Kang, X. L., Kao, C.-C., & Chou, K.-R. (2021). A large-scale survey on trauma, burnout, and posttraumatic growth among nurses during the COVID-19 pandemic. *International Journal of Mental Health Nursing, 30*(1), 102–116. <https://doi.org/10.1111/inm.12796>
- Chen, X., Cai, Z., He, J., & Fan, X. (2019). Gender differences in life satisfaction among children and adolescents: A meta-analysis. *Journal of Happiness Studies, 21*(6), 2279–2307. <https://doi.org/10.1007/s10902-019-00169-9>
- Cheng, E. H., Kam, C. C. S., & Cui, T. (2023). Revisiting grit: How much does it overlap with resilience? *International Journal of Educational Research, 119*, Article 102187. <https://doi.org/10.1016/j.ijer.2023.102187>
- Clark, K. N., & Malecki, C. K. (2019). Academic grit scale: Psychometric properties and associations with achievement and life satisfaction. *Journal of School Psychology, 72*, 49–66. <https://doi.org/10.1016/j.jsp.2018.12.001>
- Credé, M. (2018). What shall we do about grit? A critical review of what we know and what we don't know. *Educational Researcher, 47*(9), 606–611. <https://doi.org/10.3102/0013189X18801322>
- Credé, M., Tynan, M. C., & Harms, P. D. (2017). Much ado about grit: A meta-analytic synthesis of the grit literature. *Journal of Personality and Social Psychology, 113*(3), 492–511. <https://doi.org/10.1037/pspp0000102>
- Datu, J. A. D. (2021). Beyond passion and perseverance: Review and future research initiatives on the science of grit. *Frontiers in Psychology, 11*. <https://www.frontiersin.org/articles/10.3389/fpsyg.2020.545526>
- Datu, J. A. D., Yuen, M., & Chen, G. (2017). Development and validation of the Triarchic Model of Grit Scale (TMGS): Evidence from Filipino undergraduate students. *Personality and Individual Differences, 114*, 198–205. <https://doi.org/10.1016/j.paid.2017.04.012>
- Datu, J. A. D., Yuen, M., Fun, E., Zhang, J., Chan, S., & Wu, F. (2022). The satisfied lives of gifted and gritty adolescents: Linking grit to career self-efficacy and life satisfaction. *The Journal of Early Adolescence, 42*(8), 1052–1072. <https://doi.org/10.1177/02724316221096082>
- Di Fabio, A., & Gori, A. (2016). Measuring adolescent life satisfaction: Psychometric properties of the satisfaction with life scale in a sample of Italian adolescents and young adults. *Journal of Psychoeducational Assessment, 34*(5), 501–506. <https://doi.org/10.1177/0734282915621223>
- Diener, E. (1984). Subjective well-being. *Psychological Bulletin, 95*, 542–575. <https://doi.org/10.1037/0033-2909.95.3.542>
- Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment, 49*(1), 71–75. https://doi.org/10.1207/s15327752jpa4901_13
- Diener, E., & Ryan, K. (2009). Subjective well-being: A general overview. *South Africa Journal of Psychology, 39*(4), 391–406. <https://doi.org/10.1177/008124630903900402>
- Duan, W., & Guo, P. (2015). Association between virtues and posttraumatic growth: Preliminary evidence from a Chinese community sample after earthquakes. *PeerJ, 3*, Article e883. <https://doi.org/10.7717/peerj.883>
- Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology, 92*(6), 1087–1101. <https://doi.org/10.1037/0022-3514.92.6.1087>
- Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the Short Grit Scale (Grit-S). *Journal of Personality Assessment, 91*(2), 166–174. <https://doi.org/10.1080/00223890802634290>
- Feraco, T., Casali, N., & Meneghetti, C. (2022). Adaptability favors positive academic responses and posttraumatic growth under COVID-19: a longitudinal study with adolescents. *European Journal of Psychology of Education, 37*(1), 102–116. <https://doi.org/10.1007/s10212-022-00667-0>
- Feraco, T., Resnati, D., Fregonese, D., Spoto, A., & Meneghetti, C. (2023). An integrated model of school students' academic achievement and life satisfaction. Linking soft skills, extracurricular activities, self-regulated learning, motivation, and emotions. *European Journal of Psychology of Education, 38*, 109–130. <https://doi.org/10.1007/s10212-022-00601-4>
- Fergusson, D. M., Mcleod, G. F. H., Horwood, L. J., Swain, N. R., Chapple, S., & Poulton, R. (2015). Life satisfaction and mental health problems (18 to 35 years). *Psychological Medicine, 45*, 2427–2436. <https://doi.org/10.1017/S0033291715000422>
- Goldbeck, L., Schmitz, T. G., Besier, T., Herschbach, P., & Henrich, G. (2007). Life satisfaction decreases during adolescence. *Quality of Life Research, 16*(6), 969–979. <https://doi.org/10.1007/s11136-007-9205-5>
- Gonzalez, O., Canning, J. R., Smyth, H., & MacKinnon, D. P. (2020). A psychometric evaluation of the short grit scale. *European Journal of Psychological Assessment, 36*(4), 646–657. <https://doi.org/10.1027/1015-5759/a000535>
- Guo, J., Tang, X., & Xu, K. M. (2019). Capturing the multiplicative effect of perseverance and passion: Measurement issues of combining two grit facets. *Proceedings of the National Academy of Sciences, 116*(10), 3938–3940. <https://doi.org/10.1073/pnas.1820125116>
- Harmon, J., & Venta, A. (2021). Adolescent posttraumatic growth: A review. *Child Psychiatry & Human Development, 52*(4), 596–608. <https://doi.org/10.1007/s10578-020-01047-9>
- Henson, C., Truchot, D., & Canevello, A. (2021). What promotes post traumatic growth? A systematic review. *European Journal of Trauma & Dissociation, 5*(4), Article 100195. <https://doi.org/10.1016/j.ejtd.2020.100195>
- Infurna, F. J., & Jayawickreme, E. (2019). Fixing the growth illusion: New directions for research in resilience and posttraumatic growth. *Current Directions in Psychological Science, 28*(2), 152–158. <https://doi.org/10.1177/0963721419827017>
- Jiang, X., Fang, L., & Lyons, M. D. (2019). Is life satisfaction an antecedent to coping behaviors for adolescents? *Journal of Youth and Adolescence, 48*(11), 2292–2306. <https://doi.org/10.1007/s10964-019-01136-6>
- Jin, B., & Kim, J. (2017). Grit, basic needs satisfaction, and subjective well-being. *Journal of Individual Differences, 38*, 29–35. <https://doi.org/10.1027/1614-0001/a000219>
- Kilmer, R. P., Gil-Rivas, V., Tedeschi, R. G., Cann, A., Calhoun, L. G., Buchanan, T., & Taku, K. (2009). Use of the revised posttraumatic growth inventory for children. *Journal of Traumatic Stress, 22*(3), 248–253. <https://doi.org/10.1002/jts.20410>
- Lavy, S. (2020). A review of character strengths interventions in twenty-first-century schools: Their importance and how they can be fostered. *Applied Research in Quality of Life, 15*(2), 573–596. <https://doi.org/10.1007/s11482-018-9700-6>
- Magson, N. R., Freeman, J. Y. A., Rapee, R. M., Richardson, C. E., Oar, E. L., & Fardouly, J. (2021). Risk and protective factors for prospective changes in adolescent mental health during the COVID-19 pandemic. *Journal of Youth and Adolescence, 50*(1), 44–57. <https://doi.org/10.1007/s10964-020-01332-9>
- Meyerson, D. A., Grant, K. E., Carter, J. S., & Kilmer, R. P. (2011). Posttraumatic growth among children and adolescents: A systematic review. *Clinical Psychology Review, 31*(6), 949–964. <https://doi.org/10.1016/j.cpr.2011.06.003>
- Moksnes, U. K., Lohre, A., & Espnes, G. A. (2013). The association between sense of coherence and life satisfaction in adolescents. *Quality of Life Research: an International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation, 22*(6), 1331–1338. <https://doi.org/10.1007/s11136-012-0249-9>
- Morell, M., Yang, J. S., Gladstone, J. R., Turci Faust, L., Ponnock, A. R., Lim, H. J., & Wigfield, A. (2021). Grit: The long and short of it. *Journal of Educational Psychology, 113*, 1038–1058. <https://doi.org/10.1037/edu0000594>
- Muenks, K., Wigfield, A., Yang, J. S., & O'Neal, C. R. (2017). How true is grit? Assessing its relations to high school and college students' personality characteristics, self-regulation, engagement, and achievement. *Journal of Educational Psychology, 109*(5), 599–620. <https://doi.org/10.1037/edu0000153>
- Peterson, C., Park, N., Pole, N., D'Andrea, W., & Seligman, M. E. P. (2008). Strengths of character and posttraumatic growth. *Journal of Traumatic Stress, 21*(2), 214–217. <https://doi.org/10.1002/jts.20332>
- Peterson, C., & Seligman, M. E. P. (2004). *Character strengths and virtues: A handbook and classification*. American Psychological Association.
- Ponnock, A., Muenks, K., Morell, M., Seung Yang, J., Gladstone, J. R., & Wigfield, A. (2020). Grit and conscientiousness: Another jangle fallacy. *Journal of Research in Personality, 89*. <https://doi.org/10.1016/j.jrp.2020.104021>
- Postigo, A., Cuesta, M., Fernández-Alonso, R., García-Cueto, E., & Muñiz, J. (2021a). Academic grit modulates school performance evolution over time: A latent transition analysis. *Revista de Psicodidáctica (English Ed.)*, 26(2), 87–95. <https://doi.org/10.1016/j.psicoe.2021.03.001>
- Postigo, A., Cuesta, M., Fernández-Alonso, R., García-Cueto, E., & Muñiz, J. (2021b). Temporal stability of grit and school performance in adolescents: A longitudinal perspective. *Educational Psychology, 27*(1), 77–84. <https://doi.org/10.5093/psed2021a4>
- R Core Team. (2020). R: The R project for statistical computing. <https://www.r-project.org/>
- Rimfeld, K., Kovas, Y., Dale, P. S., & Plomin, R. (2016). True grit and genetics: Predicting academic achievement from personality. *Journal of Personality and Social Psychology, 111*(5), 780–789. <https://doi.org/10.1037/pspp0000089>
- Rosseel, Y. (2012). *Lavaan: An R package for structural equation modeling and more version 0.5-12 (BETA)*. 37.
- Schermelleh-engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research, 23*–74.
- Silverstein, M. W., Witte, T. K., Lee, D. J., Kramer, L. B., & Weathers, F. W. (2018). Dimensions of growth? Examining the distinctiveness of the five factors of the posttraumatic growth inventory. *Journal of Traumatic Stress, 31*(3), 448–453. <https://doi.org/10.1002/jts.22298>
- Singh, K., & Jha, S. D. (2008). Positive and negative affect, and grit as predictors of happiness and life satisfaction. *Journal of the Indian Academy of Applied Psychology, 34*, 40–45.
- Sulla, F., Renati, R., Bonfiglio, S., & Rollo, D. (2018). Italian students and the grit-S: A self-report questionnaire for measuring perseverance and passion for long-term goals. *IEEE International Symposium on Medical Measurements and Applications (MeMeA)*, 2018, 1–5. <https://doi.org/10.1109/MeMeA.2018.8438668>
- Tang, M., Wang, D., & Guerrien, A. (2020). A systematic review and meta-analysis on basic psychological need satisfaction, motivation, and well-being in later life: Contributions of self-determination theory. *PsyCh Journal, 9*(1), 5–33. <https://doi.org/10.1002/pchj.293>
- Tang, X., Upadaya, K., & Salmela-Aro, K. (2021). School burnout and psychosocial problems among adolescents: Grit as a resilience factor. *Journal of Adolescence, 86*, 77–89. <https://doi.org/10.1016/j.adolescence.2020.12.002>
- Tedeschi, R. G., & Calhoun, L. G. (1995). *Trauma and transformation*. SAGE.
- Tomaszek, K., & Muchacka-Cymerman, A. (2020). Thinking about my existence during COVID-19, I feel anxiety and awe-the mediating role of existential anxiety and life satisfaction on the relationship between PTSD symptoms and post-traumatic growth. *International Journal of Environmental Research and Public Health, 17*(19), 7062. <https://doi.org/10.3390/ijerph17197062>

- Triplett, K. N., Tedeschi, R. G., Cann, A., Calhoun, L. G., & Reeve, C. L. (2012). Posttraumatic growth, meaning in life, and life satisfaction in response to trauma. *Psychological Trauma: Theory, Research, Practice, and Policy*, 4, 400–410. <https://doi.org/10.1037/a0024204>
- UNESCO. (2021). Education: From disruption to recovery. <https://en.unesco.org/covid19/educationresponse>.
- Vishnevsky, T., Cann, A., Calhoun, L. G., Tedeschi, R. G., & Demakis, G. J. (2010). Gender differences in self-reported posttraumatic growth: A meta-analysis. *Psychology of Women Quarterly*, 34(1), 110–120. <https://doi.org/10.1111/j.1471-6402.2009.01546.x>
- von Soest, T., Bakken, A., Pedersen, W., & Sletten, M. A. (2020). Life satisfaction among adolescents before and during the COVID-19 pandemic. *Tidsskrift for Den Norske Laegeforening: Tidsskrift for Praktisk Medicin, Ny Raekke*, 140(10). <https://doi.org/10.4045/tidsskr.20.0437>
- Wang, S., Zhao, Y., & Li, J. (2023). True grit and brain: Trait grit mediates the connection of DLPFC functional connectivity density to posttraumatic growth following COVID-19. *Journal of Affective Disorders*, 325, 313–320. <https://doi.org/10.1016/j.jad.2023.01.022>
- Waters, L., Algoe, S. B., Dutton, J., Emmons, R., Fredrickson, B. L., Heaphy, E., ... Steger, M. (2021). Positive psychology in a pandemic: Buffering, bolstering, and building mental health. *The Journal of Positive Psychology*, 1–21. <https://doi.org/10.1080/17439760.2021.1871945>
- Waters, L., Allen, K.-A., & Arslan, G. (2021). Stress-related growth in adolescents returning to school after COVID-19 school closure. *Frontiers in Psychology*, 12, Article 643443. <https://doi.org/10.3389/fpsyg.2021.643443>
- World Economic Forum. (2016). New vision for education: Fostering social and emotional learning through technology. World Economic Forum. <https://www.weforum.org/reports/new-vision-for-education-fostering-social-and-emotional-learning-through-technology/>.
- World Medical Association Declaration of Helsinki. (2013). Ethical principles for medical research involving human subjects. *JAMA: The Journal of the American Medical Association*, 312(20), 2191–2194. <https://doi.org/10.1001/jama.2013.281053>
- Yu, Y., Yu, Y., & Hu, J. (2021). COVID-19 among Chinese high school graduates: Psychological distress, growth, meaning in life and resilience. *Journal of Health Psychology*, 1359105321990819. <https://doi.org/10.1177/1359105321990819>